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PAPER PRESENTATION

Bias factors related to math test performance of Ethiopian students in Israel

Michal Levi- Keren, Tel Aviv University, Kibbutzim College of Education, Israel

The present study examines bias factors which might grant a relative advantage to native Israelis over groups of immigrants in a mathematics achievement test administered to fifth grade students. The bias factor analysis process, aided by quantitative and qualitative data gathering methods, comprised three phases: (1) Using a psychometric procedure called DIF (Differential Item Functioning) to identify differential functioning in test items. DIF was examined in two differentiated groups of immigrants from the FSU and Ethiopia, which were compared to a group of native Israelis with the same ability level in the construct which the test aimed at measuring. (2) Identifying the sources of difficulty leading to DIF, while distinguishing between difficulties that are relevant to the construct measured in the test ("impact factors"), as opposed to those which are not ("bias factors"). (3) Determining whether the item incorporates bias factors. Phase 1 was based on the analysis of the results of a mathematics achievement test administered to a national, representative sample of native Israeli students and immigrant students from the FSU and from Ethiopia. Phases 2 & 3 were made through the judgment of subject-matter experts of those items found to be having DIF, as well as through interviews with immigrant students and "culture experts", who contributed a cultural perspective to the answers of the interviewees.

The paper focuses on the results related to Ethiopian students, which support Vygotsky's socio-cultural approach, emphasizing the influence of culture on the formation of high mental functions, including mathematical thinking. The practical implications of these results are discussed.

In recent years there has been a significant increase in the number of immigrants in many European countries, as well as in Canada, the US and Australia. Israel has absorbed immigrants from the day of its foundation in 1948, including, since the end of the 1980s, large immigration waves from the Former Soviet Union (FSU) and Ethiopia. Mass immigration, in Israel as abroad, tends to include large numbers of children, who, as they join their new country's education system, are forced to cope with many difficulties. In Israel, as elsewhere, follow-up research has been conducted to accompany these integration processes. Studies concerning the academic achievements of immigrant children paint a complex, multi-dimensional picture. While some indicate that immigrant students' achievements level out and, after years, may even come to exceed those of native students, there are other studies that reveal persistent academic achievement. In Israel, it was reported that the academic achievements of immigrants from the FSU and Ethiopia are lower than those of native Israelis, even long after immigration.

Many studies have tried to uncover the sources of immigrant students' academic difficulties. They pointed at a complex array of student characteristics, on both the individual and group level. These may be demographic: relating to the number of years students have spent in their new country, to the socio-economic status of their families, to their school's socioeconomic composition, etc; other characteristics are culture-dependent and therefore relate to language, ways of thinking and values typical of the students' culture of origin. However, since the findings of these studies are not mutually consistent, it is impossible to generalize about the respective impact of these characteristics. Another important component contributing to immigrant students' academic difficulties, however, has to do with learning conditions, including the use of modes of assessment which were occasionally found to be incompatible with the students' learning needs. The assessment measures used supplied only meager information regarding the knowledge the students acquired in their countries of origin. Even the use of testing accommodations, specially developed to improve assessment validity and thus to help the immigrant students skirt these problems, was not always proven to be effective.

The main innovation of this study lies in the attempt to explain immigrant students' difficulties with math tests by focusing on identification and conceptualization of the sources of difficulties they experienced with test items. This approach comprised three phases: (1) Using psychometric procedures to detect test items which are differentially difficult or easy, for two differentiated groups of immigrants from the FSU and Ethiopia which were compared to a group of native Israelis with the same ability level in the construct which the test aimed at measuring.. The measured phenomenon is called DIF: Differential Item Functioning. (2) Identifying the possible sources of DIF, namely, identifying the attributes of the items which caused the difficulty, bearing in mind that there are two kinds of difficulty: those which can be related to the construct being measured (math ability), and therefore reflect true performance differences (impact), as opposed to those which are not, and which are called bias factors .It is the latter type of factors which might distort test results and threaten the validity of the decisions taken on the basis of the test scores. (3) Determining whether the possible source of DIF is relevant to the construct being measured.

Three research questions were formulated, reflecting the three above-mentioned phases: (1) Which items function differentially (i.e., which items are DIF items), regarding the Ethiopian and FSU immigrant students who were tested in math? (2) What are the characteristics of the DIF items that were found to favor the achievement of native born Israelis? (3) Which of those characteristics are bias factors and which reflect true performance differences?

This study is based on a secondary data analysis of findings available from a comprehensive research conducted by Levin et al., in 2002[1]. In this paper, a research design combining quantitative and qualitative methods was used. The identification of DIF (question 1) was based on a statistical technique used to detect DIF items, called Delta-plot. For this purpose a stratified national sample of fifth graders was used, consisting of 530 native Israelis and 559 immigrants from the FSU and Ethiopia, who were tested in math, as part of the earlier mentioned research project. The identification of DIF sources (question 2) and the decision regarding their interpretation (question 3) were made through the judgment of subject-matter experts of those items found to be having DIF, as well as through interviews with immigrant students and "culture experts", who contributed a cultural perspective to the answers of the interviewees.

The study results support Vygotsky's socio-cultural approach, which emphasizes the impact of culture on thinking processes, including mathematical thinking. The salient bias factors among immigrant students from the FSU originate in their unfamiliarity with certain test items, which proved to be alien to their ways of thinking; and also from a lack of sufficient attention to those item-related instructions which appeared in a different typographical format. Immigrant students from Ethiopia, however, tended to have difficulties in manifesting test taking skills differing from those relevant to their indigenous culture. Additionally, the answers they supplied to certain items, in which a concrete situation was presented, were rooted in their peculiar life experience, instead of being anchored in the items' data.

This paper focuses on bias factors related to Ethiopian students, and discusses the theoretical as well as the practical implications of these results (such as providing testing accommodations), that may assist in generating further research aimed at the development of a fairer assessment culture, appropriate to Israel's current multi-cultural reality.

[1]

PAPER PRESENTATION

Many questions, few answer(s)? A non response analysis of students' evaluations of teaching.

Bert Brockx, University of Antwerp, Belgium; Pieter Spooren, University of Antwerp, Belgium; Dimitri Mortelmans, University of Antwerp, Belgium

Student evaluations of teaching (SET) are used at many universities to assess teaching quality. The validity and reliability is often discussed in research papers. Several studies that examine different aspects of SET report that a significant number of students do not return their evaluations. This can cause problems concerning the reliability and validity of SET. We do not know of any study that has examined the non-response issue in SET research. In the present paper, an exploratory study on student and course characteristics that might influence a student's decision (not) to participate in course evaluations is presented using multilevel binomial regression models. We find that some student characteristics significantly influence the fact that students complete their SET questionnaires (i.e. course grade, overall grade, gender, and first year of higher education). These findings might have implications for the interpretation of SET results and the use of SET in general. For example, the results show that good students (in terms of having received good grades) are more likely to complete evaluation questionnaires than students who received grades. All stakeholders should take this into account when drawing conclusions about teaching quality based on SET results.

Introduction

Student evaluations of teaching (SET) are seen as the most common means to assess teaching quality at universities (Apodaca & Grad, 2005). A massive amount of research papers have been published on SET (Richardson, 2005). A frequent problem with teacher evaluations is the fact that a significant number of students do not respond to the survey. Layne, Decristoforo & McGinty (1999), for instance, showed that response rates for were 47,8% for online course evaluations and 60,8% for in-class surveys. These results were confirmed by Dommeyer, Baum, Hanna & Chapman (2004).

Due to rather low response rates it might be possible that a selection bias occurs. This could for example mean that students who perform well tend to respond more easily than students who receive low grades. If these students would also have different opinions about the teacher's performance, the selection that occurred could bias the results. It might mean that the results do not reflect the opinion of the complete population but of a selective sample of students. In this paper, we focus on the topic of non response within SET and examine whether course or student characteristics influence a student's decision to participate or not.

Data

The data for the present study were gathered at the University of Antwerp during the fall semester of 2008-2009 academic year by means of the SET -37 course evaluation questionnaire (Mortelmans & Spooren, 2009). 1224 online evaluations were sent to 598 students who were subscribed in 44 courses. As evaluations were administrated through an online system every student was given the possibility to evaluate the courses, opposed to an in-class surveys which requires full class attendance. The response rate was similar to the one reported by Layne, et al. (1999), namely 41,3%.

Method The collected data have a cross classified hierarchical structure. This means that some students evaluated multiple courses by completing several evaluations. The most appropriate analysis method to analyze this data would be a cross classified multilevel binomial logistic regression analysis. However calculating a model with 49 teachers, 609 students, 1238 evaluations and several explanatory variables leads to estimation problems. Therefore, two separate multilevel logit models were estimated, with at the first level the questionnaires and at the second level the students (model1) and, in a second step, the courses (model2). The dichotomous dependent variable ('response') was coded '1' if students participated in the evaluation of a course. Several explanatory variables were added to the model. At the questionnaire level the student's course grade was added, and whether the evaluation was about an elective course or not. At the student level, the overall grade, the student's gender and whether or not it was the student's first year of higher education were added. In the second model we added the course characteristics namely the class size and the required workload.

Results and conclusion

The results show that mostly the student characteristics influence the student's decision to participate in a SET survey. Table 1 shows that female students are more likely to fill in a questionnaire than their male counterparts, also good students (in terms of grades) tend to respond more likely than students who receive low grades. On the other hand, a negative effect is found for students who are in the first year of their university career. The course characteristics show no significant effects, a questionnaire of a course with high or medium workload is not more or less likely to be responded to, than one that required low workload. The same counts for courses with high, low or medium class sizes. The results of this study might have implications for the use of SET. All stakeholders should take into account that the student's performance and gender play an important role in the decision to respond to SET questionnaires. They thus should bear in mind that the sample of students who respond to the evaluations might not be a completely representative sample of the complete population.

References

- Apodaca, P., & Grad, H. (2005). The Dimensionality of Student Ratings of Teaching: Integration of Uni- and Multidimensional Models. *Studies in Higher Education*, 30(6), 723-748.
- Dommeyer, C. J., Baum, P., Hanna, R. W., & Chapman, K. S. (Writer) (2004). Gathering faculty teaching evaluations by in-class and online surveys: their effects on response rates and evaluations [Article], *Assessment & Evaluation in Higher Education*: Routledge.
- Layne, B. H., Decristoforo, J. R., & McGinty, D. (1999). Electronic versus traditional student ratings of instruction. *Research in Higher Education*, 40, 221-232.
- Mortelmans, D., & Spooren, P. (2009). A revalidation of the SET37 questionnaire for student evaluations of teaching. *Educational Studies*, 35(5), 547 - 552.

Richardson, J. T. E. (2005). Instruments for Obtaining Student Feedback: A Review of the Literature. *Assessment and Evaluation in Higher Education*, 30(4), 387-415.

PAPER PRESENTATION

The relationship between item type, students' characteristics and media-effect in CBA

Gyongyver Molnar, University of Szeged, Hungary; Krisztina R. Toth, German Institute for International Educational Research, Germany; Beno Csapo, University of Szeged, Hungary

Paper-based assessment reached its limits, however the shift from paper-pencil (PP) to computer-based assessment (CBA) poses new questions. Validity issues regarding media-effect studies belong to one of the key areas. Several studies have been conducted with older students to measure validity (Csapo, Molnar & R. Toth, 2009), however, only a few focused on early childhood education (Choi and Tinkler, 2002). The purpose of this paper is (1) to study the media-effects in a cross-curricular competency field by first grade (age 6-7) students; (2) categorize item formats and students according to their media-dependence. Due to the young age of the target population, the instrument of the study consisted of figural, nonverbal items. The same inductive reasoning test was administered in PP and in CB mode (N=5156 and 313, respectively). The online data collection was carried out with the TAO platform. Student-level differences indicated media-effect, students' achievement was higher in PP (45.33%) than in CB format (32.6%; $t=6.11$, $p<.001$). The highest media-effect was noticeable at items where the answer and distractors contained more figures. Students' socio-economic factors, gender and frequencies of computer-usage did not influence their CB test scores.

Theoretical framework

Technology has fundamentally changed the quality of education, including educational assessment. Technology-based assessment (TBA) opens new areas, raises new issues, offers new assessment methods (see Csapo, Latour, Bennett, Ainley, & Law, 2010), changes the whole assessment process and poses several new questions (see Scheuermann, & Björnsson, 2009). It is no longer doubt that TBA will replace traditional paper-pencil (PP) testing. The transition from PP to TBA in educational context requires a step-by step procedure (Csapo, Molnar, & R. Toth, 2009); the first is the adequate control of media effect during testing. Several media effect studies were carried out in the past few years; however, only a few focused on testing very young students in technology-based environment.

Aims

Administering technology-based tests by very young students poses several challenges; therefore, special attention must be paid to control instrument validity and reliability. The purpose of this paper is to study the media effects in a cross curricular competency field by first grade (age 6-7) students, to control media effect and make detailed comparisons of test results delivered by different media.

In this paper we

- (1) compare pupils' achievement in PP and computer-based (CB) environment;
- (2) categorise the item formats according to their media-dependence; and
- (3) characterise students who achieve better or worse in CB tests.

Methodology

The sample for the PP study was drawn from 1st grade students (age 6-7; N=5156), representative for the school population of Hungary; while the sample for the CB study was drawn from 1st and 2nd grade students (age 6-8; N=313). The instrument of the study was an inductive reasoning test, developed directly for young learners. It consisted of 37 figural, non-verbal items. The same test was used in PP and CB format. Special attention was paid to the paper and screen layout of the test, which were kept as similar as possible. The online data collection was carried out with the TAO (Testing Assistée par Ordinateur) platform via Internet by using computers available at schools. The detailed item analyses were performed by using several means of classical test theory and IRT.

Findings and conclusions

The reliability index of the inductive reasoning test did not differ significantly in PP and in CB environment (Cronbach- $\alpha=.88$ and $.85$, respectively). The comparison of PP and CB test scores indicates significant differences between the achievements based on the media. The average student achievement was higher in PP mode ($M=45.33\%$, $sd=20.07\%$) than in CB format (32.66% , $SD=18.17\%$; $t=6.11$, $p<.001$). Regardless of the item type applied the delivery media caused significant achievement differences. However, depending on the used item format the amount of differences are changing. The highest media effect was noticeable at items where the answer and distractors contained more figures. The influential factor of the delivery media proved to be the strongest ($t=8.24$, $p<.001$). Regarding gender analyses, there

were no achievement differences between the achievement of boys and girls in CB test results. Similar result was found at subtest level as well. Students' socio-economic factors (e.g. number of books, number of PCs, number of mobile phones) did not influence their CB test scores; similarly the common usage of computer and/or internet did not result in higher CB test results.

The delivery media had a significant impact on first graders' achievement regardless of pupils' different background variable the measured cognitive structure, context and item format. The results suggest that if the goal was to develop equivalent summative assessment for the two media, studying the particular differences between the two media using different research condition and research design may support a developmental process towards the improvement of the validity of online assessment. Further research is needed to study the effect of media in other domains, to identify the differences of the cognitive processes relevant in the two media and for controlling the effects of other variables that were not the goal of these studies.

Educational and scientific importance

Paper-based assessment reached its limits. Existing models of assessment typically fail to measure the skills, knowledge and competencies that are increasingly important in the 21st century, and direct feedback is not available after the actual testing. Technology helps to solve this problem. Within a few years large scale international educational assessment programs plan to introduce computer-based assessments of student achievements, therefore, students are expected to be familiar with CB testing. This fact may facilitate the early use of CB testing at schools. However, most cases studies do not focus on pupils' CB testing in an educational context. In connection with media effect control, the detailed analyses of a comparison of PP and CB testing establish scientific bases to improve the efficiency, effectiveness and validity of computerized tests.

References

- Csapo, B., Latour, T., Bennett, R., Ainley, J. & Law, N. (2010). Technological Issues of Computer-Based Assessment of 21st Century Skills. Draft White Paper 3. Cisco, Intel, Microsoft. The University of Melbourne, Melbourne.
- Csapo, B., Molnar, Gy., & R. Toth, K. (2009). Comparing paper-and-pencil and online assessment of reasoning skills. A pilot study for introducing electronic testing in large-scale assessment in Hungary. In Scheuermann, F. & Björnsson, J. (Eds.), The transition to computer-based assessment. New approaches to skills assessment and implications for large-scale testing. Luxembourg: Office for Official Publications of the European Communities. pp. 113-118.
- Scheuermann, F. & Björnsson, J. (2009, Eds.). The transition to computer-based assessment. New approaches to skills assessment and implications for large-scale testing. Luxembourg: Office for Official Publications of the European Communities.

PAPER PRESENTATION

Test follow-up: developing productive synergies between summative and formative assessment

David Carless, University of Hong Kong, Hong Kong

The main aim of this paper is to explore how teachers derive formative instructional power from internal school tests. It analyzes potentials and constraints in seeking to enhance student learning capacities from test processes which carry both summative and formative purposes. The paper uses qualitative case study data from six teachers in three elementary schools in Hong Kong involving 31 classroom observations and 26 interviews with teachers. The observations were mainly of test follow-up lessons and interviews probed issues arising from them and other themes related to the interface between testing and student learning. The findings document two particular test follow-up strategies: student self-evaluation of performance on a test; and peer co-operative processes. A common thread across both of these is that they involve active student participation in the post-test learning process. The significance of the study lies in its focus on building productive synergies between summative and formative assessment. Test follow-up can be used to show that test results can look forward to future learning, as well as summarizing previous performance.

Aims Managing the relationship between summative and formative assessment is a major challenge for the enhancement of the learning aspects of assessment. The power and influence of summative assessment often undermines the learning potential of formative assessment. The development of productive synergies between these two functions of assessment represents a potentially powerful way forward. Within this theme, the particular strategy discussed in this paper is post-test follow-up as a means to develop ongoing student learning capacities. The main aims of the paper are: To explore how elementary school English teachers in three selected Hong Kong schools carry out learning-oriented follow-up to internal school tests; To contribute to the development of assessment theory by exploring how summative assessment can be used formatively to support student learning; To analyze the role of context in formative assessment and suggest some features of contextually grounded assessment practices.

Theoretical framework: Formative use of test data The framework for the paper is based on work probing the relationship between formative and summative assessment. Formative assessment is defined as the elicitation and interpretation of evidence, so as to enhance instruction and improve student learning. The formative assessment strategy discussed in this paper is the formative use of a test designed principally for summative purposes (Black et al., 2003), hereafter test follow-up. Test follow-up uses information from tests to advance student learning, so has the potential to contribute to a positive relationship between summative and formative assessment. For test follow-up to be exploited optimally it requires the right kinds of tests: those that are aligned with curriculum aims; those that are instructionally sensitive (Popham, 2008); and those that promote mastery as well as performance (cf. Dweck, 2000). There are a number of challenges for the implementation of test follow-up: frequent classroom testing risks making judgments about student learning rather than suggesting means to improve (Black et al., 2003); it can result in micro-teaching of ways to gain additional marks rather than developing student learning power (Stobart, 2008); and teachers are generally more effective at drawing inferences about student levels of understanding than they are in planning future instructional steps (Heritage et al., 2009).

Methods The research questions guiding the study are: What test follow-up strategies do the teachers carry out? What is the rationale, strengths and limitations of these test follow-up strategies? The research involved multi-site qualitative case studies of teachers implementing test follow-up. Case studies are a particularly useful research strategy to probe the context-dependent nature of classroom implementation of learning activities. The case studies were carried out in English as a foreign language classes in elementary schools in Hong Kong. The unit of analysis in the study was the teacher. Six teachers from three schools were involved over a three-year period. Data sources comprised classroom observations and interviews. Observation is the most direct way of understanding classrooms and so a series of lesson observations were conducted before and after tests. A customized observation schedule was developed to facilitate the collection of relevant information, including: the relationship between lesson content and items in tests; student learning progress and difficulties; and identifiable test follow-up practices. Semi-structured interviews were conducted with teachers to identify their views about assessment and its relationship with classroom practice. Baseline interviews with participant teachers served to understand assessment practices in the school. Post-lesson interviews probed teacher perceptions of relevant issues occurring in observed lessons. The data-set comprises 31 lesson observations and 26 interviews with teachers. Data were analyzed inductively using standard qualitative data analysis procedures, including coding, categorizing and respondent validation.

Findings Classroom observations revealed various test follow-up strategies. Those which carried potential for enhancing student learning mainly involved students as active participants in test follow-up. Peer co-operation was a key element and was exploited in various ways: students working in pairs or small groups to work out answers to challenging test questions or develop correction sheets; and students sharing test preparation or test-taking strategies. Another potentially useful strategy was engaging students in self-evaluation through written reflections on test performance: what they did well, what they were less successful in and how they wanted to improve. Whilst some students wrote relatively trivial comments, such processes had potential to remind students that a test was not just an end-point but part of ongoing learning. Teachers' potential to implement test follow-up effectively related to a complex interplay of multiple factors, including: their background, training and experience; beliefs and understandings related to testing and formative assessment; the extent of satisfaction with existing practices; and the pedagogic priorities in their own school context. Underpinning these elements were various contextual and cultural factors, pertaining to the Confucian-heritage setting of Hong Kong: the expected roles of teachers and students; the dominance of examination-oriented education; and collectivist notions encouraging positive co-operation with peers. **Significance** The theoretical significance of the work relates to the development of productive synergies between summative and formative assessment. By acknowledging the centrality of summative assessment in teachers' and students' lives, but deriving much needed formative impetus, test follow-up can be used to show that test results can look forward to future learning, as well as summarizing previous performance. The study also casts light on the interplay between assessment and educational context via the notion of contextually grounded formative assessment practices which acknowledge the realities of the host setting. Such an orientation honors the existing beliefs of teachers and the associated classroom practices, grounded as they are in a particular socio-cultural setting. It takes a pragmatic view of what is feasible in a specific context, such as Hong Kong, in view of the dominance of examination-oriented education. This starting-point can act as a seed for further development. Finally, the study also carries implications for practice. The findings suggest two main interlinked keys to test follow-up: a) the importance of active student involvement; and b) engaging students in reflecting on their work and performance, including peer learning and self-evaluation.

References

Black, P., Harrison, C., Lee, C., Marshall, B., and Wiliam, D. (2003). *Assessment for learning: Putting it into practice*. Maidenhead: Open University Press.

Dweck, C.S. (2000). *Self-theories: Their role in motivation, personality, and development*. Lillington, NC: Taylor & Francis.

Heritage, M. et al. (2009). From evidence to action: a seamless process in formative assessment. *Educational Measurement: Issues and Practice*, 28 (3), 24-31.

Popham, W.J. (2008). *Transformative assessment*. ASCD: Alexandria.

Stobart, G. (2008) *Testing times: The uses and abuses of assessment*. London: Routledge.

PAPER PRESENTATION

What do we know about the digital divide in students with an immigrant background?

Oliver Walter, Germany; Martin Senkbeil, Leibniz Institute for Science Education, Germany

In this paper we analyze the 'digital divide', i.e. disparities in the access to digital media, frequency of computer use, and computer literacy, with regard to students with an immigrant background in Germany. Since ICT competencies have an increasing relevance to young people's opportunities on the labour market, especially for students with an immigrant background, we studied the amount of differences on all three dimensions of the digital divide in a sample of 8,874 ninth-graders in Germany. In doing so we distinguished between students of different immigrant generations and different ethnic origin. Our results show increasing levels of computer competency with ascending immigrant generation. With respect to ethnic origin we found deficits for some (e.g., students from Turkey), but not for all migrant groups (e.g., students from Poland). After identifying these disparities, we related them to indicators of structure and process characteristics of the students' family, e.g. socioeconomic status. We found that disparities in computer skills between different groups of immigrants and natives can largely be traced back to differences in access to digital media and to family characteristics. Interestingly, there were different effects of these factors for different immigrant groups. Our results suggest that schools should be aware of the different patterns of the digital divide with respect to immigrant generation and ethnic origin and should try to compensate for them by making an adequate educational offer.

Aims

Many studies have been conducted on the 'digital divide' with regard to social inequalities since the early 1990s. But they often focused only on access to digital technologies and neglected other dimensions as frequency of computer use and computer literacy. Only some research has focused on migrants, especially in Europe. In addition, the existing research on migrants and the digital divide rarely distinguish between different migrant groups (e.g., according to immigrant generation and ethnic origin) and take little notice of differences due to family structure (e.g. socioeconomic status, parental education) and family process characteristics (e.g. family language, family communication) into account.

Therefore, our concern was to study access, use and knowledge of computers and the internet of different groups of immigrant students in Germany and to relate our findings to structure and process characteristics of their families. In particular, we were interested in the following questions:

- (1) What is the digital divide like between natives and students of different immigrant generations?
- (2) What is the digital divide like between natives and students of different ethnic origins?
- (3) Do disparities in computer literacy stem from differences in the access to digital media and from family structure and process characteristics?

Methodology

For answering our research questions we used data of 8,874 9th graders participating in PISA 2006 in Germany. Immigrant background was defined by the students' and parents' country of birth. We distinguished the following groups with respect to immigrant generation: (a) students without an immigrant background: The student and both parents were born in Germany (N = 6,950). (b) 2.5th generation: The student and one parent were born in Germany (N = 491). (c) 2nd generation: The student was born in Germany, both parents were born abroad (N = 731). (d) 1st generation: The student and both parents were born abroad (N = 687). Additionally, we used a second classification differentiating between students whose parents were born in the former Soviet Union (N = 441), Turkey (N = 424), Poland (N = 230) and other countries (N = 801).

Computer literacy was measured by a paper-pencil-test consisting of 14 items ($\alpha = .78$). The other dimensions of the digital divide and the family background of the students were assessed by questionnaire.

Findings

Table 1 shows the results concerning research questions 1 and 2. With respect to computer access there are only some minor differences to students without an immigrant background, especially for students from the 1st and 2.5th

immigrant generation. More pronounced disparities can be found for internet access. There, our results show that 1st generation students have substantially lesser access and that the disparities decrease over generations. In contrast to access we did not find significant lesser differences in frequency of computer use at home and at school. Instead 2nd generation students use computers a bit more often than natives at home. If we look at computer use outside both school and home we also see that the computer is even more often used by students of every immigrant generation than by natives. Even so, 2nd and 1st generation students show distinct deficits in computer proficiency, on average. In contrast to the results for immigrant generation there are greater disparities in access to digital media between groups of different ethnic origin. With the exception of students whose parents were from Poland, immigrant students have significantly lesser access to digital media than natives. Especially a substantial proportion of students from the former Soviet Union and from Turkey do not have access to the internet. The findings for frequency of computer use are similar to the ones we found for students from different immigrant generations: There are no differences in the frequency of use at home and at school, but significantly more students whose parents came from Turkey and other countries use computers outside school and home than natives. In accordance with findings reported above and with the exception of Polish students, students with another than a German origin have lower computer proficiencies, on average.

With respect to research question 3, we found that differences in computer proficiency between groups of immigrant and native students can mostly be traced back to access to digital media, family structure and family process characteristics, although these factors only explain less than 10 percent of the total variance (see table 2 for results with respect to ethnic origin). More detailed analyses point to different mediating mechanisms regarding the development of knowledge gaps between natives and different immigrant groups. Whereas access conditions as well as family structure and process characteristics contribute significantly to explain the disparities for first-generation students, only structure and process characteristics do so for 2nd generation students. The results are similar if we categorize students depending on their parents' country of origin: Family structure and process characteristics are important for Turks, access conditions and family process characteristics are important for those from the former Soviet Union.

Theoretical and educational significance

Our results have some practical implications for the promotion of computer literacy through school activities. Schools have a responsibility to teach students how to competently use a computer and the internet so as to guarantee each student equal opportunities in reaching their future vocation or profession. Schools could, for example, specifically advise parents with an immigrant background, depending on their origin and their children's specific deficits in dimensions of the digital divide, to invest in a computer and internet access at home, or if this is not possible, to provide this through access at school, a library or an internet cafe. Schools should ensure that Turks and second-generation immigrants receive the necessary computer skills. Although these students claim to use a computer frequently they seem not to be able of acquiring sufficient skills on their own. As the parents of Turkish students often lack the necessary education and cognitive skills, schools must take on the role of a mediating agent when it comes to conveying computer-oriented skills.

PAPER PRESENTATION

Multilevel analysis on quadratic relationship between socioeconomic status and math performance

Ningning Zhao, UGent, Belgium

The purpose of the present study is to explore, in a large sample of Chinese primary school students, the relationship between family socioeconomic status and mathematics performance on the base of a multi-level analysis. A rather weak relationship is found between socioeconomic status and performance in the Chinese context. The relationship follows a quadratic curve, implying that students from a disadvantaged family and higher socioeconomic background have a higher probability to attain higher mathematics scores. This can be explained on the base of Chinese cultural beliefs about exams and social class mobility. Moreover, the average socioeconomic status at the school level seems to moderate in the relation between individual SES and academic performance. This suggests that individuals from a disadvantaged family will benefit more from the school with a higher average higher family socioeconomic status than other students who are enrolled in schools with a lower average family socioeconomic status.

1. Introduction

The relationship between socioeconomic status (SES) background and academic performance has received ample attention since the publication of the "Coleman Report" in 1966 (Coleman, Campbell, Hobson, McParland, Mood, Weinfeld and York, 1966). A consistent finding is that students with a high family SES perform better than students with a lower SES. As shown in the Third International Mathematics and Science Study (TIMSS), the influence of family

socioeconomic status on educational performance appears to vary systematically depending on the economical development level of a region (Schiller, Khmelkov and Wang, 2002). Whether the relationship between SES and mathematics performance is different in other countries (developed or developing, various cultural value) is still an open question.

This brings us to the research aims of the present study: (a) to construct a comprehensive SES index based on input from previous studies; (b) to explore the general relationship between SES and mathematics in P. R. China, considering different developmental levels of the region; and (c) to analyze the extent to which aggregated SES at the school level influences student mathematics performance, regardless of students' different individual SES levels. Multilevel analysis was applied to study the impact of variables at the school, class and student level on mathematics performance.

2. Theoretical background

2.1 Measurement of socioeconomic status

SES which was approached in the 1980s stress family income, father's educational level, mother's educational level, and father's occupational status or occupation type (White, 1982). In later studies, additional variables were added to the index; e.g., home resources (Sirin, 2005), home atmosphere or context, number of books in the household, and other resources related to the learning (Caldas and Bankston, 1997; OECD, 2003).

2.2. Varying impact of SES on mathematics performance

2.2.1 Family SES and academic performance

Recently, the meta-analysis of both White (1982) and Sirin (2005) reveals that the direct relation between socioeconomic status and performance might be less strong. White's meta-analysis claimed that the meta-analysis reveals that the average correlation is .299 while Sirin's meta-analysis claimed a correlation value of .343.

2.2.2 SES and performance: the moderating effect of school aggregated SES variables

Previous studies show that higher levels of an aggregated school SES is related to an increase in student performance and in students with a different level of family SES (Perry and McConney, 2010).

3. Method

3.1 Sampling

These twenty schools are located in five Chinese regions reflecting different development levels; and are located in a rural or urban setting. Total school enrolment ranged from 318 to 897 students ($M=547.95$, $SD=140.19$). Sampling strata were based on the location of the school in a specific region.

3.2 Variables

3.2.1 Dependent variables

Mathematics performance level. All the items and cases were calibrated on a continuum scale ranging from grade one to six by Item Response Theory (IRT) programme of BiLog (See Authors, revising). Reliability of the scales (Cronbach's α) was reported to be high: for grade one to grade six respectively .94, .96, .95, .94, .94 and .93. Reported means are: -1.24, -.89, .05, .18, .69, .83.

3.2.2 Independent variables

3.2.2.1 Individual learner's level SES

In a first step, an exploratory factor analysis (EFA) was carried out by applying the WLSM method that is able to deal with eight items for the family information as categorical data (Mplus5.1). The results suggest a two-factor structure in the SES variable. A first factor grouped SES variables focusing on parents' occupation status; a second factor groups SES variables in relation to family wealth.

3.2.2.2 School level SES

Two aggregated SES indexes were calculated at the school level: (1) the average parent's socioeconomic status of the learners attending this school (SCFSES_J) and the average level of wealth of the children in the school (SCFSES_W).

4. Results

4.1 Multilevel analysis of the relationship between SES variables and mathematics performance

4.1.1 Weak relationship between SES variables and mathematics performance

These models only account for 0.41% of the variance in mathematics performance at the individual learner level (.486 vs. .484) (compare model 0 to model 6 in Table 4). This implies that the SES variables under study are not strong predictors of mathematics performance in primary school after controlling for school level variables.

4.1.2 The U-shaped relationship between SES variables and mathematics performance

Another interesting finding from the study is the U-shaped relationship between SES variables and performance in the primary school. This implies that the students with lower SES in China do not always attain lower performance levels, while students with a higher SES level do not always attain higher performance in primary schools. The performance of the students depends on the corresponding family SES level of the student.

4.2 SES and mathematics performance: the moderator effect of school level aggregated SES indexes

4.2.1 Stronger Effect of School level of FSES_J on mathematics performance

In sum, when means of SES at school level are entered into the models, about 22.02% of the total variance in mathematics performance can be explained (.227 vs. .177 see model 8 in Table 4) at the school level.

4.2.2 The moderator effect of school SES on mathematics performance

Figure 2 shows how the mathematics performance of learners with a different level of SES, based on their parents job level (recoded in three categories), varies according to the aggregated SES variable at school level.

The slope of the disadvantaged group with lower individual family SES (FSES_J_R = 1) is less steep as compared to the middle group (FSES_J_R = 2) and the advantaged group (FSES_J_R = 3). This implies that the moderating effect is stronger for learners with a higher individual SES. In general, the higher the school aggregated SES, the higher performance of learners with a higher family SES.

5. Discussion and conclusions

A variety of rationales can be presented to explain these specific findings based on data from the Chinese context. Although the cultural values and political management policies can have a positive impact, it remains nevertheless clear that disadvantaged students run a higher risk for encountering learning difficulties.

PAPER PRESENTATION

Assessment of adult's mathematical competence and the use of mathematics in work and daily life

Timo Ehmke, University of Lueneburg, Germany; Christoph Duchhardt, Leibniz Institute for Science and Mathematics Education, University of Kiel, Germany; Eva Knopp, Leibniz Institute for Science and Mathematics Education, University of Kiel, Germany; Irene Neumann, Leibniz Institute for Science and Mathematics Education, University of Kiel, Germany

The Programme for International Student Assessment (PISA) has drawn attention to the role of mathematical literacy as an important prerequisite for lifelong learning and active participation in society and culture. Many everyday situations require mathematical abilities for sound judgements or important decisions. The aim of this study is to find out how often adults use mathematics in their work and daily life and how this is connected to their mathematical competence. The sample comprises N = 461 adults from Germany (age: M = 44.2 years, SD = 12.2 years). The testing took place by individual sessions in the adults' personal home environment. A Latent-Class-Analysis identified three classes of adults which differ in their profiles of using mathematics in work and daily life. Regression analyses on the adults' mathematical competence showed statistically significant effects for age (beta = -0.19), socio-economic status (beta = 0.26), educational attainment (beta = 0.18) and the interaction between gender and educational attainment (beta = 0.57). Adding the variable "use of mathematics" to the regression model resulted in an additional effect mathematics user profile classes. The findings showed that the use of mathematics in work and daily life is a strong predictor for mathematical competence. This effect is stable even when characteristics of the social background are controlled. Further implications for the life-long learning in mathematics with regard to limitations of the study (sample bias and cross sectional design) will be discussed.

The Programme for International Student Assessment (PISA; OECD, 2003) has drawn attention to the role of mathematical literacy as an important prerequisite for lifelong learning and active participation in society and culture. Many everyday situations require mathematical abilities for sound judgements or important decisions. Mathematical literacy thereby emphasizes the knowledgeable use of mathematics as a tool for solving problems in real-world situations.

The aim of this study is to find out how often adults use mathematics in their work and daily life and how this is connected to their mathematical competence. More concrete we follow two research questions:

- (1) Which profiles can be identified concerning the use of different mathematical concepts in work and daily life?
- (2) Of what kind is the relationship between the adults' use of mathematics in work and daily life, their social status and their mathematical competence?

The sample comprises N = 461 adults from Germany (age: M = 44.2 years, SD = 12.2 years; gender: 55 percent women and 45 percent men). It was taken within a pilot study of the National Educational Panel Study (NEPS) in Germany (Blossfeld, Schneider & Doll, 2009). The testing took place by individual sessions in the adults' personal home environment. Test administrators who had been trained in advance conducted the test according to standardized guidelines. Each session took 90 minutes, and the participating adults were rewarded with a sum of 20 Euros. The test time was divided into 60 minutes for a paper-and-pencil mathematics test and 30 minutes for a questionnaire. The

mathematics test consists of 40 items (Cronbachs' alpha = 0.90) (Ehmke, Duchhardt, Geiser, Grýþing, Heinze, & Marschick, 2009). The questionnaire asks for standard sociodemographics (age, gender, socio-economic status, educational attainment) and also includes a scale on the use of different mathematical concepts in work and daily life (12 items, cronbachs' alpha = 0.86).

A Latent-Class-Analysis identified three classes of adults which differ in their profiles of using mathematics in work and daily life. The adults in the first class (63 percent of the sample) represent the "normal users". They apply elementary mathematics (e.g. fractions) in their work and daily life on average at least once per month. They almost do not use higher mathematical concepts (e.g. trigonometry). The second class (14 percent) comprises "advanced users". They use elementary mathematics as regularly as the first class. Additionally, they use advanced mathematics quite frequently. The third class (23 percent) can be described as "non-users". They report that they very seldom apply mathematics in their work and daily life.

Regression analyses on the adults' mathematical competence showed statistically significant effects for age (beta = -0.19), socio-economic status (beta = 0.26), educational attainment (beta = 0.18) and the interaction between gender and educational attainment (beta = 0.57). Adding the variable "use of mathematics" to the regression model shows an additional effect mathematics user profile classes. Also, this results in a reduction of the effects for the characteristics of social status. This can be interpreted as a mediation effect. In the final model, 35 percent of the variance in the adults' mathematical competence is explained by the characteristics of social status and their use of mathematics in work and daily life.

The findings showed that the use of mathematics in work and daily life is a strong predictor for mathematical competence. This effect is stable even when characteristics of the social background are controlled. Further implications for the life-long learning in mathematics with regard to limitations of the study (sample bias and cross sectional design) will be discussed.

References:

- Blossfeld, H.-P., Schneider, T. & Doll, J. (2009). Methodological Advantages of Panel Studies: Designing the New National Educational Panel Study (NEPS) in Germany. *Journal for Educational Research online*, 1 (2), 10-32.
- Ehmke, T., Duchhardt, C., Geiser, H., Grýþing, M., Heinze, A. & Marschick, F. (2009): Kompetenzentwicklung ýber die Lebensspanne - Erhebung von mathematischer Kompetenz im Nationalen Bildungspanel. In: A. Heinze & M. Grýþing (Hrsg.): *Mathematiklernen vom Kindergarten bis zum Studium. Kontinuität und Kohärenz als Herausforderung fýr den Mathematikunterricht*. Mýnster: Waxmann, S. 313-327.
- OECD. (2003). *The PISA 2003 assessment framework – mathematics, reading, science and problem solving knowledge and skills*. Paris: OECD.

PAPER PRESENTATION

Students' alternative conceptions of tropical cyclone causes and processes

Rod Lane, Macquarie University, Australia; Pamela Coutts, Macquarie University, Australia

Shulman (1987) argued that an important component of pedagogical content knowledge (PCK) is teachers' understanding of common student alternative conceptions, yet little is known about what students believe about many topics in the school curriculum. This paper focuses on an area of the NSW Junior Geography curriculum as the first phase of a larger study designed to investigate Geography teachers' PCK. Common student conceptions of tropical cyclone causes and processes were identified using a variety of methods. Results indicate that middle school Geography students (n=330) hold a range of alternative conceptions related to foundational scientific principles as well as the geographical concepts of location, scale and interaction with the human and natural environment. Implications for the knowledge requirements of Geography teachers are discussed.

Aims/rationale

Shulman maintains that teachers need to ground pedagogy in a detailed knowledge of students' existing conceptions. The first step is to establish the nature of these conceptions. Although there is considerable research on student alternative conceptions in the Science and Earth Science literatures (Reinfreid & Schuler, 2009) there has been little research integrating a focus on scientific processes with the geographical perspectives of spatial distribution, scale, and interaction with the human and physical environment. This study therefore aimed to identify the common alternative conceptions of tropical cyclone causes and processes held by 330 Year 8/9 students studying Geography in 18 Sydney schools. The case study of tropical cyclones was chosen because of: the lack of previous research on student conceptions in this area; the likelihood that students would have been exposed to informal ideas about

tropical cyclones; the ease with which the conceptual building blocks of understanding (such as air pressure) could be identified; and the existence of research indicating such concepts present difficulties for many students because of their abstract nature.

Methodology The mixed-method design consisted of a semi-structured interview (involving drawing tasks, stimulus response activities, and hypothetical/simulation questions) and a questionnaire. The questionnaire, with 40 true/false statements and a confidence scale, provided an indication of the distribution of alternative conceptions across the entire sample. It was assumed that a high confidence level indicated that students were either recalling factual knowledge or drawing on a theorized belief (Vosniadou, Vamvakoussi, & Skopeliti, 2008). The focus of analysis was on the identification of items of low facility where average student confidence was high as these beliefs were likely to represent strongly held alternative conceptions. Seventeen students were subsequently interviewed (with drawing, mapping and stimulus response tasks incorporated) to explore the preconceptions of the participants in greater detail and to validate the findings of the questionnaire.

Data analysis Student drawings, interview transcripts and written responses were coded and patterns of alternative conceptions identified and recorded. Descriptive statistics were generated from the questionnaire responses and items answered incorrectly by more than a third ($n=110$) of the students were then sorted by confidence. Clusters of ideas or item types were identified. Conceptions and beliefs were considered stable if they were used consistently in students' explanations on more than one occasion, for example through their questionnaire responses, written explanations, drawings and answers to semi-structured interview questions (Vosniadou, et al. 2008).

Results Analysis of the drawings, interview transcripts and questionnaire data revealed a number of common patterns and themes. The first grouping of five alternative conceptions related to students' understandings of underlying scientific processes such as sensory based conceptions of felt weight (e.g. air is weightless) and causes of wind (e.g. cold air is the main cause of strong winds) and literal interpretations of models and analogies (e.g. water evaporating from the ocean is a boiling process and clouds are made of steam). The second grouping comprised three categories of beliefs related to geographical perspectives about scale, location and lifecycle of tropical cyclones (e.g. tropical cyclones are phenomenon "about the size of my school"), internal processes (e.g. tropical cyclones "fill-up like a vacuum cleaner, get clogged-up, and stop"); and the relationship/links between different types of natural hazards (e.g. cyclones create tsunamis or are caused by earthquakes). The data also suggest that there are a number of deep-seated alternative conceptions (items of low facility with high average confidence) that are widely held by students (see Table 1 below). For each of these items, students answering incorrectly were either more confident or as confident as those answering correctly (p Table 1: Some firmly-held alternative conceptions)

Statements	% Correct	Confidence
The main reason that the tropics are hotter than the North and South Poles is because they are closer to the sun.	42.73	3
Air is weightless.	63.69	3
The terms "hurricane", "typhoon" and "tropical cyclone" describe different types of storms that occur around the world.	27.68	3
The evaporation of water from the ocean is a boiling process.	56.63	3
Most deaths and injuries in severe tropical storms worldwide are due to objects flying in the air or structures collapsing.	17.61	3

With factual items (e.g. Australia's cyclone season occurs between June and September) or items based on difficult concepts (e.g. Air pressure directly above a body of water increases as the temperature of the water increases), students' average confidence scores were low (40 and 37 respectively).

Interpretation of results and implications for theory The findings indicate that students hold a range of ideas that have the potential to interfere with their depth of their understanding in Geography. Some of these ideas relate to foundational scientific principles, others to the geographical concepts of location, scale and interaction with the human and natural environment. These findings have significant implications for the knowledge requirements of Geography teachers. The research on PCK indicates that knowledge of students' common preconceptions is essential if teachers are to enhance levels of Geographical literacy. Having identified these common categories of student beliefs, the next step therefore is to undertake research to explore Geography teachers' awareness of students' common preconceptions and their use of this knowledge to inform instruction. The results obtained are also consistent with Brewster's (2008) argument that mixed methodological approaches with a strong reliance on structured interviews provide the most reliable diagnosis of students' conceptions. Although the questionnaire provided a reasonable indication of the distribution of alternative conceptions across the sample and clearly highlighted the most entrenched/firmly held naïve beliefs, the semi-structured interviews were required to accurately identify the alternative conceptions of individual participants and provide further meaning to these overall distributions.

References Brewster, W. (2008). Naive theories of observational astronomy. In S. Vosniadou (Ed.), *International Handbook of research on Conceptual Change*. New York: Routledge.

Reinfried, S., & Schuler, S. (2009). The Ludwigsburg-Lucerne Bibliography of misconception research in the geosciences - a project to capture the international research literature. *Geography and its Didactics*, 37(3).

Shulman, L. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.

Vosniadou, S., Vamvakoussi, X., & Skopeliti, I. (2008). The Framework Theory approach to the problem of conceptual change. In S. Vosniadou (Ed.), *International Handbook of research on Conceptual Change*. New York: Routledge.

PAPER PRESENTATION

Intervention Study on Systems Thinking in Lower Secondary School

Teaching science at the lower secondary level includes the discussion of complex phenomena, such as climate change, genetic engineering and sustainable development. Systems thinking seeks to better understand such phenomena by identifying changes over time and interdependencies between elements. While systems thinking is well established in science and complex topics are found in most secondary-school science curricula, research in science education has shown, that students from primary to higher education have a poor understanding of basic system concepts.

This study examined the effects of introducing systems thinking to 9th grade students. Data on the learning progress of 79 students was collected in a pre- and post-test design, including a second post-test five weeks after the intervention. A competence model was used to develop the content of the intervention and the instruments to measure the changes.

After the intervention, the students showed significant and sustained progress in three competence areas: "model description", "dynamics" and "making predictions". In particular, the students subsequently used more structurally complex relationships, such as causal chains, junctions and feedback loops in their sketches to outline a complex situation. Further, they recognised more non-linear changes and were able to formulate more sophisticated predictions including alternative reasoning, delays and limits of growth than before. The study showed that the main concepts and representations of systems thinking can be successfully taught in a cross-curricular training and that the training also triggers conceptual change by broadening students' reasoning in complex situations.

Teaching science at the lower secondary level includes the discussion of complex phenomena, such as climate change, genetic engineering and sustainable development. In doing so, the aim is not only the acquisition of knowledge but also a better understanding of changes over time and interdependencies between elements. Systems thinking seeks to understand such complex phenomena by identifying boundaries, inputs, outputs, flows as well as parts of a system and how they are connected or working together. Basic concepts of systems thinking, such as feedback loops, delays, nonlinearity and representations such as causal loop diagrams, stock and flow diagrams or time graphs are well established in science.

Whereas complex contents can be found in most secondary school science curricula, systems thinking has not yet been established as a unifying cognitive tool to support students' better understanding. Washington State (USA) is unique in recognising the growing importance of "systems" as one of the cutting-edge concepts and abilities in K-12 Science Standards (Dorn, 2009). Recently, educational standards for systems thinking have also been discussed for public schools in Switzerland.

Research in science education has shown that students from primary through higher education have a poor understanding of basic system concepts (e.g. Sweeney & Sternam, 2000; Sweeney, 2005). Students' reasoning in complex situations is often restricted to linear arguments and to applying linear models to predict changes of any parameter. Considering this, an introduction of understanding complex phenomena by teaching basic concepts of systems thinking and thereby triggering conceptual changes of the students' reasoning in such situations might be challenging.

This study examined the effects of introducing systems thinking to 9th grade students. In particular, the students' abilities to draw a sketch of a complex situation representing interdependencies, their interpretation and calculation of linear and nonlinear changes as well as their level of differentiation in predictions were evaluated.

Data on the learning progress of 79 students was collected in a pre- and post-test design, including a second post-test conducted five weeks after the intervention to evaluate the long-term impact. A working definition of "systems thinking" and a competence model introduced by the Swiss and German research-group SYSDENE was used to develop the content of the intervention and the instruments to measure expected changes. The adoption of a coherent framework – within which contents were drawn from different disciplines – was necessary due to the existence of differing definitions of systems thinking (e.g. Forrester, 1994; Richmond, 1994; Ossimitz, 2000).

The competence model of systems thinking consists of four areas of competence. The first area, "model description", and the second one, "dynamics", are needed for the reconstruction of a system, whereas the other areas, "making predictions" and "assessing action plans" describe the use of the system. As an introduction to systems thinking, the training focused on the areas "model description", "dynamics" and "making predictions". The training consisted of 11 lessons introducing main system concepts and representations, such as causal loop diagrams and time graphs –

applying them to different contents in Geography, Biology and Mathematics. To evaluate the learning progress by means of online and paper-and-pencil tests, existing instruments for measuring systems thinking skills were adapted (Ossimitz, 2000; Bollmann-Zuberbühler, 2008) or newly designed.

The students rated the training as easily accessible and useful. After the intervention, the students showed significant progress in all three areas: "model description", "dynamics", and "making predictions". The training effects persisted until the second post-test. As a consequence of the training, students used more structurally complex relationships, such as causal chains, junctions and feedback loops in their sketches to outline a complex situation. In addition, students recognised more non-linear changes and were able to formulate more sophisticated predictions, including alternative reasoning, delays and limits of growth. Furthermore, some of the students formulated a benefit of systems thinking after the training by declaring that they were better able to identify opportunities for systems thinking in other subjects. The students concluded that it would also be useful to analyse scientific phenomena from different points of view and recognise interdependences in everyday life.

To become an effective systems thinker requires the acquisition of a set of competences and skills. This study showed that the main concepts and representations can be successfully taught in a cross-curricular training. The use of different contents helped students to recognise the benefit of systems thinking as a unifying cognitive tool and as a consequence, they used less linear reasoning and linear models to predict changes. Understanding non-linear relationships such as exponential changes requires specific mathematical knowledge and should best be introduced through experiments and iterative calculations. The study further revealed that a variety of instruments is necessary for collecting data to evaluate the different areas of competence. In particular, new instruments to measure the students' skills to identify dynamic changes were successfully applied. Nevertheless, more efforts are needed to verify the model of competence used in this study.

PAPER PRESENTATION

Collaborative conceptual change in the science classroom: discourse as process & outcome of learning

Erica Sainsbury, University of Sydney, Australia; Richard Walker, University of Sydney, Australia

The processes and outcomes of conceptual change learning were simultaneously evaluated through analysis of the discourse of first year pharmacy students involved in small-group discussion and problem-solving in the topic of "Acids and Bases". Students were videorecorded during weekly sessions, and interviewed on three occasions: before, immediately after and five months after a teaching intervention designed to introduce new conceptual understanding and facilitate the development of contextual discrimination of the meanings communicated by use of particular words in two different scientific communities (chemistry and pharmacy). Interviews were used in order to evaluate the outcomes of conceptual change, and the videorecordings were used to elucidate the processes at work in each group that promoted or constrained conceptual change. The two groups were classified as PC (Persistent Change) and TC (Transient Change) on the basis of the long term learning exhibited at the third interview. There was a clear correspondence between the processes and outcomes in that members of the PC demonstrated productive interactions leading to high levels of intersubjectivity and creation of effective zones of proximal development through extended progressive discourse, while TC members displayed poorly productive interactions, little intersubjectivity and minimal creation of ZPDs. Results were consistent with whole-cohort surveys. A surprising and complex effect of friendship was noted in that the closeness of friendships was not necessarily associated with more productive interactions. The study is important because it describes a conceptual change discourse model which is capable of relating process and outcomes, and offers directions for improving student learning.

Aims

The aim of this research was to explore the application of a discourse model of conceptual change in a first year university classroom. The model was developed on sociocultural principles, and postulates that both the process and outcomes of conceptual change can be evaluated by analysing the discourse of students, both among themselves, and with tutors. Further, the model outlines how student group interactions mediated learning, through promoting different levels of intersubjectivity, and differential creation of zones of proximal development. The study was prompted by a history of observed student difficulties in understanding and communicating meaning when using the same words in different contexts – in this case in the scientific communities of chemistry and pharmacy.

Specifically the study was designed to investigate simultaneously the processes and outcomes of conceptual change learning, where evidence for conceptual change was found when students engaged in patterns of discourse which were appropriate in the context of a particular community, and exhibited explicit contextual discrimination between the two communities.

Methodology

The study was carried out with pharmacy students at the University of Sydney, Australia. Within the compulsory unit Introductory Pharmaceutical Science, students were divided into four parallel workshop groups, undertaking weekly two-hour sessions to consolidate the learning of material on the topic "Acids and Bases" presented in lectures. Within the workshop groups, students worked together in sub-groups of four to six throughout the semester (13 weeks) to complete activities requiring discussion and collaborative problem-solving. Within each workshop, one sub-group was invited to participate in the intensive phase of the study, and two of these groups, comprising eleven students, were subsequently included in the analysis.

The intensive phase involved interviews and videorecordings. The researcher conducted three interviews with each participant: one immediately prior to commencement of the instructional period; one conducted immediately after a four week teaching intervention; and a third interview conducted approximately five months after the teaching intervention, and following a three-month vacation. These interviews represented participants' pre-instruction understanding and attitudes, post-instruction understanding and attitudes, and long-term learning respectively. Group interactions were videorecorded for three weeks in workshops in order to evaluate both verbal and non-verbal behaviours.

Interviews were transcribed verbatim and analysed for content by considering how each participant talked about the concepts under exploration. The discourse of the videorecordings was also transcribed and analysed for the ways in which participants talked about the concepts, and in addition participants' verbal and non-verbal behaviours were analysed in order to describe patterns of collaboration. Questions were also included in the interviews to elucidate the participants' perspectives about the nature of the group interactions to complement observation of behaviours within workshops.

The entire cohort of 190 students was asked to participate in pre- and post-surveys of attitudes, beliefs and knowledge relating to the concepts of "Acids and Bases" in order to investigate the extent to which the selected sample reflected the entire population.

Findings

The two intensive phase groups were selected for analysis because they represented the extremes in patterns of collaboration, which has the advantage of making subtle difference more apparent.

Clear differences were apparent between the groups in the nature and persistence of the learning achieved by their members, with one group (Persistent Change, PC) demonstrating long-term retention of both appropriate discourse and contextual discrimination, and the other (Transient Change, TC) displaying evidence of only short-term learning which appeared to be targeted primarily towards examination performance. Group dynamics and behaviours were also significantly different, with the PC group exhibiting consideration of others and collaborative, learning-focused interactions involving extended and progressive discourse, while the TC group engaged in individualistic and task-focused behaviours which were characterised by less extensive and poorly coordinated discussion. Aspects of interpersonal relationships such as perceived status, together with behaviours such as persistence at tasks, and the nature of interactions with tutors created unique learning trajectories for both individual participants and the groups in which they worked. In summary, the group which demonstrated more productive interpersonal behaviours and group dynamics also demonstrated greater long term conceptual change learning.

An interesting finding was the effect of friendship on group learning. Previous work has suggested that interactions between friends are generally more productive than interactions between individuals who are not friends. However the current results suggest a more complex relationship between friendship and learning. The TC began the study claiming to be close friends, living in community within nearby residential colleagues, whereas the PC indicated that their friendships were less close. However, the closeness of the TC deteriorated significantly as a result of interpersonal competition, whereas the collaborative interactions of the PC appear to have strengthened their friendships.

The results of the cohort surveys were consistent with the findings from the intensive phase in that students demonstrated different extents of conceptual change, but that development of new understandings and some contextual discrimination was generally apparent.

Theoretical and educational significance

This study describes the application of research methods which are capable of providing an analytical and interpretive framework for the simultaneous investigation of the processes and outcomes of conceptual change. It appears to be the first report exploring the interdependence of these two dimensions, and identifies a number of key issues which have the potential either to promote or constrain conceptual change learning. It provides a theoretically rigorous foundation for the development of curriculum and design of learning environments which are capable of enhancing student learning. With respect to processes of change, this study posits a mechanism based on transformation of conceptual understanding through discourse; with respect to outcomes, it offers an alternative to the reliance on examination results.

This study is an important contribution to the development of conceptual change theory through the introduction of a new discourse model, and to conceptual change practice through the model's powerful potential for interpreting the results of empirical investigation. The findings provide new and significant insights into the original questions regarding both the processes and outcomes of conceptual change, and suggest fruitful directions for further research and effective means of improving learning in educational settings.

PAPER PRESENTATION

Changes in preservice teachers' personal epistemologies: A longitudinal study

Jo Brownlee, QUT, Australia; Susan Walker, Queensland University of Technology, Australia; Beryl Exley, QUT, Australia; Annette Woods, QUT, Australia; Chrystal Whiteford, QUT, Australia

Personal epistemological beliefs affect learning and influence the extent to which understanding is developed and meaning is made (Hofer, 2002). Strong evidence exists to demonstrate that pre-service teachers' personal epistemology can have an influence on their learning strategies and learning outcomes (Muis, 2004). Personal epistemologies, therefore, filter how pre-service teachers experience learning in teacher education courses and engage in meaningful approaches to learning (Muis, 2004). Given this, this study examined early childhood and primary pre-service teachers' a) understanding of the relationship between personal epistemologies and beliefs about learning; and b) changes in personal epistemology and beliefs about learning as students progressed through their four year Bachelor of Education course. Data collection occurred in 2007 (Phase 1) and 2009 (Phase 2). At each time point students completed the Epistemological Beliefs Survey (EBS, Kardash, & Wood, 2000) and a subset of students participated in semi-structured interviews. Results from both the questionnaire and the interview data indicated that students' personal epistemologies became more sophisticated over time with significant differences evident between Phase 1 and Phase 2 in students' personal epistemologies and beliefs about learning. Findings from this project on change in personal epistemology and beliefs about learning can inform teacher education programs.

Personal epistemologies affect learning and influence the extent to which understanding is developed and meaning is made (Hofer, 2002). Strong evidence exists to show that pre-service teachers' personal epistemology influences their learning strategies and learning outcomes (Muis, 2004). That is, we know that personal epistemologies filter how pre-service teachers experience learning in teacher education courses and engage in meaningful approaches to learning (Muis, 2004). Given the research evidence showing that personal epistemology influences learning, the study detailed in this proposal investigated a) the relationship between personal epistemologies and beliefs about learning; and b) changes in personal epistemology and beliefs about learning for a group of early childhood and primary pre-service teachers as they progressed through their four year Bachelor of Education degree toward teacher accreditation. ParticipantsThe participants for the study were pre-service teachers in the Bachelor of Education (Early Childhood) and pre-service teachers in the Bachelor of Education (Primary) at a large University situated in a large capital city in Australia. The Primary Cohort attended one of two campuses, a large city-based campus and a smaller satellite campus. Data collection occurred in 2007 (Phase 1) and 2009 (Phase 2). Data collection and analysisAt each phase, the pre-service teachers were invited to complete the Epistemological Beliefs survey (EBS, Kardash, & Wood, 2000). The EBS consists of several subscales, labeled as Structure, Knowledge Construction, Success and Truth. In Phase 1 (2007), 194 Early Childhood pre-service teachers and 131 Primary pre-service teachers completed the EBS. In Phase 2 (2009), 80 pre-service Early Childhood teachers and 131 pre-service Primary teachers completed the survey. At each phase, a subset of the larger cohorts participated in semi-structured interviews to gather qualitative data regarding participants' personal epistemologies and beliefs about learning. Interview responses were compared to establish the extent to which changes had taken place in the pre-service teachers' personal epistemologies over time. At Phase 1 (2007), 15 Early Childhood pre-service teachers and 14 Primary pre-service teachers were randomly selected to be invited to take part. In Phase 2 (2009), 8 Early Childhood pre-service teachers and 5 Primary pre-service teachers from the original interview cohort were re-interviewed. The interviews were scenario-based, and adapted from the work of Stacey et al. (2005) to focus on literacy teaching experiences. The questions were used to encourage reflection and to facilitate articulation of personal epistemologies within the context of the pre-service teachers' fields of study.

Interview questions focused upon beliefs about knowing and beliefs about knowledge to measure personal epistemology. Results Paired sample t-tests indicated that there were significant differences between Phase 1 and Phase 2 on students' responses on the EBS. Specifically, results indicated that 3rd year pre-service teachers were more likely than 1st year pre-service teachers to believe that learning might take time, that knowledge is integrated rather than consisting of a series of facts, and that knowledge is uncertain. However, there were no significant differences on the subscales of Knowledge Construction or Success. Interview analyses revealed changes in personal epistemology and beliefs about learning from Phase 1 to Phase 2. For personal epistemology, four pre-service teachers described practical evaluativistic beliefs at Phase 1 and then complex evaluativistic beliefs at Phase 2. The remaining six pre-service teachers moved from subjectivist to evaluativistic beliefs (n=2 complex evaluativism; n=4 practical evaluativism) at Phase 2. Only three pre-service teachers did not demonstrate any changes, and of these, one pre-service teacher already held sophisticated beliefs at Phase 1, suggesting that further development would not be likely to take place over time due to a ceiling effect. For changes in beliefs about learning, one student moved from a sense making view of learning to a qualitative perspective and one student moved from quantitative to application. Five pre-service teachers did not change their beliefs over time, although it should be noted that three of these pre-service teachers already held qualitative beliefs at Phase 1. Finally, complex evaluativistic beliefs were associated with qualitative conceptions of learning, practical evaluativistic beliefs were linked with qualitative sense-making and application and subjectivist beliefs were related to quantitative conceptions. Implications The findings are important when considering that the core business of teachers relates to learning and knowing. Teachers with more sophisticated personal epistemologies and beliefs about learning are likely to be able to engage in complex problem solving tasks, and argue based on evidence for a "best" solution. Teacher education programs, therefore, need to assist pre-service teachers to promote sophisticated personal epistemologies and qualitative conceptions of learning. A need to help pre-service teachers to reconstruct personal epistemologies is thus highlighted. Such reconstruction may be possible through a focus on explicit reflection on personal epistemologies. Further research is needed to qualify if engagement in explicit reflection on personal epistemologies will progress pre-service teachers' understanding of their personal epistemologies, to calibrate these to a variety of teaching situations, and thus reconstruct their personal epistemologies.

References

- Hofer, B. (2002). Personal epistemology as a psychological and educational construct: An introduction. In B. Hofer & P. Pintrich (Eds.) *Personal epistemology: The psychological beliefs about knowledge and knowing* (pp. 3-14). New Jersey: Lawrence Erlbaum.
- Kardash, C. M., & Wood, P. (2000, April). An individual item factoring of epistemological beliefs as measured by self-reporting surveys. Paper presented at the American Educational Research Association, New Orleans, Louisiana.
- Maggioni, L., & Parkinson, M. (2008). The role of teacher epistemic cognition, epistemic beliefs, and calibration in instruction, *Educational Psychology Review*, 20(4), 445-461.
- Muis, K. (2004). Personal epistemology and Mathematics: A critical review and synthesis of research. *Review of Educational Research*, 74(3), 317-377.
- Stacey, P. S., Brownlee, J., Thorpe, K., & Class EAB016 (2005). Measuring and manipulating epistemological beliefs in early childhood pre-service teachers. *International Journal of Pedagogies and Learning*, 1, 6-17.

PAPER PRESENTATION

Greek secondary students' early encounters with mathematical proof in Algebra and Euclidean Geometry

Ioannis Kanellos, University Of East Anglia, United Kingdom; Elena Nardi, University Of East Anglia, United Kingdom; Irene Biza, Loughborough University, United Kingdom

Students' early encounters with formal mathematical reasoning are often characterised by tensions between intuitive insight and empirical or deductive inference. In this paper we explore students' early encounters with mathematical proof in order to discuss some of these tensions. To this purpose we draw on the 240 written responses of Year 9 and 10 Greek secondary students to diagnostic tests in Algebra and Geometry. The tests were produced by a group of experienced mathematics teachers, coordinated by the first author in his role as school advisor as well as researcher to this study, and were generated in the light of seminal research in this area by Harel & Sowder (1998) and Healy & Hoyles (2000), on students' emergent proof schemes and proof conceptions respectively. The tests aimed to capture students' perceptions at the time of their first encounters with proof (Year 9) and their evolving perceptions as they approach introduction to formal proof (Year 10). Quantitative (cluster analysis) and qualitative (coding and categorising) analyses of the data, informed by the taxonomies in aforementioned works, are currently in progress. Although preliminary, these analyses suggest that the issues raised by Harel & Sowder and Healy & Hoyles apply to Greek learners at this stage and mark some of the differences between the Year 9 and Year 10 scripts; they also suggest a variation of proof perceptions between Algebra and Geometry and an association between the

sophistication of students' proof schemes and the precision and breadth of mathematical language that these students employ.

Introduction

Students' early encounters with formal mathematical reasoning are often characterised by tensions between intuitive insight and empirical or deductive inference. When asked to determine the truth or falsity of a mathematical statement, or to produce a mathematical argument or proof, students are often perplexed as to what degree they are allowed to rely, for example, on visual insight, are expected to carry out numerous trials or employ the, often elusive at this stage, tools of deduction (Hanna, 2000). In this paper we explore secondary students' early encounters with mathematical proof in order to discuss some of these tensions. To this purpose we draw on a study currently in progress at the Universities of East Anglia and Loughborough in the UK, where the second and the third author are respectively affiliated. The study is being conducted in the secondary education context of Greece, location of the first author's position as a secondary school advisor. In the following we introduce the context, participants, aims and methods of the study and suggest some of its preliminary findings.

Context Greek secondary education is divided in two subsequent stages, the lower (Gymnasium, Years 7-9, ages 13-15) and the upper (Lyceum, Years 10-12, ages 15-17). Proof and proving is taught for the first time in Year 9 in two mathematical topics, Algebra and Geometry. In Algebra, proof tasks in Year 9 often involve the proof of identities such as $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$. In Geometry, proof tasks in Year 9 may involve proving statements such as that every point of an angle bisector is equidistant from the sides of the corresponding angle. Tasks such as these aim to prepare students for a more comprehensive introduction to mathematical proof in the context of the Euclidean Geometry course, as well as the more advanced treatment of Algebra, in Year 10. In Year 9 Algebra students are expected to start exploring properties of real numbers beyond the trial of specific examples and to work towards the expression of generalised properties. In Year 9 Geometry, on the other hand, constructing arguments based on empirical facts is an acceptable practice, at least early on. For example, when students are introduced to the theorems-criteria of congruency for triangles, superimposing triangles is used in order to convince the students of the validity of the criteria. Once convinced, the students engage with proving these theorems in a deductive way. We note that in Years 7 and 8 proof is not present with the exception of the inverse of the Pythagorean Theorem that is used – however without explicit discussion of proof as such – in examining whether a triangle is right-angled or not.

Aims and data collection Our study aims to examine students' perceptions at the time of their very first encounters with proof in Year 9 as well their evolving perceptions as they approach the time of introduction to formal proof in Year 10. To this purpose we administered diagnostic tests in Algebra and Geometry to students of both years and at the beginning of the school year. The tests were produced by a group of experienced mathematics teachers, coordinated by the first author in his role as school advisor as well as researcher to this study, and were generated in the light of seminal research in this area by Harel & Sowder (1998) and Healy & Hoyles (2000), on students' emergent proof schemes and proof conceptions respectively. Students had a normal school period (45 minutes) to work on each test. For example, in one of the six items in the Year 9 Geometry Test, students were given two triangles and were asked to prove that one is right-angled and the other is not. One of the eight items in the Year 10 Geometry test asked the students to divide a line segment in three equal parts via a method of their choice – excluding the use of measurement via a ruler – either explicitly demonstrated and justified in a figure or described and justified in words. One of the twelve items in the Year 10 Algebra Test asked the students to prove that $a^2 + b^2 \geq 2ab$, for real numbers a and b . We collected 240 scripts.

Data analysis and preliminary findings Quantitative (cluster analysis) and qualitative (coding and categorising) analyses of the data, informed by the taxonomies in the aforementioned works, are currently in progress. Students' responses in each item are characterised in terms of a list of proving behaviour features (a synthesis of the features discussed in Harel & Sowder and Healy & Hoyles). These characterisations are entered in a Script \times Features spreadsheet, with each cell containing the characterisation of a student's response to each item in each of the tests. There are two spreadsheets, one for Year 9 and one for Year 10 scripts. Presence or absence of each feature within each item is counted. Cluster analysis of these numerical data will lead to a typology of student proving behavior, namely groups of scripts characterised by the presence or absence of certain features. This typology will be supported by qualitative accounts of the scripts. Although preliminary, these analyses suggest that the issues raised by Harel & Sowder and Healy & Hoyles apply to Greek learners at this stage and mark some of the differences between the Year 9 and Year 10 scripts; they also suggest a variation of proof perceptions between Algebra and Geometry and an association between the sophistication of students' proof schemes and the precision and breadth of mathematical language that these students employ.

References Hanna, G. (2000). Proof, Explanation and Exploration: An Overview. *Educational Studies in Mathematics*, 44(1), 5-23. Harel, G., & Sowder, L. (1998). Students' proof schemes: Results from exploratory studies. In A. H. Schoenfeld, J. Kaput & E. Dubinsky (Eds.), *Research in Collegiate Mathematics Education III* (pp. 234-283). Providence, RI: AMS. Healy, L., & Hoyles, C. (2000). A study of proof conceptions in Algebra. *Journal for Research in Mathematics Education*, 31(4), 396 - 428.

PAPER PRESENTATION

Children's preschool SFON, subitizing and counting skills predict mathematical skills 6 years later

Minna M Hannula-Sormunen, University of Turku, Finland; Erno Lehtinen, University of Turku, Finland; Pekka Rasanen, NMI, University of Jyväskylä, Finland; Roland H. Grabner, ETH, Switzerland

Research on mathematical development and number processing, especially the study of early developmental factors, still seriously lags behind the successful identification of the predictors of literacy. This project aimed at charting, longitudinally, numerical development and delineating the early factors producing both later success and failure in school mathematics. In this 7-year longitudinal study of 39 normally developing children, the participants' Spontaneous Focusing On Numerosity (SFON), subitizing-based enumeration and counting skills were assessed at the age of 5-6 years, while their mathematical skills, Raven's non verbal IQ and working memory for numbers were tested at the age of 12 years. Results of path analyses show that subitizing-based enumeration and counting skills predicted uniquely mathematical skills at age 12, while SFON was indirectly, via counting skills related to mathematical skills at age 12. These associations remained significant when working memory and non-verbal IQ at age 12 were controlled for. Working memory was significantly related to mathematical skills at age 12, while IQ was not. Children's SFON continues to be an effective component of mathematical development throughout the childhood years until the end of primary school.

PAPER PRESENTATION

Pre-school children's number and problem-solving concepts compared: UK - Japan.

Jennifer (Ewers-) Rogers, Liverpool Hope University, United Kingdom

International league tables of academic performance show that Japanese pupils consistently outperform English pupils, yet their relative starting points upon starting school are not known. A comparative study investigating early conceptual development was carried out in the UK and Japan examining a range of abilities known to be significant factors generally in school success. 110 pre-school children with an average age 4 years, 55 from each nation were individually assessed in a study matching gender, age, sample size and background. Quantitative data from the results of early number showed that the young Japanese participants significantly out-performed English pre-schoolers on cognitive-linguistic measures at a level approaching significance ($\chi^2 = 3.5$, $p = .056$). They were also able to use more symbolic representation of number ($\chi^2 = 9.52$, $p > .001$). Qualitative data provide further, explanatory detail. The results overall allow consideration and comparison of the philosophy and pedagogy of teaching in the early years with philosophy, pedagogy and educational performance at later stages in the two countries (Alexander, 2001).

Introduction: Global cooperation and competition have expanded interest in comparisons of pedagogy and performance internationally - and particularly of relationships between the two. Tables of academic performance in Mathematics and Science (TIMSS) frequently show pupils from Pacific Rim and Scandinavia achieving the highest results (Mullis, Martin and Foy, 2005). Of note is that Japanese pupils consistently outperform English pupils by the age of 9, despite starting school almost two years later at age 6+. Findings from a range of research areas show that many of young children's early competences are underpinned by the ability to sequence a series of events. Fluck and Henderson (1996) report pre-school children's difficulty in using their counting skills for problem solving, corroborated by a range of recent reports. Problem solving depends upon formal experience in sequencing. While much educational assessment of children takes place within the 'secondary' language mode of writing, relatively little is known about the extent of 'primary' oral ability which allows the construction of meaning from experience as well as direct expression of conceptualisation. The paper reports on a comparative study in the UK and Japan examining early conceptual development and a range of abilities known to be significant factors generally in later school success.

Methodology: To compare children's understandings of number for the relationship between levels of cognitive-linguistic competence and later academic success the tests were conducted at the age at which they approach statutory education. As English children start Primary School at around age 5 years and Japanese children commence Elementary School at 6+ years, tests were administered to participants with an average age of 5 years. Participants 110 pre-school children, 55 from each nation, (56 M and 54 F) aged 40-59 months, were individually assessed (Japanese, $M = 49.09$; English, $M = 50.15$, p Materials: Activities were devised which require participants' to apply their existing knowledge in new situations to reveal the nature and extent of underlying concepts and meta-cognitive abilities. Expression in natural language allowed a valid examination of conceptual knowledge. Reliability was allied to four principles. Firstly that the orally presented tasks eliciting spoken responses were identical in both countries, with materials and content appropriate, 'culturally fair' and reliable (Anastasi, 1988; p.298) in both settings and valid for assessing the cognitive development of very young children. This eliminated using standardised tests, not widely available for this young age-group, and the author developed bespoke tests specifically for this study. Linguistic

accuracy of target questions was measured for reliability and validity at the developmental stage through reverse translation using native speakers. Two tests assessed counting and cardinal number concepts. The Dolls and Stickers game assessed oral number the various ways in which number (numerosity) was conveyed in speech. In the Boxes Game children's graphical/written recordings were examined for clarity in conveying concepts of cardinal number in symbolic form. Ethical safeguards: Ethical safeguards for testing very young nursery/kindergarten participants was considered by the stakeholders and consent obtained through the universities and schools to meet the standards of each country, prior to project clearance and administration. Methods of Analysis: Responses to the Dolls and Stickers task were examined for the correct use of cardinality in orally reporting numbers 3, 1 and 2. A secondary assessment was correct use of the colours yellow, green and red. In the Boxes Game, graphical forms of representing cardinal number were coded as idiosyncratic, pictorial/iconic or symbolic/numeric. Results Statistical tests found a significant difference for all children overall between the means for the oral representation of numbers 1, 2 and 3 in the Dolls game (Cochran Q = 8.19, p df = 2); children were able to represent number 1 orally significantly more easily than the number 2 ($\chi^2 = 5.6$, p) and the number 3 at a level approaching significance ($\chi^2 = 3.5$, $p = .056$) according to the McNamer test. However Japanese participants significantly out-performed English pre-schoolers on cognitive-linguistic measures at a level approaching significance ($\chi^2 = 3.5$, $p = .056$). In the Boxes game the Japanese children made consistently more use of symbolic and numeric representation overall, with greater use made by their older than their younger children: for number 1 ($\chi^2 = 7.38$ $p > .01$); number 2 ($\chi^2 = 7.38$ $p > .01$); and number 3 ($\chi^2 = 9.52$ $p > .001$) Conclusion One of the dangers of intercultural educational comparisons is the temptation to 'borrow' practice. This must be viewed with caution as cultural differences inevitably involve unmatched variables and 'importing' is fraught with danger for teachers and pupils. Instead we need to consider the reasons underpinning effectiveness in a particular educational setting i.e. to consider the social, cultural, political and historical factors and conditions (i.e. the context) and only then can the adoption, or adaptation, of some aspects 'at home' be considered. Comparative studies offer greater insights and understanding of both individual and group functions and potential, and differing degrees of balance between the two. If raising achievement to international levels and improvements in social chances and life chances are to be improved in the UK, then looking outward to other ways of doing and being within early years practice may offer a way forward (Tobin, Wu and Davidson, 1989). Particularly so when Japanese pupils consistently outperform English pupils by the age of 9, despite starting school almost two years later at age 6+, and in view of receiving a concrete and conceptually based curriculum throughout the early years of kindergarten and school.

PAPER PRESENTATION

Exploring Students' Experiences Of Understanding The Threshold Concept Of Function

Max Scheja, Stockholm University, Sweden; Kerstin Pettersson, Stockholm University, Department of Mathematics and Science Education, Sweden

This study explores the nature of university students' experiences of understanding the threshold concept 'function'. Fifteen teacher students taking an introductory course in mathematics were at the beginning of the course asked to reflect in writing on the meaning of 'function'. Subsequent interviews explored in greater detail individual students' conceptual understandings of this concept. At the end of the course, students were again asked to reflect in writing on the meaning of function and then to elaborate further on those written reflections in a qualitative research interview. In a previous study of students' understandings of limit and integral an intentional analysis of the interview transcripts underscored the crucial interplay between understandings developed within an algorithmic and conceptual context respectively. The present study seeks to develop this contextual framework for analysing students' understanding in mathematics by linking the analysis of students' emerging understandings of function to ongoing research on threshold concepts in higher education and more broadly to research on students' experiences of understanding disciplinary ways of thinking and practising.

AIM

The study aimed at exploring the nature of university students' experiences of understanding the threshold concept 'function'.

METHODOLOGY

Fifteen teacher students taking an introductory course in mathematics were at the beginning of the course asked to reflect in writing on the meaning of 'function'. Interviews were then conducted with a subset of the students to explore in greater detail individual students' understandings of this concept. This procedure of asking students to reflect in writing and then to elaborate in interviews on their understandings was repeated towards the end of the course, to investigate any changes in the students' understandings of 'function'. The individual interviews, which lasted between 30 and 60 minutes, were transcribed in full with the students' informed consent. The data—consisting

of the students' written and oral reflections on the concept of function—were analysed within a theoretical framework developed in constructivist research on learning and conceptual change. This framework underscores the importance of understanding individual students' personal motives and beliefs in approaching a learning task and so the analysis focused on discerning students' varying ways of explaining the meaning of the concept of function, and on describing these in terms of contextualised conceptions supporting different understandings of the concept at hand.

FINDINGS

The analysis of the students' written reflections and student interviews is still underway, but preliminary findings indicate that students varied a great deal in their personal understandings of the meaning of function. Looking across the whole data material students seem to express seemingly incoherent, fragmentary and sometimes contradictory conceptions of function. For instance, students talk about function in terms correlations of various sorts (e.g. between time, distance and speed when travelling by taxi etc.) that indicate a common sense view of the concept. Students also bring to the fore conceptions linked to previous learning experiences from earlier school stages, defining function in terms of a simple curve. From these rather fragmented notions of function it is easy to get the impression that students have not yet grasped the conceptual meaning of function. However, from the analysis it was also evident that students' communication of their understandings had to be recognised as part of a dynamic process of coming to grips with a mathematical threshold concept offering certain resistance in terms of understanding. For instance, there was evidence of students' beginning to develop more abstract and conceptually loaded conceptions of function implying a gradual extension of the context for interpreting this mathematical concept. Drawing on previous studies on students' experiences of understanding threshold concepts in mathematics incoherence and fragmentation may in fact form part of a crucial process of developing understanding. Linking these ideas to recent research within the threshold concepts framework on modes of variation, the conceptions identified can be said to represent stages or positions in the process of coming to understand threshold concepts in mathematics. Importantly, these stages are not fixed or isolated. They involve dynamic interpretive processes on the part of the learner, driving the process of coming to understand the threshold concept or, for that matter, subject area. Previous analyses of students' learning of mathematics suggest that a key to understanding lies in the ability to shift contexts. In particular it is through contextual shifts that students may gradually traverse different modes of variation and be made aware of the boundaries of the discipline thus gradually building an awareness of the ways of thinking within mathematics. And in the present study it is this potential for understanding that is emphasised in the analyses of the meanings that students ascribe to the mathematical concept of function.

THEORETICAL AND EDUCATIONAL SIGNIFICANCE

While most of the previous research on conceptual understanding has focused on students' difficulties and shortcomings in coming to grips with mathematical concepts, this study offers an alternative approach to studying students' understanding of mathematics. It focuses, not on misunderstandings, but on the potentiality for learning implied in the range of understandings brought to the fore in a group of teacher students' ways of dealing with the task of explaining the meaning of the mathematical threshold concept of function. Adopting a view on student learning which emphasizes potentiality rather than fallibility has important implications for teaching. From such a perspective, guiding students' efforts to develop conceptual understanding of particular teaching areas does not mean accepting or ignoring apparent mistakes or misconceptions. Rather it means taking them seriously enough to look for ways to help students extend and develop these efforts within contexts that allow important aspects of concepts to be recognized as crucial ingredients in understanding those concepts. Such a perspective, which reveals students' ways of contextualizing concepts and learning tasks, enables teachers to engage, not only with students but also with students' efforts to understand. In that sense it also provides a crucial pathway for linking the students' provisional understandings to ways of thinking endorsed within the discipline.

PAPER PRESENTATION

Use of information sources about socio-scientific issues in elementary school and high school

Maria Joao Fonseca, IBMC - Instituto de Biologia Molecular e Celular, Universidade do Porto and Faculdade de Ciencias, Universidade do Porto, Portugal; Patricio Costa, Faculdade de Psicologia e de Ciencias da Educacao, Universidade do Porto, Portugal; Leonor Lencastre, Universidade Porto, Portugal; Fernando Tavares, IBMC - Instituto de Biologia Molecular e Celular, Universidade do Porto and Faculdade de Ciencias, Universidade do Porto, Portugal

Schools are cornerstones in the promotion of information literacy required for personal and public decision-making about socio-scientific issues, such as biotechnology. However, several reports have evidenced students' and teachers' limited competencies concerning the search and evaluation of scientific information. The purpose of this study was to unveil the relationship between use and trust in information sources about biotechnology among biology teachers and elementary and high school students. Particularly, it aimed to: 1) identify the main information sources used; 2)

understand if and to what extent the use of information sources is influenced by their perceived reliability; and 3) analyze if and how teachers' use and trust in information sources affect students' choices and opinions. Following a quantitative assessment approach through questionnaire implementation, data was collected from 93 teachers and 1196 students. SPSS was used to perform descriptive and inferential statistics (t-tests, ANOVA, and non-parametric statistics). Data analyses reveal that school textbooks, scientific magazines and the television are among the main information sources used by teachers and students. Overall, the respondents' choices appear to be more strongly influenced by the availability and less by the perceived reliability of the sources. Furthermore, there was not an explicit relationship between the use and trust patterns identified for teachers and students. These findings suggest a deficit in information literacy instruction, and indicate the need for strategic interventions, namely involving improved teacher training programs to enhance teachers' own information literacy, and assist them in scaffolding the development of these competencies by their students.

PAPER PRESENTATION

Learning about ecological systems by constructing qualitative models with DynaLearn

David Mioduser, Tel Aviv University, Israel; Ruth Zuzovsky, Tel-Aviv University, Israel

Understanding complex systems has become a challenging intellectual endeavor for scientists and science students as well. For science students, the systems approach and specific concepts in it (e.g., emergence, self-organization, non-linearity) represent a serious learning challenge. Portions of this knowledge appear to them epistemologically counterintuitive, and/or incongruent with the approaches, assumptions and practices characterizing the way they learn Science with the curricula prevalent in educational systems. This presentation focuses on the contribution of Qualitative Modeling (QM) with "DynaLearn" modeling environment, to students' system thinking and understanding of ecological systems. More specifically, on students' ability to: (a) understand and represent complex ecological systems; (b) construct qualitative models of systems; and (c) apply the systemic perspective in different ecological contexts and phenomena. Participants were 25 Junior-High students in two groups, attending a Marine Biology Summer course. Experimental group completed a set of modeling activities using "DynaLearn". Data were collected from students' concept maps and documentation, qualitative models and documentation, and responses to post-intervention questions about different systems and ecological phenomena. Results are clearly indicative of the contribution of qualitative modeling with DynaLearn to students' ability to understand structural and behavioral aspects of the systems under study, to construct qualitative models of the systems, and to apply the gained knowledge when learning about different ecological systems.

Understanding complex systems has become a challenging intellectual endeavor for scientists and science students as well. The development of systemic approaches since the early years of the previous century, opened ways of thinking about and studying phenomena in the world unveiling aspects, interrelationships and processes that were overlooked by traditional science. For science students, the systems approach and specific concepts in it (e.g., emergence, self-organization, non-linearity) represent a serious learning challenge. Portions of this knowledge appear to them epistemologically counterintuitive, and/or incongruent with the approaches, assumptions and practices characterizing the way they learn Science with the curricula prevalent in educational systems.

This report is part of a larger study conducted with Junior High-School students aiming to assess the contribution of Qualitative Modeling (QM) with "DynaLearn" modeling environment, to students' system thinking and understanding of ecological systems. DynaLearn (DL) supports the construction of models in a succession of Learning Spaces - from simple representations (entities and relationships), toward more complex representations (quantities, quantity spaces, direct and proportional relationships, feedback loops, conditions and assumptions).

This presentation focuses on the contribution of QM with DynaLearn to students' ability:

- to understand and represent complex ecological systems;
- to construct qualitative models of systems, and
- to apply the systemic perspective in different ecological contexts and phenomena.

Method

Participants were 25 High School students in two groups, attending a summer course in Marine Biology comprising short lectures, lab activities and a field trip. In addition as treatment variable, the experimental-group (DL) completed a set of modeling tasks using DynaLearn, while the control group (C) that did not use DynaLearn did a Web-based inquiry-task.

Data collection was conducted using 3 instruments:

- Students' concepts maps and documentation - both groups.
- "Challenging questions" questionnaire - both groups.
- Students' models and documentation - experimental group.

Concept mapping: Done twice by DL group (pre- and post-intervention) and once by C group.

Modeling tasks: students constructed a series of models using DynaLearn's learning spaces 2, 3 and 4. Following each modeling activity, they documented their experiences answering questions about their models, the modeling process and the insights gained from one modeling step to the next.

Results

Question 1: On the contribution of qualitative modeling with DynaLearn to students' ability to understand and represent complex ecological systems

Students' concept maps were analyzed focusing on the following variables:

- Overall configuration of the system's representation - e.g., hierarchical or Net-type.
- Foci - focus on structural static properties or on dynamic aspects (processes and causal relationships).
- Guiding organizing principle: e.g., formal-classification principles or ecological-systems' principles.
- Type of relationships: e.g., mainly structural or referring to causal processes and chains.
- Scientific accuracy: on a scale from high to low level of accuracy.

A brief account on some results follows:

Pre- post- experimental group concept maps comparison:

- Increase (40% > 71%) in Net-type, and decrease (60% > 29%) in hierarchical, types of representations
- Increase (60% > 86%) in the use of ecosystemic organizing principles and decrease (40% > 14%) in using formal-classification organizing principles
- Increase in representing structural relations (10% > 29%) and mixed structural/process relationships (60% > 71%)
- Slight decrease in scientific accuracy (80% > 70%)

Concept map comparison between experimental and control groups:

- None of the representations in the C group was Net-like
- Less ecosystemic representations in the C group (DL-86% vs. C-54%)
- Most representations in the C group were of structural type (DL-29% vs. C-62%)
- Less representations in the C group combined structural/process relationships (DL-79% vs. C-38%)
- Less scientific accuracy in C group's representations (DL-71% vs. C-23%)

Question 2: On student's ability to construct qualitative models of an ecological system

Brief summary of results for three of the variables considered:

- Students understanding of the phenomena modeled

At first, half of the students phrased their modeling aim as specific questions, e.g.,: How much effort the patella exerts when attaching to the rock in varying intensities of waves.

At the end of the modeling activities most students (80%), defined phenomena in more generic and systemic ways, i.e., The relationship between crabs, barnacles and patella; The effect of jellyfish on the Israeli marine shore.

- Understanding types of relationships in the system

Values for this variable include the relationships: single/unidirectional; parallel /unidirectional; one-to-many; causal-chains; feedback-loops. Along the modeling activities we observed:

- Decrease in single/unidirectional relationships (40% > 10%)
- Decrease in parallel/unidirectional relationships (20% > 10%)
- Increase in one-to-many relationships (0% > 10%)
- Increase in chain-relationships (30% > 50%)
- Increase in feedback-loop relationships (0% > 20%)
- Insights related to complexity and the worth of modeling for learning

Qualitative analyses of student's documentation unveil their perception of complexity and the contribution of modeling for understanding it. Examples of insights: "The modeling activity enabled predictions"; "The modeling activity enabled to understand the dynamics of the system"; "The modeling activity allowed studying many variables and many relationships"; "The modeling activity taught me that some changes have long-term and far effects – If you touch one thing, everything can change".

Question 3: On the contribution of QM to student's ability to understand different phenomena and systems

"Challenging questions" were administered to both groups after the intervention. Students had to apply the knowledge gained to provide descriptions, explanations, and predictions concerning a marine ecosystem. Sample results:

- The average total score by DL students was much higher than that of the C group (78.3% vs. 45.8%).

- DL students outperformed C students (DL-59% vs. C-36%) in understanding different types of relationships in ecosystems
- On predicting changes that might occur in a system in response to an interference (external agent, change in conditions), most students in the DL group (60%) succeeded in delineating long chains of events, vs. none in the C group.

In summing up the results, it is clear that from the perspective of systems thinking, the modeling activity affected students' perception of systems in a more dynamic and comprehensive way.

PAPER PRESENTATION

Developing optimization as a reasoning strategy for dealing with socio-scientific decision-making

Nicos Papadouris, University of Cyprus, Cyprus; Costas Constantinou, University of Cyprus, Cyprus

This paper reports on an exploratory investigation of high-school students' ability to use an optimization strategy for processing information in socio-scientific decision-making tasks. We have developed specially designed curriculum materials for this investigation. We have implemented these materials with two groups of high-school students (N=28) over a course of nine ninety-minute sessions. Prior to and after the teaching intervention we collected data through open-ended tasks, that asked students to either address specific socio-scientific decision-making situations or evaluate the appropriateness of given decisions regarding those same situations. Each student responded individually while 10 students also participated in follow-up interviews. Data analysis demonstrated a significant shift towards more analytic and thoughtful decision-making approaches, after the teaching intervention. Specifically, most students spontaneously selected to apply the targeted optimization strategy and provided appropriate justifications for their decisions. Additionally, there was a substantial reduction in the number of students who either resorted to non-compensatory approaches that excluded some of the criteria or employed invalid approaches for synthesizing all the available information. Finally, there was a significant increase in the percentage of students who were able to elaborate reasoning flaws characterizing commonly invoked decision-making approaches. These data provide encouraging indications for the possibility of devising learning environments for promoting students' decision-making reasoning strategies, which is an important component of science learning. At this stage, we are in the process of revising the curriculum materials using the data that emerged from its implementation and we plan for a controlled experiment to investigate the effectiveness of this approach.

Introduction

Decision-making skills are widely recognized as a central aspect of scientific literacy and, hence, an important aim of science teaching. However, research on teaching and learning about decision-making, within science education, has been very limited. This is evidenced by the rather poor research base on students' initial ideas and the difficulties they encounter when engaged with socio-scientific decision-making tasks and also by the lack of teaching innovations in this area. This paper is part of a research project that seeks to develop and validate curriculum materials for a certain aspect of decision-making. Specifically, they are focused on the reasoning component of comparing the possible solutions so as to identify the most appropriate one and they seek to help students develop a specific optimization strategy that could serve this role. The learning materials have been implemented in the classroom environment so as to evaluate their potential effectiveness and identify possible ways to revise them. Below we briefly describe the learning materials, we discuss methodological issues relevant to their implementation and we present empirical results from the evaluation of their potential effectiveness.

Overview of the learning materials The learning materials are primarily web-based and they have been designed using the STOCHASMOS platform. Students work in groups, following a guided inquiry approach. They are assigned the role of consultants that should advise the government on the most appropriate technology to be used, in conjunction with the existing oil-fired power stations, in order to provide a specific amount of electrical energy. There are three possible solutions: installing wind parks, installing photovoltaic parks or converting some of the existing stations so as to use natural gas. Students are provided with information on the possible solutions and relevant criteria, which they need to process so as to formulate an evidence-based decision. Throughout their engagement with the learning environment, students are guided to (i) recognize the complexity stemming from the presence of both strengths and weaknesses in all three solutions, (ii) appreciate the need for systematic data processing that synthesizes the entirety of the available data and (iii) gradually develop and elaborate a specific optimization strategy as a possible way to meet this need. In brief, this strategy involves, converting raw data into a single scale, adjusting for the possible variation in the importance of the criteria, through the assignment of weights, and using the adjusted scores to obtain overall weighted values and determine the most appropriate solution.

Methods

The curriculum materials have been implemented in the context of a summer science club. Participants were 28 high-school students (aged 16-17) and the teaching intervention lasted nine ninety-minute sessions.

Prior to and after the teaching intervention we collected data through seven open ended tasks. In four of them students were asked to address specific decision-making situations relevant to the selection of the site for installing a water desalination plant. Students were provided with information linking the given criteria and the possible solutions, which they were asked to process and formulate a detailed suggestion as to the most appropriate solution. In the remaining tasks students were given certain suggestions relevant to these same situations and they were asked to judge their appropriateness. Students responded individually and ten of them (36%) also participated in follow-up interviews so as to gain further insights into their reasoning.

Students' responses were processed in order to document the qualitatively different ways of dealing with decision-making situations and the positions they adopted in judging the appropriateness of given decisions. The comparison of the students' responses prior to and after the teaching intervention, using non-parametric tests, provided encouraging indications as to effectiveness of the curriculum materials. In addition to this, the interview data allowed us to identify and document the main reasoning difficulties undermining students' attempt to address decision-making situations.

Findings Prior to the teaching intervention none of the students was able to synthesize the available information by weighing the strengths and weakness of the rival solutions in a systematic and valid manner. Most of them employed non-compensatory approaches that only relied on some of the relevant criteria and precluded tradeoffs among the various solutions. For instance, one such response was: "I would suggest Sotera. It is the best on two out of the three criteria". Those who attempted to synthesize the data employed flawed approaches, such as the direct comparison of the advantages and disadvantages of the rival solutions using the raw data without adjusting for the variation in the corresponding metrics. In addition to this, only 25% of the students were able to identify reasoning flaws in the decisions they were asked to reflect on. These findings provide empirical support to the position that such reasoning skills do not typically emerge as a spontaneous outcome of conventional science teaching or maturation.

After implementing the learning materials, the majority of students (76%) spontaneously selected to address the given tasks using the optimization strategy (figure 1). Most of the remaining students sought to integrate all the available information, though in an error-prone manner. One such example involves arbitrarily dismissing the magnitude of the difference among rival solutions on certain criteria as "insignificant". In addition to this shift in the percentage of students who were able to apply holistic decision-making approaches, most of them (87%) were also able to elaborate reasoning flaws inherent in the given decision-making approaches.

Concluding remarks The results from data processing suggest that students' interaction with the learning materials facilitated the shift towards more analytic and holistic approaches that consider tradeoffs among the strengths and weaknesses of possible solutions. In addition to this, it has helped them appreciate flaws inherent in commonly invoked decision-making approaches. These encouraging indications are directly related to the need for an emphasis shift in science teaching from only addressing content to also integrating objectives related to reasoning strategies. At this stage, we are in the process of revising the activity sequence, based on the available data, so as to further increase its potential and we plan for a controlled experiment to investigate the effectiveness of this approach.

PAPER PRESENTATION

Characterizing the language of students' written explanations in TIMSS' science items

Birgitta Frandberg, Chalmers University of Technology, Sweden; Anita Wallin, Faculty of Education, Sweden; Per Lincoln, Chalmers University of Technology, Sweden

Abstract. This study describes certain lexical features of the language used by Swedish grade 8 (aged 15) students answering science items in TIMSS 2007. The language of the students' freely formulated written responses to science items can be seen as an expression of the conventions of a specific discourse within science education in secondary school. The specific discourse is assessment by written tests. Data from TIMSS offers an opportunity to investigate the language used by a large group of students, carefully sampled. Drawing from systemic functional linguistics, we estimated the degree of technicality of the explanations from a sample of 1938 written answers. Answers were on average 14 words long and varied between 1 and 77 words, the average amount of science terms were 1,64, with a range of 0 to 9. There was a difference in use of science terms between achievement groups, with the explanations from the group of high achievers having the highest level of technicality. Although the girls, on average, use more words, their answers do not include a larger number of science terms. The use of science terms in the answers varies

according to the use of science terms in the items. The results indicate a discourse of tests and explanations in science education where students are not expected, and therefore not practiced, to use a specialized language.

Aim

When science education is viewed as processes of socialization constructed by discourse and interaction, the language used becomes a central issue for research (Kelly, 2008). Language is in socio-linguistic research regarded not just as a tool but also as constitutive of meaning and social context. (Dimopoulos, Koulaidis, & Sklaveniti, 2005; Halliday & Martin, 1993; Lemke, 1990; Veel, 1998).

The discourse of science and school science is regarded as particularly difficult due to among other things its grammatical and lexical features and ultimately how it constructs meaning (e. g. Lemke, 1990). The view of the central role of language in science education has resulted in a large body of research in spoken and written language used by teachers and students in science classrooms and in textbooks of science (Halliday & Martin, 1993; Hatzinikita, Dimopoulos, & Christidou, 2008; Lemke, 1990). However, written explanations in answers to test items from large samples of students are not well investigated from a linguistic perspective.

Studies of texts and text use in some Swedish compulsory classrooms have revealed science education as a predominantly oral activity (af Geijerstam, 2006), and high achieving students was shown to produce more technical texts compared to those written by low achievers. The sample in the study was however small, and there was a call for studies of larger groups.

The subject of this study is the language used in a specific discourse within science education, the discourse of assessment by written tests, with scientific explanations for natural phenomena. The aim is to describe the extent of adaption of student language to the register of the language used in school science, in the area of matter and transformation of matter. Student responses to five items were analyzed regarding some lexico - grammatical features seen as typical for scientific language. The main questions are: How can the language used by students in explanations of phenomena in the specific scientific/school scientific context of written tests be described in relation to lexico-grammatical features as science terms, nominalizations and passive verbs in the register of scientific language? Does the language used differ between girls and boys, or between groups of students of different success in TIMSS 2007, and between separate items with respect to these same features?

Theory and Method

To identify features typical for scientific language we relied on the notion of register and linguistic code from the theory of systemic functional linguistics (Halliday & Martin, 1993). Features useful for this study are the use of specialized terminology, frequent use of nominalizations, and frequent use of verbs in passive voice. We used student answers from the Swedish part of TIMSS 2007. Only answers with an explanation were analyzed. In order to answer the questions of the study, the explanations were grouped in different ways, according to gender and according to obtained achievement scores in TIMSS 2007.

Five items from TIMSS 2007, year 8 (aged 15), were selected. These were the ones that most directly addressed the subject area of matter and processes involving changes of matter and at the same time requested responses freely formulated by the students.

The total number of words in each explanation, the number of different science terms and total science terms used in each explanation were counted. According to Martin (1993) technical or science terms can be of three kinds; words which have a meaning in everyday language and rendering a new meaning in science, words used as technical in related fields, and words indexical of a field. In this study we categorized a word as technical when it can be assigned to any of the above-mentioned groups. Additionally, the ratio of total science terms to total number of words in each answer was calculated. In the following is used the term technical density.

Findings

Preliminary results in short: The explanations in the sample are between 1 and 77 words long, with a mean of 14,7. Girls produce on average longer explanations than boys on all items, with a mean no of words for explanations from girls 15,44 compared to 11,97 for boys. The difference is statistically significant. The number of science terms in explanations produced by students is on average 1,64, varying between 0 and 9, and technical density (science terms/total words) is on average 0,1166. The technical density of answers varies according to the technical density of items. Number of different science terms used by all students varies between the items, from 34 to 51. Mean technical density does not vary with statistical significance between girls and boys, despite the difference in length of answers. High achievers on the total TIMSS 2007 produce answers with statistically

significant higher technical density than low achievers. High achievers in total use twice as many different science terms as low achievers.

Relevance

The discourse of tests in science education is significant in that it often is the ground for grading of students and therefore an important issue to know more about. If students are to be offered possibilities to learn science it is necessary for teachers and teacher educators to be aware of the difficulties linked to the written language of scientific explanations. Further research into differences shown between achievement groups with respect to technicality is suggested.

References

- Dimopoulos, K., Koulaidis, V., & Sklaveniti, S. (2005). Towards a Framework of Socio-Linguistic Analysis of Science Textbooks: The Greek Case. *Research in Science Education*, 35, 173-195.
- af Geijerstam, Å. (2006). Att Skriva I Naturorienterande Ämnen I Skolan. *Studia linguistica Upsaliensia*. Uppsala: Acta Universitatis Upsaliensis.
- Halliday, M., & Martin, M. O. (1993). *Writing Science. Literacy and Discursive Power. Critical Perspectives on Literacy and Education*. London/Washington D.C.: The Falmer Press.
- Hatzinikita, V., Dimopoulos, K., & Christidou, V. (2008). PISA test items and school textbooks related to science: A textual comparison. *Science Education*, 92(4), 664-687. doi:10.1002/sce.20256
- Lemke, J. L. (1990). *Talking Science: Language, Learning, and Values. Language and educational processes*. Norwood, N.J: Ablex.
- Veel, R. (1998). The greening of school science. Ecogenesis in secondary classrooms. In *Reading Science. Critical and Functional Perspective on Discourses of Science*. (Martin, J.R. & Veel, R.). London: Routledge.

PAPER PRESENTATION

Relations of students cognitive abilities, learning-related attitudes and GPA at Grade 3, 6 and 9

Sirkku Kupiainen, University of Helsinki, Finland; Jarkko Hautamäki, Helsinki University, Finland; Natalija Gustavson, University of Helsinki, Finland; Jukka Marjanen, University of Helsinki, Finland; Pekka Rantanen, Haaga-Helia University of Applied Sciences, Finland; Mari-Paoliina Vainikainen, University of Helsinki, Finland

The study is part of a longstanding research project on the formation and fostering of learning to learn competence as part of educational effectiveness. The present paper is based on the first data from a longitudinal large-scale assessment study in Southern Finland, collected in spring 2010, encompassing all the municipality's Finnish-speaking 1st, 3rd, 6th and 9th graders (à 2000 students). The objective is to look at changes in the role the different cognitive and affective factors play in 3rd, 6th and 9th graders' school achievement. The data comprises results from eight cognitive tasks covering reasoning skills, reading comprehension and mathematical thinking, together with a large array of affective scales, covering dimensions relevant for learning and school work. The preliminary findings of SEM reveal that 1) the explanatory power of the factors measured in the assessment vis-à-vis school achievement increases in step with grade; 2) the role of affective factors – OR students' ability to manifest them – increases with age; 3) the weight of learning enhancing attitudes increases along school careers vis-à-vis achievement. The study provides empirical data on the development of general cognitive skills and students' learning-related attitudes and beliefs across the middle school years, and on students' developing accuracy in manifesting them in self-report questionnaires. The study also provides teachers with knowledge regarding the role of diverse affective factors for students' learning, which can and should be taken into account in an age-appropriate way at school.

Introduction

The study is part of a longstanding research project on the formation and fostering of learning to learn competence in formal educational setting as part of a quest for measuring educational effectiveness (Hautamäki & al. 2002; 2006; 2010). The overarching point-of-view is developmentally informed educational psychology of schooling (Olson, 2003). The present paper is based on an ongoing large-scale study, covering four age cohorts of students in a municipality in Southern Finland. This first stage of a forthcoming longitudinal study comprised the assessment of the learning to learn competence of all the municipality's Finnish-speaking 1st (not included in this study), 3rd, 6th and 9th graders (7, 9, 12 and 15-year-olds, approximately 2000 students per cohort). Aims The research objective of the current paper is to look at changes in the relative role the different cognitive and affective factors play in 3rd, 6th and 9th graders' school achievement. Actual research questions are: 1) How well does students' school achievement reflect their cognitive competence as evinced in the assessment vis-à-vis the various affective factors that direct the use of these cognitive abilities toward the expectations and demands of the school and/or can be interpreted by the teacher as doing so, and 2) Are there structural changes in the relationships between these three factors –cognitive competence,

learning and school related affective factors, and GPA – between grade 3, 6 and 9 students and if so, how should they be interpreted. Data The data, collected in spring 2010, comprises results from eight cognitive tasks in three main domains (reasoning skills, reading comprehension, mathematical thinking) together with some twenty five affective scales from self-reported questionnaires, covering dimensions relevant for learning and successful school work (e.g., academic self concept, interest, learning strategies, means-ends-beliefs, learning motivation, self-efficacy) for each age cohort of 3rd, 6th and 9th graders. The cognitive tasks and the affective scales have been used earlier in several large-scale cross-sectional and one longitudinal study and altered slightly from cohort to cohort to accommodate the developmental stage of the students. The cognitive tasks can be scaled via common items and calibrated to Piaget's theory of cognitive development based on earlier studies. Data regarding students' socio-economic background and school achievement was collected concurrently, together with parental and teacher data on grades 3 and 6. Methodology The cognitive scales for the three age cohorts will be compared and combined applying Rasch scaling (Bond & Fox, 2007). To answer the main research questions, structural equation modelling will be used (AMOS) supported by other appropriate statistical methods (PASW Statistics). Preliminary findings At this point, Rasch scaling has been executed only for the 9th grade data, revealing excellent coverage across all ability levels for almost all the cognitive tasks. Moreover, the one tasks based directly on Piaget's theory revealed the expected 'qualitative jump' with the items requiring full formal operational thinking mastered by just a fraction of the students at grades 6 and 9 (due to the complexity of the task it was not included in the 3rd grade test booklet). The preliminary findings of the SEM analyses (AMOS) reveal that 1) the explanatory power of the factors measured in learning to learn assessment vis-à-vis school achievement increases in step with students' school careers (.37 vs. .41 vs. .45); 2) the role of affective factors – OR students' ability to 'know' or interpret themselves and to answer the respective questionnaires (see Harter 1999) – increases with age; 3) at least in this study, while at grade 6 negative attitudes play a clear role vis-à-vis school achievement, especially for girls, at grade 6, 'positive' factors (agency, learning orientation) take the role of definitive priority for both boys and girls. Overall, the model explains better girls' achievement than boys', which seems to reflect the longstanding gender gap in educational achievement in Finland – at least as it is marked by teachers. Theoretical and educational significance With three cross sectional views on students who could theoretically be (and to a great degree actually are) from the same families, assessed with cognitive tasks and questionnaires built to be comparable across grades through common items, the present study allows for as close an approximation of a developmental view on cognitive skills central to learning at school and after it, which can be used for hypotheses building for the next stage of the longitudinal study. Likewise, it provides a similar opportunity to look at the development of students' learning-related attitudes and beliefs, and of students' developing accuracy in manifesting them in self-report questionnaires. On the theoretical level, the study can be seen as a valuable contribution for the quest for a developmental model of schooling which has guided learning to learning research from its beginning. At the practical educational level, the study can be seen to directly provide teachers with new theoretically based knowledge regarding the role for students' learning of diverse affective factors which can and should be taken into account in an age-appropriate way when trying to foster both curricular achievement and students' readiness for lifelong learning.

References

- Harter, S. (1999) *The construction of the self. A developmental perspective*. New York. Guilford Press.
- Hautamäki J., Arinen P., Eronen S., Hautamäki A., Kupiainen S., Lindblom B., Niemivirta M., Pakaslahti L., Rantanen P. & Scheinin P. (2002) *Assessing Learning-to-Learn. A Framework*. National Board of Education, Evaluation 4/2002
- Hautamäki A., Hautamäki J. & Kupiainen S. (2010) *Assessment in Schools – Learning to Learn*. International Encyclopedia of Education (2010), vol. 3, pp. 268
- Hautamäki J., Kupiainen S., Arinen P., Hautamäki A., Niemivirta M., Rantanen P. & Scheinin P. (2006) *Learning-to-learn assessment in Finland – versatile tools to monitor and improve effectiveness and equity of the education system*. In Jakku-Sihvonen R. & Niemi H. (eds.) *Research-based teacher education in Finland – reflections by Finnish teacher educators*. *Kasvatusalan tutkimuksia* 25/2006, s. 189–202

PAPER PRESENTATION

‘Yes, We Can’: Linking Teachers’ Networks and Student Achievement through Collective Efficacy

Nienke Moolenaar, University of Twente, Netherlands; Peter Sleegers, University of Twente, Netherlands; Alan Daly, University of California, San Diego, United States; Daniel Van Amersfoort, Open University, Netherlands

Educational reform efforts aimed at increasing student achievement have embraced collaborative practice as a means to intensify teacher interaction in support of improved instruction and student learning. While recent studies suggest the importance of strong teacher networks for school conditions that may benefit student achievement, empirical evidence of the direct effect of teacher networks on student learning is weak. The goal of this study was to examine the relationship between schools' social network structure and student achievement and the potential mediating role

of teachers' collective efficacy beliefs. Data were collected from 775 teachers of 53 elementary schools in a large educational system in the Netherlands. Student data were obtained at the school level, representing the results of 1383 sixth grade students on a nation-wide standardized final test administered one month after the collection of the teacher data. Using social network analysis and multiple regression analysis, we analyzed data from a quantitative teacher survey in combination with school level student achievement data. The teacher survey consisted of a Likert-type scale on perceived collective efficacy and social network questions on work-related and personal advice. A direct effect of social network structure on student achievement could not be evidenced. Yet, findings suggest an indirect effect of social network structure on student language achievement through collective efficacy. Highly dense teacher networks are associated with strong teacher collective efficacy, and in turn, strong teacher collective efficacy was related to school level student achievement.

Theoretical framework

Around the globe, educational researchers, practitioners, and policy-makers are showing interest in the potential of networks to foster systemic improvement in instructional quality and student achievement. Research suggests that relationships among teachers are important in building strong school communities (Penuel, Riel, Krause, & Frank, 2009), and that strong teacher networks can give teachers a sense of belonging and efficacy (Grodsky & Gamoran, 2003). In line with this argument, educational social network studies often emphasize the potential importance of teacher networks for school change, educational reform, and student achievement (Moolenaar, 2010). However, while recent studies suggest the importance of strong teacher networks for school conditions that may benefit student achievement, empirical evidence of the effects of teacher networks on student learning is limited. Recent research suggests that the relationship between student achievement and teacher collaboration, while important for instructional improvement, 'is likely indirect' (Goddard, Goddard, & Tschannen-Moran, 2007). As main benefits of collegial relationships that may affect student achievement, scholars refer to feelings of equally shared responsibility for positive outcomes, alignment of expectations for students, increased feelings of effectiveness (Little, 1987), and raised sense of efficacy (Bandura, 1993). Collective efficacy is a concept that amalgamates these benefits as it expresses shared perceptions of a group's ability to achieve collective goals (reflected in the motto 'Yes, we can'). Perceived collective efficacy is both associated with teacher collaboration (Ashton & Webb, 1986) and student achievement (Goddard, 2002). As such, collective efficacy may be a mechanism that can explain how configurations of teacher networks affect student achievement. To test this assumption, this paper is aimed at examining teachers' collective efficacy as a plausible mechanism that explains the suggested relationship between teacher network structure and student achievement.

Method
Context and sample. Our study takes place in the Avvansa School District, a large educational system of 53 elementary schools in the Netherlands. Data on social networks and collective efficacy were gathered from 775 educators (teachers and principals), reflecting a response rate of 96.8 %. **Social networks.** We examined teachers' work-related and personal advice networks in the sample schools using social network analysis. To assess the work related advice network in the sample schools, the educators were asked to answer the question: 'Whom do you go to for (work related or personal) advice?'. We examined density and centralization of the advice networks among educators within each school. These social network characteristics were calculated using UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). **Collective efficacy.** Perceptions of collective efficacy of the school staff were measured with five items (Goddard, 2002). This instrument was translated and adjusted to the Dutch context of elementary education. The scale was designed to assess faculty perceptions of collective efficacy. For example, in one item teachers were asked: 'Teachers in this school are able to get through to difficult students'. **Student achievement.** We included student achievement as in mathematics and language on a standardized test that was administered to 1383 sixth-grade students of the sample schools (age 11-12). The nation-wide standardized Final Primary Education Test is considered to be a reliable and valid measure of student achievement (Cito, 2009). **Results** Based on the findings from multilevel analysis (see Table 1), we could not confirm a direct effect of teachers' social network structure on student achievement at the school level of analysis. Neither the density, nor the centralization of advice networks was found to directly affect student achievement in mathematics or language. However, findings suggested the density of work related and personal advice networks affected teachers' perceptions of collective efficacy, which in turn was associated with increased student achievement. Dense networks appear to support and nurture teachers' confidence in the capacity of their team to impact students' learning and achieve school goals. As such, collective efficacy served as an intervening variable that may explain how dense social networks among educators may ultimately benefit student achievement.

Significance Increasing student performance through strong professional teacher communities is high on the agenda for educational leaders across the globe. In this paper we suggest that the benefit of strong teacher networks for student achievement lies in its potential to foster teachers' collective efficacy beliefs. By offering shared experiences, creating a feeling of collectivity, and providing the opportunity to exchange expertise, strong teacher networks nurture teachers' beliefs in the capacity of their team, which in turn was associated with increased student achievement. A potential route to school improvement therefore may be to grow strong ties among teachers, cultivate their collective belief in 'yes, we can', and as a result, harvest increased student achievement.

References

- Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement*. New York: Longman.
- Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, 28, 117-148.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *UCINET for Windows: Software for social network analysis*. Harvard, MA: Analytic Technologies.
- Cito (2009). *Final Primary Education Test*. Arnhem, The Netherlands:
- Cito.Goddard, R. D. (2002). Collective efficacy and school organization: A multilevel analysis of teacher influence in schools. *Theory and Research in Educational Administration*, 1, 169–184.
- Goddard, Y. L., Goddard, R. D. & Tschannen-Moran, M. (2007). A theoretical and empirical investigation of teacher collaboration for school improvement and student achievement in public elementary schools. *Teachers College Record*, 109, 877-896.
- Grodsky, E., & Gamoran, A. (2003). The relationship between professional development and professional community in American schools. *School Effectiveness and School Improvement*, 14(1), 1-29.
- Little, J. W. (1987). Teachers as colleagues. In V. Richardson-Koehler (Ed.), *Educator's handbook: Research into practice* (pp. 491-518). New York, NY: Longman.
- Moolenaar, N. M. (2010). *Ties with Potential: Nature, Antecedents, and Consequences of Social Networks in School Teams*. Unpublished doctoral dissertation. University of Amsterdam, The Netherlands.
- Penuel, W. R., Riel, M. R., Krause, A., & Frank, K. A. (2009). Analyzing teachers' professional interactions in a school as social capital: A social network approach. *Teachers College Record*, 111(1), 124-163.

PAPER PRESENTATION

Handling school inspection and their results: Differentiation of school types

Sebastian Wurster, Humboldt Universitat zu Berlin, Germany; Holger Gaertner, Freie Universitaet Berlin, Germany

The current state of research on the effects of school inspection is heterogeneous: intended and unintended effects are reported. Based on a theory of Ehren and Visscher (2006) this paper focuses on the hypothesis that several types of schools exist that deals in different ways with the inspections and its results. According to the school type feedback of results should be school specific. For the identification of these types German schools in the federal states of Berlin (N= 283) and Brandenburg (N= 278) were examined. Latent class analysis revealed four types of schools. The "active schools" are characterized by a high activity level, good inspection results and extensive communication and reflection of the results. The "unsatisfied schools" are distinguished by a substandard inspection result, low activity level and negative perception of the inspection procedure. The "(self-) satisfied schools" received an excellent result. The quality of inspection procedure is estimated very positive. The activity level is low. These schools seem not to have reasons to act. The „reactive schools" got a substandard result. Characterizing for this type is a low activity level except for a high preparation activity before the inspection proceeded. Although the result is not outstanding, the result and procedure are accepted. The findings suggest a differentiated inspection procedure (especially the feedback) and acting of the support systems depending on the type of school, to assist school development best.

Extended Summary

Aims

Recently school inspections have become an important instrument in managing education. They were implemented for two reasons: to improve and to control school quality. To this day empirical findings do not provide a clear answer to the question whether inspections have a positive or negative impact on school quality improvement (de Wolf & Janssens, 2007).

This paper focuses on the hypothesis that schools deal in different ways with school inspection and its results. A theoretical framework was developed by Ehren and Visscher (2006) to systemize different impacts of school inspections and to explain the different effects. Feedback should be given differently depending on the type of school. For low innovation capacity schools inspection feedback should include clear instructions for action. In contrast for high innovation capacity schools school inspection should only feedback strengths and weaknesses to promote an autonomous development.

The research questions for this study are the following:

- How do school principals and teachers perceive school inspections and inspection reports?
- And if there are differences: Can we identify types of reaction patterns to school inspection?

Methodology

The empirical part of this paper uses a survey (October 2008) that is based on the views of principals and teachers concerning the impacts of school inspections. The survey includes questions concerning the acceptance and benefits of inspections and the communication and reflection of the results. Besides, it looks on the use of support, changes in schools activities, negative consequences and quality of inspectors diagnostic. Additionally, the results of the inspections were used to characterize types of schools according to the hypothesis above. To identify these types a Latent Class Analysis (LCA) was conducted. To select the appropriate latent class model information criteria and bootstrap analysis were applied.

The data base includes N=391 German schools in the federal states of Berlin (N= 176) and Brandenburg (N= 215) that were inspected in school years 2006/07 und 2007/08. The two states have a similar inspection proceeding. The overall response rate was 70% (Berlin 60% and Brandenburg 76%). An analysis of non-participants revealed no differences between the schools taking part and those not taking part with respect to either student performance or their evaluation by inspectors.

Findings

Four types of schools can be derived from the results.

1. The "active schools" (approx. 25%) are characterized by the highest self-reported activity level, good overall inspection results and extensive communication, reflection and dissemination of the results. The schools in this class have also the highest external support demand level to accomplish actions. Despite time stress these schools show a high acceptance of inspection. The inspection results are accepted as well as the perceived diagnostic validity of the inspection process.
2. The „reactive schools"(approx. 21%) got a substandard result. Characterizing for this type is a low activity level except for a high preparation activity before the inspection proceeded. Distinctive for this type is little communication and reflection of the results. These schools are lowest on dissemination and results processing. Although the result is not outstanding, the result and procedure are accepted. Also the benefits of inspection and the diagnostic validity of the inspection team are estimated sufficient.
3. The "(self-) satisfied" (approx. 26%) received an excellent result and communicate the feedback school-wide. The quality of inspection procedure (feedback, perceived diagnostic validity, low perceived time constraints) is valued very positive. The activity level instead is low. These schools seem not to have reasons to act.
4. The "unsatisfied schools" (approx. 29%) are distinguished by the worst overall inspection result and negative perception of the inspection procedure, diagnostic validity and also negative and undesirable consequences. Activity level is low and the results are little communicated and reflected within the school. A high time charge for little perceived use is described. The class of unsatisfied schools can be divided into two subtypes. Characteristic for both subtypes is the substandard overall inspection result and the negative perception of the inspection process. But Subtype 1 (ca. 23%) shows a high level of self-reported activity, intended action and action planning. Schools of this type receive few external supports. In contrast Subtype 2 (ca. 14%) has the lowest activity of all types and low dissemination and results processing.

Theoretical and educational significance of research

The described types of schools involve the theoretical model proposed by Ehren and Visscher (2006). A differentiated inspection procedure (especially the feedback) and acting of the support systems and school supervision authority, depending on the type of school, seems to be needed to assist school development best.

References

- De Wolf, I. F. & Janssens, J. G. (2007). Effects and side effects of inspections and accountability in education: an overview of empirical studies. *Oxford Review of Education*, 33 (3), 379-396.
- Ehren, M. C., & Visscher, A. J. (2006). Towards a theory on the impact of school inspections. *British Journal of Educational Studies*, 54 (1), 51-72.

PAPER PRESENTATION

Why school norms and teacher cooperation do NOT pay off in terms of student learning

Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany; Brigitte Steinert, German Institute for Internat. Educat. Research, Germany; Jan Hochweber, DIPF, Germany

The school has been considered "the unit of change" in educational systems. Improvement programs focus on professional development, collaboration, and school culture (e.g., shared norms and achievement orientations) – eventually changing classroom teaching and learning. However, while effects of teaching on student learning are well

understood (Baumert et al., 2009; Klieme et al., 2009), there is less rigorous knowledge about school processes, and effect sizes are much smaller.

This paper reports on a representative study of language development in ninth grade, $n = 209$ schools, 1579 teachers, 9980 students. HLM models specify the impact of school level (achievement orientation, strength of competence goals, cooperation among German language teachers) and classroom level factors (structure, teacher support, cognitive challenge, frequency of opportunities for language learning).

Professional goals and collaboration had an effect on structure and frequency of learning opportunities. Teacher support and cognitive challenge had an impact on student motivation and achievement, respectively. This pattern supports the theory of basic dimensions of teaching quality. Professional activities at the school level, however, seem not to focus on those aspects of school/teaching quality that can make a difference for student learning.

Theoretical background

The school has been considered the unit of change in educational systems. Since the 1970s, the Anglo-American field of school improvement has endorsed this idea (Chrispeels & Harris, 2006, p. 295). Improvement programs regularly focus on professional development, collaboration, and school culture (e.g., shared norms and achievement expectations) – eventually changing classroom teaching and learning.

However, effects of school level variables on student learning tend to be rather small. Meta-analyses of school and instructional effectiveness prove that individual prerequisites of learning and individual activities bear more significance to the students' learning results than the characteristics and processes of instruction, and even far more than school process characteristics (Hattie, 2009; Seidel & Shavelson, 2007; Scheerens & Bosker, 1997).

Research Questions

Drawing on a school achievement study that is representative for Germany we assess in how far differences in the development of achievement and learning motivation in the subject of German in ninth year students can be explained by differences in the professional norms and practices (school level) on one hand, instructional quality and teaching practices (classroom level) on the other hand. Also, we want to study the pattern of relations between school and classroom characteristics.

Research Method, Design, and Hypotheses

This paper reports on a representative study of language development in ninth grade, $n = 209$ schools, 1579 teachers, 9980 students, in Germany. HLM models specify the impact of school level (achievement expectations, strength of educational goals, cooperation among German language teachers) and classroom level factors (structure, teacher support, cognitive challenge, variability of teaching methods). In each school, two classes from the same year were assessed. Students were assessed both at the beginning and the end of the school year. Change in achievement and change in motivation, estimated from IRT models and classical test analysis, respectively, are used as dependent variables. Data were analyzed with a series of three-level models, allowing for an analytical dissection of school, class and individual levels.

At the classroom level we identified three basic dimensions that had already been ascertained in earlier studies (e.g., Klieme, Pauli and Reusser (2009); Baumert et al., 2009; Pianta & Hamre, 2009):

- (1) clear, well-structured teaching, (structuredness)
- (2) a supportive learning climate that is oriented towards the students (teacher support) and
- (3) challenging, cognitively activating demands (cognitive challenge).

Student perceptions of lessons were used to assess these constructs. We also took into account a fourth scale for questions regarding the variability of teaching methods used in the classroom.

Following the learning and teaching theory assumptions of Klieme, Pauli and Reusser (2009) we expect supportive teacher behavior to be crucial to the development of motivation, while cognitively challenge should be important for achievement development. Both of these criteria are likely to be positively influenced by well-structured instruction. Contrary to the three basic dimensions that become effective as „deeper characteristics of instruction“, the fourth scale pertinent to the variability of teaching methods constitutes a "surface characteristic" of teaching, and we do not expect this scale to bear an effect on learning development.

The following predictors are applied at the school level: achievement expectations of the German teachers, norms that are shared among the German teaching staff (here: the strength of language-related educational goals) as well as

cooperation among the German teaching staff. These aspects of professional culture are generally assumed to influence the quality of instruction and also cognitive and motivational learning processes.

Results

First, the impact of school level variables on instructional quality and teaching practices was analyzed using a series of three-level HLM-models. Each dimension of instructional quality and practice was analyzed (I) without controls and (II) controlling for gender, SES, migration status, and cognitive ability, both on the student and (as a compositional variable) on the class level, plus school type on the school level.

Teacher cooperation at school level had a significant positive gross effect on perceived structure and variability of instructional methods, while strength of educational goals at school level had a negative gross effect on structure and variability. However, all these effects vanished once controls were introduced, with strong effects of school type masking most other effects.

Second, the impact of instructional quality and teaching practices on students' achievement growth and change in motivation was analyzed using another series of three-level HLM models. Once again, models were run (I) without controls and (II) with control variables on all three levels. It turns out that none of the school level predictors (teacher cooperation, strength of educational goals, and achievement expectations) had an effect on achievement or motivation.

However, two of the class level indicators of instructional quality had an impact on student learning, as predicted. The indicator of cognitive challenge bears a significant and also sizeable effect on the increase in achievement, at both the individual and the classroom level. Also, teacher support has a significant effect on the development of student motivation on the classroom level. As expected, the variability of learning opportunities, considered to be a "surface characteristic", neither impacts student achievement nor student motivation.

Discussion

At the level of classroom instruction, the study supports our model of instructional quality which assumes three basic dimensions, with cognitive challenge being the most important predictor of achievement growth, and teacher support being the most important determinant of motivational development. However, these effective aspects of instructional quality do not correlate with aspects of professional culture at school level (i.e. cooperation, achievement expectations and strength of educational goals). The school level factors do have an impact on instructional practices, but this impact is on variability of teaching methods and perceived structure – i.e. on those aspects of instructional quality and practice that do NOT have an effect on student learning. This pattern explains why professional culture at the school level does not pay off in terms of learning.

Thus, the theoretical assumption that school quality, and more precisely the professional norms and cooperation among teaching staff, mediated by instructional quality, influences student learning, receives no support from the DESI data. The practical consequence for school development reads as follows: Professional development at school level should carefully and explicitly aim at those aspects of classroom practice that have been shown to be important for student learning, rather than, e.g., sharing many teaching methods among colleagues, which as such does not stimulate student learning

PAPER PRESENTATION

Does Instructor Affective Support Matter for Undergraduate Students?

Gonul Sakiz, Marmara University, Turkey

Research indicates the need for assessing the connection between students' functioning in schools and perceived affective dimensions of learning environments (Turner, Meyer, Midgley, & Patrick, 2003). Although considerable research has examined the role different types of teacher support on students' functioning in learning environments, insufficient emphasis has been placed on the affective dimensions of teacher support. In the current study, the construct of Teacher Affective Support, first developed by Sakiz (2007), were improved, renamed as Instructor Affective Support, and administered to 367 undergraduate students enrolled in a teacher training department of a major teaching and research university in Istanbul. Associations among perceived instructor affective support, academic enjoyment, academic anxiety, academic hopelessness, and academic effort were tested using a structural model. Direct and indirect influences of given variables were examined. Perceived instructional support directly and/or indirectly influenced academic enjoyment, academic anxiety, academic hopelessness and academic effort. Overall, the structural model explained 42% of the variance in academic enjoyment, 24% of the variance in academic

anxiety, 65% of the variance in academic hopelessness, and 77% of the variance in academic effort behaviors of junior college students.

Research has indicated the need for assessing the relationship between students' functioning in schools and perceived affective dimensions of learning environments (Turner, Meyer, Midgley, & Patrick, 2003). Although considerable research has examined the role teacher support plays in early adolescents' functioning in schools, insufficient emphasis has been placed on the affective dimensions of teacher support. Because a primary goal of education is to increase students' learning capacities and advance their academic accomplishments, schools must begin by providing environments in which students feel safe, cared for, and valued. If teachers can establish affective learning environments in classrooms by internalizing and modeling affective behaviors, students first observe, then start imitating, and, eventually, internalize these behaviors which lead to greater experience of belonging and academic and emotional fulfillment in classrooms. Therefore, more attention should be directed to examining teacher affective support in learning environments. Research, up to date, has documented the influence of different components of teacher affective support on student outcomes in various developmental levels. For example, Buyse, Verschueren, Doumen, Van Damme, and Maes (2008) reported that emotionally supportive learning environments involving teacher warmth, respect, and interest in students moderated between externalizing and internalizing behaviors of kindergarten students and their relational functioning (conflict and closeness) in classrooms. A recent study by Rudasill, Gallagher and White (2010) showed that classroom emotional support involving teacher characteristics such as warmth, kindness, respect, and concern for students had a significant moderator effect between children's temperament (attention and activity level), measured when children were 4-and-a-half-years-old, and their reading and mathematics achievement levels in third grade. Stipek et al. (1998) reported that the affective learning climate in mathematics classrooms, involving variables such as teacher interest in students, respect, and valuing, was the most powerful indicator of students' academic motivation in fourth- through sixth-grades and positively related to students' learning goal orientation, help-seeking and risk-taking behaviors, and positive emotions. Similarly, Reedy, Rhodes and Mulhall (2003) found that teacher characteristics like interest in and concern for students decreased early adolescents' depressive symptoms and increased their self-esteem over the years, from sixth- through eighth-grades. Although we know a little bit about the influence of several teacher affective characteristics on K12 students' academic, emotional and motivational behaviors, those teacher characteristics have not been explored all together until recently. Sakiz (2007) combined all affective characteristics under one category. Following an extensive analysis of theory and research, the characteristics and behaviors of teachers providing affective support to their students were determined as caring, respect, kindness, concern for and interest in students, valuing, recognizing, treating fairly, holding high expectations, encouraging, listening, and warmth. In that study, teacher affective support emerged as a significant predictor of middle school students' sense of belonging, academic emotions, academic self-efficacy, and effort in mathematics. In the current study, the potential influence of teacher affective support on college students' emotional and motivational outcomes were explored. First, Teacher Affective Support Scale was improved and renamed as Instructor Affective Support Scale. Confirmatory Factor Analysis was performed and a satisfactory fit was obtained (Figure 1). For the exploration, a structural model was developed. It was hypothesized that perceived instructional support would increase college students' academic enjoyment and academic effort and decrease academic anxiety and academic hopelessness in a wide range of courses.

Participants and Procedure

Three hundred and sixty-seven undergraduate students enrolled in a teacher training department of a major teaching and research university in Istanbul, Turkey, responded to the questionnaire. From the participating students, 126 (34%) were in their first year, 83 students (23%) were in their second year, 67 students (18%) were in their third year and 91 students (25%) were in their fourth year in the programme. The average age of the students in the study was 20.82 (SD = 1.76), ranging from 17 to 32. A greater number of female students (n=220, 59.9%) than male students (n=128, 34.9%) participated. Nineteen students (5.2%) did not respond to the gender question. Students responded to the survey items with respect to the course they were taking at the time of the survey administration. Data Analysis Descriptive, reliability, missing data, and normality analyses were conducted using Statistical Package for Social Sciences (SPSS). Structural equation modeling (SEM) was performed using AMOS statistical software package. Within two-step modeling, the original structural model was respecified as a measurement model and tested for its adequacy in the first step. The latent constructs in the hypothesized structural model were represented by their items as measured indicators and were allowed to intercorrelate during the examination of the measurement model. A priori alpha level was set at .05 for all estimations.

Results

Psychometric Properties of the Final Measure The internal consistency reliability estimates for each scale was determined as follows: The reliability estimates for the Instructor Affective Support Scale (13 items, $\alpha = .956$), Academic Enjoyment Scale (3 items, $\alpha = .909$), Academic Anxiety Scale (4 items, $\alpha = .752$), Academic Hopelessness

Scale (2 items, $\alpha = .777$) and Academic Effort Scale (5 items, $\alpha = .744$) were all in a satisfactory range. Structural Model The hypothesized model provided an adequate fit to the given data (Table 2) [$\chi^2(308, N = 367) = 872.319, p = .00$, CFI = .977, TLI = .978, RMSEA = .071 (with 90% CI lower bound = .065 and upper bound = .076)]. As shown in Figure 2, instructor affective support was significantly positively related to academic enjoyment [$b = .650, p < .001$]. Overall, the structural model explained 42% of the variance in academic enjoyment, 24% of the variance in academic anxiety, 65% of the variance in academic hopelessness and 77% of the variance in academic effort behaviors of junior college students. Indirect effect analysis also showed the significant impact of instructor affective support on student outcomes. The results improved our understanding of the factors influencing college students' emotions and motivation. Instructor affective support needs to be studied further with the participation of students in different fields. Gender effect should also be explored.

PAPER PRESENTATION

Group work at university: Insights into the interplay of students' emotions and appraisals

Karen Kimmel, RWTH Aachen, Germany; Marold Wosnitza, RWTHUniversity Aachen, Germany

This paper stresses the critical role of emotions in group work and examines how university students' emotional orientations towards a real-life group assignment relate to their cognitive, motivational, management, assessment and interpersonal appraisals of the task. For this purpose, students' emotional orientations (measured by a newly developed instrument) and group work appraisals were conceptualized as multi-dimensional, interrelated and emerging. Matched questionnaire data of 338 teacher students reveal that students' emotional orientations are strongly associated with multiple dimensions of the task. More precisely, findings show how students' appraisals of specific dimensions of the task predict positive and negative emotional orientations towards the group assignment. In sum, for a holistic understanding of students' emotional experiences of group work, it is critical to systematically examine these in light of their appraisals of distinct dimensions of the task. Overall, such insights may enhance educational practice and ensure that group work is perceived as emotionally rewarding by students.

PAPER PRESENTATION

Exploring patterns of task specific goal setting and motivation regulation

Allyson Hadwin, University of Victoria, Canada; Elizabeth Webster, University of Victoria, Canada; Stephanie Helm, University of Victoria, Canada; Lindsay McCardle, University of Victoria, Canada; Mariel Miller, University of Victoria, Canada

The purpose of this study was to examine the evolution of motivation regulation and goal setting by undergraduate students over 9-weeks in an academic semester. Weekly online reflections were coded for (a) goal quality, and (b) type of academic challenge experienced that week. Students self-evaluated goal attainment from the previous week and rated their efficacy for achieving the goal they set this week. Findings indicated that motivational challenges (particularly willpower) were the most frequent challenges students encountered over the course of a semester. When students confronted motivational challenges, they tended to set low quality behavioral goals that were met with future motivational and goal management challenges. However, over the course of an academic semester, students developed increased confidence in their abilities to achieve goals, self-reported higher goal attainment, and set goals of higher quality in terms of specificity and proximity.

Self-regulated learning (SRL) refers to a learner's deliberate planning, monitoring, and regulating of cognitive, behavioral, and motivational-emotional processes towards completion of an academic task/goal. SRL can be thought of as conducting experiments about one's own learning. Students identify a challenge or problem, hypothesize about how and why the problem occurred, and set some goals to address the problem. To achieve goals, learners make plans and set procedures in action concurrently self-monitoring and collecting informal data about progress and processes. These data inform regulatory adjustments to studying now or on future tasks (Winne & Hadwin, 1998). However, a paucity of research has examined the challenges students perceive during studying, or the ways they respond to and adapt to those challenges over time. Motivation in Self-Regulation. Winne and Hadwin (2008) posit that students regulate motivational state much like they regulate other aspects of learning. They recognize a discrepancy between products and evaluations relative to affective or motivational standards they hold and follow one of three possibilities to regulate motivational state: they change conditions, operations, or standards. From this perspective goals and standards are entwined with motivational states. Research on motivation regulation has found that college students identify using a wide variety of motivation strategies in response to hypothetical learning scenarios (Wolters, 1998). However, there is a need for research measures that capture dynamic regulation as it develops over time in authentic learning tasks (Winne et al., 2002; Winne & Hadwin, 2008; Zimmerman, 2008).

Specifically, research should examine: (a) how students monitor and regulate motivational challenges during authentic learning activities, and (b) how students respond to and adapt to motivational challenges over time. Goals for SRL. Goals are fundamental for self-regulatory cycles because they define standards for planning, choosing strategies, monitoring, evaluating, and regulating learning. Goals also provide insight about: (a) how learners interpret tasks in relation to their beliefs, (b) what they value, and (c) what they can do. Goals are fundamentally dependent on the first phase of SRL. How students translate assigned goals into their own goals is partly determined by their task understanding. Misalignments can lead to setting goals that are vague, inappropriate, or lacking specificity needed to guide work on the task. To support SRL, goals must provide accurate and appropriate standards for establishing plans, selecting study tactics, and monitoring and evaluating progress. Findings to date indicate that students can learn to set better goals for SRL; the goals are: (a) anchored in shorter blocks of time defining what would be achieved in a 1-2 hour study session (temporal properties); (b) process oriented; and (c) specific in identifying standards, processes, and strategies to be achieved or enacted (specificity) (Gendron et al., 2009; Zimmerman, 2008). In post-secondary learning contexts, students are usually tasked with setting their own goals and translating distal assigned goals and tasks into manageable proximal goals that can be used to guide studying and learning activities on a daily basis. However, there is a paucity of research that examines the quality and effectiveness of self-set goals for regulating learning in authentic university tasks and contexts. The purpose of this study was to examine the ways students regulate their learning in the context of motivational challenges. Specifically, this study examined weekly online goal setting as a strategy for regulating motivation by examining the following research questions: (a) What kinds of motivational challenges do students encounter over a semester and how prevalent are those challenges compared to other cognitive, goal management, and time planning challenges students encounter? And (b) how do students regulate motivational challenges in terms of the goals they set?

Methods.

Participants included 43 undergraduate students (20 female, 23 male) enrolled in a first-year, graded elective course (ED-D 101: Strategies for University Success). Students completed online reflection-planning notes each week. A document template was posted listing each question, and providing space for responses. Students saved each reflection with a new date. Online reflections might be considered a type of structured diary measure of SRL (Schmitz & Wiese, 2006). Reflections were used as a tool to promote active self-regulation. Students were asked to focus on academic learning in any of their discipline related courses. They were not limited to a particular course or any particular type of challenge. Reflection was prompted by a series of questions. The first part of the reflection prompted students to: (a) reflect on the previous week's strategies, (b) self-evaluate goal attainment on a scale of 0 (goal not achieved) to 10 (goal fully achieved), and (c) describe one thing they struggled with in their learning this past week. The second part of the reflection prompted students to: (a) state one goal for studying/learning this upcoming week, and (b) rate their confidence for accomplishing that academic goal this week on a scale of 0 (not at all confident) to 10 (extremely confident). Data were collected weekly for 9 weeks.

Findings.

Goals were coded for quality on four attributes including specificity about: (a) the target for the goal, (b) a temporal period for achieving the goal, (c) a standard, and (d) an action or process to be engaged. Challenges were coded with five general categories emerging including: cognitive, motivational, goal management/planning, managing self or environment, or no challenge at all. Conditional probability matrices were used to examine patterns in week-to-week goals and challenges. Findings revealed that students engaged in cycles of maladaptive motivation regulation. Motivational challenges (particularly willpower) were the most frequent challenges students encountered over the course of a semester. When students confronted motivational challenges, they tended to set low quality behavioral goals that were met with future motivational and goal management challenges. However, over the course of an academic semester, students developed increased confidence in their abilities to achieve goals, self-reported higher goal attainment, and set goals of higher quality in terms of specificity and proximity.

Discussion.

One challenge for future research is to explore the effectiveness of technologies for illuminating adaptive and maladaptive patterns in motivation regulation over time. Findings in this study demonstrate that documenting goals, efficacy, and challenges and self-evaluating goal attainment may not be sufficient to break the cyclical patterns in goal setting quality, type, and challenges encountered

PAPER PRESENTATION

Effects of a Tutorbased Learning Strategy Training for Students

Cornelia Gutmann, Ulm University, Germany; Tina Seufert, Ulm University, Germany

To help first-year students in their phase of orientation the University of Ulm provided a four weeks "Trainingscamp", where students have the possibility to repeat and consolidate their mathematical skills and got an introduction for learning strategies. The students ($n=198$) worked together in tutorials of about twelve people. Before the Trainingscamp the tutors have been trained to teach mathematical skills as well as cognitive, metacognitive and motivational learning strategies. One part of the tutorials received a semester-ongoing training for the same learning strategies as at the Trainingscamp. In an empirical study we wanted to find out whether the Trainingscamp in fact had positive effects on students motivation and their learning strategy use as well as possible longitudinal effects. The unexpected and disappointing results showed that at the very beginning of the course of studies the training leads to partly highly significant negative effects concerning motivational aspects and strategy use development. Over the course of semester the group with the ongoing strategy training recovered significantly concerning motivation and strategy use but not for metacognitive strategy use. Nevertheless, the results reassured us that strategy training is not detrimental per se. Rather, the timing of such a training seems to be crucial: after the first and unavoidable "shock of realism" students could be helped to reflect on expectations, motivational and emotional reactions. Based on this they could be prompted to use especially metacognitive and meta-motivational strategies to better cope with failure and high demands.

Introduction

At university first-year students have to deal with many new affordances: generally, they have to deal with an increasing amount of issues, get used to less interactive lesson formats like lectures and have to learn in a more self-regulated way. Moreover, from a motivational point of view students often feel like the little fish in the big pond (Marsh, 2005), i.e. they have a new reference group and instead of feeling superior, competent and self-confident they are worried about mastering the given requirements. To help students in this phase of orientation several universities provide programs where specific competences like mathematical skills are repeated and consolidated. Before the semester starts at Ulm University a four weeks "Trainingscamp" has been invented where students had the possibility to repeat and consolidate their mathematical skills and got an introduction into important learning strategies. They visited lectures about mathematics and have to write an "exam" at the end. To deepen and to exercise the subject matter from the lectures and the strategies the students ($n=198$) worked together in small groups of about twelve people together with a student tutor every day during the Trainingscamp. The tutors have been trained to teach mathematical skills as well as cognitive, metacognitive and motivational learning strategies. After the trainingscamp all students had tutorials in addition to their math lectures during the first semester. One part of those groups received an ongoing training in their tutorials for the same learning strategies as at the Trainingscamp. These groups have been compared with tutorials without this additional training (trained and untrained tutorials: $n=44$).

Method

In an empirical study we wanted to find out whether the Trainingscamp in fact had positive effects on students motivation and their learning strategy use. Moreover, we analyzed whether the additional strategy training during the semester had longitudinal effects on motivation and their learning strategy use. With repeated measures, before (t_0) and after the Trainingscamp (t_1) as well as after the first semester (t_2) we measured motivational and strategical aspects. Specifically, we assessed students current motivation for math (QCM; Rheinberg, Vollmeyer & Burns, 2001), motivational orientations with subscales from the inventory for capture of study- and achievement motivation (SELLMO; Spinath et al., 2002). Students self-reported strategy use has been assessed by the German version of "The Motivated Strategies for Learning Questionnaire" (MSLQ; Pintrich et al., 1991). Additionally, we assessed several parameters like spatial abilities and math grades that were used in the ANCOVA for comparing the trained and untrained group.

Results

With respect to motivational aspects and strategy use the analysis with repeated measures from t_0 to t_1 revealed an unexpected and disappointing result. For motivational scales we found that students current motivation and avoidance motivation remained stable, whereas their learning goal orientation decreased significantly ($F(1,197)=14.95$, $p<.001$). The strategy use can be divided in cognitive, metacognitive and concentration/persistence aspects. While we found almost no changes over time for the cognitive strategies, despite the fact that students used (superficial and less effective) repeating strategies significantly more after the trainingscamp ($F(1,197)=4.50$, $p<.05$). However, the students of the tutorials with additional strategy training during the first semester at least partly recovered from the first tremendous decrease in motivational orientation and strategy use: the ANCOVAs revealed that they reported more motivation for math than the untrained control group after the same period of time ($F(1,197)=4.38$, $p<.05$).

Summary and Discussion

We analyzed the effects of a tutorbased learning strategy training on the development of strategy use and motivation for first-year students. Results showed that besides the well-meant program for basic mathematic skills and a first introduction into learning strategies the students lost learning goal orientation as well as their approach motivation, used more ineffective repeating and less metacognitive strategies and reported losses of persistence and concentration. Overall, they developed a – from a theoretical point of view – unfavorable learning behavior. In our view it seems plausible that the highly challenging math course even potentiated the "fish-in-the bowl-feeling" of students and led to a desperate behavioral pattern of superficial but "fast" learning. However, by implementing an additional training during the first semester we have been able to stop the negative development for cognitive and motivational strategies (the tutors focused on these strategies because of their familiarity with them), but not for the metacognitive strategies. Nevertheless, the results reassured us that strategy training is not detrimental per se. Rather, the timing of such a training seems to be crucial: after the first and unavoidable "shock of realism" students could be helped to reflect on expectations, motivational and emotional reactions. Based on this they could be prompted to use especially metacognitive and meta-motivational strategies to better cope with failure and high demands.

References

- Marsh, H.W. (2005). Big-fish-little-pond effect on academic self-concept. *Zeitschrift für Pädagogische Psychologie*, 19, 119-127.
- Pintrich, P.R., Smith, D. A. F., Garcia, T. & McKeachie, W. J. (1991). The Motivated Strategies for Learning Questionnaire (MSLQ). Ann Arbor, MI: NCRIPTAL, The University of Michigan.
- Rheinberg, F., Vollmeyer R., Burns B. C. (2001). FAM: Ein Fragebogen zur Erfassung aktueller Motivation in Lern- und Leistungssituationen. Online-Artikel: www.psych.uni-potsdam.de/people/rheinberg/messverfahren/index-d.html
- Spinath, B., Stiensmeier-Pelster, J., Schöne, D. & Dickhäuser, O. (2002). Skalen zur Erfassung der Lern- und Leistungsmotivation (SELLMO). Göttingen: Hogrefe.

PAPER PRESENTATION

The development in motivation in early secondary school and later exam participation and results

Ineke van der Veen, University of Amsterdam, Netherlands; Thea Peetsma, University of Amsterdam, Netherlands

This study focuses on the relationship between the development in motivation in early secondary school and later exam results and changes in the school career of students in the lowest type of secondary school in the Netherlands. For decades educators have been concerned about the decline in achievement, motivated behaviour and motivational beliefs of children after the transition from primary to secondary school. We can expect that the decline in motivation of students in the lowest school type can be more extensive, as the percentage of early school leavers is highest there: almost three times higher than in higher school types.

Participants were 335 16-year old students of six pre-vocational secondary schools in the Netherlands who attended the fourth and final year. When these students were in the first year of secondary school they participated in a longitudinal study, filling in a self-report questionnaire for four times during regular class time.

The analyses showed that not the change but the level of motivation in the first year predicted future exam results. For instance, the effort students made for maths in the first year was positively related with maths exam results in the fourth year of secondary school. Another finding was that students who did not change schools, had a higher general well-being and a more positive development in general well-being than students who did change schools.

PAPER PRESENTATION

Student Engagement in the Engineering Classroom

Jonathan Hilpert, Indiana University Purdue University Fort Wayne, United States; Jenefer Husman, Arizona State University, United States

The purpose of this study was to examine the relationship between instructor practice and student engagement in the engineering classroom. Our results provide a description of how engineering professors' instructional practices – such as activating student prior knowledge and engaging students in authentic learning activities – might relate to student motivation and cognitive engagement. Our results provide information about the types of instructional practices that might promote knowledge building, collaboration, perceived instrumentality for coursework, and self-efficacy.

Student engagement in learning is important because students who are meaningfully engaged are more likely to construct strong knowledge structures (Corno & Mandinach, 2004). Engagement is a multi-dimensional construct with behavioral and cognitive components (Corno & Mandinach, 2004; Fredricks, Blumenfeld, & Paris, 2004). Cognitive engagement is a psychological state in which students are monitoring their own learning, which entails weighing alternative view points of a topic, and employing useful strategies for rehearsing, organizing, and elaborating on new information (e.g. Sinatra & Nussbaum, 2004). Behavioral engagement is when students are involved in meaningful learning activities that demonstrate good quality of effort. Many instructional techniques can be used to facilitate deep engagement including conducting experiments, debate, authentic problem solving, and developing self explanations (Ormrod, 2010). Many of these techniques promote weighing alternative points of view, comparing prior knowledge with previously un-encountered information, and contrasting ideas to resolve discrepancies. In general, these cognitive processes allow for more links between cognitive structures, allowing for easier retrieval and more flexible use of information.

Teacher Practices

Deep student engagement, both behavioral and cognitive, is often facilitated through effective instructional practices (Blumenfeld, Kempler, & Krajcik, 2006). Students are considered engaged when evidence of meaningful participation in collaborative and knowledge building tasks are present. Students are cognitively engaged when they participate in activities that allow them to explore all possible sides of an issue or concept, rehearse, organize, and elaborate on information, and meet their skill level as learners. These can range in level of student autonomy from structured guided practice to autonomous problem based learning (Rosenshine, 2003)

Student Perceptions

Effective teacher practices are just one side of the equation, and there is a need for research that explores teacher/student dynamics in STEM classrooms (Heller, Beil, Dam, & Haerum, 2010). In order to navigate learning environments provided by professors, students must be motivated to consider and engage new information. Students who perceived new information to be valuable and who expect to perform well at a given learning task (Wigfield & Eccles, 2001), and are thus more likely to engage, both behaviorally and cognitively. Commonly referred to as multi dimensional mediational models of learning (e.g. Linnenbrink, 2007), engagement is hypothesized to mediate the relationship between student motivation and learning (Dole & Sinatra, 1998)

Purpose of the study

In the fall of 2009 we began an evaluation of a professional development program at a large southwestern university in the United States designed to promote constructivist teaching practices in freshman engineering classrooms. The purpose of this study was to examine instructor practices in the engineering classroom. We wanted to determine which types of instructional practices resonated with students and resulted in higher levels of students' self reported cognitive and behavioral engagement.

Method

Preliminary observations were conducted in eleven engineering classrooms at a large public university in the southwest. During the observations detailed running records and evaluations of the of the courses were taken. The topics of the courses included, Programming in C++, Introduction to Mechanical and Aerospace Engineering, Programming in Java; Informatics; Engineering Design; Digital Design, and Society and Technology.

Participants

Participants were eleven freshman engineering educators. Eight of the instructors were male, and three of the instructors were female. All of the instructors were experienced engineering educators at the university. 349 engineering students, enrolled in the observed courses, were also surveyed (demographics pending).

Measures

Student Perceptions of Classroom Knowledge-building (SPK): The SPOCK subscales (Shell et al., 2005) were administered to assess students' knowledge building (cognitive engagement) and collaboration (behavioral engagement).

Perceptions of Instrumentality (PI): The PI scale (Husman, Derryberry, Crowson, & Lomax, 2004) was administered to determine perceived instrumentality of a particular college course selected by the participant.

MSLQ Self-efficacy (MSLQSE): The MSLQ self-efficacy subscale (Pintrich, Smith, Garcia, & McKeachie, 1994) was administered to assess students' confidence in their ability to complete the coursework.

Reformed Teaching Observation Protocol (RTOP). Moment to moment running records and evaluations of the courses were taken using a modified version of the RTOP, a research tool designed to evaluate instructor practices in science classrooms.

Analysis/Results

A series of one way ANOVA's were conducted across instructors to determine if significant differences existed between instructors for student self reported Knowledge Building, Collaboration, and Perceived Instrumentality. Results indicated there were significant differences across instructors for students self reported Knowledge Building [$F(9,338) = 4.23$ $p < .001$] Collaboration [$F(9,338) = 4.78$, $p < .001$], and Perceived Instrumentality [$F(9,338) = 4.38$, $p < .001$].

Based on follow-up pairwise comparisons, running records for instructors whose students mean scores were significantly higher than two or more of their colleagues were examined to determine what instructional strategies may be related to student responses. Miles & Huberman's (1994) recommendations for coding qualitative data were followed. Coding indicated instructors with high mean scores 1) presented material in small steps, 2) provided feedback via individual contact with students, and 3) employed instructional techniques that promoted meaningful communicative interaction among students revolving around content.

The students' who reported the highest mean scores were in classrooms where their instructors demonstrated evidence of activating student prior knowledge before instruction and actively engaging students in learning activities when presenting new information. Common strategies were isolated

Discussion

Engineering instructors who helped students activate relevant prior knowledge may have been better able to motivate students to engage by helping them to see how new information builds on old information and is related to future goals such as completing a class project or learning how to solve engineering problems. Engagement in the classrooms existed on a continuum from low to high. On the low end, instructors simply talked about new ideas, presented power point slides, or drew diagrams on the board. On the high end, instructors provided opportunities for peer interaction, novel problem solving, and guided practice. These techniques seem to have promoted deep cognitive engagement among students.

PAPER PRESENTATION

Analysing students' intention to change academic procrastination based on the Transtheoretical Model

Carola Grunschel, Bielefeld University, Germany; Lena Schopenhauer, Bielefeld University, Germany; Stefan Fries, University of Bielefeld, Germany

Academic procrastination is a highly prevalent phenomenon among students. According to previous research, a majority of students wishes to reduce academic procrastination. However, it has not been investigated whether these students intending a behaviour change differ from those not intending a change. The goal of this study was to address this question on the basis of the Transtheoretical Model (TTM) of change. Behaviour change is viewed as a result of passing five discrete stages. The variables self-efficacy and pros of change are assumed to increase, and cons of change to decrease across the stages. In an online survey (N=380 students, 266 female) participants' categorization to the stages of change, academic procrastination, students' motivation to change, and the TTM variables were assessed. Almost half of the students indicated implementing their intentions without procrastinating. The others had either not thought of a behavioural change, or were merely intending a change. The goodness of categorization was supported by significant differences between the stages concerning students' academic procrastination and motivation to change. The expected differences between the stages regarding self-efficacy, pros and cons of change were also significant. Hence, these results deliver in combination with the stages of change the groundwork for developing effective interventions.

References

- Nýbbling, R., & Bengel, J. (2008). Patientenfragebogen zur Messung der Rehabilitationsmotivation – PAREMO [Patient questionnaire for measuring motivation for rehabilitation – PAREMO]. In J. Bengel, M. Wirtz, & C. Zwingmann (Eds.), *Diagnostische Verfahren in der Rehabilitation* [Diagnostic measures for rehabilitation] (pp. 101-104). Göttingen, Germany: Hogrefe.
- Prochaska, J. O., DiClemente, C. C. & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist*, 47, 1102–1114.

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology*, 31, 503–509.

Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychological Bulletin*, 133, 65–94.

Tuckman, B. W. (1991). The development and concurrent validity of the procrastination scale. *Educational and Psychological Measurement*, 51, 473-480.

Motivational developments in primary school: A longitudinal study on group-specific differences

Lisette Hornstra, University of Amsterdam, Netherlands; Ineke van der Veen, University of Amsterdam, Netherlands; Thea Peetsma, University of Amsterdam, Netherlands; Monique Volman, University of Amsterdam, Netherlands

This study is aimed at examining developmental patterns in motivational beliefs (task value and self-efficacy) and motivated behavior (effort), as well as related developments in academic achievement during the last four years of primary school. Because parental socialization practices with regard to school can differ for boys and girls, or for children from different ethnic or socio-economic backgrounds, developmental differences in motivation between these groups were examined. Participants were 712 primary school children. These students filled in a self-report questionnaire with scales on task value and self-efficacy five times between 3rd and 6th grade. Their teachers rated each student on effort during each measurement. Achievement scores on math and reading comprehension were collected from the schools. Results showed an overall decline in task value, while self-efficacy and effort remained stable. Developments in motivation were related to developments in reading comprehension achievement, but not math achievement. Some differences in developmental patterns were found between boys and girls, and between students from different ethnic or socio-economic backgrounds, indicating the importance of distinguishing these different groups.

Aims

Research has consistently found a decline in students' motivation for school during the secondary school years (e.g., Fraine, Damme, & Onghena, 2007; Gottfried, Fleming, & Gottfried, 2001; van der Veen & Peetsma, 2009). There are also some indications that this decline is already apparent in primary school (e.g., Nurmi & Aunola, 2005; Spinath & Spinath, 2005). Considering the large impact of motivation on achievement (Eccles, Wigfield, & Schiefele, 1998), this decline can be considered worrisome. The number of studies that have focused on developments in motivation during primary school is however rather limited. Especially longitudinal studies on motivation that also examine related developments in academic achievement are needed. Also, studies that address differential developmental patterns of motivation and achievement between different groups of students are scarce. There are several reasons to assume motivational patterns may differ for students with different background characteristics, such as different socio-economic and ethnic backgrounds. Most of these reasons have to do with different socialization practices and differences with regard to the values and behaviors parents encourage in their children (Verkuyten, Thijs, & Canatan, 2001). In their review, Hughes, et al. (2006) described how encouraging a positive ethnic identity in minority children is positively related to self-esteem, academic orientations and outcomes. Also, it was found that ethnic minority parents are more likely to have higher expectations for their childrens' academic potential (van der Veen, 2003). On the other hand, ethnic minority students as well as students from a low socio-economic status (SES) background are more likely to feel a disidentification with school, to feel more incompetent (Verkuyten et al., 2001), and they are more likely to be faced with lower expectations from their teachers (van den Bergh, et al., 2010). Also differences between boys and girls may be expected due to differences in parents' socialization practices for boys and girls (Meece, Glienke, & Burg, 2006). There is a large body of research on gender differences in motivation, especially regarding motivation for math. However, there are still a lot of contradictory findings on gender differences in motivation (Pajares & Graham, 1999; Pajares & Valiante, 2001; Skaalvik & Skaalvik, 2004). Moreover, it is especially unclear whether there are developmental differences in motivation between boys and girls (Meece et al., 2006). In motivation research, a distinction is often made between motivational beliefs such as task value (beliefs about the importance and relevance of school tasks) and self-efficacy (expectations about competence to perform on a task), and behavioral outcomes of motivation (e.g., the amount of effort a student puts into his or her schoolwork). The proposed study will examine developmental patterns of motivation, i.e. task value, self-efficacy, and effort, during the second half of primary school and will focus on differences in these developmental patterns between students from different socio-economic and ethnic backgrounds as well as gender differences. In the proposed study, the following research questions will thus be addressed: 1a How do task value, self-efficacy, and effort develop during the second half of primary school? 1b How do these developments differ by gender, social and ethnic background? 2a How do the developments in task value, self-efficacy, and effort relate to developments in academic achievement? 2b To what extent does this differ by gender, social and ethnic background?

Methodology

712 primary students participated in this study: 50% were boys and 50% girls. Twelve percent of the students were from non-Dutch (mostly Turkish or Moroccan) background, and 15% had a low, 50% a medium and 34% a high SES background. The students filled in a self-report questionnaire five times: the first in the 3rd and the last in the 6th grade. At the first measurement the students were on average 9 years old. The questionnaire included Likert-type scales (range 1-5) on task value and self-efficacy. During each measurement, teachers also rated each student on effort. School records on students' gender, ethnic background and socio-economic status (SES) were collected as well as achievement scores on math and reading comprehension. The data were analysed using multivariate Latent Growth Curve Analyses (LGCA) with Mplus (Muthén & Muthén, 2007). The rate and level of growth of the different variables were examined and related to each other. To investigate differences in the rate and level of growth of the different variables and whether the relationships of the level of growth in academic achievement with the other variables in the model differed between the groups, a multi-group LGCA was performed with groups being boys vs. girls, students from Dutch-background vs. students from non-Dutch background and students from low, medium and high SES.

Results and conclusion

The data of the first three measurements have been analysed. From 3rd to 5th grade students showed an overall decline in task value while their self-efficacy and effort remained stable (see figure 1). We did find differences in developmental patterns between groups of students based on gender and social and ethnic background. For instance, we found that girls showed lower initial levels of self-efficacy and effort, but the same rate of growth as boys. Furthermore, high SES students showed higher initial levels of effort than middle or low SES students, but no differences in growth rate. Also, Dutch-background and ethnic minority students did not differ in their initial level of self-efficacy, however, ethnic minority students showed a significant increase in self-efficacy, while Dutch-background students showed a significant decrease. The development in reading comprehension was best explained by the development in self-efficacy. Figure 1. Overall developments in self-efficacy, task value and effort from 3rd to 5th grade. * Outcomes of measurement 4 will become available in November 2010, outcomes of measurement 5 in July 2011.

The results indicate the importance of examining developments in both motivation and achievement. These outcomes also show the importance of differentiating between groups of students based on gender and background differences, as these groups showed different developmental patterns in motivation. Further research will be aimed at finding out which factors of the learning context contribute to these developments in primary students' motivation for school.

PAPER PRESENTATION

Characteristics of students with specific educational needs in mainstream primary education

Marjon Bruggink, Windesheim University of Applied Sciences, Netherlands; Sui Lin Goei, VU University Amsterdam, Netherlands; Hans Koot, VU University of Amsterdam, Netherlands

The research reported in this paper wishes to specify the characteristics of students with specific educational needs (whether they are academic or behavioural), as perceived by their teachers as in need of more care, in mainstream primary education in The Netherlands. Data were collected on 151 students in mainstream primary education in The Netherlands, who were designated by their teachers as needing more care or a different approach, regarding academic achievement (mathematics and reading), self-competency, externalising and internalising behavioural problems, executive functioning and student-teacher relationship. The results are important for teachers to discriminate between groups of students with different sets of educational and pedagogical needs, whether they are classified or non-classified special educational needs, and accordingly to adapt their instructional, pedagogical and managerial strategies to the needs of these students. This paper addresses an issue/topic that directly impacts the quality of (inclusive) education as well as educational results.

Context and aim

The research reported in this paper wishes to specify the characteristics of students with specific educational needs (whether they are academic or behavioural) in mainstream primary education in The Netherlands. The results are important for teachers to discriminate between groups of students with different sets of educational and pedagogical needs and accordingly to adapt their instructional, pedagogical and managerial strategies to the needs of these students. This paper addresses an issue/topic that directly impacts the quality of education as well as educational results.

Nowadays, throughout Europe, teachers in mainstream education face major challenges teaching a very heterogeneous population of students with a diversity of academic and behavioural needs due to the policy of including children with special educational needs in mainstream education. There is a growing trend towards the inclusion of all students, including those with emotional and behavioural disorders (EBD; Mastropieri & Scruggs, 2004;

McLesky, Henry, & Hodges, 1999). Inclusion was mentioned among the five major challenges with regard to quality and education in the European countries (Working Committee on Quality Indicators, 2000).

In the Netherlands this shift towards more inclusion and integration is called 'appropriate education' and it involves meeting the needs of every student, including students who need extra care. Although the Dutch government has focused on diversity and adaptive teaching for many years since the nineties of the past century, recent research of the Dutch Inspection of Education reported that 40% of the teachers in mainstream primary education do not adapt their instruction effectively to the needs of their students. This is probably due to a number of factors. For teachers it is often difficult to specify the special needs of students who need extra care and instruction (Smeets, 2007). Furthermore, most teachers designate only the students with classified diagnoses and disorders as having special educational needs, and needing special facilities and education, and therefore focus exclusively on the problems and deficits of a student's learning. Last but not least, teachers lack a variety of differentiated instructional strategies and interventions to accommodate the needs of students in learning.

The research reported wishes to specify the sets characteristics of students with specific educational needs in mainstream primary education in The Netherlands. Dutch research of Smeets, Van der Veen, Derriks and Roeleveld (2007) and Van der Veen, Smeets and Derriks (2008) shows that teachers label approximately a quarter of their students to show some form of "problem behavior" or "in need of care". To our knowledge, no research has yet been done on the specific sets of student characteristics of students of whom the teacher thinks they have specific educational needs. The main research question of this study is as follows: What are the characteristics of students with specific educational needs in Dutch mainstream primary education, according to their teacher? This study is the first of a set of three studies on specific educational needs, based on the perception of their teacher, in mainstream primary education in The Netherlands.

Method

Participants were 151 students from grade 5, 6 and 7, whom the teachers designated as having specific educational needs from 14 schools in mainstream primary education in the Netherlands. Teachers were asked to designate students as having specific educational needs in their classrooms, according to the following definition: "Students who need more pedagogical, instructional and/or managerial care or a different approach to meet the educational goals that have been set for them". Data were collected in April-June 2010, regarding: 1. General information: such as sex, grade, family background and recent academic achievement in mathematics and comprehensive reading. 2. Externalising and internalising problem behaviour: teachers filled in the Problem Behavior at School Interview (PBSi, Erasmus, 2000), an instrument that measures externalising and internalising behaviour in school contexts. 3. Executive functions: teachers filled in an inventory about executive functions (Brief, Smidts & Huizinga, 2010) such as inhibition, cognitive flexibility, emotional regulation, taking initiatives, working memory, planning, tidiness. 4. Relationship with the teacher: teachers filled in inventory about types of student-teacher relationship (LLRV, Koomen, Verschueren & Pianta, 2007), such as conflict, independence and closeness. 5. Self-competence of the student (CBSK): students filled in a self-competency scale.

Results

89 (58.9%) were male and 62 (41.1%) were female. 20% were classified as having an official diagnosis (such as dyslexia or adhd); 30% were low achievers in mathematics and comprehensive reading. The data were analysed by given means (sd) in comparison to means (sd) of the normgroup. Second, high-achievers and low-achievers on mathematics and reading were identified. Third, male and female were compared on academic achievement and all of the scales from the inventories. Finally, we identified students with special educational needs and (sub)clinical scores regarding behavioural problems, interaction problems and executive functions. Correlations between the (sub)clinical scores and the other scales are computed.

Preliminary results show the following:

- Compared to the norm group students with specific educational needs have lower self-concept;
- Students with specific educational needs regarding externalising and internalising behaviour do not differ significantly from student without specific educational needs; students with specific educational needs score higher on depression;
- Boys with specific educational needs score significantly higher in mathematics than girls with specific educational needs. The average score in comprehensive reading of girls is somewhat higher than the average score of boys, but not significantly;
- Boys with specific educational needs have significantly more conflicts than girls with specific educational needs. They also have more problems regarding inhibition, tidiness and evaluation of their own behaviour. These boys score higher on the scales adhd, odd and cd and significantly lower on pro-social behaviour than girls with specific educational needs;

Conclusion and discussion

Results will be discussed in terms of classified special educational needs versus specific educational needs as perceived by the teacher. Furthermore, the discussion will focus on how the teacher can meet the pedagogical, instructional and managerial needs of these students by designing individual education plans for classroom instruction.

PAPER PRESENTATION

Why do parents employ private tutors for their children? Psychological perspectives on a global issue

Judith Ireson, Institute of Education-London, United Kingdom; Katie Rushforth, Institute of Education-London, United Kingdom

Parental involvement in their children's learning takes a variety of forms including face to face interaction and more distal influencing of children's activities outside the home. This paper addresses parental factors that influence children's participation in extra lessons and private tutoring to support learning and achievement. It explores parents' views of learning, their sense of efficacy in helping their children with schoolwork and the pressures and preventive factors that influence the employment of tutors. Information was collected through a questionnaire survey of 1170 parents whose children were in year 6 (age 10-11 years), year 11 (age 15-16 years) and year 13 (age 17-18 years) and from interviews with 58 parents. Findings indicate that parents' views of the importance of effort in learning are associated with children's participation in extra classes and private tuition. At home, parents support their children's learning and the majority of parents felt that this was sufficient to enable their child to do well in school. Parents recognised their own limitations and weighed their child's needs against the intellectual capital in the family, time available and relationship issues. The majority of parents employed tutors to help their children do well in tests and examinations and the pressure to seek extra help was keenly felt in areas where there were high stakes tests for selective secondary schools. These findings show that psychological factors deserve consideration when seeking to understand factors that influence the demand for private tutors.

Aims

Theoretical perspectives that have been used to explain the worldwide demand for private tutoring, or 'shadow education' tend to emanate from economic, educational or comparative perspectives (Bray, 2003; Dang and Rogers, 2008). These perspectives focus on factors at a macro level that influence demand such as the quality of national education systems, the extent of competition through high stakes testing for places in secondary schools and higher education, and the economic advantages gained from higher level qualifications. While these factors are significant, this paper argues that more proximal, psychological factors also play a part in parents' decisions to employ private tutors and therefore deserve greater consideration in the research literature. As there is very limited research on psychological factors that relate specifically to private tuition, this study turns to theoretical perspectives on learning and motivation including the seminal work of Dweck (1999) showing that learners' conceptions of intelligence as a fixed or malleable entity are associated with different views of the role of effort in learning. It also draws on the work of Hoover-Dempsey, and colleagues (Hoover-Dempsey, Battiato, Walker, Reed, DeJong and Jones, 2001; Green, Walker, Hoover-Dempsey and Sandler, 2007) who found that parents are more likely to be involved in their children's education and homework if they believe they should be involved, believe they can help and perceive that their children and their teachers want them to be involved. In relation to the employment of private tutors, financial demands and pressures from a selective education system may also influence parents as they weigh up the need to employ a private tutor.

Methods

The data for this paper was collected as part of a larger project that obtained information from students in schools in England and their parents. A stratified sampling strategy was employed through the distribution of questionnaires to students in 30 primary and 28 secondary state maintained schools, which were selected to represent a range of demographic areas. In total, questionnaires were returned from 2468 students and 1170 parents. Students, who were in year 6 (age 10-11 years), year 11 (age 15-16 years) and year 13 (age 17-18 years), took questionnaires home for their parents to complete, and completed questionnaires were received from 474 parents of year 6 children, 359 year 11 and 357 year 13. Interviews were also held with 58 parents. Parent questionnaires contained items on extra lessons and private tuition provided for their child and reasons for arranging these, help given with schoolwork, views on learning and effort, and demographic information. Interviews focused in more depth on the reasons for employing private tutors and parents' attitudes towards private tuition.

Summary of key findings

The main reasons given by parents for employing a private tutor were to improve their child's performance in tests and examinations and to increase understanding of the subject. In the sample as a whole, the majority of parents (65%) disagreed that their child's ability set a limit on their achievement and 71% agreed that with enough hard work their child could get high grades. A five-item scale of parents' views of learning was constructed and found to be associated with children's participation in private tutoring. Most parents of year 6 children (64%) felt that the family provided enough help, but this proportion was lower in year 11 (51%) and year 13 (53%), indicating that some parents had a lower sense of efficacy with more advanced aspects of the curriculum. Parents recognised their own limitations and weighed their child's needs against the intellectual capital in the family, time available and emotional constraints. They cited their own difficulties with specific content and lack of familiarity with the modern curriculum and methods as reasons for employing a tutor and, in a few cases, spoke of strained relationships with the child if they tried to help. Pressure to employ a tutor was evident in certain parts of the country where there were high stakes tests for selective secondary schools. Parents themselves perceived a demand for extra tuition and children also approached their parents if they felt they were not making sufficient progress. Evidence suggested that a combination of psychological and educational factors influenced parents' decisions.

Significance

This paper presents the first systematic study of the conceptions and motivational factors that play a part in parents' decisions to seek extra lessons and private tutors for their children. It demonstrates that greater consideration should be given to psychological factors in the private tutoring literature, alongside the economic, cultural and educational factors that have received attention to date. Parental views of learning would benefit from more detailed examination within countries, to reach a more nuanced understanding than is offered by the prevailing tendency to draw broad contrasts between Eastern and Western cultures.

PAPER PRESENTATION

Conceptual Change in Adopting the Nationwide Special Education Strategy in Finland

Helena Thuneberg, university of helsinki, Finland; Jarkko Hautamaki, Helsinki University, Finland; Mari-paoliina vainikainen, University of Helsinki, Finland; Raisa Ahtiainen, University of Helsinki, Finland; Touko Hilasvuori, University of Helsinki, Finland

The study analyzed conceptual change in the ongoing nationwide special education reform in Finland. The number of students having an official special education decision was 8% of the students in basic education in the year 2007. For half of them education was organized in segregated special classes or schools – this despite the country's commitment to the Salamanca statement, UNESCO 1994. To intervene this development, the Ministry of Education launched a new Special Education Strategy, SPES (Nov 2007). Our data consist of four documents from the municipalities (n=235, i.e. over half of the total amount) obtained in four time-points. Comparison of the special and strategy term representations between the time-points revealed that the amount of the special®-expressions significantly decreased and in the same amount the strategy-terms increased. Similarly the therapeutic/ symptom/medical terms were replaced by pedagogical terms. After one and half years of the process, at the first level of implementation: non use, orientation, preparation, were still about 22% of the municipalities, at the second level: mechanical use, routine, were 60% and at the third level: refinement, integration and renewal, were 18% of the municipalities. The conclusion is that they have advanced in applying the SPES in the intended goal-direction. However, from the systemic-discursive perspective, adopting concepts from an external input in a top-down process is not straightforward and, thus, it is quite probable that meanings vary considerably between the different discourses.

1. Introduction

The goal of this study is to add new knowledge in the stock of evermore important topic of understanding the implementation of educational reforms. We take advantage of an extensive reform in Finland, comparative in importance and extent to the foundation of Finnish Basic Education. A new Special Education Strategy (SPES) was launched in Finland by the Ministry of Education in 2007. There was the need for reconsideration of the system, because the number of the official special education referrals had been growing uncontrollably for years being 8% in the year of 2007 (Statistics 2007). For half of those students education was organized in segregated special classes or schools – this despite the country's international commitments (e.g. the Salamanca statement, UNESCO, 1994) to promote inclusion and a common school for all. To solve this contradiction the new strategy emphasizes inclusion and the "neighborhood school principle".

2. Aims of the study

The main research objectives were: (1) to analyze the conceptual change in the Special education strategy knowledge construction process. The change trend in municipality documents of four time-points was assumed to reflect the

educational reform process in the field in general, by giving an overall picture of the reform advancement in the national level; (2) to identify the variation between the municipalities and to roughly classify the municipalities according to their stage of implementation of the strategy. The systemic-discursive perspective (cf. Luhmann) was applied in order to understand the mechanics of the concept integration. For conceptualizing the change process we used, among others, the expansive learning model (cf. Engeström. 1989).

3. Methodology

Data: the municipality documents. Four documents were obtained from the municipalities: 1. The initial applications (December 2007) for the Ministry of Education, which included an organization plan for special education, 2. The more specified plan (June 2008), for the Board of Education, 3. The intermediate report (April 2009) for the Board of Education and 4. The municipality's plan of education (September 2009) for the Jyväskylä University and the board of Education.

Method: For the first aim, the identification of the change trend, we applied the content analysis and quantification of the main SPES concepts in the document data in four time-points during one and half years. The reliability of the analysis was strengthened by the on-going expert team discussions. By a simple search-function of Microsoft Word, the term occurrences were identified, analyzed in their contexts and calculated. For the second aim, to assess the advancement and direction of the process, the documents were categorized using the criteria of stage of implementation (Hall & Loucks, 1977). Because intensified support was a new concept, its emergence and elaboration in the documents was considered as a valid indicator for the level of development.

4. Results

The first objective, the conceptual change trend: 31 concepts with totally 63 592 occurrences were identified. The result was that the amount of the special[®]-expressions (related to the existing system) significantly decreased and the strategy terms (promoting the new strategy) increased between the two four time-points, but the difference leveled in the two last-timepoints. Similarly the therapeutic/ symptom/medical terms were replaced by pedagogical terms, but again the difference leveled from the rapid spurt towards to the last time-point.

The second objective, the variation between the municipalities: After the process had been going on almost for two years, at the 1st level: non use, orientation, preparation, were still about 22% of the municipalities, at the 2nd level: mechanical use, routine, were 60% and at the 3rd level: refinement, integration and renewal, were 18% of the municipalities. The frequent observation was that at the first level overrepresented were either (a) very small municipalities, which might be due to the fact that they had less personal and other resources available, and less experience about similar projects. They were often those, who want but cannot yet, or (b) those municipalities, which had just before the launch of the SPES and reorganized their special education system. They were those, who can, but do not want. The municipalities at the second level of implementation could be characterized of knowing and doing, but in a superficial manner, i.e. the principles were not yet genuinely integrated. For the third level was characteristic that inclusive practices were self-evidently in use, but even that was not enough anymore and the municipalities were modifying their practices and refining their systems.

5. Conclusion

The conclusion is that the cities and municipalities had advanced in applying the SPES in the intended goal-direction – but they did and do it in their own pace and way. From the systemic-discursive point of view, concept spread is not a straightforward process and, thus, it has been shown that now when the strategy concept labels seem largely to be spread in the field, they more or less bear different meanings, from subtle nuances to more profound differences. The meanings have modified and now are varying within the sub-systems (e.g. among teachers/school health care professionals/ psychologists/school administration) and are deviating more or less from the originals. Although in order to assure a common language, we need to emphasize the precise usage of concepts and opening of the meanings in multi-professional conversations, from the systemic-discursive perspective we are inclined to think that "the incommensurability of the discourses" (Königswieser & Hillebrand, 2005) is profound. That is why the wisest thing seems to be to support the local initiative and recreation of the concepts from the starting points of the discourses of concern, which is in line with Olson's (2003) emphasis on the importance of the local interpretation and the need for administration to take the local conditions into account for a real change to occur. This comes close to that, which in literature has been referred by the concept of logical generalization (cf. Barnett, D. & al.) a compromise of research and local school practice.

PAPER PRESENTATION

The Psychology of Containment: Schools and the Mis/use of Diagnostic Categories

Penny Van Bergen, Macquarie University, Australia; Linda Graham, Macquarie University, Australia; Naomi Sweller, Macquarie University, Australia

In this study we examine the ages and rate at which Australian boys and girls in the state of New South Wales are being enrolled in special schools for emotional disturbance (ED) and behavioural disorder (BD). Our aim was twofold: first, to determine whether any diagnostic changes have occurred in the relationship between age and special school enrolments (that is, the trends in enrolment) across the last decade, and second, to compare these enrolments by gender. We find that boys are over-represented in both ED and BD, but, critically, substantially more so in 2007 than in 1997. These findings suggesting a changing pattern of diagnosis unrelated to prevalence in the population. Implications for subsequent school functioning are discussed.

Challenging behaviour has been identified as one of the most significant issues confronting Australian schools (APPA, 2008; Ferrari, 2009a). Diagnoses and the use of segregated settings for emotional disturbances (ED) and behavioural disorders (BD) have each spiralled (Graham & Sweller, in press), to the point where one third of special schools in the state of New South Wales are now reserved specifically for students classified as "ED/BD" (NSW DET, 2009). Nonetheless, in targeting "at risk" students for support, current educational responses can both stigmatise certain groups and hasten their alienation with the school system (Norwich, 2007). Moreover, whilst international research has long pointed to disproportionate representation of African American students and boys in 'non-normative' categories of special education (Hosp & Reschly, 2001; Oswald, Best, Coutinho & Nagle, 2003; Wehmeyer & Schwartz, 2001), little is known about the profile of Australian students being diagnosed.

Method

Our study draws on annual government school enrolment data published by the New South Wales Department of Education and Training (NSW DET). First, the number of students enrolled in special schools with diagnoses of emotional disturbance (ED) or behavioural disorder (BD) was calculated, broken down by age and gender. Next, a series of curve estimation analyses were used to estimate linear and quadratic trends in the percentage of students enrolled in a special school with either ED or BD diagnoses at each age.

Results

For special school enrolments due to diagnoses of emotional disability (ED), significant linear and quadratic trends in age were observed. This was the case for both boys and girls, and in both 1997 and 2007. Interestingly, however, whilst trends did not differ by the year of inquiry, the nature of these trends was different for girls than for boys. For boys, the combined linear trends, $F(1, 11)s > 4.94$, $ps F(2, 10)s > 9.50$, $ps F(1, 11)s > 28.63$, $ps F(2, 10)s > 13.11$, ps rate of the rise in enrolments across age. There was no clear peak or fall in enrolments, but instead a pattern of very low enrolments to age 12, followed by an acceleration of enrolments between the ages of 12 and 17 (see Figure 1).

For special school enrolments due to diagnoses of behavioural disorder (BD) age trends are less clear; changing with both gender and year of inquiry. For boys, there is a significant linear trend in 1997, $F(1, 11) = 6.39$, $p > .05$, indicating a consistent rise in enrolments across age. In 2007, however, the trend is quadratic, $F(2, 10) = 4.07$, p number of special school enrolments for BD are much larger in 2007 than in 1997.

For girls there is a significant linear trend in 1997, $F(1, 11) = 5.47$, $p F(1, 11) = 14.01$, $p F(2, 10) = 6.60$, p

Discussion

Consistent with international trends showing over-representation of particular groups of students in special education, the ED and BD enrolment data show that boys are entering segregated schooling earlier than girls and at a greater rate. Moreover, the gender discrepancy in BD diagnoses increases between 1997 and 2007. Although a gender discrepancy in might be expected in some categories of disability, where genetic and other indices do suggest genuine gender differences, these differences cannot fully explain the rate of over-representation shown for ED and BD, the findings of over-representation in special education based on race and geographical location, or the changing profiles of ED and BD diagnosis over the decade from 1997 to 2007. Moreover, we note that boys are even more highly over-represented than the international literature suggests (e.g. see Oswald et al., 2003). Thus, we suggest that such variation reflects differences in processes of identification, categorisation and enrolment, and not in the incidence of disability (OECD, 1999).

These findings have considerable implications, with claims that segregated settings are becoming "holding areas for students that regular schools are either unable to or unprepared to work with" (Dempsey, 2007, p. 76; also see Graham & Spandagou, in press), or, worse, that students are in many cases graduating to juvenile justice centres

(Bouhours, 2006; de Plevitz, 2006; also see Graham, Sweller & Van Bergen, in press). We suggest that this is a problem increasingly likely to affect boys.

PAPER PRESENTATION

Teacher Resilience: Conceptualisations, research and practice

Susan Beltman, Curtin University, Australia; Marold Wosnitza, RWTHUniversity Aachen, Germany; Caroline Mansfield, Murdoch University, Australia

One challenge for the future of education in a global/networked society is the quality and resilience of teachers in changing times. Specifically, there is concern in many countries about the high attrition rates of early career teachers. This paper presents a systematic review of literature related to teacher resilience. The review underpins a larger research project aiming to enhance the resilience of early career teachers by embedding evidence-based practice within pre-service teacher education programs. A shift in thinking from attrition to resilience offers the potential for more positive, effective interventions to occur. Definitions of resilience include the ability to "bounce back" after experiencing difficult events, and it is often conceptualised as an outcome of the interaction of risk and protective factors. A search of databases such as ERIC and ProQuest revealed over 250 articles linked to key words such as 'resilience' and 'burn out' published from 2000 onwards. The selected papers are analysed according to their research methods, key empirical findings, and suggestions for practice. The paper will provide an overview of how resilience has been conceptualised, strengths and limitations of current research and suggest directions for future research. The findings have significance for those interested in the construct of resilience, teacher retention and attrition, and pre-service teacher education programs.

Aims

One challenge for the future of education in a global/networked society is the quality and resilience of teachers in changing times. Specifically, there is concern in many countries about the high attrition rates of early career teachers. While many studies have examined why teachers leave the profession, some recent research has, more positively, focused on what sustains teachers and explores teacher resilience. Resilience is often conceptualised as an outcome of the interaction of personal and contextual risk and protective factors. Definitions highlight the ability to "bounce back", and to thrive, rather than just survive, in the face of challenges. This paper reviews recent empirical studies, discussing how teacher resilience has been conceptualised and investigated, key risk and protective factors for teachers, and recommendations for enhancing teacher resilience. It underpins a larger research project aiming to enhance resilience of early career teachers by embedding evidence-based practice within pre-service teacher education programs.

Methodology

The review was conducted in three phases. Phase 1 involved an extensive search of education, social science, psychology and health science data bases, publisher data bases, key journals and web sites for empirical papers in the area of teacher retention and resilience. Searches used key words such as 'resilience' and 'burn out', were limited to material published from the year 2000 and resulted in 260 items. Phase 2 involved closer scrutiny of phase 1 results to determine the empirical studies published in peer-reviewed journals specifically concerning both teacher resilience (n=45) and beginning teacher retention (n=36). In Phase 3 a thorough review of the remaining 50 papers was conducted summarising the aim of each paper, how resilience was conceptualised, the participants, the methodology, key findings and implications. Tables were then constructed to provide an overview of these key factors across all papers.

Findings

The paper will present key findings of the literature in relation to conceptualisations of resilience, the research methods used, risk and protective factors for teacher resilience, and the implications for various groups. Conceptualisations of resilience in the papers revealed some common ideas. For example, resilience is a dynamic process or outcome that is the result of interaction over time between a person and the environment. Of the selected papers, 13 had "resilience" or "resiliency" in their titles. Twenty-three papers explicitly discussed resilience, although not all defined it. The other 27 papers focused on resilience related constructs such as teacher self-efficacy, burn out, coping strategies and social supports. With regard to research methods, most studies were conducted in the USA (n=17) and with early career teachers (n=21). Sample size varied from 1 to 3235 participants. Methodological approaches used were classified as qualitative (n=29), quantitative (n=12) or mixed methods (n=9). The largest proportion (n=23) of studies used qualitative methods with fewer than 30 participants. A variety of data sources was used with interviews the most common (n=34). The papers were also analysed to identify the key factors for teacher resilience. Twenty-five separate personal and contextual challenges were identified with the most common challenge being classroom management and disruptive students (n=11). Challenges impacted on teachers' stress, self-efficacy,

motivation and future career intentions. There was a sense of frustration that the same challenges have been known for years. Not all challenges were seen as problematic, with some teachers found to be ready for, and actively seeking, new challenges. Thirty papers reported particular personal characteristics assisting teachers to thrive. These included personal attributes (such as persistence and a sense of humour), self-efficacy, coping skills, interpersonal and teaching skills, professional growth, self-care and qualifications. These characteristics were often inferred from interviews and observations, rather than measured. A number of papers highlighted the importance of altruistic motives and noted that teachers were not primarily motivated by extrinsic rewards. Forty papers referred to contextual supports. These were: school/administrative support, mentor support, the school students, support of peers and colleagues, pre-service program, and support of family and friends. School structures were supportive for new teachers when leadership was strong, open, supportive, and well-organised, resources distributed fairly, and encouraging feedback provided. School students had not been envisaged as a category of support but in challenging schools teachers had a deep respect for the way their students dealt with difficult circumstances and felt a powerful responsibility and commitment to them. The literature reported implications for stakeholders including employers, schools and teacher educators. Developing and retaining resilient teachers required changes or adjustments for pre-service programs, schools and employing authorities.

Theoretical and educational significance of the research

The findings have significance for those interested in the construct of resilience. Despite being framed in the language of different theoretical perspectives, the findings of the studies supported the notion of resilience as a dynamic, complex, idiosyncratic and cyclical construct. The findings are also significant for schools and employing bodies. Papers included suggestions for creating supportive structures, induction programs, school principals, and casual teachers. A few authors raised the issue of financial bonuses for teachers who perform well. Some suggested that as teachers' motivations are primarily altruistic, "financial perks", an extrinsic motivator, seem unlikely to dramatically impact on recruitment. Others argued that not all beginning teachers were planning a lifelong career in the profession, so providing opportunities for challenges with appropriate rewards, might extend their time in the profession. Recommendations for pre-service teacher education programs were made regarding the role of the practicum, staff support, and support from fellow students. In conclusion, the paper contributes to theoretical understandings of the nature of resilience in the context of teaching. Reviewing current empirical research has shed light on the complexity of the personal and contextual challenges and supports faced by teachers, and on the benefits of focussing on developing resilience in the multiple contexts of teachers' preparation and work. Longitudinal studies with larger samples and intervention studies would add to this emerging area of research.

PAPER PRESENTATION

Finding valued relationships: beginning teachers networking to meet their professional needs

Alison Fox, University of Cambridge, United Kingdom; Elaine Wilson, University of Cambridge, United Kingdom

This paper explores the networking activity of three beginning Science teachers during a school – university based Post Graduate Certificate of Education year-long course in the UK. We examine how three beginning teachers establish and sustain effective relationships which support their development as a teacher and ensure that they remain in the profession. An ethnographic-based approach was taken, with the researcher also acting as tutor to the trainees. This approach allowed us to collect longitudinal data about developing relationships. Data collection included network diaries, (web-log) e-journals, interviews, a mapping activity and interviews with school-based teacher mentors. The findings reveal that when beginning teachers are proactive networkers they are more likely to solve emerging problems and feel more in control within the school context. Furthermore how and with whom the new teachers networked revealed that informal social networks are significant.

Aims

This study builds on earlier published work inquiring into the role of others to teacher development in school – university partnership teacher education. While it has been shown that beginning teachers draw on a range of people to support them in their development, in more or less proactive ways, the processes of relationship development are not well understood. This work address the question 'how do beginning teachers find and develop effective relationships?'.

Theoretical underpinnings

The study adopts a network theory approach which is underpinned by the idea that personal or ego-centric networks can reveal significant social connections (Wasserman and Faust, 1994; Nardi et al, 2000). Social network analysis methods are used to frame from where advice is sought, what information is gained, how informal support is used and where collaboration enacted. These methods are usually applied to known and bounded networks but we have

applied them in an exploratory way to beginning teachers' evolving networks. We were already aware that valued relationships were likely to be found beyond the formal in-school mentor and in-Faculty tutor links (Fox and Wilson, 2009). This ego-centric network theory approach was useful to explore inductively the processes of networking used to meet beginning teachers' perceived professional needs.

Methodology

An ethnographic approach was taken to be able to follow and explore with beginning teachers the development of their relationships over time. The methods used produced large amounts of rich data and involved intense researcher activity, given a dual role of the researcher acting as both tutor and researcher, so a limited sample of beginning Science teachers were asked to volunteer to be involved in the research study. Three PGCE trainees (two male - one female; two career changers – one recent graduate) were selected to be followed through their one year PGCE course. The course pattern involved beginning teachers working in two contrasting placement schools, with feedback given on observations of their teaching by the tutor in each of the three school terms, and their maintaining a reflective e-journal, shared with the university based tutor. Additionally the beginning teachers agreed to keep a diary of their network activity and to be interviewed three times over the course about their networking activity, generating a visual representation or network map (Fox et al, 2007) at each interview. Mentors were also invited to reflect on the trainees networking on each school visit.

An integration of these data sources (allowed individual relationships to be tracked for each beginning teacher, to reveal factors (affordances or barriers) that contributed to the development of the most valued relationships. Value was considered in the light of the trainee's perceived needs.

Findings

Although all three beginning teachers were able to identify and talk about their professional needs, they showed different levels of proactivity in working with others to meet these needs. To some extent their proactivity was dependent on the school cultures they found themselves in and to some extent related to their own sense of identity as a developing teacher. Frank developed a rich, cross-school network in his second placement, the result of such networking activity leading him to talk about a sense of belonging, which helped him decide to commit to teaching. For Frank relationships with staff through social football activity was particularly crucial in allowing him to develop not only as a Science teacher but resulting in him also contributing to teaching in the PE department. Claire, who came into teaching with a particular view of how she wanted to support learning in her classrooms, found that her view was not shared in the school cultures of either school she was placed in during her training. Individuals were flexible to support her in developing her practice in her first school but she needed to seek out like-minded individuals quite effortfully in her second school and was, at one point, very close to deciding to leave the course. Based on reflection on her experiences Claire chose her first teaching post carefully, having developed a clear idea of what she wanted a workplace to provide. Nigel was much less proactive about relationship building beyond the use of formal links and he was not always able to match the expectations of him in developing his practice. We reflect on the factors that affected his more limited use of networking. These findings are set within the backdrop of a wider data set, which also indicates the interplay of school culture and individual agency.

Significance

It appears that beginning teachers can take considerable responsibility for meeting their needs through relationship building and that this is in fact important in terms of their socialisation into the teaching profession. In making connections with others who are 'like-minded' beginning teachers are likely to gain both professional and personal support. The challenges are that this requires effort in school cultures in which trainees are not yet embedded and in what might seem quite serendipitous ways. Whether to share a lift, strike up a conversation after professional studies sessions or decide where to spend break times appear significant decisions to the likelihood of developing effective relationships. There is arguably perhaps a role for schools and teacher educators to make these choices explicit, to discuss networking as an explicit tool for professional development and to facilitate opportunities for teachers to meet in conducive social ways to support such networking. Whilst clues have been given through accounts from Frank, Claire and Nigel as to how to find 'like minded' individuals and develop valued relationships, more research is needed to understand the processes of support being given in these relationships.

References

- Fox, A., McCormick, R., Procter, R. & Carmichael, P. (2007) The design and use of a mapping tool as a baseline means of identifying an organisation's active networks, *International Journal of Research & Method in Education*, 30(2), 127-147.
- Fox, A. & Wilson, E. (2009) "Support our networking and help us belong!": listening to beginning secondary school science teachers, *Teachers and teaching: theory and practice*, 15(6), 701-718.

Nardi, B. A., Whittaker, S. & Schwarz, H. (2000) It's not what you know, it's who you know: work in the information age, *First Monday*, 5(5).

Wasserman, S. & Faust, K. (1994) *Social network analysis: methods and analysis* (Cambridge, Cambridge University Press).

PAPER PRESENTATION

Can teacher educators learn from pupils: first exploration of pupils views on good teachers

Anouke Bakx, Fontys PABO Eindhoven, lectoraat L&I., Netherlands

This article reports on a first exploration of pupils' views on qualities of primary school teachers. A questionnaire (N = 2,516) was used to measure pupils' perceived teacher qualities. Results show that eleven different categories with teacher qualities can be distinguished. The three most important categories mentioned by Dutch pupils are (1) teachers' personality-related qualities; (2) didactic skills and guidance; and (3) authority. Involvement of pupils in the description of teacher quality might lead to an enriched view on teacher quality. It might lead to a perspective on teacher quality in which personality-related qualities play a larger role, compared to the present Dutch view on teacher quality.

Introduction

In 2005, the Dutch Ministry of Education decided that schools should introduce integral personnel management to stimulate teachers' development and create opportunities for career development in education. Indeed, a new reward-system offers possibilities for differentiation within the teaching profession. However, it should be clear what is defined as 'a good teacher' (teacher quality) and how 'very good teachers' can be distinguished from 'average good teachers'. In this study the concept of teacher quality concerning primary education has been explored.

Teacher quality

Defining 'very good teachers' seems to be complex. There is no general consensus upon this concept (e.g. Berliner, 2001; Waldrup, & Fisher, 2003; Palmer, Stough, Burdinski, & Gonzales, 2005). Effectiveness studies on teacher quality show that didactic and pedagogic quality combined with communicative competence are essential in order to gain good results with pupils (eg. Hattie, 2009; Marzano, 2003; Ryan & Deci, 2000; Scheerens, 2007). The same aspects for teacher quality emerge from descriptive studies on teacher quality, together with 'teachers' knowledge'. This concerns an integrated expertise of specific content knowledge, didactical and pedagogical knowledge and skills (Beijaard, Verloop, & Vermunt, 2000; Darling-Hammond, 1999; Stronge, 2007). Other studies show that teachers' personality characteristics might be important in relation to teachers quality (Cornelius-White, 2007; Hattie, 2009; Timmering, 2009), but there is no consensus on the role of personality in teachers' quality (Borich, 1988).

In 2006 the Dutch government adopted a law concerning the 'basic quality of teachers'. Seven teacher competencies have been described, which are used within the entire educational field within the Netherlands (www.lerarenweb.nl): (1) interpersonal competence; (2) pedagogic competence; (3) subject knowledge and methodological competence; (4) organisational competence; (5) competence for collaboration with colleagues; (6) competence for collaboration with the working environment; and (7) competence for reflection and development (www.bekwaamheidsdossier.nl/cms/bijlagen/SBLcompetence_primary.pdf). These seven teacher competences concern a 'basic level' or a starting point for junior teachers. This competence-view on teacher quality does not entirely comprehend all qualities as reported in international research. Amongst others, subject knowledge and personality-related qualities form no specific part of the Dutch view on teacher quality. Next to this, the seven competencies do not specify what a 'very good teacher' is. In the Netherlands, policy makers are responsible for the formal definition of teacher quality, as used in teacher education. Dutch teachers have been involved in this definition process. However, primary school pupils have not been involved in these kinds of exercises. They are never asked 'what is a very good teacher?'. Pupils spend much time with their teachers within the classroom and might be seen as important 'stakeholders'. Our research question is: What are good teachers according to primary school pupils? The aim of this study was to broaden the perspective on teacher quality, involving pupils.

Method

A questionnaire for pupils was constructed, containing one question: 'What is a good teacher?' (see also Figure 1). To help the pupils, three questions were given: (1) What does a good teacher? (2) What is a good teacher like? (3) What should a good teacher be able to do?

Respondents

In total 2,515 pupils from 31 primary schools in the Netherlands have participated in this study. They anonymously completed the questionnaire as part of a lesson activity. The pupils' age varies from nine to twelve years old.

Data-analysis

All together 18,750 'qualities' of good teachers have been mentioned by the pupils. Two researchers - independently of each other - have placed all the qualities into data-sheets. All together, 131 different qualities have been reported, which have been combined into categories. These categories with qualities have been compared and discussed by the two researchers. Final categories have been constructed based on consensus of the two researchers.

Results

Eleven different categories of qualities of good teachers can be distinguished. According to pupils the most important quality of teachers concern personality-related qualities like humour, being nice and being kind. Next to this, didactic skills and guidance are mentioned. Pupils state that good teachers perform well concerning explaining, motivating, teaching in general, structuring the educational activities and offer differentiation. Third, authority is reported by the students: this refers to a certain degree of strictness, honest punishments and remaining silence in the classroom.

Conclusion

There is no consensus on the definition of teacher quality for primary school teachers. The concept of teacher quality varies within the different countries of the European Union (Snoek et al., 2009), probably due to the specific cultures. In the Netherlands, teacher quality is specified by seven competencies. Pupils state that personality-related qualities are the most important for good teachers. Humour, being kind and nice are important, next to the didactic skills and guidance. These last two qualities also appear as important qualities from effectiveness studies on teacher quality. Third, authority was mentioned by the students. This aspect, as well as subject knowledge is no part of the seven Dutch competencies for teachers. Pupils' view on teacher quality might enrich our perspective on quality of primary teachers.

References

- Berliner, D. (2001). Learning about and learning from expert teachers. *International Journal of Educational research*, 35, 463-482.
- Beijaard, D., Verloop, N., Vermunt, J.D. (2000). Teachers' perceptions of professional identity: an exploratory study from a personal knowledge perspective. *Teaching and Teacher Education*, 16(7), 749-764.
- Borich, G.D. (1988). *Effective teaching methods*. Columbus, Ohio: Merrill.
- Cornelius-White, J. (2007). Learner-Centered Teacher-Student Relationships Are Effective: A Meta-Analysis. *Review of Educational Research*, 77(1), 113-143.
- Darling-Hammond, L. (1999). *Teacher Quality and Student Achievement: A Review of State Policy Evidence*. Seattle: University of Washington, Center for Teaching and Policy.
- Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Londen: Taylor & Francis.
- Landelijk Platform Beroepen in het Onderwijs (2008). *Erkenning van excellentie: Naar niveaudoifferentiatie voor leraren*. [Admitting of excellence: towards the differentiation of levels for teachers.] Utrecht: LPBO.
- Marzano, R.J. (2003). *What works in schools. Translating research into action*. Alexandria (VA): Association for Supervision and Curriculum Development.

PAPER PRESENTATION

Satisfaction with the academic studies in first-year students: Only a matter of academic performance?

Julia Karbach, Saarland University, Germany; Kathrin Kaub, Saarland University, Germany; Corinna Reichl, Saarland University, Germany; Nicolas Becker, Saarland University, Germany; Hans-Werner Bedersdorfer, Saarland University, Germany; Roland Bruenken, Saarland University, Germany; Frank Spinath, Saarland University, Germany

Over the last years, a number of studies have investigated the level of academic study satisfaction (ASS) in university students. Most authors agree that ASS is a variable of particularly high relevance because it is associated with the physical and mental well-being of students as well as with premature university dropout. Recent studies have suggested that ASS is a multidimensional construct including the satisfaction with (1) the contents of the academic program (ASS-content), (2) its terms and conditions (ASS-conditions), and (3) the process of coping with academic stress (ASS-coping). While the role of university-related variables (e.g. the quality of courses) and motivational student-related variables (e.g., vocational and academic interests) for the prediction of ASS is already well documented, less is known about the potential role of more general student-related variables (i.e., academic performance, social behavior, overall life-satisfaction, personal significance of the studies). Data from a sample of 381 first-year students indicated that academic performance was a strong predictor for all three aspects of ASS. ASS-content was also predicted by social integration, overall life-satisfaction, and the personal significance of the studies.

In addition, overall life-satisfaction predicted ASS-conditions and social behavior was most relevant for ASS-coping. Thus, our findings suggest that general student-related variables are important components for the prediction of ASS. While the influence of academic performance seems to be relatively general, the predictive value of the variables social behavior, overall life-satisfaction and personal significance of the studies is more specific and varies for the three dimension of ASS.

Aims

In students of all ages, the satisfaction with their academic studies is associated with their physical and mental well-being. In university students, this academic study satisfaction (ASS) is generally considered as an indicator for the quality of universities and therefore plays an important role in the process of recruiting prospective students. Moreover, it is one of the key variables with respect to premature university dropout. Conceptually, the construct ASS is based on the person-environment fit theory (French, Caplan, & Harrison, 1982), which assumes that the degree of satisfaction depends on the fit between a person's needs and abilities and the potential and demands of the environment, respectively. Earlier publications suggested that ASS is a multidimensional construct, including the three sub-dimensions satisfaction with (1) the contents of the academic program (ASS-content), (2) its terms and conditions (ASS-conditions), and (3) the process of coping with academic stress (ASS-coping) (Spieß et al., 1996; Westermann et al., 1996). With respect to predictors of ASS, a number of studies point to the importance of university-related variables, such as the quality of courses and facilities as well as motivational student-related variables, such as academic motivation and vocational interests (e.g., Hiemisch, Westermann, & Michael, 2005; Schiefele & Jacob-Ebbinghaus, 2006). The predictive value of these variables was different for the three components of ASS and could be increased for all of them when both university-related and motivational student-related variables were considered in the same model (resulting in up to 53% of explained total variance). However, so far there is not much evidence for the role of more general student-related variables, such as academic performance or overall life satisfaction, that have been emphasized in a theoretical framework proposed by Apenburg (1980). Although he did not assess any sub-dimensions of ASS, he assumed that the level of general ASS is best predicted by (1) the students' academic development (i.e., their academic performance), (2) their social behavior and integration (i.e., interaction with their environment), (3) overall life-satisfaction (assumed to be relatively stable over time), and (4) the personal significance attributed to their studies (assumed to be highly variable between students). Apenburg claimed that the area of academic development is the strongest predictor for ASS, whereas the predictive value of social behavior and integration may be more variable. Thus, the aim of the present study was twofold: First, we tested the predictive value of the Apenburg model for the three dimensions of ASS (ASS-content, ASS-conditions, ASS-coping). Second, we investigated whether the four components in the model (academic development, social behavior and integration, overall life satisfaction, significance of the studies) are of differential predictive value for the three dimensions of ASS.

Methodology

A total of 381 first-year students from Saarland University pursuing a teaching certification ($n=289$) or enrolled in the Bachelor of Science for psychology ($n=92$) were included into the study. Participants completed the study-satisfaction questionnaire (Spieß et al., 1996; Westermann et al., 1996) and a test battery including measures for each one of the four components proposed by Apenburg (1980): (1) Academic performance (academic self-concept, self-efficacy, German high school GPA), (2) social behavior and integration (perceived social support, mental stability/anxiety), (3) life satisfaction (self-regulation, general life satisfaction, hours/week of part-time employment), and (4) the personal significance attributed to their studies. We tested the three-dimensional structure of ASS and the predictive value of the general student-related variables on these dimensions by means of confirmatory factor analyses using structural equation modeling.

Findings

Our data showed that the three dimensions of ASS are correlated ($r=.31-.43$) but clearly separable constructs. Significant predictors for ASS-content were the academic self-concept, overall life satisfaction, the personal significance of the studies, German high school GPA, and the amount of part-time employment (43% of explained total variance). ASS-conditions was best predicted by a model including the academic self-concept, German high school GPA, and the amount of part-time employment (11% of explained total variance). Finally, the academic self-concept, anxiety, and German high school GPA were reliable predictors for the ASS-coping (42% of explained total variance). Theoretical and educational significance of the research. The findings of our study support the view that study satisfaction is indeed a multidimensional construct. Though these dimensions are related, the predictive value of general student-related variables for each one of them was different. Consistent with Apenburg (1980), academic performance (academic self-concept, German high school GPA) served as general predictor that was relevant of all three dimensions of study satisfaction. In contrast, we also identified variables with specific predictive value: Overall life satisfaction was only related to ASS-content, while anxiety only was a significant predictor for ASS-coping. Part-time employment had a negative impact both on ASS-content and ASS-conditions. In sum, the general student-related

variables investigated in this study proved to be reliable predictors for all three aspects of ASS. The general role of academic development on the one hand and the specific role of social integration on the other hand are consistent with the Apenburg framework (1980). As a next step, it seems worth investigating whether combining general student-related variables with the previously investigated university-related and motivational student-related variables will add incremental validity to the prediction of ASS, and whether the predictive value of these variables changes over the course of one's studies.

References

- Apenburg, E. (1980). *Untersuchungen zur Studienzufriedenheit in der heutigen Massenuniversität*. Frankfurt am Main: P. D. Lang.
- French, J.R.P., Caplan, R.D., Van Harrison, R (1982). *The mechanisms of job stress and strain*. New York: Wiley.
- Hiemisch, A, Westerman, R., & Michale, A. (2005). Association of medicine students' satisfaction with study goals and their feasibility. *Zeitschrift für Psychologie*, 213, 97-108.
- Schiefele, U. & Jacob-Ebbinghaus, L. (2006). Student characteristics and perceived teaching quality as conditions of study satisfaction. *Zeitschrift für Pädagogische Psychologie*, 20, 199-212.
- Spies, K., Westermann, R., Heise, E. & Schiffler, A. (1996). Discrepancies between needs and supplies as determinants of student satisfaction. *Empirische Pädagogik*, 10, 377-409.
- Westermann, R., Heise, E., Spies, K. & Trautwein, U. (1996). Identification and measurement of components of study satisfaction. *Psychologie in Erziehung und Unterricht*, 43, 1-22.

PAPER PRESENTATION

Effects of citizenship education on citizenship of students: A review study

Ellen Geboers, University of Amsterdam, Netherlands; Femke Geijssel, University of Amsterdam, Netherlands; Wilfried Admiraal, University of Amsterdam, Netherlands; Geert ten Dam, University of Amsterdam, Netherlands

Abstract

For this paper proposal a literature review was carried out on the effects of citizenship education in secondary schools on students' citizenship. Although in many Western countries schools are obligated to provide citizenship education, the effectiveness of different forms of citizenship education is still unclear. This paper focuses on 28 articles in which effects of citizenship education are described. After the assessment of the studies' research designs, effects of different types of citizenship education are analyzed and critically assessed in relation to the citizenship practices of young people. The effects are analyzed in terms of social tasks that students need to fulfill in their daily lives and types of competences. Citizenship education in the classroom appears to teach knowledge, skills, attitudes, reflection and behavior, primarily on democratic principles. The conclusions about the effects of citizenship education are discussed as well as the quality of the studies which have been analyzed.

Introduction

Active participation in modern society requires citizenship knowledge, skills, attitudes and reflection on social issues. Citizenship is learned during life course through participation in different social practices. School is not only one of those practices that are part of young people's everyday life. It is an institution that by means of citizenship education explicitly aims at facilitating and optimizing the learning processes of citizenship. Ideally, the school is a place for young people to accumulate democratic experiences and reflect upon these experiences. In almost all European countries as well as in Canada, Australia, and the US citizenship education is introduced in the curriculum. Imperative in introduction is the assumption that schools can play a role in citizenship development. However, the question remains whether this assumption is tenable because no research has systematically reviewed the literature on this topic. A democratic, pluriform society predominantly requires that citizens be prepared to make their own critical contributions. In a political interpretation of citizenship, youngsters are primarily seen as future citizens and are prepared, for example by enhancing civic knowledge for political voting. However, associating citizenship with the civil society, involves young people's everyday lives in which they interact with others (family, work, and school) (Biesta, 2007). Citizenship education, in both the political and the social domain, should be aimed at stimulation of the critical capacities of young people to enhance the quality of their participation (Ten Dam & Volman, 2004; Lawy & Biesta, 2006). The currently proposed paper focuses on the effects of citizenship education including the political and the social domain of the contemporary discourse of citizenship. We examine whether this broad conceptualization of citizenship education is reflected in and supported by the results of empirical studies.

Methodology

The international articles in this paper cover the period of 2003-2009. We performed a systematic search procedure including four steps. In the first step, data bases of the digital library of the University of Amsterdam were examined

using the following keywords: 'citizenship or civi*' and 'education', and 'competence', and 'knowledge', and 'skills', and 'attitudes', and 'reflection', with * used as a joker. This step was repeated three times, as a rerun of each search led to slightly different results. The following data bases were examined: Eric (Educational Resources Information Center); PsycINFO; Catalogue of the University of Amsterdam; PICARTA; Web of Science; Academic search premier and Scopus (abstract and citation database of peer-reviewed literature). In the second step we added the database ScienceDirect and examined the new combination of databases with the following keywords: 'citizenship or civi* education' and 'competenc*', and 'knowledge', and 'skills', and 'attitudes', and 'reflection', and 'democra*', and 'youth development', with * used as a joker. In August 2009, a third step included a rerun of the earlier searches to update our output. In this third step Scopus was excluded as this database was no longer available. The fourth step included a check of the reference lists. We performed a selection procedure in two stages. In stage 1, we evaluated the abstracts with the following criteria to include an article: Manuscripts published between 2003 and 2009; Journal articles that were available online; Journal articles which were based on empirical research; Journal articles which have been published in peer reviewed journals; Studies with participants referring to students in the age of thirteen to sixteen years, i.e. the first stage of secondary education, and Studies with a focus on citizenship or citizenship education. In stage 2, the full-texts of the articles were checked for these criteria. Moreover, articles without a problem definition or research question were removed. A total of 28 studies concerning effects of citizenship of students and the role of secondary education were included. Two aspects of these 28 articles were categorized: citizenship education and students' citizenship. The type of citizenship education is categorized in: curriculum in school, curriculum out of school, pedagogical climate and extracurricular activities. The reliability of this classification equals Cohen's κ ; 0.94 (two coders). To classify students' citizenship, we applied the conceptual framework of citizenship of youngsters of Ten Dam, Geijssels, Reumertman, and Ledoux (2010). In this framework, citizenship of youngsters is specified into citizenship competences and citizenship behavior regarding the social tasks that youngsters need to fulfill. With social tasks, we used the following categories to study the effects on the student level: acting democratically (political), acting democratically (social), acting in a social responsible manner, dealing with conflicts and dealing with differences (with a Cohen's κ ; (two coders) of 0.90). With competences and behavior the following categories were used: knowledge, attitudes, skills, reflection, and behavior (with a Cohen's κ ; of 0.90). Finally, we categorized the research design of each study in terms of a cross sectional design, longitudinal design, quasi-experimental design with control group, quasi-experimental design without control group, review study design, and a qualitative exploratory design (with a Cohen's κ ; of 1).

Results and conclusions

In the final paper the descriptive statistics and cross tables will be presented and moreover, if possible, effect sizes were calculated to gain an insight of the magnitude of the effects reported in the reviewed literature applying Cohen's f and d . In empirical studies on citizenship, the political domain of citizenship, and not so much the social domain, appears to be emphasized. So, citizenship education today seems primarily aimed at learning to act democratically and to a much lesser extent at learning to act in a socially responsible way and dealing with differences. Moreover, students' attitudes towards citizenship are mostly studied as an effect of citizenship education. Citizenship education in the classroom appears to teach knowledge, skills, attitudes, reflection and behavior on democratic principles. In the literature there is hardly any attention paid to the ability of young people to deal with conflicts. With regard to the teaching strategies, organizing an open and democratic classroom climate in which discussion and dialogue takes place appears to be effective in the development of citizenship of young people in secondary education. Furthermore, the literature review shows important shortcomings in the methods used to examine youths' citizenship development in an empirical way. With these conclusions, the review study will challenge educational scientists to increase the empirical base of citizenship education and to allow more informed decision-making regarding citizenship education in policy and practice.

PAPER PRESENTATION

How accurate and stable are parents' and teachers' judgments of children's test anxiety?

Constance Karing, Universitat Bamberg, Germany; Tobias Dorfner, Bamberg University, Human Sciences, Germany; Cordula Artelt, Bamberg University, Germany

Although test anxiety is one of the most common types of anxiety in children and has got a negative impact on school performance, only few studies have investigated parents' and teachers' judgment accuracy of children's test anxiety. However, the few existing cross-sectional studies found a rather low accuracy of teachers' or parents' judgments of children's test anxiety. To our knowledge, so far no study has examined the stability of teachers' and parents' judgment accuracy in the domain of test anxiety. Against this background, the present study investigates mothers' and teachers' judgment accuracies of children's level of worry and emotionality in the school subjects of German and mathematics and the stability of the accuracy of these judgments over a period of one year. Data were obtained from a sample of 74 German language and 73 mathematics teachers, 830 mothers and their 5th and 6th grade children in

the context of the BIKS study. For the whole group our analyses revealed that, on average, mothers tend to underestimate children's worry and overestimate children's emotionality in both subjects and at both measurement points, whereas German language and mathematics teachers tended to overestimate children's emotionality as well as worry at both measurement points. However, when looking at the children with high test anxiety, we found both mothers and teachers consistently underestimate children's worry and emotionality in both school subjects. Furthermore, our results showed stability coefficients of low to medium size over a period of one year for mothers as well as for teachers.

Theoretical framework.

Test anxiety is one of the most common types of anxiety in children between the ages of 9 and 12 and it often persists into adolescence (e.g. Suhr-Dachs & Döpfner, 2005). Moreover, several studies have demonstrated that academic achievement is negatively influenced by test anxiety (e.g. Seipp & Schwarzer, 1991). But according to Liebert and Morris (1967), test anxiety is not a homogenous trait. It can be distinguished into two components: worry and emotionality. Previous studies found that worry was stronger negatively related to school achievement than emotionality (e.g. Schwarzer, Seipp & Schwarzer, 1989). Thus, it seems advisable to assess both components of test anxiety. Furthermore, given that students develop subject-specific competences, control- and threat expectations during the course of school years, they can also develop subject-specific test anxiety. Thus, it seems beneficial to assess students' test anxiety referring to unique school subjects. Given the high prevalence rate of test anxiety among children and the negative impact of test anxiety on school performance, it is worthwhile to investigate the accuracy of parents' and teachers' judgments of children's level of test anxiety. The few existing studies found a low accuracy of teachers' and parents' judgments of children's test anxiety (e.g. Lukesch-Toman & Helmke, 1979; Spinath, 2005). However, these studies neither examined test anxiety in specific school subjects nor did they differentiate between the two components of test anxiety. Furthermore, they investigated judgment accuracy only at one measurement point. Although stability coefficients of medium size over a period of six months were found for elementary school teachers' judgment accuracy of students' school achievement (Lorenz & Artelt, 2010), no study has examined the stability of teachers' and parents' judgment accuracy in the domain of test anxiety.

Aims.

The present study addresses the following research questions: a) How accurately do teachers and mothers judge children's level of worry and emotionality in the school subjects of German and mathematics?, b.) How valid are their judgments for children with high test anxiety?, c.) How stable are teachers' and mothers' judgment accuracies over a period of one year?

Methods.

In our analysis, we used data from 74 German language and 73 mathematics teachers, 830 mothers and their children at grade 5 (t1) and grade 6 (t2). The students attended 40 secondary schools (lower, middle and higher track) in Germany. Children's emotionality and worry in the school subjects of German and mathematics were measured at t1 and t2 by means of two short scales for each school subject, each consisting of 3 items. Students were rated at t1 and t2 by their teachers and mothers by using the same items. Students whose emotionality and worry scores were at least one standard deviation above the mean were labeled as high test anxiety group. Difference scores between children's ratings and teachers' or mothers' judgments were computed to determine whether teachers and mothers are accurate in judging the level of children's worry and emotionality in German and mathematics. To examine the stabilities, we calculated correlations between the difference score at t1 and the difference score at t2 for both components of test anxiety.

Results and Discussion.

Our analyses for the whole group revealed that, on average, German language and mathematics teachers tend to overestimate children's emotionality as well as worry at both measurement points. This is consistent with previous research on elementary school teachers' judgment accuracy of general test anxiety (e.g. Spinath, 2005). Furthermore, mothers tend to overestimate children's emotionality, but they tend to underestimate children's worry in both subjects and at both measurement points. These inaccurate judgments may not only represent a diagnostic problem, they can also be regarded as an indicator of disturbed family communication or a lack of mothers' interest in their children. However, when looking at the children with high test anxiety, we found both mothers and teachers consistently underestimate children's worry and emotionality in both school subjects. An underestimation of children's worry cognitions and emotionality however, can lead to a delayed help. Furthermore, for both groups, our results showed stability coefficients of low to medium size over a period of one year for teachers as well as for mothers. The implications of these findings for research and practice are discussed.

Scientific significance. Up to now, there is no study known to us that examined teachers' and parents' judgment accuracy of subject-specific test anxiety simultaneously and thereby distinguished between worry and emotionality. Furthermore, no study has addressed the stability of teachers' and parents' judgment accuracy in the domain of test anxiety. Moreover, it seems to be useful to assess both components of test anxiety in different subjects, given that our results indicate that possible interventions aiming at fostering judgment accuracy might need to vary depending on school subjects, anxiety components as well as judges.

References.

- Lorenz, C. & Artelt, C. (2009). Fachspezifität und Stabilität diagnostischer Kompetenz von Grundschullehrkräften in den Fächern Deutsch und Mathematik. *Zeitschrift für Pädagogische Psychologie*, 23, 211-222.
- Liebert, R. M. & Morris, L. W. (1967). Cognitive and emotional components of test anxiety. *Psychological Reports*, 20, 975-978.
- Lukesch-Toman, M. & Helmke, (1979). Gesamtschule und dreigliedriges Schulsystem in Nordrhein-Westfalen – Einschätzungen und Sichtweisen der Eltern. Paderborn: Ferdinand Schöningh.
- Schwarzer, R., Seipp, B. & Schwarzer, C. (1989). Mathematics performance and anxiety: a meta-analysis. In: Schwarzer, R., Ploeg, H. M. van der, & Spielberger, C. D. (Eds.). *Advances in test anxiety research* (Vol. 6). Lisse, The Netherlands: Swets & Zeitlinger.
- Seipp, B. & Schwarzer, C. (1991). Angst und Leistung – Eine Meta-Analyse empirischer Befunde. *Zeitschrift für Pädagogische Psychologie*, 5 (2), 85[®]–97.
- Spinath, B. (2005). Akkuratheit der Einschätzung von Schülermerkmalen durch Lehrer und das Konstrukt der diagnostischen Kompetenz. *Zeitschrift für Pädagogische Psychologie*, 19, 85[®]–95.
- Suhr-Dachs, L. & Döpfner, M. (2005). Leistungsängste- Therapieprogramm für Kinder und Jugendliche mit Angst- und Zwangsstörungen (THAZ). Göttingen: Hogrefe.

PAPER PRESENTATION

Developing a learning centered model for designing and managing study programmes

Tobias Jenert, University of St. Gallen, Switzerland

So far, research as well as development concerning teaching and learning in higher education have focused primarily on learning in the context of individual courses. Modern theories of adult learning, however, suggest that a course of study be seen more holistically, stressing students' persistent development within various in- and out-of-class learning experiences. Therefore, not only courses but also study programmes should be designed and managed according to pedagogical principles, with the aim to provide a consistent framework in which educationally purposeful learning activities can take place. The need for pedagogically founded principles for programme design is amplified by the Bologna reform which aims at redesigning study programmes but provides only administrative guidelines. The study presented in this paper addresses this issue by developing a comprehensive model for the design and management of study programmes according to pedagogical principles. The model is labeled learning centered as it starts out from students' perceptions of specific programme features. Conducting case studies in different study programmes, (1) students' perceptions and practices of studying were reconstructed together with (2) the structure of each programme as well as (3) programme designers' educational intentions. The resulting model for programme design and management comprises two dimensions. A leadership dimension, in which educational goals are developed and justified, and an ownership dimension in which students and teachers act according to their perceptions and intentions. The model provides strategies for programme designers and managers to purposefully align both dimensions.

Research on teaching and learning in higher education has first and foremost centered on individuals - i.e. students' and teachers' approaches to learning and teaching - as well as methods (Entwistle, McCune, & Scheja, 2006). As a consequence, concepts on how to improve and innovate education at higher education institutions (HEI) have mainly stayed on the level of individual courses, e.g. trying to implement new teaching and learning methods (Aineley, 2008). Yet, there are both theoretical as well as practical reasons to argue for a broader perspective on student learning and, as a consequence, reach beyond the course-level and focus on entire study programmes: Over the last thirty years or so, learning theories have increasingly been stressing the importance of (a) social-material contexts (McInerney & van Etten, 2002) as well as (b) learners' subjective experiences. This suggests that a course of study should not be regarded as a mere addition of more or less independent courses but rather as a holistic learning experience leading to persistent individual growth of the learners. In this understanding, a study programme comprises the total of a student's educationally purposeful social-material experiences at a HEI, both within and outside the classroom (Hu & Kuh, 2002). A second reason why educational researchers and designers should take a closer look at the design of study programmes lies in the Bologna process: The introduction of the European Credit Transfer System as well as the

low-tiered study structure force HEI to systematically craft their programmes' internal structure. Due to the fact that there are virtually no pedagogical concepts concerning the design of study programmes, these design processes have so far been dominated by administrative considerations, largely neglecting students' experiences and their resulting action strategies within the programme structures (Winter, 2009; Hildbrand et al., 2008). It can be concluded that there is a lack of knowledge on how to design study programmes in a pedagogically purposeful way. The aim of the study underlying this proposal is to develop a comprehensive model for designing and managing study programmes. The model is labeled learning centered as it starts out from understanding learners' perspectives on specific programme design features. Therefore, students' perceptions of different programmes are investigated as well as their educationally relevant action strategies in coping with the programme environment, e.g. selection of learning activities, attribution of resources for learning, and social interactions with peers. Thus, relevant design dimensions are identified providing programme designers with a tool to judge how their design decisions impact on students' perceptions and strategies. Methodologically, the study is grounded in a cultural psychological framework (Bruner, 1990; Shweder, 1991) influencing both, the theoretical model as well as the empirical research. When investigating the causes of human action, cultural psychology considers the characteristics of socio-material contexts, and people's (social) meaning-making within these contexts (Shweder, 1991). For modeling the interrelations between design features and students' actions within study programmes, this means to reconstruct and to link three major aspects: (1) The intentions the programme designers had in mind when crafting an existing study programme (e.g. objectives and expectations). That way, the educational purpose of a study programme is determined. (2) The resulting programme structures including the curriculum (module structure, obligatory and elective elements, workload, dominant teaching, learning, and assessment methods, etc.), extra-curricular features (support of internships, student associations, etc.), and general support (introduction to studying, counseling, etc.). (3) Students' perceptions (perceived programme objectives, feasibility of the programme structures, etc.) and their action strategies concerning the programme features (selection of elective courses, attribution of resources for learning, coping strategies, social behavior towards peers, etc.). Concerning the empirical research, qualitative case studies (Travers, 2001) were conducted to empirically elaborate the programme design model. The cases were sampled according to the method of "maximal structural variation" (Kleining & Witt, 2000), combining different types of university and disciplinary cultures. Thus, relevant aspects of programme design can be identified irrespective of organizational or disciplinary characteristics. Data stems from expert interviews with programme designers, document analysis, and focus groups with students. All data was analyzed with qualitative content analysis (Flick, 2009; Mayring, 2003). The findings of the study show that often students neither know what they are supposed to learn during their studies nor how to organize their study in order to accomplish certain outcomes. Yet, when students are insecure, "hidden curricula" (Bergenhengouwen, 1987) are constructed, often leading to undesirable behavior from an educational point of view. This problem is addressed by proposing a pedagogically oriented model for the design, management, and further development of educational programmes in higher education. The model consists of two major dimensions: (1) The programme leadership dimension comprises the normative foundations of an educational programme. Processes within this dimension are, among others, the definition of desirable educational outcomes by identifying and weighing different stakeholders' respective influences as well as the identification of educational activities suitable for developing and assessing the desired outcomes. In contrast, (2) the programme ownership dimension addresses teacher's and student's actual expectations and practices. Programme ownership means that teachers and students know and accept the intended programme outcomes, understand how to best accomplish them, and are ready to act accordingly. Thus, programme management aims at aligning normative concepts on the leadership level and actual practices on the ownership level. To accomplish such an alignment, (a) teachers and students must be involved into the developmental process on the leadership level, (b) a permanent position for the management of a programme has to be established acting as a contact person and communicator, and (c) permanent support for teachers and students must be available to actuate the desired practices of teaching and studying. The model provides a conceptual framework for educational design that reaches beyond the course level addressing the students' experience of higher education in a more holistic way. The specific potential of this model is its grounding in students' perceptions stressing student learning as the key responsibility of programme design and management.

PAPER PRESENTATION

Developing children's narrative identity in primary school

Eero Ropo, University of Tampere, Finland; Maiju Huttunen, University of Tampere, Finland

In this paper we report results of an intervention in which the main aim was to develop student identity in primary schools. Theoretical framework of the study is based on empirical studies of identity formation of young people. The intervention was executed in a second grade primary school class from a suburban environment. Two teacher students spent 2,5 months with the class developing and experimenting teaching materials and methods, interviewing

and observing the pupils. Pupils' work sheets, writings, drawings and other products were the data collected for the analyses. All data were analyzed qualitatively using narrative approach.

Results showed that the ten weeks long intervention program was long enough to produce changes in pupils' outcomes. For instance, written and drawn narratives of identity became longer and more detailed during the teaching period. Differences between boys and girls were also found. Implications for school education will be discussed in the paper.

In this paper we report results of an intervention in which the main aim was to develop students' narrative identity in primary schools. The study is part of a larger research project on identity and knowledge construction (Know-Id) started in 2010. In main project our purposes are twofold. First, we want to understand the identity formation processes both in school and university contexts. Second, we aim at developing teaching and learning environments to enhance identity development.

Identity as concept has a long history (see e.g. Holstein & Gubrium 2000; Shotter & Gergen 1989, Baumeister 1986). Identity, as part of personality, is often related to such concepts as values, personal or social development, moral development, and citizenship education (Veugelers 2007). In education developing student personality, self, or identity as a goal is almost self-evident. However, it has been found that school education does not seem to support student identity development optimally (Lannegrand-Willems & Bosma 2006).

Identity development in adolescence has most often been studied from the psychological point of view, as part of personality or self, although it is often hypothesized that identity relates to individuals' subject matter preferences and choices in the school, motivation for learning and studying, and many other aspects of knowledge selection, processing and construction (see e.g. Ropo 1999). Recent studies on identity development in the schools typically have focused on specific groups, such as adolescent girls (Spreckels 2008; Eckert 1993), boys (Georgakopoulou (2005), or young people in general (e.g. Ferrer & al. 2008). Some intervention studies have also focused on modifying or affecting the identity development (Kerpelman & al. 2008; Montgomery & al. 2008).

In this study we approach identity from narrative perspective. Main reasons for this framework are that we, like many other researchers, view narrative as the major process through which identity develops and is formed (e.g. Pasupathi & McLean 2010, xxi). Narrative is also regarded as a method to express and describe the identity of a person. It is evident that personal narratives have their roots in the early childhood when children start to refer to personally experienced past events using one or two word expressions (Fenson et al. 1993; Reese 1999). Children's narratives get little by little richer when they are able to construct increasingly complex stories about the past events. This development continues in adolescence (Fivush, Haden & Adam 1995). It is found that these stories are not only about what has happened, but also about the meanings of the past event for both the narrator and one who is commenting the story. It has been found that the nature of mother – child relationship is at least partly related to how many evaluative aspects children's stories have (McAdams 1996). We hypothesize that it is through these kinds of narrative processes that children's personal, social and cultural identity is formed and developed.

Methods

A second grade primary school class from a suburban environment in Finland was chosen for the study. Two fifth year primary teacher students spent 2,5 months with the class as practice teachers developing and experimenting instructional methods, interviewing and observing the pupils. The research group designed the teaching methods collecting afterwards pupils' work sheets, writings, drawings and other products into each pupil's individual portfolios. Pupils were also asked to write autobiographical narratives and to draw pictures of themselves in the beginning and end of the teaching period. All narratives and other materials pupils produced during the project period were analyzed qualitatively using narrative approach.

Results

Results showed that the ten weeks long intervention program was long enough to produce changes in pupils' outcomes. For instance, pupils' written and drawn narratives became longer and more detailed during the teaching period. The titles of the assignments were typically such as "write a story of yourself who am I", "draw a picture of yourself", "tell me about your family", etc. Pupils seemed to become more aware of their roots and family history, life courses of their family members. Recognizing own emotions and feelings were also practiced and getting to know one's close and larger living environment was part of the study. All the results will be reported in more detail in the paper.

Detailed results showed that girls' narratives are richer and more detailed than boys, but during the project boys' narratives developed the most. In addition to that the most interesting result of the study was that the children whose

identity and self-esteem seemed to be weakest developed the most. Also the parents of the pupils participated in the project for instance by providing information on family roots.

Implications for the formation of narrative identity will be discussed in the paper. We will also discuss the goals of school curriculum, and identity ideals that schools seem to have concerning what the society prefers and what is a good citizen. It was found that already 8-year old children recognize what society wants from them and what kind of citizens are good citizens.

PAPER PRESENTATION

Implementing hands-on experience in project management education

Shai Rozenes, Ruppin Academic Center, Israel; Ida Kukliansky, Ruppin Academic Center, Israel

The project management discipline is expanding within many engineering activities. This discipline can facilitate successful accomplishment of an engineering project. Therefore, academic institutes all over the world teach the "project management" program. This study presents a novel approach that educates engineering students to become successful project managers based on contextual learning. This approach embeds a practical project within the project management program. The student has to implement the academic know-how into the embedded project. The study utilizes a questionnaire – a quantitative tool to measure the students' attitudes to the preferred and the actual learning environment. The learning environment was divided into five categories: student supportiveness, independent learning, integration between the practical activities and theory classes, guidance contribution and difficulties in reality. The results show that the actual rank in about 60% of the questions was identical or even higher in comparison to the preferred rank. About one fourth of the questions revealed that the preferred rank was higher than the actual rank by 1. The relatively small gap between actual and preferred learning environments indicates that the students were satisfied with the educational process.

Introduction

The field of project management has been developing in recent years within many engineering activities. Therefore, many academic institutes all over the world teach the "project management" program. One of the theoretical anchors of the project management program teaching process can be contextual learning, that adapts the learning process to the experiences and interests of the learner, emphasizing higher-level thinking, knowledge transfer across academic disciplines, and collecting, analyzing and synthesizing information and data from multiple sources and viewpoints (Smith, 2000). The aim of this study is to present and evaluate a novel approach, based on contextual learning that educates engineering students to become successful project managers combining academic know-how with the practical project. This approach considers the main knowledge required in the field of project management (Meredith & Mantel, 2006).

Method

Participants The participants were 82 third year students (53 males and 29 females) at the Industrial Engineering and Management (IEM) department at the Ruppin School of Engineering. **Procedure** The education process combines project management academic theory and practice. The program is conducted as a workshop in which all participants participate in discussions, while performing genuine assignments. Student teams choose a real life project as a case study to facilitate the learning process. This project is presented, during the workshop, to illustrate the implementation of project management tools and techniques within their organizational environment. The program outline, fourteen weekly sessions of four hours, is shown in Figure 1 (Appendix). The software package used is MS Project software, a very popular worldwide package. The lecturer monitors the process by the following guidelines: (a) Supervisory meetings are scheduled for every alternate week; (b) Progress reports are prepared by the team for each meeting; (c) The supervisor discusses progress with the students referring to the schedule. The project supervisors assess the process by the following guidelines: (a) Progress reports: the supervisor receives progress reports at each meeting. The reports are assessed throughout the semester. (b) Final reports: the project team writes an engineering report that describes the entire progress with a scientific approach. (c) Viva: each and every project team member is examined by the IEM staff to prove his/her knowledge. **The questionnaire** The instrument used for evaluating the learning environment included a questionnaire in a preferred and actual form. The preferred form, showing students' personal perceptions of their preferred learning environment was filled out by the students at the beginning of the PM course and the actual form was filled out at the end of the course. Our instrument on the actual and preferred forms was built according to the Science Laboratory Environment Inventory (SLEI) questionnaire (Fraser et al., 1995) that was validated among 7000 university students in several countries. The questionnaire includes 35 questions on a Likert scale of 1 (strongly disagree) to 5 (strongly agree), divided into five categories: (a) Student supportiveness – Extent to which students know, help, and are supportive toward each other (b) Independent learning – Extent to which

students learn by themselves, including acquaintance with designated software c) Integration – Extent to which practical activities are integrated with theory d) Guidance – Extent to which guidance contributed to the students e) Difficulties - Extent to which the student has difficulties in reality The Cronbach's alpha coefficient showing the reliability of the questionnaire was 0.83 for the preferred form and 0.78 for the actual form. Results The mean, median and the standard deviations (SD) of the 82 participants by categories for the preferred and actual form of the questionnaires are summarized in Table 1. The averages of the "Student supportiveness" category were higher than in the other categories in both forms of the questionnaire.

Table 1. Questionnaire Summary

Category	Actual form	Preferred form	Mean	Median	SD	Mean	Median	SD
a)	4.21	40.66	4.47	50.44	b)	3.42	40.39	3.74
c)	3.95	40.55	4.21	40.51	d)	3.64	40.49	3.91
e)	3.42	30.40	3.94	40.45				

The average difference between actual and preferred ranks in the entire questionnaire was only 0.33 (about one third unit). Figure 2 (Appendix) depicts the joint distribution of the responses by categories, showing the ranking in the preferred and actual form of the same question. It can be seen that the preferred rank in all the categories is slightly higher than the actual rank. Other studies have shown that students rank their attitudes to the preferred learning environment higher than the existing one (Dorman, 2008). The actual rank in about 60% of all the questions was identical or even higher in comparison to the preferred rank. About one fourth of the questions revealed that the preferred rank was higher than the actual rank by 1.

Discussion

This paper presents an academic project management program that can be used in globally, and which prepares students to become future project managers, implementing practical aspects by using a real life project within the organizational framework. Positive students' attitudes are important because they strengthen motivation and interest, and thus promote meaningful learning of the topics in project management. The results show that the majority of students were satisfied with their learning environment; their actual form rank was at least like the preferred form rank. The relatively small gap between actual and preferred learning environments shows the student's satisfaction with the educational process based on contextual learning.

References

- Dorman, J. P., 2008. Using student perceptions to compare actual and preferred classroom environment in Queensland schools. *Educational Studies*, 34, 299-308.
- Fraser, B.J., Giddings, G.J., and McRobbie, C.J., 1995. Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environments. *Journal of Research in Science Teaching* 32, 399–422.
- Meredith, J.R. and Mantel, S.J. Jr., 2006. *Project management - A managerial approach*. John Wiley & Sons, Inc. 6th ed.
- Smith, A.J., 2000. *The Washington state consortium for contextual teaching and learning*. Center for the Study and Teaching of At-Risk Students, Seattle.

PAPER PRESENTATION

Effects of structured analyses on theory based reflection

Anne Levin, Universitat Bremen, Germany

The perspective of experts is influenced by their beliefs and orientations. Therefore teachers pedagogical attitudes and beliefs are of practical significance for teaching (Bromme, 1992). To support student in developing skills in theoretical based analysis an instruction based structure to guide students through the process of analyzing and reflecting given authentic situations was developed. Two experimental studies were conducted to test the differential effects of three modes resp. two modes of instruction on the acquisition of elaborated theoretical knowledge. During the first experiment teaching-students were instructed to analyze relevant situations in terms of theoretical conditions resp. to generate solutions for a given problem. students in teacher training (n = 153) were randomly assigned to one of two experimental conditions and one control group: structured analysis I (structured analysis and interpretation referring to own experiences and assumptions followed by analysis and interpretation based on a theoretical concept); structured analysis II (structured analysis and interpretation based on two different theoretical concepts); unstructured analysis (control group). Results show moderate to high positive effects on learning outcomes (concerning the acquisition of more elaborated knowledge). Structured analyses had also small effects on the number of given references to theoretical concepts. There was no difference found between the two experimental groups. The second study (n = 61) used an incomplete two by two design (structured vs. unstructured instruction and inexperienced (first-year students) vs. experienced students (in at least the fourth year)). Structured analyses as well as the experience (Master vs. Bachelor student) had big effects on the number of given references to theoretical concepts during the process of analyzing as well as on the justification of proposed solutions.

The perspective of experts is influenced by their beliefs and orientations. Therefore teachers' pedagogical attitudes and beliefs are of practical significance for teaching (Bromme, 1992). The ability to analyze situation and to reflect one's own actions and intentions referring to extensive pedagogical content knowledge has significant relevance for teachers who want to become experts in their field (Bromme 1992, Berliner, 2001). This assumption of Bromme and Berliner is supported by studies that prove, that teachers who are more successful in conducting cooperative learning in classes display pedagogical attitudes and beliefs which are more elaborated and complex (Haag & Dann, 2001). The ability to reflect one's actions and underlying beliefs and orientations are critical for developing expert knowledge. As Bromme and Tillema put it: "Becoming a professional is not a process of substituting theory by experience, but a process of fusing theory and experience." (Bromme & Tillema, 1995). The results of a questionnaire (involving 144 students of education of the Technical University in Berlin (Levin, 2010)) showed, that students of education have significant problems in referring to theories and theoretical models while analyzing specific cases or interpret examples of teacher-students interactions. One major reason for avoiding a deeper reflection was a stated lack of procedural knowledge that leads to a helplessness according to the ability to structure the process of analysis and reflection. To support students in developing skills in theoretical based analysis we developed an instruction based structure to guide them through the process of analyzing and reflecting given authentic situations. Two experimental studies were conducted to test the effects of three modes resp. two modes of instruction on the acquisition of elaborated theoretical knowledge. Two hypotheses were tested: Structured analysis should lead to higher effects on learning outcomes than unstructured analysis. Students using structured analysis I should be able to elaborate theoretical knowledge in a deeper way than students using structured analysis II due to linking theoretical knowledge to their previous knowledge. During the first experiment students in teacher training who were taking part in a lecture of educational psychology were instructed to analyze relevant situations in terms of theoretical conditions resp. to generate solutions for a given problem. Students in teacher training $n = 153$, (Levin, 2010) were randomly assigned to one of two experimental conditions and one control group: structured analysis I (structured analysis and interpretation of a presented situation referring to own experiences and assumptions followed by analysis and interpretation based on a theoretical concept); structured analysis II (structured analysis and interpretation of a presented situation based on two different theoretical concepts); unstructured analysis (control group) - unstructured analysis and interpretation based on two different theoretical concepts. During four sessions (periods between the sessions ranged from two to three weeks) students worked on four different situations. Results were openly discussed. Two weeks after the last intervention a test was written (irrelevant for the passing of the following examination). Results show moderate to high positive effects on learning outcomes (concerning the acquisition of more elaborated knowledge). Structured analyses had also small effects on the number of given references to theoretical concepts. There was no difference found between the two experimental groups. Inquiries showed excessive demands due to the structured instruction. Therefore the structure was revised in order to improve comprehensibility. Time to work on the authentic situations was expanded. Two hypotheses were tested: Structured analysis should lead to a significant rise of references to theoretical concepts compared with the unstructured group. Students of the master course were expected to excel students of the bachelor courses according to the number of stated references on theoretical concepts (during the process of analyzing the situation and of the justification of proposed solutions). The second study ($n = 61$) used an incomplete two by two design (structured vs. unstructured instruction and inexperienced (first-year students) vs. experienced students (in at least the fourth year)). The BA courses (parallel courses, same teacher, same schedule and content) were randomly assigned to one of two conditions: structured analysis II (structured analysis and interpretation of a presented situation based on two different theoretical concepts) and unstructured analysis (control group) - unstructured analysis and interpretation based on two different theoretical concepts. During three sessions (sessions were held weekly) students worked on three different situations. Results were openly discussed. Two weeks after the last intervention a fourth situation was analyzed. Structured Analyses as well as the experience (Master vs. Bachelor student) had big effects on the number of given references to theoretical concepts during the process of analyzing as well as on the justification of proposed solutions.

Literature:

- Berliner, D.C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35, 463-482.
- Bromme, R. (1992). *Der Lehrer als Experte – zur Psychologie des professionellen Wissens*. Bern: Verlag Hans Huber.
- Bromme, R. (1993). Können Lehrer Experten sein – können Experten Lehrer sein? Eine Studie zu subjektiven Konzepten über den Lehrer als Experten. In Bauersfeld, H./Bromme, R. (Hrsg.), *Bildung und Aufklärung, Studien zur Rationalität des Lehrens und Lernens*, (S. 33-58).
- Münster. Bromme, R. & Tillema, H. (1995). Fusing Experience and Theory: The Structure of Professional Knowledge. *Learning and Instruction*, 5, 261-267.

romme, R. (1995). Was ist „pedagogical content knowledge“? Kritische Anmerkungen zu einem fruchtbaren Forschungsprogramm. In Hopmann, S./ Riquarte, K. (Hrsg.) Didaktik und/oder Curriculum. Zeitschrift für Pädagogik, Beiheft 33, 105-15.

Haag, I. & Dann, H.-D. (2001). Lehrerhandeln und Lehrerwissen als Bedingungen erfolgreichen Gruppenunterrichts. Zeitschrift für Pädagogische Psychologie, 15, 5-15.

Levin, A. (2010). Effekte strukturierter Situationsanalysen auf Wissensvertiefung und Entwicklung von Reflexionsvermögen Vortrag auf der 74. Tagung der AEPF in Jena vom 13. – 15. September 2010

PAPER PRESENTATION

The Effects Generative Testing Methods on Text Retention and Text Comprehension

Kim Dirkx, Open University, Germany; Liesbeth Kester, Open University of the Netherlands, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Retrieval by means of multiple-choice, free-recall or short-answer tests has shown to be a very effective study strategy for long-term retention of facts from expository texts. Because today's education emphasizes meaningful learning rather than rote learning, the present research investigated the effects of two generative testing methods namely summarizing and concept mapping on retention and comprehension compared these methods to free-recall and restudy. Students (N=250) were given a Biology text and either reread it, or took a test on the material. A final test was administrated after 5 minutes (i.e., measure short term retention) or one week (i.e., measuring long-term retention). Before the experiment, students were trained in restudy or one of the three testing methods. In addition, prior knowledge, verbal ability and working memory were measured to correct for individual differences. Preliminary results show an superior effect of tests versus restudy on delayed retention. Summarizing seems to benefit long term comprehension. Final results will be presented during the Earli of 2011.

Students often prepare for an exam by rereading their notes or the textbook (Karpicke, Butler, & Roediger, 2009). This study strategy, has proven however, not to be the most effective study strategy for long-term retention (Callender & McDaniel, 2009; Roediger & Karpicke, 2006). A better strategy for that purpose is testing or the act of retrieval (Karpicke et al; Roediger & Karpicke). This so-called memory effect of testing or testing effect has often been investigated since its first mention in the literature (e.g., Glover, 1989).

The traditional testing effect research has investigated the effect of tests in laboratories with educationally irrelevant material such as lists of words or unrelated word pairs and used recognition, cued-recall, or free-recall tests to measure retention (Butler & Roediger, 2007; Karpicke & Roediger, 2007, 2008, see McDaniel, Roediger, & McDermott, 2007; Roediger & Karpicke, 2006). From those more traditional experiments, free recall has shown to be an highly effective testing method. The effectiveness of free recall has been ascribed to the need for retrieval without cues. Retrieval without cues has been suggested to enhance the retrieval effort thereby enhancing memory traces and consequently long-term retrieval (Glover, 1989). Roediger and Karpicke suggested that the limit interest in the testing effect and the lack of incorporation in education is a result of the limited range and usability of materials used in the more traditional testing effect experiments. More recent testing effect research has acknowledged that problem and investigated long-term memory retention of material actually used in education such as foreign vocabulary words, expository texts and materials from test preparation books with educationally relevant tests, such as, multiple-choice, short-answer or essay tests. Here we want to take this line of research one step further.

Due to changes in educational demands, secondary education emphasizes the obtainment of higher cognitive skills such as comprehension and application. In result new testing methods, that enable assessment of such skills, are being implemented in schools. Two such testing methods are concept mapping and summarizing. Here we call them generative tests. Students need to generate without cues what they remember. In contrast to free recall concept mapping and summarizing explicitly require students to organize the information and draw relations between concepts/ideas/facts.

The question investigated in the present research is whether an testing effect can be found using these generative testing methods. Concept mapping and summarizing require students not only to recall information but also to (hierarchically) organize the recalled information. Free-recall, in contrast, asks students to write down everything they remember from, for example, a text without paying attention to wording or text structure. In line with the testing effect research, it is hypothesized that recall by means of free-recall, concept mapping, and summarizing will lead to better delayed (after one week) retention compared to restudy, and that restudy will yield higher immediate (after 5 minutes) retention. Moreover, it is expected that concept mapping and summarizing will enhance comprehension more than free recall because these generative testing methods require students to make inferences and relations between the information they learn.

Data collection runs from October 20th 2010 till December 10th 2010. In total 250 Dutch sophomore secondary school students, taking biology courses for two to three hours a week, will be included. We will present in this summary the result of a subsample of 35 students that already finished the complete experiment. A randomized 4 x 2 factorial design with between-subject factors learning strategy (restudy, free recall, summarizing, concept mapping) and retention interval (5 minutes, 1 week) is used. Prior knowledge, reading comprehension and working memory capacity are tested prior to the start of the experiment to determine the potential effects of individual student characteristics. During the experiment participants read a 500 word text on metabolism from an often used Biology textbook. The students either take a test or restudy the text during 10 minutes. After 5 minutes or one week a final short-answer test of 17 items (both retention and comprehension questions) is administered.

Preliminary data of 35 students are displayed in the appendixes. Restudy leads to very high short-term recall levels (after 5 minutes), but this advantage of restudy disappears after one week (long-term recall). In addition, after one week all three test groups had higher recall scores than the restudy group. This indicates a testing effect (see figure 1). The preliminary data was cautiously analyzed using Kruskal Wallis with Condition (restudy after 5 minutes or one week, free-recall after 5 minutes or one week, concept mapping after 5 minutes or one week, summarizing after 5 minutes or after one week) as grouping variables. Results showed that the conditions significantly differed from each other ($H=15.394$; $p=.031$). A Mann Whitney U test showed that there is a tendency for the superiority of summarizing on long-term recall compared to restudy ($p=.064$). Figure 2 shows that there are only small differences in retention between the four strategies. Summarizing and restudy seem to be just as effective on the short term and free recall and concept mapping seem to be a little less effective. Long term retention is much higher in the test conditions. In figure 3 it is seen that students in the summary condition yielded far higher comprehension test scores both after 5 minutes, and one week compared to the other conditions. In contrast to what was expected, concept mapping seems no more effective than free recall.

The results of the complete sample ($N=250$) will be available in December 2010. We are pleased to present and discuss final results, during the Earli 2011 in Exeter.

References

- Callender, A. A., & McDaniel, M. A. (2009). The limited benefits of rereading educational texts. *Contemporary Educational Psychology*, 34, 30-41.
- Glover, J. A. (1989). The "testing" phenomenon: Not gone but nearly forgotten. *Journal of Educational Psychology*, 81, 392-399.
- Karpicke, J. D., Butler, A. C., & Roediger, H. L. (2009). Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? *Memory*, 17, 471-479.
- Roediger, H. L., & Karpicke, J. D. (2006). The power of testing memory. Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181-210

PAPER PRESENTATION

Dialogical interactions in mathematics: Promoting achievement in a global world

Ricardo Machado, Universidade Nova de Lisboa, Faculdade de Ciencias e Tecnologia, Portugal; Margarida Cesar, Universidade de Lisboa, Instituto de Educacao, Portugal

Having access to knowledge, and knowing how to use it, is essential to avoid social exclusion (Cesar & Oliveira, 2005). Mathematics assumes an important role in students' schooling paths. But students often develop negative social representations about mathematics that shape their underachievement and are also shaped by it (Gorgorio & Planas, 2005; Machado, 2008). Communication plays an essential role in mathematics learning (Sfard, 2001). Collaborative work can be used as a mediation tool to facilitate mathematical knowledge appropriation and the development of students' abilities and competencies (Cesar, 2009).

This study is from the Interaction and Knowledge research project. Its main aims were studying and promoting collaborative work in formal educational scenarios. Assuming an interpretative approach, action-research projects were developed in around 600 mathematics classes (5th to 12th grades, 10/11 to 17/18-year-olds) all over Portugal. We focus on an 8th grade class, from a school near Lisbon, chosen as a paradigmatic example. The main participants were these students ($N=21$), the teacher/researcher and two other observers. Data were collected through questionnaires, tasks inspired in projective techniques, an instrument to evaluate students' abilities and competencies, observation, documents and students' protocols. Data were treated and analysed through a narrative content analysis (Clandinin & Connelly, 1998) from which inductive categories emerged.

The analysis of some students' solving strategies and mathematical thinking illuminates the potentialities of collaborative work to promote more positive social representations about mathematics and students' mathematical performances. We illustrate the interactive interplays that facilitated those changes through the analysis of students' paths.

Having access to knowledge, and knowing how to use it, is essential to avoid social exclusion (Cesar & Oliveira, 2005). According to Sfard (2008), thinking is communicating. It is important to face students with opportunities to develop those complex mental functions, particularly through their access to mathematical mental tools (Cesar, 2009). But although being important in students' schooling paths, they often develop negative social representations about mathematics that shape their underachievement and are also shaped by it (Gorgorio & Planas, 2005; Machado, 2008). As social representations are a dynamic, multi-faced and dialogic construct (Markova, 2005), they can inform us about how the others interpret the context and situations that they are experiencing, particularly in their learning process within mathematical classes. As communication plays an essential role in mathematics learning (Sfard, 2001), it is important to create thinking spaces (Perret-Clermont, 2004) where students develop complex mental functions (Vygotsky, 1934/1962) through dialogical interactions (Renshaw, 2004). They share their argumentations and points of view. In these spaces/times (Cesar, 2009), students give meanings to the words, to their actions and to those of others with whom they interact (Bakhtin, 1929/1981). Thus, teachers need to benefit their practices in order to develop students' reflective and critical participation. Assuming the collaborative work, namely in peers, as a daily practice and establishing a coherent didactic contract is a way to promote students' access to (mathematical) knowledge and the development of their abilities and competencies (Cesar, 2009). Working in peers also facilitates students' transitions (Zittoun, 2006), namely their access to the mathematical knowledge they learned in different contexts, scenarios, and/or situations – an essential step towards empowering students mathematically (Cesar, 2009).

The problem that originated this study are students' negative social representations about mathematics and their impacts in students' (under)achievement and in their school and social inclusion. The research questions we address in this paper are: (1) Which are the 8th graders' social representations about mathematics at the beginning of the school year?; (2) Which changes do we observe in those social representations during the school year?; and (3) What are the impacts of collaborative work on students' social representations about mathematics, in their (mathematical) knowledge appropriation and in their mobilization and development of abilities and competencies?

This study is from the Interaction and Knowledge research project. Its main aims were studying and promoting collaborative work in formal educational scenarios. Assuming an interpretative approach (Denzin, 2002), action-research projects (Mason, 2002) were developed in around 600 mathematics classes (5th to 12th grades, 10/11 to 17/18-year-olds) all over Portugal. We focus on a class (8th grade), from a school near Lisbon, chosen as a paradigmatic example of an illiterate and poor multicultural context in which students usually failed and dropout of school. The main participants were these students (N=21), the teacher/researcher and two other observers. Students worked collaboratively during the whole school year, in dyads and small groups. Data were collected through questionnaires (September and June), tasks inspired in projective techniques (September, January and June), an instrument to evaluate students' abilities and competencies (September), observation, documents and students' protocols (whole school year). Data analysis was based in a narrative content analysis (Clandinin & Connelly, 1998) from which inductive categories emerged (Cesar, 2009), allowing to trace students' learning paths and the mathematical knowledge they mobilized.

The analysis of some students' solving strategies and mathematical thinking illuminates the potentialities of collaborative work to promote more positive social representations about mathematics and students' mathematical performances. For instance, how some students' engaged in mathematical activities they were unable to face until then and how that empowerment contributed to their inclusion. It also illuminates the role of dialogical interactions in students' access to mathematical knowledge, in the development of complex mental functions and (mathematical) abilities and competencies such as making, testing and explaining their own conjectures.

References

- Bakhtin, M. (1929/1981). *The dialogical imagination* (M. Holquist, Ed.) (M. Holquist, & C. Emerson, Trans.). Austin: University of Texas Press. [Original published in Russian in 1929]
- Cesar, M. (2009). Listening to different voices: Collaborative work in multicultural maths classes. In M. Cesar, & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 203-233). Rotterdam: Sense Publishers.
- Cesar, M., & Oliveira, I. (2005). The curriculum as a tool for inclusive participation: Students' voices in a case study in a Portuguese multicultural school. *European Journal of Psychology of Education* XX(4), 29-43.

- Clandinin, D. J., & Connelly, F. M. (1998). Personal experience methods. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 150-178). Thousand Oaks: Sage.
- Denzin, N. K. (2002). The interpretative process. In A. Haberman, & M. Miles (Eds.), *The qualitative researchers companion* (pp. 349-366). Thousand Oaks: Sage.
- Gorgorio, N., & Planas, N. (2005). Social representations as mediators of mathematics learning in multiethnic classrooms. *European Journal of Psychology of Education*, XX(1), 91-104.
- Machado, R. (2008). *Brocolos e matematica: Representacoes sociais da matematica de alunos do 8.º ano de escolaridade*. Lisboa: APM. [Master thesis]
- Markova, I. (2005). *Dialogicality and social representations: The dynamics of mind*. Cambridge: Cambridge University Press.
- Mason, J. (2002). *Researching your own practice: The discipline of noticing*. London: Rand Falmer.
- Perret-Clermont, A.-N. (2004). Thinking spaces of the young. In A.-N. Perret-Clermont, C. Pontecorvo, L. Resnick, T. Zittoun, & B. Burge (Eds.), *Joining society: Social interaction and learning in adolescence and youth* (pp. 3-10). Cambridge: Cambridge University Press.
- Renshaw, P. (2004). Introduction. Dialogic teaching, learning and instruction: Theoretical roots and analytical frameworks. In J. van der Linden, & P. Renshaw (Eds.), *Dialogic learning: Shifting perspectives to learning, instruction, and teaching* (pp. 1-15). Dordrecht: Kluwer Academic Publishers.
- Sfard, A. (2001). There is more to discourse that meets the ears: Learning from mathematical communication things that we have not known before. *Educational Studies in Mathematics*, 46, 13-57.
- Sfard, A. (2008). *Thinking as communicating*. Cambridge: Cambridge University Press.
- Vygotsky, L. S. (1934/1962). *Thought and language* (*Myshlenie i rech'*, Trans.). Cambridge MA: MIT Press. [Original published in Russian in 1934]
- Zittoun, T. (2006). *Transitions: Development through symbolic resources*. Greenwich: Information Age Publishing.

PAPER PRESENTATION

Teachers and peers: processes of exclusion and inclusion in children's preschool groupings during lea

Peter Kutnick, The University of Hong Kong, Hong Kong; Antonella Brighi, University of Bologna, Italy

This study poses that interactive learning and social inclusion should be studied in both child-adult and child-peer cognitive/learning contexts, in order to develop an understanding of children's co-constructive processes of knowledge within the pre-school. Most knowledge of effective pre-schools is based upon teacher-scaffolded interactions, but a majority of children's learning time is spent without a teacher present.

Our study aims to: identify types of child- and teacher-oriented groupings that characterize cognitive/learning activity among 4 year-olds in pre-school; describe the activities that children undertake in these groupings; and assess learning groupings for types of learning activity, cognitive challenge social inclusion/exclusion.

25 pre-school classrooms were selected and observed in England and in Italy. A mapping system characterized cognitive/learning activity undertaken in various groupings of 4 year-olds and found these groupings were differentiated by number per group, composition of group, activities engaged and cognitive challenge. 103 maps identified 536 groupings. Analyzing the groupings by descriptive and inferential statistics, two distinct pedagogic worlds were identified: large, teacher-oriented groups of children, and small peer-oriented groups. In the teacher-oriented groups children were involved in learning activities in a socially inclusive context – where boys and girls, friends and non-friends interacted under teacher direction. Peer-oriented groups tended to be solitary or socially exclusive – accentuating gender differences in task choice, learning partner and cognitive challenge of activity. Findings suggest that cognitive/learning tasks may be undertaken in either of these pedagogic worlds, but different social activity involved may imply dissimilar pathways of teacher-oriented, inclusive or gendered exclusive knowledge construction.

INTRODUCTION

Most western countries offer universal pre-school access to 4 year-olds; identifying that this experience will enhance a child's cognitive and social development and facilitate entry to primary school. Recent studies of pre-school experience have found that effective pre-schools have high levels of teacher-pupil interaction within a socially inclusive learning environment; and this combination of interaction and inclusion are strongly associated with ease of primary school entry and learning. Effective pre-school studies, though, mainly focus on teacher-scaffolded activity, teacher-child interaction and associated inclusion. The studies separate this activity from free play – within which cognitive and social interaction is likely to be associated with social exclusion among children.

Within the study reported here, we focus on cognitive/learning time in pre-school classrooms. We note, though, that during cognitive/learning time teachers spend most of their time with children but children spend most of their time away from a teacher and in the presence of peers. While there have been excellent descriptions of cognitive/learning time co-constructed between child and teacher, there is little consideration of child-peer cognitive/learning time and the processes of inclusion/exclusion associated within this time.

This study poses that there may be distinct pedagogic worlds (related to child-adult and child-peer activity) that can be identified during cognitive/learning time and that interactive learning and social inclusion should be studied in both child-adult and child-peer cognitive/learning worlds in order to develop an understanding of children's co-constructive processes of learning within the pre-school.

AIMS:

Our study aims to: identify the types of child-oriented and teacher-oriented groupings that characterize cognitive/learning activity (4 year olds in pre-school); describe the activities that children undertake within these groupings; and, assess these groupings for types of learning activity, cognitive challenge and social inclusion/exclusion.

METHODOLOGY:

Pre-schools were selected as characteristic early education settings in local communities in England and Italy. Ethical permission was granted before the study began. A total of 25 pre-school classrooms (children mean age was 4 years) were selected and observed during the summer term. Each classroom was visited 3 or 4 times, allowing for a representative sample of cognitive/learning activities.

Instrument:

'Mapping' (Kutnick, Blatchford & Baines, 2002; 2006) allowed observation of number, type and composition of groupings per classroom as children undertook learning activities. Each map provided group-level summaries of: those involved in learning activities, types of activity, level of cognitive challenge and interaction. Groupings observed clearly differentiated between 'teacher-oriented' (defined as a grouping of children that undertook an activity with the teacher present) and 'child-oriented' (groups undertook a teacher structured activity mainly without teacher presence). Within each grouping maps also identified: grouping size, gender and friendship composition; who composed the groups; whether an adult was present and his/her role; and quality of interaction and communication. A total of 103 maps identified 536 groupings. Analysis considered the total number of groups (N=536), and used descriptive and inferential statistics (Pearson Chi Square Analyses, Anova) to assess differences between groupings.

FINDINGS:

Teacher- and child-oriented groups:

Observations found a clear distinction between teacher- and child-oriented groups. Teacher groups displayed an inclusive mix of sex (boys and girls) and friendship (friends and acquaintances) and were composed of 6-9 children interacting with the teacher on teacher-assigned tasks. Child groups worked either individually or in small (2-3) groupings and were homogeneously composed of boys- or girls-only and were friends-only while they undertook teacher-assigned learning tasks. Analyses found that children undertook their cognitive/learning activities in separate pedagogic worlds; a teacher-oriented world being interactive and inclusive and the child-oriented world being active and exclusive.

Interaction/communication:

Communication differed by teacher- and child-orientation. About 38% of teacher and child groups exhibited joint interaction with communication. Scaffolded interactions were most likely in teacher-oriented groups. 35% of activities exhibited parallel interaction. There was a high proportion of solitary activity without communication exhibited only in child-oriented groups.

Activity:

Teacher-oriented, inclusive groups undertook activities associated with preparation for entry to schooling (mid-high cognitive challenge). Child-oriented, exclusive groups undertook sex-differentiated activities; this exclusivity was also associated with different activities for male and female groups and different levels of cognitive challenge. Boys undertook mid-low cognitive challenge activities of large and small construction and scripted toys. Girls undertook mid-high and high challenge activities of art, 3Rs and pretend play.

SIGNIFICANCE:

Effective pre-schooling is said to draw upon teacher scaffolded interactions and inclusive pedagogy to promote cognitive/learning and preparation for primary school. Yet, our mapping analysis identified that much of children's cognitive/learning time is directed by teachers but undertaken without the presence of a teacher. Mapping of cognitive learning activities of 4 year-olds revealed much action and interaction within their groups, but these activities took place in two (separate) pedagogic worlds which characterized both England and Italy. The teacher-

oriented world was interactive and inclusive; groups composed of 6-9 children who worked with the teacher and included boys and girls, friends and acquaintances. Teacher-oriented groups undertook mid-high cognitive activities oriented towards preparation for entry to primary school. The child-oriented world was composed of groups that undertook teacher structured cognitive/learning activities; these groups were interactive but were limited in size and characterized by homogeneity of sex, friendship. Child-oriented activities had different gender orientations – girls pursued school preparatory activities and boys pursued scripted actions with toys and manipulative objects. Gendered activities were also differentiated by level of cognitive challenge.

We explain learning within inclusive and exclusive pedagogic worlds by drawing upon 'first generation' activity theory. We note that cognitive/learning activities were undertaken in an 'interactive social environment' but children's interactions were 'mediated' by culturally defined orientations of child-adult and child-peer groups. Moreover, as most pre-school children spend their cognitive/learning time away from the presence of a teacher, we suggest that interactive learning mediated in this socially exclusive context may characterize the orientation to learning that children are likely to carry into their primary school. We suggest that further studies are required to further ascertain how pre-school learning experience can be made more inclusive.

PAPER PRESENTATION

Studying the quality of communication in emerging self-managing student team companies over time

Johanna Poysa-Tarhonen, University of Jyväskylä, Finland; Jan Elen, Katholieke Universiteit Leuven, Belgium; Pasi Tarhonen, Honeywell Inc., Finland

This paper looks at the development of the quality of communication in self-managing student team companies over time to better understand how relatively large student teams (n=16-19) gradually develop. In the study, shifting levels of interpersonal dynamics serve as indicators of the quality of communication in student teams. The study contributes to current knowledge by following a temporal perspective on change in groups and addresses unpredictability and complexity as a fundamental feature of teams' functioning. This research, reporting on four videotaped team meetings of three student teams, collected during their first year as entrepreneur students, utilizes a mixed method approach as a combination of quantitative analyses and qualitative interpretations by combining statistical and time-series model identification methods (statistical process control) and qualitative content analysis. The results enabled accurate information of the significant patterns of interactions over the process and how these different patterns unfold in micro-level in teams. The results arising out of the study might be helpful for teachers/team coaches to craft targeted support for teams to better e.g. mitigate or prevent negative incidents or series of events to occur in the consequence of team development.

To better succeed and to stimulate employee commitment, an increasing number of modern knowledge-intensive work organizations are establishing teamwork-based working models and less hierarchical, self-managing working practices (Knights & McCabe, 2003). The self-managing work team can be characterized as a collective that has the authority to decide how members' efforts will be organized, monitored and managed to accomplish the team's work (Hackman, 1995; van der Vegt, 2010).

This research examines three emerging, self-managing student team companies (co-operatives) within a business school context and specifically looks at the development of the quality of communication in these teams over time. The aim of the study is to better understand how relatively large teams (n=16-19) gradually develop. This understanding may be used to coach (beginning) self-managing teams in their learning process. In the study, shifting levels of interpersonal dynamics (Losada, 1999) over time serve as indicators of the quality of communication in student teams. The study contributes to current knowledge by following a temporal perspective on change in groups and addresses unpredictability and complexity as a fundamental feature of teams' functioning (e.g. Arrow et al., 2004). It is expected that details of the nonlinear interactions in teams cannot be predicted and that patterns of group behaviour can best be studied by focusing on the evolution of group behaviour, e.g. by identifying changes in regard to the shifts to qualitatively different patterns of interactions in groups.

Data were obtained from four videotaped team meetings of three heterogeneous teams, collected at regular intervals over their first academic year as entrepreneur students. Teams' meetings were videotaped using a 360° camera that allowed observations of all the participants simultaneously. To better understand emerging teams' performances a mixed method approach was adopted that implied the combination of quantitative analyses and qualitative interpretations. First, to study the quality of communication, the videotaped team meetings were coded at phrase level in regard to three pairs of variables (positivity/negativity, inquiry/advocacy, other/self) that Losada (1999; Losada & Heaphy, 2004; Fredrickson & Losada, 2005) had identified to imply significant qualities of communication in terms of interpersonal dynamics in business teams. Next, the amount of different pairs of variables was calculated and

compared to ratios of high-, medium- and low-performance teams as identified by Losada (1999). This first phase of analysis marked each code with a time stamp. Second, the data was aggregated in one-minute intervals and time series analysis was conducted on these data. The one-minute interval ratios were first inverted and normalized to calculate the mean value of the combination of three abovementioned pairs of variables at points in time. To identify changes in the patterns of group interactions, the data were processed further by using statistical and time-series model identification methods (statistical process control, see e.g. Wheeler & Chambers, 2000; Oakland, 2002). The aim was to identify statistically significant states from the time series data that were biased strongly towards extremes (e.g. highly positive or negative states) or indicated statistically significant state changes (e.g. a clear change from positive to negative). Third, to fully understand teams' behaviours the extreme states and state changes were traced in the discussion data. These data served as meaning units to analyze the contents and actual meanings of communication among team members during the significant states (e.g. Graneheim & Lundman, 2004).

The results showed that in all the three teams the quality of communication in regard to the interpersonal dynamics stayed relatively identical (medium-level) over the measurements if compared to Losada's (1999) classification into high-, medium- and low-performance business teams. In all the teams the results indicated clear state changes in teams' behaviours basically with respect to three forms of patterns: violations (uncontrolled variations in team's performances, be they positive or negative), continues flows of violations (oscillation behaviour) and (biased) trends (be they positive or negative). Interpretations in these qualitatively different patterns exhibited regularities in terms of qualitative themes that had to do particularly with the beginning, self-organizing teams' functioning, such as the processes of coordination and self-organization (e.g. Druskat & Pescosolido, 2002), and the micro-practices of power in peer-led teams (e.g. Davis, 2008). The results enabled accurate information of the significant patterns of interactions over the process and how these different patterns unfold in micro-level in teams. This may be helpful e.g. for teachers/team coaches to craft targeted support and interventions for teams e.g. to mitigate or prevent negative incidents or series of events to occur in the consequence of team development.

References

- Arrow, H., Poole, M., Henry, K., Wheelan, S. & Moreland, R. (2004). Time, change and development: Temporal perspective on groups. *Small Group Research*, 35, (1), 73-105.
- Fredrickson, B. & Losada, M. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologists*, 60, (7), 678-686.
- Davis, C. (2008). Dueling narratives: How peer leaders use narrative to frame meaning in a community mental health care teams. *Small Group Research*, 39, (6), 706-727.
- Druskat, V. & Pescosolido, A. (2002). The content of effective teamwork mental models in self-managing teams: Ownership, learning and heedful interrelations. *Human Relations*, 55, 283-314.
- Graneheim, U. & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24, 105-112.
- Hackman, J. (1995). Self-managed teams. In N. Nicholson, R. Schuler, & A. van den Ven (Eds.), *Encyclopedic dictionary of organizational behaviour*, p. 511-512. Cambridge, MA: Blackwell.
- Knights, D. & McCabe, D. 2003. Governing through teamworking. Gender and team tensions. *Journal of Management Studies*, 6, 1589-1619.
- Losada, M. (1999). The complex dynamics of high performance teams. *Mathematical and Computer Modeling*, 30, 179-192.
- Losada, M. & Heaphy, E. (2004). The role of positivity and connectivity in the performance of business teams. *American Behavioral Scientist*, 47, (6), 740-765.
- van der Vegt, G., Bunderson, S. & Kuipers, B. (2010). Why turnover matters in self-managing work teams: Learning, social integration, and task flexibility. *Journal of Management*, 36, (85), 1168-1191.
- Oakland, J. (2002). *Statistical process control*. Oxford: Butterworth-Heinemann.
- Wheeler, D. & Chambers, D. (2000). *Understanding statistical process control*. Knoxville, Tennessee: SPC Press, Inc.

PAPER PRESENTATION

Individual and group level expressions of social skills as predictors of satisfaction & performance

Michele Notari, PHBern, Switzerland; Baumgartner Adrian, PHBern, Switzerland

The study looks for empirical answers to the following question: To what degree are self-rated individual social skills and the distribution of social skills within learning groups predictive for group member's satisfaction with group performance and quality of collaboration? Data collection took place in a project based learning curriculum of pre-service teachers. Two questionnaires were used, one at the beginning and one at the end of the learning cycle which lasted for one semester. The investigation of 60 learning groups (N = 155 teacher training students) revealed the

following results: Self-rated social skills on the individual level were for the most part non-significant predictors for the satisfaction with group performance and the quality of collaboration. A different picture emerged on the group level: Groups in which members show a high and/or amongst themselves homogeneous expression of specific social skills (i.e. exchange orientation, prosocial behavior, leadership) are more satisfied and collaborated better than groups with high and heterogeneous expressions of skills.

Executive Summary

Commonsense dictates that individual social skills are relevant ingredients for successful collaborative learning. However, we could find hardly any studies who tried to identify empirically and systematically the social skills most predictive of group performance and collaboration. Furthermore, those few studies have relied almost exclusively on the individual, neglecting that group success and collaboration is as much dependent on individual skills as on the skill configuration within the whole group. In our own study, we have chosen a project-based (PBL) learning curriculum as a context to analyze collaborative learning processes. In PBL learners have to organize themselves as a group, negotiate goals, assign responsibilities, communicate and resolve emerging conflicts (Eastman & Owens Swift, 2002). It is expected that students practice and refine these skills during the collaboration process (Peterson, 1997).

Research design

Research questions:

Which individual social skills are associated with group process variables (i.e. satisfaction with performance and quality of collaboration) in a collaborative project-based learning setting?

What configurations of social skills within learning groups (i.e. heterogeneous vs. homogeneous distribution and low vs. high expression of a skill) are associated with differences in group process variables?

At the start of the PBL curriculum students completed a questionnaire (t1) self-assessing various social skills. According to Peterson (1997) and Heuermann and Krutzkamp (2003) the questions concerned perceptions of personal social skills. At the end of the project students were given a second questionnaire (t2) tapping their satisfaction with the course of the project and their judgement about the quality of collaboration during the project.

Self-assessment of individual social skills (t1)

The questionnaire contained 16 self-referential statements which students rated on a four-point scale (totally agree – do not agree at all). The 16 statements were reduced to five factors using principal component analysis. The five factors explained 66.9% of total variance. All factor scales had acceptable internal consistencies (Cronbach's Alpha): exchange orientation (i.e. being able to cooperate, compromise, resolve conflicts etc.): (Cronbach's Alpha = .685), prosocial behavior: (Alpha = .600), initiative: (Alpha = .705), leadership: (Alpha = .627), assertiveness: (Alpha = .652).

Group process variables (t2)

Students rated six process variables (i.e. satisfaction with performance, efficiency of collaboration, clear division of responsibilities, clarity of leadership, mutual support giving, group harmony and ability to bring in one's ideas) on a four-point scale (totally agree – do not agree at all).

Analyses

In our research design individuals are nested within learning groups. As we were interested in the predictive power of individual level (level 1) and group level (level 2) variables on satisfaction and quality of collaboration, a multilevel analysis approach was pursued using the hierarchical linear modelling software HLM 16.2 (Raudenbush, Bryk & Congdon, 2004). This was done for all outcome variables for which the intraclass correlation coefficient (ICC) demonstrated significant level 2 variance (all other outcome variables were analysed with linear regression models). The basic regression equation was as follows:

level 1: outcome = $\gamma_0 + \gamma_1$ (individual social skill) + r

level 2: $\gamma_0 = \gamma_{00} + \gamma_{01}$ (mean social skill) + γ_{02} (SD social skill) + γ_{03} (interaction mean x SD) + u₀

$\gamma_1 = \gamma_{10} + u_1$

The social skill expression on level 2 consisted of group members average skill level (mean), variability of skill level within groups (SD) and the interaction between mean and variability.

Selected results

Individual social skills as predictors of satisfaction and quality of collaboration

Of the five social skills we investigated only two demonstrated predictive value. Students high in leadership skills saw their groups as less mutually supportive ($B = -.18$, $p = .065$) and students high in assertiveness thought they had been less capable of bringing their ideas into the project ($B = -.31$, $p = .009$).

Configuration of social skills within groups as predictors of satisfaction and collaboration

Members from groups in which the individual exchange orientation is high (mean) and at the same time homogeneously distributed (SD) report a more efficient collaboration ($B = -2.77$, $p = .048$) and a clearer division of responsibility ($B = -2.32$, $p = .061$) than other groups. Other meaningful effects were found for prosocial behavior and leadership: Group member's satisfaction with performance ($B = -2.04$, $p = .098$) and with the efficiency of collaboration ($B = -2.02$, $p = .033$) is lower when prosocial behavior within the group is high but heterogeneously distributed. At the same time these groups show a clearer division of responsibility ($B = -2.86$, $p = .030$). Groups high in leadership skills (irrespective of the distribution of this skill) report more efficient collaboration ($B = .55$, $p = .008$) and a clearer division of responsibility ($B = .35$, $p = .090$).

Conclusions

The associations emerging on the individual and the group level were not identical which hints at the necessity of considering both. Groups in which most members show a high individual level of a specific social skill (i.e. exchange orientation, prosocial behavior, leadership) fare better than groups with low individual expressions of these skills. Detrimental to the group process seems to be an uneven distribution of a specific social skill combined with an overall high level of the skill within the group. Astonishingly not many effects on the individual level were related to satisfaction and quality of collaboration. This is evidence for the context-dependency of social skills (Rose-Krasnor, 1997), i.e. whether a specific social skill is beneficial for collaboration in project-based learning depends on the group one is placed in and on the social skills levels of one's group members.

References

- Eastman, J. K. & Owens Swift, C. (2002). Enhancing Collaborative Learning: Discussion Boards and Chat
- Raudenbush, S.W., Bryk, A.S., & Congdon, R. (2004). HLM 6 for Windows [Computer software]. Lincolnwood, IL: Scientific Software International, Inc.
- Rose-Krasnor, L. (1997). The nature of social competence: A theoretical review. *Social Development*, 6, 111 - 135.
- Peterson, M. (1997). Skills to enhance problem-based learning. Online: <http://www.med-ed-online.org/f0000009.htm> (10.29.2010).

PAPER PRESENTATION

Back and Forth between Reading and Writing: Experienced Teachers Study with Wiki

Yael Poyas, Oranim College of education, Israel

This research study examined three groups of teachers ($N=52$), studying literature in the Wiki environment, within the framework of an M.Ed. program at an academic college of education in Israel. The Wiki environment was chosen because it is interactive, hypertextual, collaborative, available hands-on, transparent to all those using it, and particularly appropriate in a textual environment. Learners' satisfaction with this method, their attitude to it, the speed of their writing, as well as the processes of the texts' formation were examined. The data were gathered by means of the Wiki features, and also derived from the participants' feedback and from the lecturer's ongoing notes in the field. The learners' satisfaction was generally on a high level, and the group's product was satisfactory; however, the students encountered difficulties that should be taken into account during the planning of Wiki-assisted teaching. The results reveal variance among the learners due to differences in their mother tongue and their cultural background; their willingness to accept the Wiki environment's characteristic features was influenced by their specific professional perspective, previous learning habits, and by the prevalent academic norms. The way the topics for writing were chosen affected the process by which the written texts were finalized.

The paper analyzes findings of a three-year research of Wiki-assisted teaching. The Wiki environment is interactive, cooperative and multimodal, enabling collaborative writing of texts among participants, as well as follow-up of the written product's development and each learner's contribution. The integration of Wiki environments and a 'Wiki pedagogy' (Ruth & Houghton, 2009) is rapidly gaining ground in institutions of higher education. When using ICT, two cultural factors, among others, must be taken into account: a) the learners' perceptions of teaching and learning (Alsunbul, 2001; Farabaugh, 2007; Wang & Beasley, 2008); b) academic norms regarding knowledge (Lyndsay, 2006; Wang & Beasley, 2008). The present study examined the impact of learners' characteristics on their readiness to accept Wiki pedagogy features, in three courses for teachers during three consecutive years.

The Study Participants:

The groups of teachers were taking M.Ed. literature courses in the years 2007-2009. Most of the learners in the three groups were women, reflecting the situation among teachers in Israel as a whole. The learners' age ranged from 26 to 63 years, while half of them were over 41 years old. groups200720082009Arabs972Jews101410Total192112 Apart from the national and linguistic variance, the teachers shared other characteristics such as experience in the field,

commitment to their workplace, a relatively advanced age, and the teaching of humanities and social studies. Description of the courses: The class work was mostly whole group discussions in Hebrew. The aims of Wiki integration were the following: a) to encourage a literary discussion with maximum participants; b) to increase collaboration among colleagues; c) to turn learners' interpretations into a subject of study in the course; d) to develop a motivating group project. The task: The task in the three courses was identical - to write an entry about a selected topic, connected to the literary work studied, relating it to entries written by colleagues, supplementing or expanding them. The tasks differed in the following preconditions: the way the topics were chosen – by the lecturer or by the learners; the levels of involvement in the processes of assessment – mere recommendation to assess colleagues' work or an explicit request to do so.

Research questions: 1. What patterns of the teachers' use of Wiki were exposed, in relation to their age, culture and mother tongue and task characteristics? The hypothesis was that the younger Hebrew speaking teachers would collaborate earlier than others. 2. Which attitudes did the teachers display to the writing and the study in the Wiki environment? The hypothesis was that the culture of teaching at their schools and in academia would influence the experience and the attitudes, as well as the level of difficulty the learners encountered. Data collection: The data were gathered from three sources: 1. Data provided by the Wiki environment. 2. Feedback by the participating teachers. 3. The lecturer's reflective diary. a) The Wiki environment provided information about the dates when the participants contributed to the editing of the entries and the 'discussion' pages. b) The entries were surveyed at three different points of time throughout the course, to examine the development of the writing, adherence to the subject of the entry and amount of information included, their organization and structure, and the number of links to their colleagues' pages and to other Internet pages. c) The 'discussion' pages were examined to ascertain a) the participants and b) the contents of the feedback. d) The written and oral feedback provided by learners throughout the course enabled an exploration of the learners' attitudes.

Findings and Discussion

Most learners expressed satisfaction with the activity in the Wiki environment (87%). Reasons mentioned: 1. The ongoing connection between the writing process and the lessons increased involvement during the course. 2. Exposure to colleagues' entries, provided food for thought. 3. Comments, written on the 'discussion' pages, helped and guided writing. Learners mentioned they were proud of contributing to knowledge beyond the limits of the specific course (60%). The preliminary apprehension at the Wiki transparency was replaced by a sense of sharing: you are not alone in the Wiki environment. Age and professional status: Unlike our hypothesis, teachers' age was not a decisive factor in their willingness to participate in the Wiki environment. It was affected more strongly by their perception of themselves as teachers with a social status and authority: They said it was not appropriate for them to reveal the process of their writing and partial work. Academic culture: The study confirmed our hypothesis that long-term academic habits of learning and teaching would affect participants' writing. Academic norms influenced their willingness to guide and criticize their colleagues' work. Evaluation was perceived as the lecturer's role. When required to react, the learners avoided criticizing their colleagues' entries on the 'discussion' pages. Most of the learners (80%) mentioned that they wished to preserve the exclusiveness of their entries and to prevent colleagues' intervention in their pages. Culture and language: Approximately half of the Arab learners postponed their activity in the Wiki environment and were in need of linguistic assistance in the editing of their entries. Some of them said they felt helpless when facing the multidirectional and unstructured task, which demanded interpretive daring - more so than their Jewish colleagues. Choice of topic: The way topics were chosen affected the pace and process of writing. When topics were learners' choice, learners began writing more rapidly and enthusiastically, but slowed down during the course, owing to new challenges arising in the group's discussions and in colleagues' entries. When topics were lecturer's choice the stage of entry took longer and the writing became more assiduous towards the end of the course. This affected the likelihood of exploiting the learners' entries during classroom discussions. The findings show that when teaching in the Wiki environment cultural, linguistic and professional components should be taken into account.

Bibliography

- Alsunbul, A. (2001). Education in the Arab world at the outset of the third millennium. Alexandria, Egypt: University Library.
- Farabaugh, R. (2007). 'The Isle is Full of Noises': Using Wiki Software to Establish a Discourse Community in a Shakespeare Classroom. *Language Awareness*, 16(1), 41-56.
- Lyndsay, G. (2006, May). Using Wikis in schools. Future lab innovation in education. Retrieved December, 1, 2009, from: http://www.futurelab.org.uk/resources/documents/discussion_papers/Wikis_in_Schools.pdf
- Ruth, A. & Houghton, L. (2009). The wiki way of learning. *Australasian Journal of Educational Technology*, 25(2), 135-152.

Wang, L., & Beasley, W. (2008). The Wiki as a web 2.0 tool in education. *International Journal of Technology in teaching and learning*, 4(1), 78-85.

PAPER PRESENTATION

Global Learning Environments – Integrating Virtual and Actual Sites for Teaching

Ken Stevens, Memorial University, Canada; Barbara Craig, Victoria University, New Zealand

Teachers are increasingly likely to teach in the spaces between schools as well as within the institutions to which they are appointed. Moreover, teachers are interacting with learners beyond the confines of the traditional school day. Teachers in some parts of the world are providing instruction beyond traditional classrooms in networks of schools that are located beyond major centres of population. In other places they are collaborating in networks of schools in inner city urban communities. Small, geographically isolated and large inner city urban schools alike are finding new opportunities in a global networked society. Using new digital technologies (Web 2.0) in the delivery of teaching and learning creates possibilities for teachers today to network and collaborate beyond their institutional walls (Granic, C'ukusic & Walker, 2009; O'Brien, Varga-Atkins & Qualter, 2008). Research on rural and urban learning networks is based on the convergence of two conceptual frameworks: (i) open and closed schools and (ii) horizontal and vertical integration. The convergence of these two frameworks guides the transfer of knowledge and skills from teacher education designed for teaching in traditional, physical, classrooms to include virtual teaching and learning based on a matrix of conceptual, pedagogical, technological and organizational change (Stevens, 2007). A process of teacher education is outlined in which teachers are prepared for the integration of actual (or physical) classes with virtual learning environments as schools are networked. The implications for teaching and learning in a global networked society have institutional, policy, financial and pedagogical implications.

This research is based on the convergence of two conceptual frameworks: (i) open and closed schools and (ii) horizontal and vertical integration. The convergence of these two frameworks will guide the transfer of knowledge and skills from traditional teacher education, focused on single classrooms, to open learning environments that include both inter-institutional teaching and learning and local and global community engagement. The two frameworks will be interpreted within a matrix of conceptual, pedagogical, technological and organizational change (Stevens, 2007). Schools as we have known them are autonomous institutions with their own teachers, their own students and their own cultures. Schools in each community to a considerable extent duplicate what schools are doing in other communities with students being taught by teachers assigned to teach face to face to whole classes, small groups and, in some cases, individually. There is nothing remarkable about this model of the school and it is an accepted part of the global educational landscape. Perhaps the most remarkable feature of this model of the school is that it remains largely unchallenged. This will be considered to be a "closed" model of the school. The "open" model is based on schools academically and administratively integrating with one another and with other institutions for at least part of a school day. Information and communication technologies facilitate the linking of classes in schools to share teaching, learning and resources. New digital technologies encourage learners to take control of their own learning, connecting them to experts locally and globally and allowing participation in virtual spaces. The open model challenges the closed model of the school by questioning the need for appointing all teachers to schools, rather than, in appropriate cases, some teachers being appointed to networks of schools (Ertl & Plante 2004). It questions the appropriateness of learners engaging solely with their peers within their own, physical classrooms and, it questions the very notion of a school itself. The open model of the school is grounded in the application of information and communication technologies to teaching and learning and the construction and deconstruction of virtual classes. In the open model of the school teaching and learning takes place electronically between as well as in classrooms. In the open model teaching and learning involves collaboration and connections between students, between students and teachers, students and experts, and, more often than not, beyond the confines of their own classrooms, their own school and their own country. In the closed model, teaching takes place only in classrooms.

The electronic linking of schools across dispersed sites to create academically and administratively integrated educational structures that support traditional, on-site teaching and learning, can be conceptualized as "horizontal integration" (Stevens & Stewart, 2005). By extending this model at the local or community level through connecting digitally with selected homes, services, libraries and businesses, "vertical integration" can be achieved. By vertically integrating homes into sites (local schools) that are horizontally integrated into federated teaching and learning structures (school district intranets), intellectual and skill capacity building can be leveraged. This model challenges the traditional concept of the school that is open only certain hours of the day and certain weeks of the year.

There are implications of the shift from closed to open classes and in the horizontal and vertical integration of schools for global learning (Barab, et. al., 2001). Schools can be extended in terms of time, space, organization and capacity.

This will be demonstrated on the basis of New Zealand research in inner city urban environments (Craig & Coman, 2009) and from Canadian research in rural communities (Hawkes & Halverson, 2002; Stevens & Stewart, 2005). The New Zealand research considers the pedagogical advantages of aggregating 6 urban high schools into a learning network and connecting them to wider opportunities through a bridge onto the Kiwi Advanced Research and Education Network (KAREN).

There are implications for the professional education of teachers for schools that have the capacity to engage with global learning environments (Green & Hannon, 2007; Lai, 2005; Scardamalia & Bereiter, 2006). New Zealand and Canadian research identifies specific technology gaps, teacher preferences for training approaches as well as new ways of relating to learners, to learners' parents, to networks and to communities that have implications for teacher professional development. Five implications will be analyzed in concluding this paper and will, hopefully, generate discussion that will inform current and future research.

References

- Barab, S.A., Thomas, M.K. & Merrill, H. (2001). Online Learning: From Information Dissemination to Fostering Collaboration, *Journal of Interactive Learning Research*, Vol. 12, No.1, pp: 105 – 143
- Craig, Barbara & Clare Coman (2009). Wellington Loop Preliminary Report December 2009 Department of Internal Affairs, New Zealand Government.
- Ertl, H. & Plante, J. (2004). Connectivity and Learning in Canada's Schools, Ottawa, Statistics Canada, Government of Canada.
- Granic, Andrina, Maja C'ukusic & Rob Walker (2009). mLearning in a Europe-wide network of schools. *Educational Media International* Vol.46, No. 3, September 2009, 167-184.
- Green, H. & Hannon, C. (2007). Their Space: Education for a Digital Generation, London, Demos.
- Hawkes, M. & Halverson, P. (2002). Technology Facilitation in the Rural School: An Analysis of Options, *Journal of Research in Rural Education*, 17 (3), 162-170
- Lai, K-W. (2005). e-Learning Communities: Teaching and Learning With the Web, Dunedin, University of Otago Press
- O'Brien, M., Varga-Atkins, T. & Qualter, A. (2008). The Liverpool learning networks: Developing, deepening, delivering. Final report of the Liverpool learning networks research project. Liverpool: The University of Liverpool for Liverpool City of Learning.
- Scardamalia, M. & Bereiter, C. (2006). Knowledge-building: Theory, Pedagogy and Technology, In: R.K.Sawyer (ed), *The Cambridge Handbook of the Learning Sciences*, New York, Cambridge University Press.
- Stevens, K.J. (2007). A Matrix for e-Collaboration to Provide Extended Learning Opportunities in Rural Schools, In: Ned Kock (ed) *Encyclopedia of E-Collaboration*, Hershey & New York, Idea Group Reference.
- Stevens, K.J. & Stewart, D (2005). *Cybercells – Learning in Actual and Virtual Groups*, Melbourne, Thomson-Dunmore Press.

PAPER PRESENTATION

Overcoming the Unshared Knowledge Barrier by Fostering Awareness of the Partners' Meta-Knowledge

Tanja Engelman, Knowledge Media Research Center, Germany; Friedrich W. Hesse, Knowledge Media Research Center, Germany

The present experimental study focuses on two problems occurring in computer-supported collaborative learning situations: First, it has been empirically proven that groups mainly discuss shared information, that is, information that is already known to all group members, while unshared information, that is, information that is known to only one member, is often neglected. However, such unshared information could be task-relevant. Therefore, taking unshared information into consideration should be fostered. Second, Wegener's theory of transactive memory system points out that groups perform better when the group members are informed about their collaborators' knowledge. However, acquiring correct knowledge about what others know is difficult. An approach for solving these two problems is introduced which provides the group members with the collaborators' meta-knowledge structures and underlying information by means of digital concept maps. The study compares 20 triads with spatially distributed group members that had access to their collaborators' meta-knowledge maps with 20 triads collaborating without these maps. Results on overcoming the unshared knowledge barrier showed, as expected, that the triads being provided with such maps started sooner to discuss unshared information, applied more of their collaborators' unshared information, and processed unshared information more deeply. Results on fostering group performance, however, demonstrated in contrast to Wegener's theory that being informed about the collaborators' meta-knowledge is not sufficient to increase computer-supported collaborative problem-solving. These results are discussed with regard to the results of comparable prior studies that had provided the group members additionally with their collaborators' concrete task-relevant knowledge.

Collaboration over distance becomes increasingly important. However, computer-supported collaboration still causes a lot of problems. Beside all the problems occurring in group situations, the group members also have to deal with problems of computer-support. The present empirical study focuses on two problems: First, empirical studies (e.g., Stasser et al., 1995) demonstrated that groups mainly focus their discussion on shared information, that is, information that is already known to all group members, while unshared information, that is, information that is known to only one member, is often neglected. However, such unshared information could be task-relevant. Therefore, taking unshared information into consideration should be fostered. An effective approach for solving this communication bias is role allocation (e.g., Stasser et al., 2000): Each group member is allocated to a role and is explicitly informed about the collaborators' expertise. In the present study, a different approach was investigated that makes the collaborators' expertise salient by fostering awareness regarding the collaborators' meta-knowledge structures and underlying information. Second, not knowing what the others know causes collaboration problems (Engelmann & Hesse, 2010). According to Wegner (1986), a transactive memory system provides a group with information about where in the group, that is, in which individual memory, specific knowledge is stored. Via communication a group member has access to the collaborators' knowledge. Empirical results showed that an effective transactive memory system increases group performance (e.g., Liang et al. 1995). Although, it is important to know what the collaborators know, it is not easy to acquire such knowledge, especially for newly formed groups participating in a computer-supported collaboration. A proven approach for a solution to this problem is to provide the group members access to the representations of the collaborators' knowledge and its underlying information by means of digital concept maps (e.g., Engelmann & Hesse, 2010). However, to date, it is not clear whether this tool for fostering knowledge and information awareness is effective because it makes the collaborators' concrete task-relevant knowledge available or because it makes the collaborators' meta-knowledge available. According to Wegener's theory of transactive memory system, it should be sufficient to be informed about the others' meta-knowledge to increase the group performance. Therefore, in the present study, a tool for fostering awareness regarding the collaborators' meta-knowledge structures is investigated with respect to its effect on computer-supported collaborative problem-solving. In the present empirical study, 20 triads with spatially distributed members who had access to their collaborators' meta-knowledge and underlying information both represented in digital concept maps were compared with 20 triads collaborating without seeing their collaborators' maps. Participants were 120 university students from different fields of study. The gender composition in the triads between the conditions was constant and the acquaintance among the group members was controlled. The group members were required to rescue a fictitious kind of spruce forest. The information units were evenly distributed among the three group members. Each participant had access to several unshared information units and with one member or with both members shared information units. After an individual phase in which each group member was asked to become familiar with her/his own knowledge and information, both represented via a digital concept map, they were requested to collaborate to solve the problems. To do this they had to compile their knowledge and information by creating a group concept map. Only in this collaborative phase were they able to speak with each other by using Skype. In the control condition, the group members had access to both their own working window containing their own knowledge and information, as well as to their shared working window for creating the group map. In the experimental condition, the group members had additionally access to their collaborators' working windows containing their collaborators' meta-knowledge structure and underlying information. Results on overcoming the unshared knowledge barrier showed, as expected, that the triads having been provided with the collaborators' meta-knowledge maps started sooner to discuss unshared information, applied more of the collaborators' unshared information, that is, they included more often unshared information of their collaborators in the group map, and processed unshared information more deeply. In contrast to our hypotheses, being informed about the collaborators' meta-knowledge is not sufficient to foster computer-supported collaborative problem-solving. The conditions did not differ regarding the group performance, although the results of the group maps analyses indicate that the two conditions used different strategies while creating their maps. To sum up, having access to the collaborators' meta-knowledge structures fosters sharing of unshared information and leads to better processing and application of unshared information. In addition, it results in the use of a different strategy regarding group map creation. However, in contrast to Wegener's theory of transactive memory system, the results gave evidence that it is not sufficient to know who knows what in the group, that is, to be informed about the others' meta-knowledge in order to increase group performance in computer-supported collaborative problem-solving tasks. These results are discussed with regard to the results of prior studies that provide the group members additionally with their collaborators' concrete task-relevant knowledge. Further analyses and studies are planned for finding the reasons for why knowing the collaborators' meta-knowledge is not sufficient.

Engelmann, T. & Hesse, F.W. (2010). How digital concept maps about the collaborators' knowledge and information influence computer-supported collaborative problem solving. *International Journal of Computer-Supported Collaborative Learning*, 5, 299-320.

Liang, D.W., Moreland, R., & Argote, L. (1995). Group versus individual training and group performance: The mediating role of transactive memory. *Personality and Social Psychology Bulletin*, 21, 384-393.

Stasser, G., Stewart, D.D. & Wittenbaum, G.M. (1995). Expert roles and information exchange during discussion: The importance of knowing who knows what. *Journal of Experimental Social Psychology*, 31, 244-265.

Stasser, G., Vaughan, S.I., & Stewart, D.D. (2000). Pooling unshared information: The benefits of knowing how access to information is distributed among members. *Organizational Behavior and Human Decision Processes*, 82, 102-116.

Wegner, D.M. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behaviour* (pp. 185-208). New York: Springer.

PAPER PRESENTATION

In quest of a framework for blending physical and virtual manipulatives in science experimentation

Georgios Olympiou, University of Cyprus, Cyprus; Zacharias Zacharia, University of Cyprus, Cyprus

In this study we aimed to investigate the effect of experimenting with Physical Manipulatives (PM), Virtual Manipulatives (VM), and a blended combination of PM and VM on undergraduate students' understanding of concepts in the domain of Light and Color. A pre-post comparison study design was used for the purposes of this study that involved 70 participants assigned to three conditions. The first condition consisted of 23 students that used PM, the second condition consisted of 23 students that used VM, and the third condition consisted of 24 students that used the blended combination of PM and VM. In the case of the blended combination, the use of VM or PM was selected based on whether it provides an advantage/affordance that the other medium of experimentation (PM or VM) cannot provide. All conditions used the same inquiry-oriented curriculum materials and procedures. Conceptual tests were administered to assess students' understanding before, during, and after teaching. Results revealed that the use of the blended combination of PM and VM enhanced students' conceptual understanding in the domain of Light and Color more than the use of PM or VM alone.

Aims Recent research studies have documented the need for the development of a framework that portrays how Physical Manipulatives (real world physical/concrete material and apparatus) and Virtual Manipulatives (virtual apparatus and material that exist in virtual environments, such as computer-based simulations) could be combined in order to enhance students' learning through science experimentation (Authors, 2010; Jaakkola et al., 2010). The purpose of this study was to contribute towards the development of such framework. Specifically, we set as our learning objective the improvement of students' conceptual understanding and proceeded with the development of a framework that blends PM and VM affordances/advantages according to the effect they have on students' conceptual understanding. In doing so, we identified through prior research the PM and VM affordances that were found to support students' conceptual understanding and created blended combinations of PM and VM for all of the study's experiments. The research question of this study was: Should the use of a blended combination of PM and VM be preferred over the use of PM or VM alone, when the enhancement of students' conceptual understanding through laboratory experimentation is at task?

Methodology

A pre-post comparison study design was used for the purposes of this study that involved 70 undergraduate students, who were enrolled in an introductory physics course that was based upon the Physics by Inquiry curriculum (McDermott et al., 1996). The participants were randomly separated into three conditions. The first condition was assigned 23 students to use PM, the second condition was assigned 24 students to use VM, and the third condition was assigned 24 students to use the blended combination. The students in all conditions were randomly assigned to three-member groups as suggested by the curriculum of the study. Blending PM and VM was based on each medium's unique advantages/affordances that were identified through prior research. In other words, PM or VM were selected whenever they had an affordance/advantage over the other medium for each one of the experiments involved in this study. The combination, as such, varied across the study's experiments according to the learning objectives that each experiment aimed to serve. The curriculum used in this study involved the 3 sections of the module of Light and Color of the Physics by Inquiry curriculum, namely, introduction to light and shadows, colors in painting and colored light. As far as the material/manipulatives used for conducting the experiments of the curriculum, the use of PM involved physical material, whereas, the use of VM involved the Virtual-Lab Optilab (see Figure 1; Hatzikraniotis et al., 2007). The duration of the study was 13 weeks. All conditions were facilitated in the same laboratory environment that hosts both conventional equipment and a computer network arranged at the periphery. Students met once a week for one and a half hour. The time-on-task was the same for all conditions. INSERT FIGURE 1 ABOUT HERE Previously validated conceptual tests were administered to assess students' conceptual understanding before, during and after the study (see Figure 2). All tests contained open-ended questions, which were scored and coded blind to the condition in which the student was placed. The reliability measures were above 0.93

across all tests. INSERT FIGURE 2 ABOUT HERE The data analysis involved both quantitative and qualitative methods. The quantitative analysis involved: (a) one-way ANOVA for the comparison of the pretest scores of the three conditions on each test, and (b) one-way ANCOVA for the comparison of the posttest scores of the three conditions on each test. The qualitative data analysis focused on identifying and classifying students' conceptions concerning light, shadows, colored paint and colored light. The analysis followed the procedures of open coding (Strauss & Corbin, 1996).

Findings and Discussion

The ANOVA procedure indicated that the three conditions did not differ in pretest scores across all of the study's tests. However, the ANCOVA procedure revealed differences among the study's three conditions. Bonferroni-adjusted pairwise comparisons suggested that students' posttest scores in the PM alone and VM alone conditions were significantly lower (pLight & Color concepts that were introduced through the curriculum material of this study, more than the PM or VM conditions did. The qualitative analysis confirmed the findings of the quantitative analysis. Specifically, the PM&VM condition was found to have, in all posttests, the highest prevalence for each scientifically-accepted conception and the least for each misconception. The fact that the use of a blended combination of VM and PM, which is grounded on a framework similar to the one developed in this study, appears to be more conducive to learning through laboratory experimentation than the use of PM and VM alone, challenges the already established norms concerning teaching and learning through experimentation in the science classroom. Specifically, it challenges the laboratory experimentation as we experienced it through PM or VM, in a way that calls for its redefinition and restructuring, in order to include blended combinations of VM and PM.

References

Authors (2010). Learning and Instruction.

Hatzikraniotis, E., Bisdikian, G., Barbas, A., & Psillos, D. (2007). Optilab: Design and development of an integrated virtual laboratory for teaching optics. In C. P. Constantinou, Z. C. Zacharia, & M. Papaevripidou, Proceedings of the 7th International Conference on Computer Based Learning in Science. Greece: TEI Crete.

Jaakkola, T., Nurmi, S., & Veermans, K. (2010). A Comparison of Students' Conceptual Understanding of Electric Circuits in Simulation Only and Simulation-Laboratory Contexts, *Journal of Research in Science Teaching*. DOI 10.1002/tea.20386.

McDermott, L. C. & The Physics Education Group (1996). *Physics by Inquiry*. NY: Wiley.

Strauss, A., & Corbin, J. (1996). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. London: Sage Publications.

PAPER PRESENTATION

Chaining single versus dual format representation to improve mental model building from animation

Jean-Michel Boucheix, University of Dijon, LEAD-CNRS, France; Richard Lowe, School of Education, Curtin University, Australia; Dian Kemala Putri, University of Djakarta, Indonesia

The goal of the experiment presented in this paper was to test whether mental model building from animations could be improved by using external simplified representations of the dynamic process, such as static key frames are in effect 'small scale models'(Johnson-Laird, 1998). We chained similar or different pairs of representations to examine the effect of various couplings on learning from a complex animation of an upright piano mechanism. Across a presentation, the presence and temporal location of a series of static pictures showing the key step of the dynamic process and of the animation were manipulated. Four versions of the presentation with different representational couplings were compared across four groups in a learning task given to 82 participants. In each version, information was delivered in two learning stages. In the first version, a series of 6 Static pictures (St) depicting key steps of the mechanism were simultaneously presented during the learning stage 1 then followed by presentation of the Animation (An) during the learning stage 2: St+An. In the second version, the presentation order was reversed An+St. The two other versions were controlled modalities using a single format, respectively St+St and An+ An. Results of comprehension post-tests indicated significantly higher mental model scores the dual format versions than for the single format versions. The findings are discussed in terms of working models.

Building internal 'runnable' mental models (Mayer, 2005) that are of high quality from an external animation requires managing high levels of processing demands. Johnson-Laird (1998) argued that in order to be manipulable in working memory, mental models need to be "simplified representations" or "small-scale models" of the external world. The experiment presented in this paper examined whether the building of mental models from animations could be improved by chaining them with external simplified representations of the dynamic referent content. Previous studies have used simplified formats such as a series of static pictures or animation segments to depict the key steps of an

animation (e.g. Kriz & Hegarty, 2007; Arguel & Jamet, 2008; Rebetz, & al., 2009; Béétrancourt & Morand, 2010). However, in most studies, key steps were presented alone (with text), or at the same time as the animation. Results were not consistent, showing no or slight comprehension differences between the tested versions. In this study, we used an alternative approach to test the effect of the presentation of simplified external representations, on learning from a complex animation. We manipulated the presence and the temporal location of (i) a series of static pictures and (ii) the corresponding animation. A complex animation of an upright piano mechanism was used without text (Figure 1). Four pairings of presentations were compared. In each presentation, the information was delivered in two learning stages. In the first version, a series of 6 Static pictures (St) depicting key steps of the mechanism were simultaneously presented during the learning stage 1 then followed by presentation of the Animation (An) during the learning stage 2: St+An. In the second version, the presentation order was reversed An+St. The two other versions were controlled modalities using a single format, respectively St+St and An+ An. Higher quality mental models were predicted in the St+An, and to a less extent in the An+St condition, than in the single format conditions. In the St+An condition, we expected that in the first learning stage, learners would build a mental model of the mechanism operation by making inferences between the static key steps via active comparison and mental manipulation of the various pictures in the series. In the second learning stage, learners would use the presented animation to check this mental model. Feedback from the animation would allow them to adjust their representation previously built in stage one. In the An+St condition, learners could apply a first model built in the learning stage one to perform inferences between the static pictures in learning stage two. In the single format conditions, there are no such opportunities to 'test' the first-stage mental model against an alternative representation.

Method

After testing for spatial abilities and prior knowledge, the 82 participants (undergraduate students) were randomly assigned to four groups (two dual-format and two single-format conditions). The material was composed of a series of static pictures and an animation of the upright piano mechanism. During the learning period, each participant studied how the piano mechanism worked from the depictions provided. Total learning time was fixed at 3'30", with 1'45" for each stage (An or St) of the learning session. A cross movement post-test was a direct measure of the recall of the local motion of each component. On a single picture of the upright piano, learners moved crosses on the screen using the computer mouse to show the direction and amplitude of each piano component's movement. The second post test was a comprehension measure of the quality of the mental model of the piano operation. Participant had to write a precise explanation of 'what happens for each component of the piano when a pianist presses the key and then releases it'. Results Figure 2 shows the performance (% of correct answers) for each post-test. test and mental model quality test, for each type of presentation. A repeated measures ANOVA showed mainly a significant interaction between the type of presentation and the two post-tests, $F(3,78) = 6.52$, p Univariate analysis showed a significant effect of the type of presentation for the mental model score, $F(3,74) = 4.44$, $p = .006$, Eta square = .15. Scores for St+An and An+St were higher than scores for St+St and An+An, $F(1,74) = 10.01$, $p = .002$. Univariate analysis for the local motion score showed no effect of the type of presentation, $F(3,74) = 0.85$, $p = .046$, Eta square = .03.

Discussion and future work In learning from animation, the use of manageable representation of the dynamic process improves mental model building quality. We showed that dual external format presented sequentially were more efficient than single format. "Small-scale models" such as static key frames, should not be used as substitutes instead of animations, but as "working models" to learn more from animations. In future work, eye tracking recording will be used in order to investigate how learners "work-with" dual versus single formats.

References

- Arguel, A., & Jamet, E. (2009). Using video and static pictures to improve learning of procedural contents. *Computers in Human Behavior*, 25(2), 354-359.
- Kriz, S., & Hegarty, M. (2007). Top-down and bottom-up influences on learning from animations. *International Journal of Human-Computer Studies*, 65, 911-930.
- Johnson-Laird, P. N. (1998). Imagery, visualization, and thinking. In J. Hochberg (Ed.), *Perception and Cognition at the Century's End* (pp. 441-467). San Diego, CA: Academic Press.
- Mayer, R.E. (2005). *The Handbook of Multimedia Learning*, New York: Cambridge University Press.
- Morand, L. & Béétrancourt, M. (2010). Collaborative Learning with Single or Multiple Animations. EARLI Conference, SIG2. Comprehension of Text and Graphics, Týbingen, August 25-28.
- Rebetz, C., Béétrancourt, M., Sangin, M., & Dillenbourg, P. (2010). Learning from animation enabled by collaboration. *Instructional Science*, 48, 471-485.

PAPER PRESENTATION

Emotional effects in multimedia learning

Steffi Heidig (Domagk), University of Erfurt, Germany; Jan L. Plass, New York University, United States; Eunjoon Rachel Um, The New York Times, United States; Helmut M. Niegemann, University of Erfurt, Germany

In contrast to cognitive factors, emotional variables are rarely discussed in multimedia learning research. However, emotions can affect cognitive processing and are assumed to affect learning mediated through motivation, learning strategy use and the use of cognitive resources (e.g., Pekrun, 1992). Based on a study by Um, Song, and Plass (2007), we examined the effects of positive emotions on learning. Additionally, we investigated motivational and cognitive factors mediating the effect of emotions on learning. As Um et al. (2007) further showed that an appealing design of a multimedia learning material may induce positive emotions in learners, we applied a 2x2-design, using both a mood induction procedure and the design of the learning material as methods to manipulate the learners' emotions. The results indicate that an appealing design was able to induce positive emotions and facilitate comprehension. In contrast to Um et al.'s (2007 study, transfer performance has not been affected by positive emotions or design. A further analysis on the mediating motivational and cognitive factors aims at providing insight on the effects of emotions on learning.

Theoretical framework

Research on multimedia learning so far has mainly focused on cognitive factors, especially on balancing the amount of cognitive load induced by the design of the learning environment (e.g., Mayer, 2009; Plass, Moreno, & Brýnken, 2010). Emotional factors however, have so far largely been neglected, although they have been shown to affect cognitive processing and problem solving (e.g., Bless, 2001; Isen et al., 1984). The cognitive-motivational model (Pekrun, 1992) further predicts learning effects of emotions that are mediated by cognitive and motivational mechanisms such as intrinsic motivation, learning strategy use and the use of cognitive resources. In the context of multimedia learning, Um, Song, and Plass (2007) showed that positive emotions during learning facilitated intrinsic motivation as well as comprehension and transfer performance. Their results further indicate that an aesthetically more appealing design may induce positive emotions compared to a less appealing one. In the present research aimed to replicate and extend that study we explore the effect of an aesthetically appealing design on learners' emotions, and the effect of emotions on motivation and learning. In accordance with the cognitive-motivational model on the effects of emotions (Pekrun, 1992), we further introduced learning strategy use and task-irrelevant thinking as dependent variables as there are assumed to mediate the effects of emotions on learning. Methodology Design

A 2x2 factorial design was applied, manipulating the participants' emotions externally to the learning task by presenting short films in the beginning of the study (positive vs. neutral) or internally by varying the design of the learning material (positive vs. neutral). The neutral learning material was designed in a black and white layout, whereas the positive learning material featured warm colors and baby face cues.

INSERT_TABLE_1 Data Sources

The participants were 121 college students (85.3% female). The mean age was 21.98 years (SD=2.13). The participants were randomly assigned to the 4 treatment groups: positive emotions/positive design (PEPD, n=31), positive emotions/neutral design (PEND, n=30), neutral emotions/positive design (NEPD, n=30), neutral emotions/neutral design (NEND=control, n=30).

Materials

A multimedia learning environment on immunization served as learning material (positive or neutral design; Um et al., 2007). Online questionnaires included the Positive Affect Schedule (PAS) from the Positive and Negative Affect Schedule (PANAS) to assess the participant's emotional state, a 7-item-scale to assess intrinsic motivation, 23 items for learning strategy use, 15 items on task-irrelevant thinking as well as a learning test including comprehension and transfer tasks.

Procedure

After a short instruction, the participants were presented either the positive or the neutral film in order to externally induce emotions and answered the PAS. This was followed by the learning period (positive or neutral design). The participants then answered the PAS for the second time, the intrinsic motivation-, learning-strategy- and task-irrelevant-thinking-scale and the learning test. Results Manipulation Check

A ONEWAY ANOVA revealed a main effect for the external emotion induction on the PAS, $F(1, 119)=13.60$, $p\&\eta^2=.10$. Participants who were presented the positive film reported more positive emotions than subjects who watched the neutral film.

INSERT_TABLE_2 Does an aesthetic design of a multimedia learning material induce positive emotions?

ANOVAs for repeated measures on the PAS scores (after film, after learning) of each experimental group showed that

- externally induced emotions decreased over time (PEND-group: $F(1, 29)=26.57$, $p\&\eta^2=.48$),
- an aesthetic/positive design helped to maintain positive emotions (PEPD-group: $F(1, 30)=2.08$, $p=.16$),

- positive emotions were induced by the aesthetic design of the learning material (NEPD-group: $F(1, 29)=5.57$, $p=.03$, $\eta^2=.16$),
- the control group remained at a neutral emotional level ($F(1, 29)=.21$, $p=.65$).

Therefore, an aesthetically appealing design seems to facilitate positive emotions during learning. Do positive emotions facilitate learning outcomes?

A two-factor ANOVA revealed no main effect for positive emotions on comprehension, $F(1, 117)=.91$, $p=.34$. However, it showed a main effect for design on comprehension, $F(1, 117)=7.00$, $p=.01$, $\eta^2=.06$. Learners that were presented an aesthetically appealing learning material performed better on comprehension tasks than learners that were presented with a neutral design. Further, a second two-factor ANOVA indicated neither a main effect for positive emotions on transfer, $F(1, 117)=3.65$, $p=.06$, nor a main effect for design on transfer, $F(1, 117)=.02$, $p=.85$. Hence, the four groups did not differ in their transfer performance. Do cognitive and motivational factors mediate the effect of emotions on learning?

Preliminary correlational analyses showed relations between the learner's emotions and motivation, learning strategies as well as task-irrelevant thinking. Further, multiple regression models indicated an effect of these variables on comprehension and transfer. We did not provide any numbers yet, as we are going to analyze these relationships using structural equation modeling and present the results.

Discussion

In sum, the results of the study indicate that the presentation of an aesthetically appealing learning material may induce positive emotions and facilitate comprehension. A facilitating effect of positive emotions and design on transfer as reported by Um et al. (2007) could not be fully replicated in the presented study. Both studies however, show first evidence that emotional factors may play a decisive role in multimedia learning and should therefore been taken into account when designing multimedia learning materials. Further, SEM-analyses are going to provide insight in mediating factors between emotions and learning. More research is needed to examine the role of emotions in complex learning processes, and appropriate aesthetic design factors for an emotional multimedia design.

References

- Bless, H. (2001). The consequences of mood on the processing of social information. In A.Tesser & N.Schwarz (Hrsg.), *Blackwell Handbook in Social Psychology* (S. 391-412). Oxford, UK: Blackwell Publishers.
- Isen, A.M., Daubmann, K.A., & Nowicki, G.P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and social Psychology*, 56(6), 1122-1131.
- Mayer, R.E. (2009). *Multimedia learning* (2. Aufl.). Cambridge: Cambridge University Press.
- Pekrun, R. (1992). The impact of emotions on learning and achievement: Towards a theory of cognitive/motivational mediators. *Applied Psychology: An International Review*, 41, 359-376.
- Plass, J.L., Moreno, R., & Brýnken, R. (2010). *Cognitive Load Theory*. Cambridge: Cambridge University Press.
- Um, E., Song, H., & Plass, J.L. (2007). The Effect of Positive Emotions on Multimedia Learning. Paper presented at ED-MEDIA, June 25th-29th, Vancouver/Canada.

PAPER PRESENTATION

Effects of Gaps in Worked Examples on Motivation and Complex Skill Acquisition in Medical Education

Lena Hofmann, University of Munich, Germany; Karsten Stegmann, Universität Landau, Germany; Matthias Siebeck, University of Munich, Germany; Frank Fischer, Universität München, Germany

An important competence of medical doctors is the communication with patients, especially in breaking bad news (BBN) situations. Protocols like SPIKES (Baile et al., 2000) provide steps how to appropriately communicate BBN situations. According to common competence definitions, it is not sufficient to have knowledge on the SPIKES. In addition, the application of knowledge (including the underlying motivation) is necessary as well. Worked-out examples have been broadly applied to support acquisition of applicable knowledge and learners are usually highly motivated to learn with worked-out examples. Research has shown that especially self-explanations during learning with worked-out examples are related with learning. Self-explanations have been successfully triggered by adding gaps into the worked-out example and ask learners to anticipate the next steps. Videos can be used as worked-out examples especially when no predetermined solution is available. In our study 159 medical students learned the complex skill of delivering a cancer diagnosis which is linked to coping with negative emotions. We examined the effect the completeness of video-based worked-out examples (complete vs. with gaps) on knowledge acquisition, motivation and complex skill acquisition regarding BBN. We found a positive effect of the video-based worked-out example in general on motivation but not on knowledge acquisition. Furthermore, students that worked with

incomplete worked-out examples (with gaps) were significantly better in the complex skill of BBN than those who worked with complete worked-out examples.

An important competence of medical doctors is to adequately communicate with patients, especially in breaking bad news (BBN) situations. Protocols like SPIKES (Baile et al., 2000) provide steps how to communicate BBN situations. According to competence definitions it would not be sufficient to have knowledge on the SPIKES. In addition, the application of knowledge (including the underlying motivation) is necessary as well. However, situations like BBN are connected with negative emotions that may reduce the motivation to perform the learned skill. Medical doctors who feel high anxiety or shame regarding BBN may rather try to be quick and superficial instead of prudent. Worked-out examples have been broadly applied to support acquisition of applicable knowledge and learners are usually highly motivated to learn with worked-out examples. They can serve as expert models and are especially helpful to enhance problem solving skill when combined with self-explanations (Crippen & Earl, 2007). Self-explanations can be implemented in gaps within incomplete worked-out examples and have shown to support the quality of self-explanations for near and medium transfer (Stark, Mandl, Gruber, & Renkl, 1999). There is an immense body of evidence that worked-out examples enhance knowledge acquisition and self-efficacy under certain conditions (Renkl, 1997). Videos can be used as worked-out examples especially when no predetermined solution is available because diversity is demonstrated with complex content in context (cf. McLaren et al., 2006). However, whether worked-out examples affect the acquisition of complex communication skill and whether motivation to apply the knowledge is positively affected is rarely examined yet.

Research question

To what extent does the completeness of video-based worked-out examples (complete vs. with gaps) affect knowledge, complex skill and motivation in the context of medical education?

Method

In a one-factorial pre-post design we implemented a video-based worked-out example and varied the completeness (complete vs. with gaps). 159 medical students at the LMU Munich were randomly assigned to one of the two conditions. The learning session on BBN is a mandatory module of the Medical Curriculum Munich (MeCuM). Learners were asked to read a 2000 words summary on the SPIKES (15 minutes).

Learning material and task. 30 minutes were given for the video-based worked-out example that lasts 11 minutes. This video showed a simulated BBN situation where a medical student in the role of the doctor delivers a cancer diagnosis to a patient. It was segmented into 11 episodes. For each episode, learners could open an analysis of the doctor's acting according to the SPIKES and suggestions how to do better.

Independent variables. In the incomplete condition, four episodes were stopped before the doctor took action. Learners were asked to write down how they would proceed. After they had submitted their solution, learners were asked to compare their procedure with the solution suggested by the expert.

Dependent variables. BBN-related motivation was measured before and after the worked-out example using four items with a 5-point Likert scale with sufficiently high reliability. Knowledge regarding BBN was measured before and after the worked-out example with a video-based test. In this test, the learners watched three video-based examples without instructional explanations from two different simulated BBN cases. Learners were asked to describe how they would act after each episode. The answers were coded with a coding scheme based on SPIKES with the amount of steps listed according to the SPIKES as the indicator for knowledge on this procedure. To exclude effects of the different BBN cases we z-standardised the scores separately and included the order as a random factor in the statistical analysis. The BBN skill was measured on the following day. Each student was allocated a 10 minutes time slot to deliver a cancer diagnosis in a realistic scenario to simulated patient (SP). Deliveries took place in individual sessions and were videotaped. After 10 minutes the students got feedback from the SP (10 minutes). The quality of BBN conversations was coded with a coding scheme based on the SPIKES. Inter-rater reliability was sufficiently high. The amount of steps listed according to the SPIKES served as measure for the complex skill regarding BBN.

Results

We found a general positive effect of the video-based worked-out example on BBN-related motivation. No effects of the completeness of the worked-out examples were found. With respect to knowledge acquisition we did neither find an effect of the worked-out example nor an interaction effect with completeness. The completeness had a positive effect on complex skill acquisition with respect to BBN. Learners who learned with gaps in their worked-out examples showed a significantly higher skill during the BBN simulation in the transfer scenario with the SP.

Discussion

Our results provide evidence that video-based worked-out examples can foster complex skills regarding communication in the context of medical education. While the knowledge seems to be acquired just by reading the text on SPIKES, the worked-out examples facilitated the motivation and skill regarding BBN. The gaps increased this effect regarding the skill, which might be due to the usage of self-explanations. Finally, incomplete video-based worked-out examples seem to be a good preparation for simulation-based learning with SP.

References

- Baile, W. F., Buckman, R., Lenzi, R., Glober, G., Beale, E. A., & Kudelka, A. P. (2000). SPIKES-A six-step protocol for delivering bad news: application to the patient with cancer. *The Oncologist*, 5(4), 302-311.
- Crippen, K. J., & Earl, B. L. (2007). The impact of web-based worked examples and self-explanation on performance, problem solving, and self-efficacy. *Computers & Education*, 49(3), 809-821.
- McLaren, B. M., Lim, S.-J., Gagnon, F., Yaron, D., & Koedinger, K. R. (2006, June 26-30). Studying the effects of personalized language and worked examples in the context of a web-based intelligent tutor. Paper presented at the 8th International Conference on Intelligent Tutoring Systems, Jhongli, Taiwan.
- Renkl, A. (1997). Learning from worked-out examples: A study on interindividual differences. *Cognitive Science*, 21, 1-29.
- Stark, R., Mandl, H., Gruber, H., & Renkl, A. (1999). Instructional means to overcome transfer problems in the domain of economics: Empirical studies. *International Journal of Educational Research*, 31(7), 591-609.

PAPER PRESENTATION

Interactivity in multimedia learning: Using the INTERACT model to structure and inform research

Jan L. Plass, New York University, United States; Steffi Heidig (Domagk), University of Erfurt, Germany; Ruth N. Schwartz, New York University, United States

Since the introduction of computers as tools for learning, interactivity has been much discussed as holding strong promise for educational use (e.g., Hannafin & Peck, 1988; Bransford et al., 1999; Renkl & Atkinson, 2007). But does interactivity in fact improve the quality and effectiveness of learning environments? Empirical investigations to date have yielded mixed results (e.g., Moreno & Mayer, 2005; Moreno & Valdez, 2005; Schwan & Riempp, 2004). Two critical factors seem to have played a part in producing these inconsistencies. First, definitions and theoretical treatments of interactivity have not been consistent (e.g., Betrancourt, 2005; Kennedy, 2004; Sims, 1997; Moreno & Mayer 2007). Similarly, approaches to operationalizing this construct in research have varied widely (e.g., Moreno & Mayer, 2005; Schwan & Riempp, 2004). In response, we propose a standardized definition as well as a process approach for operationalizing interactivity. The Integrated Model of Multimedia Interactivity (INTERACT) describes a system of six interdependent components of interactivity (Domagk, Schwartz, & Plass, 2010). The relationships and feedback among these components comprise interactivity. Because the components can be individually considered and systematically varied, the application of INTERACT as a model for investigating interactivity can facilitate more rigorous empirical investigations, comparisons between studies, and the derivation of broad principles for the design of interactive learning environments. Additionally, constructs such as learner control, guidance, and feedback, commonly discussed with regard to interactivity, can be reconsidered using the INTERACT model.

Since the introduction of computers as tools for learning, interactivity has been much discussed as holding strong promise for educational use (e.g., Hannafin & Peck, 1988; Bransford et al., 1999; Renkl & Atkinson, 2007). But does interactivity in fact improve the effectiveness of learning environments? Empirical investigations to date have yielded mixed results (e.g., Moreno & Mayer, 2005; Moreno & Valdez, 2005; Schwan & Riempp, 2004). Two critical factors seem to contribute to these inconsistencies. First, definitions and theoretical treatments of interactivity have not been consistent (e.g., Kennedy, 2004; Sims, 1997; Moreno & Mayer 2007). Similarly, approaches to operationalizing this construct in research have varied widely (e.g., Moreno & Mayer, 2005; Moreno & Valdez, 2005; Schwan & Riempp, 2004). In response, we propose a standardized definition as well as an approach for operationalizing interactivity. The Integrated Model of Multimedia Interactivity (INTERACT) describes a system of six interdependent components of interactivity (Domagk, Schwartz, & Plass, 2010). The relationships and feedback among these components comprise interactivity. Because the components can be individually considered and systematically varied, the application of INTERACT as a model for investigating interactivity can facilitate more rigorous empirical investigations, comparisons between studies, and the derivation of broad principles for the design of interactive learning environments. Defining Interactivity

Formal definitions, although varying widely (e.g., Kennedy, 2004; Moreno & Mayer, 2007), agree that interactivity requires two fundamental conditions: (a) at least two participants, and (b) reciprocity. Accordingly, we define interactivity in multimedia learning as follows:

Interactivity in the context of computer-based multimedia learning is reciprocal activity between a learner and a multimedia learning system, in which the [re]action of the learner is dependent upon the [re]action of the system and vice versa.

This emphasizes the dynamic relationship between the learner and the learning system, acknowledging that a multimedia learning environment per se cannot be interactive, but can only include features with the potential to engage the learner (Kennedy, 2004).

Operationalizing Interactivity

Beyond definition, the concept of interactivity must be operationalized to support systematic investigations. Previous attempts at classification have focused on systems and affordances (Sims, 1997, Schwier & Misanchuk, 1993). Some recent approaches, though considering the learner, continue to emphasize the medium rather than cognitive processes evoked (Moreno & Mayer, 2007; Kalyuga, 2007). Although Kennedy's learner-focused model of interactivity (2004) stresses both behavioral and cognitive activities, it is not far-reaching enough. Neither individual differences of the learner nor affective aspects are considered, and the mental model is viewed as an end product only, rather than as part of the continuous feedback loop. The INTERACT model takes a systemic approach, including both the learner and the learning environment, focusing on interactivity as a process, and introducing the critical components of affect and individual differences, which have not previously been integrated into discussion of interactivity. Additionally, INTERACT views the mental model as part of an integrated feedback process: Knowledge structures result in, but also lead to, changes in behavior, cognition, and emotion.

The INTERACT-Model

The Integrated Model of Multimedia Interactivity (INTERACT) includes six principal components which together make up an integrated system: the learning environment, behavioral activities, cognitive/metacognitive activities, motivation and emotion, learner variables, and the learner's mental model. The interactivity process is represented by the feedback loops connecting these components. Each of these components is theoretically based and will be discussed in more depth during the presentation.

Insert Figure 1

Applying INTERACT

The INTERACT model is both theoretically and practically significant. Together, the elements of the INTERACT model and the relationships among them represent the complex and dynamic interplay between a multimedia learning system and a learner. The identification of these six specific components, and the feedback loops that describe the flow of the interactive process, introduces into the construct of interactivity the conceptual clarity needed to interpret and compare previous findings as well as to guide future research on interactive learning environments. For example, the most commonly discussed types of interactivity—learner control, guidance, and feedback—can be understood and illuminated using the INTERACT model. Finally, on a practical level, INTERACT can provide educators and educational designers with a process approach that allows them to design and evaluate effective interactive components for multimedia instruction.

References

- Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Domagk, S., Schwartz, R.N., & Plass, J.L. (2010). Interactivity in multimedia learning: An integrated model. *Computers in Human Behavior*, 26, 1024–1033
- Hannafin, M. J., & Peck, K. L. (1988). *The design, development and evaluation of instructional software*. New York: MacMillan.
- Kalyuga, S. (2007). Enhancing instructional efficiency of interactive e-learning environments: A cognitive load perspective. *Educational Psychology Review*, 19, 387–399.
- Kennedy, G. E. (2004). Promoting cognition in multimedia interactivity research. *Journal of Interactive Learning Research*, 15, 43–61.
- Moreno, R., & Mayer, R., (2005). Role of guidance, reflection, and interactivity in an agent-based multimedia game. *Journal of Educational Psychology*, 97 (1), 117-128.
- Moreno, R., & Mayer, R. E. (2007). Interactive multimodal learning environments. *Educational Psychology Review*, 19, 309–326.
- Moreno, R., & Valdez, A. (2005). Cognitive load and learning effects of having students organize pictures and words in multimedia environments: The role of student interactivity and feedback. *Educational Technology , Research and Development*, 53, 3, pp. 35–45.

- Renkl, A., & Atkinson, R. K. (2007). Interactive learning environments: Contemporary issues and trends. An introduction to the Special Issue. *Educational Psychology Review*, 19, 235–238.
- Schwan, S., & Riempp, R. (2004). The cognitive benefits of interactive videos: learning to tie nautical knots. *Learning and Instruction*, 14, 293–305.
- Schwier, R. A., & Misanchuk, E. R. (1993). *Interactive multimedia instruction*. New Jersey: Educational Technology Publications.
- Sims, R. (1997). Interactivity: A forgotten art? *Computers in Human Behavior*, 13(2), 157–180.

PAPER PRESENTATION

Knowledge and Clinical Decision Making by Novice, Intermediate and Experienced Midw

Jill Scevak, University of Newcastle, Australia; Nerida Ambler, University of Newcastle, Australia

Quality of Prior Knowledge and Clinical Decision Making by Novice, Intermediate and Experienced Midwives This study reports an investigation of knowledge growth and structure in novice and intermediate student and experienced midwives. Fifteen student midwives were asked to reflect on their first and last (20th) birth and twelve experienced midwives were asked to reflect on their last birth. All verbal protocols were coded for type of knowledge recalled based on a coding scheme developed for the study. The theoretical basis of the coding scheme was derived from the research literature that the development of expertise is strongly linked with the growth of sophisticated knowledge structures. Non-parametric statistical tests (Wilcoxon Signed Ranks & Mann-Whitney) were used to examine the group differences across the coding categories. The SOLO Taxonomy (structure of the learning outcome) was used to examine group differences in the structure of knowledge. Results indicated that the experienced midwives were more likely to have a more sophisticated structured knowledge base. The results suggest an important role for prior knowledge and its structure in explaining the differences between the groups in the quality of their clinical decision making, implications for nurse education and professional development are discussed.

Midwives are faced with potential clinical problems in every delivery they attend and their ability to deal with these problems in a competent way is important for safe and effective midwifery practice. The major aim of nurse educators and university nursing schools is to develop midwives with good clinical problem solving abilities. The study of clinical problem solving used by nurses, medical doctors and students has attracted much attention in the research literature and the focus of these research studies has been on the differences between expert and novice problem solvers (Boshuizen & Schmidt, 1992). To account for these differences factors such as clinical experience (Norman, Trott, Brooks & Smith, 1994; Tabak, Bar-Tal & Cohen-Mansfield, 1996), structure and use of knowledge for problem solving (e.g. Patel & Kaufman, 2000; Hassebrock & Prietula, 1992; Boshuizen & Schmidt, 1993) and reasoning processes used in processing clinical data for diagnosis (e.g. Leprohon & Patel, 1995; Patel, Groen & Arocha, 1990) have been examined. A major theme arising from this literature is the importance of the structure and use of knowledge for problem solving. Differences in the quality of knowledge structures amongst expert and novices accounted for the differences in the quality of their decision making (Freeman, 2003; Simpson & Know, 2003; Fox-Young, 2002; Danerek & Dykes, 2001). The relationship between the quality of knowledge structures and quality of decision making has been demonstrated in number of studies (e.g. Rikers, Schmidt & Boshuizen, 2002; Gilhooly, 1996; Bordage, 1994; Grant & Marsden, 1987). For example Boshuizen and Schmidt (1992, 1993) used the verbal protocol method and were able to discriminate between the quality of knowledge structure used by medical doctors at varying levels of expertise in their diagnosis. They found that recall of case relevant information was found to be non-linear, with both experts and novices recalling less information than intermediates. Experts reasoning was based on higher-order propositions or 'encapsulated clinical knowledge' whereas novices and intermediates reasoning was based on data acquisition and elaboration. Rikers, Schmidt & Boshuizen (2002) found that experts process clinical cases almost entirely in an encapsulated mode. While the research literature would suggest that the quality of prior knowledge distinguishes experts from novices in the quality of problem solving little of this research has been extended to the practice of midwifery. The aim of this study is to examine the acquisition of midwifery competence and associated knowledge, skills and attitude by midwives in the practice of midwifery through analysis of the development and application of prior knowledge in clinical decision making by student and experienced midwives while performing a normal vaginal delivery. The study used a mixed methods research design first; a verbal protocol method was used to gather data about the prior knowledge used by midwives in their decision making during a normal vaginal delivery. Transcribed verbal protocols were then coded for the type and quality of knowledge using a coding scheme developed for the study. Coded protocols were subjected to a frequency counted and non-parametric tests (Wilcoxon Signed Ranks Test & Mann-Whitney Test) were used to examine group differences across the coding categories. Fifteen student and twelve experienced midwives were asked to reflect on their actions and decision-making processes in a normal vaginal delivery they had recently performed through structured interviews (the sequence of questions followed the chronology of the birth process). Student midwives were interviewed twice, after their first and last (20th) normal vaginal delivery assessment. Student midwives were classed as novices at the beginning of their training and as

intermediate at the end of their training. Intra-subject performance was examined to analyse the changes in use of prior knowledge and decision-making processes associated with the development of midwifery competence. Protocol analysis was used to identify the differences in the use of relevant knowledge, its structure and clinical decision making processes between student and experienced midwives were also analysed. The results of the study found that differences in the quality of prior knowledge and the structure of knowledge used in decision making distinguished between novices, intermediates and experts. In addition, a change in the quality of prior knowledge and structure of knowledge used in decision was evident in the transition from novice to intermediate. These findings have important implications for the training of midwives and for the professional development of midwives. To improve clinical decision making in midwives the aim of the curriculum should encourage the development of a well-structured knowledge base in the context of midwifery through the process of critical reflection.

PAPER PRESENTATION

Academia as Multiple Workplaces: Re-location, Re-location, Re-location

Lynn McAlpine, University of Oxford, United Kingdom

Increasingly PhD graduates who imagine traditional academic positions are unable to find such jobs; they end up in fixed-term appointments as post-doctoral fellows or researchers on others' grants. Few studies document their experiences and most that do draw on data from the late 1990s and early 2000s. This longitudinal study reports on the experiences of a small number of social science researchers in two universities in the UK during 2008-2010. A biographical identity-trajectory perspective results in a rich portrayal of work-life intersections and the role of re-locations as integral, yet disruptive, to their academic work.

Purpose

This paper examines longitudinally the workplace experiences of social sciences post-docs and researchers hired on other's grants. It raises questions about the long-term impact of the increasing fragmentation of academic work. Perspectives Like others examining academic experience (Colbeck, 2008), this study uses an identity perspective. Identity-trajectory (McAlpine et al, in press) incorporates a biographical view of identity: personally distinct past experiences influence present intentions and engagement in academic work as well as future imagined possibilities. Essential to this view is the interweaving of personal values, intentions and responsibilities in how work is approached and experienced. Further, by exercising ongoing agency (Archer, 2000) despite social and physical constraints (Billett, 2009), individuals have some ability to decide which aspects of the practices they encounter they will engage in. Yet unexpected constraints (as well as serendipity) may lead elsewhere.

Methods

The approach draws on a long tradition in research on teaching, that of narrative inquiry (Clandinin & Connelly, 1990). Essential to this approach were participant narratives describing how they constituted their identities (Sfard & Prusak, 2005) at different points in time. These participant narratives could then form the basis for researcher-constructed narratives that amongst other things: made connections between events; represented the passage of time; and showed the intentions of individuals (Coulter & Smith, 2009). Data sources and analysis Six social science researchers in two UK universities completed demographic updates several times over a year, recorded in logs a weeks' activity once a month for several months, and were interviewed approximately one year after data collection began. In the following year, a similar cycle was repeated. Researcher-generated case narratives were constructed through successive re-reading of each participant's multiple accounts; these case narratives preserved the unique features constituting each identity-trajectory through time. Then, these case narratives were re-read seeking emergent themes, with reference as appropriate to the original participant accounts.

Results

While intellectual passion and work-life intersections emerged as themes, what is highlighted here are multiple forms of relocation. These relocations, often involving the intersection of the workplace and the personal, resulted from appointments that were of relatively short duration (1-1.5 years). Relocations represented shifts that could be social, geographical, linguistic, cultural or intellectual. A particular disruption was the intellectual relocation that often occurred as individuals moved into new appointments. Participants were often doing research in a new field, perhaps with little connection to their own interests. These relocations disrupted the development of their identity-trajectories, particularly their sense of their own expertise and ability to contribute.

Significance

Increasingly, social sciences PhD graduates cannot expect to find a traditional academic job immediately post-graduation (UK CGE, 2009) in fact, may wait five years (Nerad et al, 2006). Concurrently, the number of social science

researchers in the UK and the US is growing (UK CGE, 2009; Horta, 2008). The emergence of the theme of relocation in this study reinforces Krause's (2009) assertion of the increasing fragmentation of academic work and leads to questions as to the long-term implications on knowledge construction of fixed-term academic work.

References

- Archer, M. (2000). *Being Human: The Problem of Agency*. Cambridge: Cambridge University Press.
- Billett, S. (2009). Conceptualizing learning experience: Contributions and mediations of the social, personal and brute. *Mind, Culture and Activity*, 16(1), 32-47.
- Clandinin, J., & Connelly, M. . (1990). Narrative, Experience and the Study of Curriculum. *Cambridge Journal of Education*, 20(2), 241-253.
- Colbeck, C. L. (2008). Professional identity development theory and doctoral education. *New Directions for Teaching and Learning*, 113, 9-16.
- Horta, H. (2008). Doing a post-doc: what are the benefits for the scholarly achievements of academics? Paper presented at the Consortium of Higher Education Researchers, Pavia, Italy.
- Juzwik, M. (2006). Situating narrative-minded research: A commentary on Anna Sfard and Anna Prusak's "Telling identities". *Educational Researcher*, 35, 9, 13-21.
- Krause, K. (2009). Interpreting changing academic roles and identities in higher education. In M. Tight, K. Ho Mok, J. Huisman, and C. Morpew (eds.). *The Routledge International Handbook of Higher Education* (pp. 413-425). Abingdon, UK: Routledge.
- McAlpine, L., Amundsen, C., & Jazvak-Martek, M. (in press). Living and imagining academic careers. In L. McAlpine & G. Akerlind (eds.). *Becoming an academic: International perspectives* London: Palgrave Macmillan.
- Nerad, M., Rudd, E., Morrison, E., & Picciano, J. (2006). *Social science PhDs – five+ years and out: A national survey of PhDs in six fields*. University of Washington, Seattle, US: Center for Innovation and Research in Graduate Education.
- Sfard, A., & Prusak, A. (2005) Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity *Educational Researcher*, 34(4), 14-22. UK Council for Graduate Education (2009). *What do researchers do? First destinations of doctoral students by subject 2003-2007*. Lichfield: UK CGE.

PAPER PRESENTATION

Pedagogical horizons for action in supporting students' future orientation in higher education

Terhi Skaniakos, University of Jyväskylä, Finland; Leena Penttinen, University of Jyväskylä, Finland; Marjatta Lairio, University of Jyväskylä, Finland

The topic concerns the development of career guidance practices within higher education. We are introducing an idea of pedagogical horizons for action. The aim is to provide a pedagogic model, which is useful in understanding the students need and future oriented career questions, and educational contexts, in which the guidance is provided to support the students knowledge, awareness and competence of work life. The aim of the model it to map out the possibilities of creating and enhancing students' and teachers' perspectives of work orientation, by which we refer to three specific aspects: personal relation to work life (awareness, attitude), professional skills (both generic and specific), and employment skills. The model is based on theoretical scrutiny of the "future orientation" presented by Savickas (2005) and "horizons for action" by Hodgkinson and Sparkes (1997), and combined with the pedagogical understanding of teaching and guidance in higher education context. From the perspective of university students, there are several kinds of contexts in which the career questions are made. These constitute individual horizons for action. In addition to the individual dimension it has been our aim to add a pedagogic perspective to the model. It provides with a broader educational context to the same phenomenon. The students' future questions and the possibilities of work life orientation are presented in relation to different educational contexts and activities. In addition to presenting the model, we will discuss its applications and make suggestions for the development of guidance and pedagogical practices in higher education.

The topic of this paper concerns the development of career guidance practices within higher education, especially from the perspective of work life. We are introducing an idea of pedagogical horizons for action. The aim is to provide a pedagogic model, which is useful in understanding both, the students' needs and future oriented career questions, as well as the educational contexts, in which the guidance is provided to support the students knowledge, awareness and competence of work life. The model enables to map out the possibilities of creating and enhancing students' and teachers' perspectives of work life orientation, by which we refer to the understanding of the career and work life contexts in general. Furthermore, we have theoretically classified the concept into three specific categorisations: 1) personal relation to work life (awareness, attitude), 2) professional skills (generic and specific), and 3) employment skills (knowledge of labour market, job seeking skills etc.). The model of pedagogical horizons for action is based on theoretical scrutiny of the "future orientation" presented by Savickas (2005) and "horizons for action" by Hodgkinson

and Sparkes (1997), combined with the pedagogical understanding of teaching and guidance in higher education context. Students' future orientation is approached from a holistic life design perspective (Savickas & al. 2009). This draws attention to the particular career concerns which individuals are impelled to ask themselves. According to Savickas (2005), positive answers to these questions can reinforce students' ability for career construction. From the perspective of university students, there are several kinds of contexts in which the career questions are made. These constitute individual horizons for action (Hodkinson and Sparkes 1997). Both, personal habitus and the opportunity structures of the labour market influence to these actions. From the individual perspective, the horizons for action can both limit and enable our understanding of the possibilities of career choices we can make. The work of Savickas and his colleagues (2009) also brings life-long, holistic, contextual and preventive dimensions to the development of the model. In addition to the individual dimension it has been our aim to add a pedagogic perspective to the model. It provides with a broader educational context to the same phenomenon. The students' future questions and the possibilities of work life orientation are presented in relation to different contexts, including teaching and supervision, tutoring, career guidance, peer support, mentoring, internships, student exchange, work experience and leisure time activities. These contexts can be seen as spaces which can enhance students' work life orientation, and in which the students interact with the teachers and other staff members, as well as peer students, and gain learning experiences. Thus the understanding of the constitution of pedagogical horizons of action is crucial in development of both, pedagogics and guidance in higher education. The model of pedagogical horizon for action in supporting students' work life orientation in higher education is introduced in the basis of the above presented theoretical framework. In addition to the actual model, we will discuss its applications and make suggestions for the development of guidance and pedagogical practices in higher education.

Savickas, M.L. (2005). The Theory and practice of career counseling. In S. D. Brown & R. W. Lent (eds.) *Career development and counseling. Putting theory and research to work*. Hoboken, NJ: John Wiley & Sons, 42–70.

Hodkinson, P. & Sparkes, A.C. (1997). Careership: A sociological theory of career decision making. *British Journal of Sociology of Education* 18(1), 29–44.

Savickas, M.L., Nota, L., Rossier, J., Dauwalder, J-P., Duarte, M.E., Guichard, J., Soresi, S., Van Esbroeck, R., van Vianen, A. E.M. (2009) Life designing: A paradigm for career construction in the 21st century. *Journal of Vocational Behavior* 75, 239–250.

PAPER PRESENTATION

Learning Of Medical Expertise: Development Of Conceptual Comprehension And Clinical Reasoning Skills

Mirjamaija Mikkilä-Erdmann, University of Turku, Finland; Ilona Ahopelto, University of Turku, Finland; Henna Vilppu, University of Turku, Finland; Mari Murtonen, University of Turku, Finland; Erkki Olkinuora, University of Turku, Finland; Pekka Kaapa, University of Turku, Finland

The purpose of this study was to investigate, how medical students develop their comprehension and reasoning skills concerning the central cardiovascular system. Medical teaching aims to educate physicians who are capable of linking theoretical medical knowledge to practical clinical skills. This requires both deep biomedical understanding and knowledge how apply it in clinical contexts. Hence, the research questions in this study were: 1. what kind of conceptions concerning cardiovascular system do students have during their first and second study year? 2. How do these conceptions change? 3. How is the level of biomedical understanding related to the clinical reasoning skills? The participants of this study were 119 medical students. A pretest-posttest -design was used. Students were investigated during their first and second study year. Our results indicate that the quality of preconceptions concerning cardiovascular system among first and second year medical and dental students varies a lot. Most of the students had relevant understanding, but also a substantial number of misconceptions, such as "serial loops" were diagnosed also after the instruction. The level of biomedical understanding seems also to be connected to the success in clinical reasoning. Students who had improved their biomedical understanding the most reached the highest scores in the clinical reasoning task and vice versa. Our study will enhance theoretical understanding of the longitudinal development of medical comprehension.

References

Boshuizen, H.P.A., & Schmidt, H.G. (1992). On the role of biomedical knowledge in clinical reasoning by experts, intermediates and novices. *Cognitive Science*, 16, 153–184.

Boshuizen, H.P.A., Schmidt, H.G., Custers, E.J.F.M., & Van De Wiel, M.W. (1995). Knowledge development and restructuring in the domain of medicine: The role of theory and practice. *Learning and Instruction* 5, 269–289.

Chi, M.T.H. (2008). Three types of conceptual change: Belief revision, mental model transformation, and categorical shift. In S. Vosniadou (Ed.), *International handbook on conceptual change research*. New York: Routledge.

de Bruin, A.B.H., Schmidt, H.G., & Rikers, R.M.J.P. (2005). The role of basic science knowledge and clinical knowledge in diagnostic reasoning: a structural equation modeling approach. *Academic Medicine*, 80 (8), 765–773.

Kaufman, D.R., Keselman, A., & Patel, V.L. (2008). Changing conceptions in medicine and health In S. Vosniadou (Ed.), *International handbook of research on conceptual change*. New York: Routledge.

Woods, N.N. (2007). Science is fundamental: the role of biomedical knowledge in clinical reasoning. *Medical Education* 41, 1173–1177.

PAPER PRESENTATION

Promoting self-regulated learning strategies by web-based journals in medical studies

Kristin Schmidt, University of Freiburg, Germany; Andreas Lachner, University of Gottingen, Germany; Sabine Rey, University of Gottingen, Germany; Bjoern Stucke, University of Gottingen, Germany; Cornelius Froemmel, University of Gottingen, Germany; Matthias Nuckles, University of Freiburg, Germany

In this study we investigated the potential of web-based learning journals to encourage self-regulated learning in medical studies. The study is a part of a joined interdisciplinary research project of the department of medicine at the University of Göttingen and the department of Educational Science at the University of Freiburg. A key element is the implementation and evaluation of a web-based learning journal. Learning journals are a method to reflect on one's learning processes and learning outcomes during the course of, for example, a lecture or seminar. In our present study, we contrasted two different versions of web-based journals: a metacognitive version encouraging the application of metacognitive strategies and a cognitive version stimulating the elaboration of learning contents. 86 medical students produced several journal entries as follow-up work to a four-week medical course. They were randomly divided into one of four different conditions of a 2 (metacognitive journal) x 2 (cognitive journal) quasi-experimental design. Results showed that the metacognitive journal supported the generation of learning goals and the monitoring and reflection of learning processes. The cognitive journal stimulated the usage of cognitive strategies such as elaboration of learning contents. Using web-based journals in medical education seems to be promising to stimulate beneficial strategies involved in self-regulated learning.

Introduction

Self-regulated learning is the ability to control and influence one's learning processes positively: The learners take personal initiative, apply powerful strategies to attain individually valued learning goals and monitor their understanding in order to detect and eliminate possible comprehension problems (Schraw, 1998; Zimmerman, 2002). Self-regulated learning skills are indispensable in all academic studies and especially in medical education. Studying medicine requires memorizing thousands of facts, looking at disease pattern from different theoretical perspectives, thereby relating theoretical concepts to clinical symptoms and practical experience. In order to master these manifold and complex demands, medical students need high competences in self-regulated learning.

In this presentation, we present a joint interdisciplinary research project of department of medicine at the University of Göttingen and the department of educational science at the University of Freiburg, in which we investigate the educational potential of web-based learning journals in medical studies. The study we present here is a pilot to a series of studies, in which we will successively implement and investigate combinations of different types of instructional support. The heart of our project is a web-based journal. It encourages students to adopt self-regulation to their learning processes. In the first phase of the three-year project, different versions of the web-based journal will be implemented and investigated by quasi-experimental field study designs. In the second phase, medical students will be offered a training in self-regulated learning strategies in addition to the web-based journal. It will be investigated whether combining indirect strategic support in terms of the web-based journal will be enhanced by direct support in terms of the strategy training. In the last phase of the project, the lecturers will be offered a teacher training that shows them ways how to encourage their students to apply self-regulated learning strategies.

Against this background, the present study focused on the comparison of two different versions of the web-based learning journal: a metacognitive version and a cognitive version. This comparison was inspired by the observation that different conceptualizations of journals are discussed in the existing research literature (see, e.g., Nýckles, Hýbner & Renkl, 2009; Schmitz & Wiese, 2006). The metacognitive version provided medical students with prompts for the planning of learning goals as well as for the monitoring and evaluation of learning processes and outcomes. The cognitive version encouraged the students to elaborate and organize the learning contents thoroughly. Organization and elaboration was stimulated by prompting the students to explain a medical topic to a fictitious layperson, for example, a patient. We expected that introducing a fictitious audience would help the students to better relate newly learned medical concepts to their prior knowledge and reorganize the contents in order to make them intelligible to a layperson.

In our present pilot study, the main research question was, whether the two web-based journal versions would support medical students in eliciting the learning processes and strategies as expected. We further asked the students to indicate their satisfaction with the web-based journal.

Methodology

Participants were randomly divided into one of four conditions of a 2 (cognitive journal) x 2 (metacognitive journal) quasi-experimental design. We asked the students to write a journal entry once a week during the learning unit "ophthalmology and otolaryngology" that lasted about one month. Eighty-six students of medicine with an average age of 24.89 (SD=4.25) participated in the study. They were in the fourth year of their medical education. Dependent variables were the frequency of cognitive and metacognitive strategies and the degree of acceptance of keeping a learning journal regularly. The extent to which different subcategories of cognitive and metacognitive strategies were present in the students' journals entries was rated on Likert-type rating scales. The strategies were rated by two independent raters (ICC = .80 to .92).

Results

The data analysis showed that students in the metacognitive conditions applied more metacognitive strategies (i.e., planning, monitoring and regulation) than students without metacognitive support, $F(1,82)=40.17$, $p\&\eta^2=.33$. On the other hand, students in the cognitive conditions used more elaboration and organization strategies and the students without cognitive support, $F(1,82)=22.93$, $p\&\eta^2=.22$. A more detailed analysis revealed, that students with cognitive support more often than the other groups attempted to relate theoretical concepts and own practical experiences. The results from the acceptance questionnaire, on the other hand, suggested that the medical students to some respect perceived a goal conflict between achieving a good grade in the examination and acquiring practically applicable knowledge through journal writing. Many of them acknowledged the usefulness especially of the cognitive journal version, but they suspected that the task of explaining a topic to a layperson such as patient might not be efficient as preparation of an exam that contained mostly multiple-choice questions.

Conclusion

In summary, these results suggest that web-based journal writing can be a useful method to support essential self-regulated learning strategies in medical studies. Medical students, who were provided with metacognitive support, elicited a raised number of planning, monitoring and evaluation strategies in their journal entries. Students with cognitive support better elaborated and integrated theoretical concepts with personal experiences from their practical training. On the other hand, the results also show that introducing a web-based journal as a singular intervention may not be fruitful in the long run. Students' statements from the acceptance data suggest that additional measures such as a strategy training may be useful, especially to inform the students about the advantages of deep-level learning strategies in acquiring sustained and applicable knowledge. Also, offering training interventions for the lecturers could be fruitful, for example, to inform them about alternative assessment methods that (compared to multiple-choice tests) are more compatible with deep-level learning strategies.

PAPER PRESENTATION

ICT Pedagogy for Multigrade Schools: Modernization of an ancient school type

Andrea Karpáti, UNESCO Centre for Multimedia in Education, Hungary; Pal Molnar, Eotvos Lorand University, Hungary

Multigrade schools are partially divided school spaces coordinated by a teacher who manages two classes that learn different disciplines at different levels during the same time period. The 19th school type prevails in rural areas around Europe and often produces lower than average student achievement and professional burnout among teachers. The paper presents results of a teaching experiment that involved the development of a new, ICT-supported learning environment with collaborative microworlds and individualised learning spaces, an interdisciplinary, multi-age curriculum and a new teacher training model called Mentored Innovation.

Pre- and post hoc interviews and focus group discussions with school principals, local stakeholders and selected students and results of experimental teaching documented in lesson plans, teaching blogs and teachers' e-portfolios revealed significant changes in methodology and professional self-perception and motivation of teachers. Schools integrated the enhancement of digital literacy for students and adults in the village. Head teachers introduced a distributed leadership style and shared knowledge practices to raise staff motivation and prevent burnout. However the level of ICT resources remained low, innovative pedagogy resulted in a significant raise in digital literacy both for staff and students. Professional networking with similar institutions resulted in peer learning and adaptation of methods conceived in other small village schools. This study proved that Multigrade schools may be effective if

teachers reconstruct their learning environment through ICT applications, profoundly change curricula and methods to suit their special learning conditions and teach students as a multi-age, multi-skills community.

Introduction and aims

Multigrade education is an organizational method of primary level education for communities with a small number of school age children situated mainly in rural settlements with low income families, and consequently, limited local financial resources for education. Teaching and learning occurs in partially divided school spaces coordinated by a teacher who manages two classes that learn different disciplines at different levels during the same time period. A decrease in child birth, and the number of school age children during the last few decades resulted in an increase in their number all around Europe. (NEMED, 2008)

According to biannual Hungarian national assessments, the knowledge level of pupils in small village schools with a staff of 2-3 primary educators is significantly lower than the national average (Imre, 2009). The integrity and self-esteem of small villages are closely linked to these schools, therefore, between 20007-2009, an ICT supported pedagogical model was collaboratively developed and piloted by teachers of these schools and educational researchers of ELTE. The paper presents findings about the way this identity building exercise affected ICT literacy and methodology of teaching, learning and communication in Multigrade schools.

Methodology

Based on principles of the Trialogical Learning Theory, (Paavola, Lipponen and Hakkarainen, 2004), we invited Multigrade teachers to form a knowledge building community, learn ICT supported communication skills and co-develop their new curriculum with researchers. We designed a Mentored Innovation Model for ongoing peer support through a knowledge construction environment enriched with Web 2.0 solutions. (Kárpáti and Munkácsy, submitted). While models of dialogical coaching that utilized models owned by instructors to form new knowledge structures in teachers have repeatedly failed, working around a shared knowledge objects (collaborative art projects and performances, development of lesson plans and digital teaching aids) in a trialogical relationship was introduced for in-service teacher education.

A new type of ICT-supported learning environment was set up where collaborative microworlds (for practice, creation, assessment and communication) and individual learning spaces were interconnected. Discipline-based curriculum for grade level teaching was replaced by integrated arts and science modules that promoted multi-age, multi-level, interdisciplinary learning.

First, the new learning infrastructure and methodology was piloted first with 21 schools (a stratified sample of the 605 Hungarian Multigrade institutions). Pre- and post hoc interviews and focus group discussions were conducted with school principals, local stakeholders and selected students. Experimental teaching was documented in lesson plans, teaching blogs and teachers' e-portfolios. (Karpáti and Dörner, 2009, 2010) In the second iteration, student performance was assessed. (Results will be reported in Karpáti and Munkácsy, in press). The presentation focuses on the first study and describes the ICT supported pedagogical model for Multigrade schools.

Conclusions

Survey results are summarized using the list of criteria of the innovative, progressive school (Ilomäki and Lakkala, 2010):

a. Content of the vision of the school and the integration of ICT in this vision

The school's mission is to revive, actualize and disseminate local culture and thus contribute to the sustainability of life in a small agricultural settlement. ICT use blended in smoothly with this vision. Social Web applications were found much more important for learning than in average size Hungarian schools.

b. Leadership type

With a staff of 2-4 teachers, leadership is naturally distributed and village inhabitants – parents, business owners, political leaders – are actively involved in shaping the fate of their only cultural institution beside the church. The principal acts as a catalyst, peacemaker and manager of change. Computer supported communication and information sharing helps shape and structure often emotional and contradictory face-to face encounters.

c. The culture of knowledge work in the school

Shared knowledge practices include regular brainstorming sessions involving partner schools via Skype, networking with parent groups and businesses to realize collaborative ICT projects (producing digital teaching aids about local attractions or problematic "hot topics", WebQuests, internet based "Ask the Expert" sessions, collaborative narrative and image production like "Wandering Tales" started in one village and passed on to the next to continue, etc.)

d. Level of ICT resources

Accessibility and sufficiency of resources is a major issue with all Multigrade schools in Hungary. ICT tools in use are "second hand", therefore, teachers' ICT competence and use is restricted. Thanks to pedagogical training, the

educational value of existing infrastructure is much higher than presumed. Surprisingly, students' ICT competence and use is also around the national average as parents readily make considerable financial sacrifice to provide tools and internet access for their children.

e. Working practices of the teacher community

In the national survey, professional isolation was mentioned by teachers as a major burnout factor. In the post-hoc survey, members of the Gardonyi Network perceived themselves as part of a community of practice. One year later, the community is still active and supports, through donations and professional assistance, one of the schools that fell victim to the red mud flooding caused by an aluminum factory in October 2010 in Hungary.

f. Pedagogical practices and ICT

Conceptions about the pedagogical use of ICT were jointly developed by Multigrade teachers and their mentors. The number of learning activities that utilize ICT has grown significantly.

Significance of the study

This study proved that Multigrade schools may be effective if teachers reconstruct their learning environment through ICT applications, profoundly change curricula and methods to suit their special learning conditions. Students should be taught as a multi-age, multi-skills community and not a set of clashing grade level classes imposed upon each-other in the undivided learning space. Innovation in this educational setting means the courage of being different from the mainstream pedagogical models. Our teaching model was selected by UNESCO for dissemination in Africa in 2009. Here, Multigrade schools present an economic way to provide schooling in rural areas where students are numerous but teachers are scarce.

PAPER PRESENTATION

Opening up learning through improvised use of technology

Patrick Dillon, University of Eastern Finland, Finland; Teemu Valtonen, University of Eastern Finland, Finland;
Mikko Vesisenaho, University of Eastern Finland, Finland; Ruolan Wang, University of Nottingham, United Kingdom

The aim of the work reported in this paper is the use of improvisation and ICT as vehicles for improving the transfer of skills in learning. Improvisation is a process that can be an effective vehicle or 'carrier' for transferable skills. It deals with the problem of how to cross boundaries between formal and informal learning and learning in different environments and educational sectors.

Improvisation of learning is an activity of collaboration, transformation, and discovery. Important skills are likely to develop via the concurrency of various activities, for example: Breaking out of the well-rehearsed patterns of learning behaviour that might hold learners back professionally, socially, or personally. Attending to the 'how' and not just the 'what' of learning. Communicating more effectively, collaborating more fully, and attending to listening, responding, and building with others. Working with everyone and everything available in a continuous, creative process.

In this paper we will outline: (i) a method for identifying improvisations that have creative and innovative potential; and (ii) a method for consolidating improvisations into a flexible, adaptive and transferable technique. We will illustrate the methods through concrete examples of improvisations based on informative cases and propose some tools, pedagogies and strategies for cross-sectoral transfer of skills via improvisation and use of ICT.

The aim of the work reported in this paper is the use of improvisation and ICT as vehicles for improving the transfer of skills in learning. Improvisation is a process that can be an effective vehicle or 'carrier' for transferable skills. As such, it deals with the problem of how to cross boundaries between formal and informal learning and learning in different environments and educational sectors. The paper reports work in progress at The Information and Communication Technology Research Group (Tietotekniikan opetuskäytön tutkimus- ja kehittämisyksikkö) (ToTY) at the University of Eastern Finland, the Visual Learning Lab (VLL) at the University of Nottingham and the School of Education at the University of Birmingham.

Improvisation is commonly associated with jazz and theatre (King, 1997; Martin et al. 2002) and it is used in management and business (Brown & Duguid, 1991; Crossan & Sorrenti, 1997; Pasmore, 1998). Improvisation means the coincidence of creative, emergent and collaborative activities. Research has shown that whereas people can use ICT imaginatively (e.g. in social networking) they seldom recognise its educational potential. Through our work in improvisation with (mobile) text-based and audio-visual ICTs, we are defining new patterns of use and new relationships amongst learners, technological tools, information and society. We are developing strategies for self-validation and transfer of skills so that the contribution that improvisation makes to learning becomes personally meaningful through the use of ICT and integral to lifelong learning.

In most traditional learning environments, learners are expected to build cumulatively on what they already know and can do (constructivism). Or they are taught directly what to do and given limited latitude to take the risks with learning. Either way, learners are unlikely to perform 'out of track', rather they repeat existing behaviour patterns, passively playing out the roles they have already learned. We are interested in facilitating improvisation as a means to create playful and collaborative learning environments within more formal educational structures (Loi & Dillon, 2006; Dillon & Loi, 2008).

Lobman and Lundquist (2007) use the term 'unscripted learning' to describe scenarios of improvisational learning. They argue that both teachers and students are essentially improvisers and performers. Improvisational performance in learning is the key to creativity, and fine-tuning creativity between teachers and students is crucial to knowledge acquisition and construction. As creativity is an essential ingredient in any effective teaching and learning situation, another question that needs to be addressed is how can we create an environment where improvisation can be encouraged and captured, and where creativity can flourish? Teachers obviously play an important role as they are on the front line working with students. Improvised learning with unanticipated outcomes should be possible in all educational settings.

Improvisation of learning is an activity of collaboration, transformation, and discovery. Important skills are likely to develop via the concurrency of various activities, for example: Breaking out of the well-rehearsed patterns of learning behaviour that might hold learners back professionally, socially, or personally. Attending to the 'how' and not just the 'what' of learning. Communicating more effectively, collaborating more fully, and attending to listening, responding, and building with others. Working with everyone and everything available in a continuous, creative process.

In this paper we will outline: (i) a method for identifying improvisations that have creative and innovative potential; and (ii) a method for consolidating improvisations into a flexible, adaptive and transferable technique. We will illustrate the methods through concrete examples of improvisations based on informative cases and propose some tools, pedagogies and strategies for cross-sectoral transfer of skills via improvisation and use of ICT.

The outcomes of this research will provide: (i) policy makers with a framework to encourage and support ICT as a vehicle for improvisation within and between educational sectors; (ii) teachers with tools pedagogies and strategies to encourage and support ICT and improvisation; (iii) individual learners with transferable skills that may be utilised and adapted throughout their educational and professional lives.

Brown, J.S. and Duguid, P (1991). Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning and Innovation. *Organization science*, 2(1): 40-57.

Crossan, M.M and Sorrenti, M (1997). Making sense of improvisation. *Advances in strategic management*, 14: 155-180.

Dillon, P. & Loi, D. (2008). Adaptive educational environments: theoretical developments and educational applications, *UNESCO Observatory Refereed E-Journal*, 3.

King, J (1997). *What Jazz is? An insider's guide to understanding and listening to jazz*. England: Penguin Group.

Lobman, C and Lundquist, M (2007). *Unscripted Learning – Using Improved Activities Across the K-8 Curriculum*. New York: Teachers College Press.

Loi, D. and Dillon, P. (2006). Adaptive educational environments as creative spaces, *Cambridge Journal of Education*, 36 (3), 363-381.

Martin, A., Leberman, S. and Neill, J. (2002). Dramaturgy as a Method for Experiential Program Design. *The Journal of Experiential Education*, 25(1): 196-206.

Pasmore, W.A (1998). Organizing for jazz. *Organization science*, 9(5): 562-564.

PAPER PRESENTATION

The role of strategic theories in learning using computer-based representations

James Aczel, The Open University, United Kingdom; Jonathan San Diego, King's College London, United Kingdom

This paper examines how learners interact with variations in representations presented in a computer environment. In particular, it explores how analysis of learning in terms of the notion of strategic theories can provide insight into learners' cognitive processes when using such representations. The study reported here looked at problem-solving using concurrent mathematical representations (numbers, graphs, algebra). For each task, the set of representations was presented in one of three instantiations. These were: Static (non-moving, non-changing, non-interactive);

Dynamic (animated, following keyboard inputs); and Interactive (directly manipulable using a mouse). A variety of data was collected from 18 participants: learners' shifts in attention were recorded using an unobtrusive eye-tracking device and screen capture software; keyboard and mouse actions were logged automatically; utterances and gestures were video recorded; and notes and sketches were recorded in real-time. This rich data was analysed in an integrated way, with the aim of characterising learners' strategies. The results show that participants tend to use multiple strategies over the course of task completion, and that the number and type of representation influence the strategies used. It is argued that this form of strategic analysis offers a systematic way of understanding learning journeys.

Aims

Computers are offering learners new ways to interact with visual representations, and to make links between these representations; yet learners' traditional difficulties with representations often remain (Dunham & Osborne, 1991); and indeed dynamic, linked and interactive representations may carry their own additional difficulties (Ainsworth, 2006). At the same time, developments in technology for real-time capture of gestures and utterances (Blake & Scanlon, 2002), eye-tracking (Hansen et al., 2001), and notes and sketches (Mann et al., 2008) mean that it is now possible to capture rich data on learners' interactions with representations. However, the very richness of this data presents problems. Firstly, software to coordinate and integrate the analysis of these different multiple streams of data is only recently beginning to appear. Secondly, the processes of rendering, collating, synchronising, transcribing, coding, and comparing such data are time-consuming. Finally – and this is the focus of this paper – it is not at all clear how best to bring theory to bear on the analysis of this data to provide genuine insight into learners' cognitive processes. This paper explores how analysis of learning in terms of the notion of strategic theories (Aczel, 2006) can provide insight into learners' cognitive processes when using variations in computer-based representations.

The representation study

In order to explore the sense that learners make of multiple mathematical representations when problem-solving, a study was conducted in which a set of representations was presented in one of three instantiations. These were: Static (non-moving, non-changing, non-interactive); Dynamic (animated, following keyboard inputs); and Interactive (directly manipulable using a mouse). A variety of data was collected from 18 participants: shifts in attention were recorded using an unobtrusive eye-tracking device and screen capture software; keyboard and mouse actions were logged automatically; utterances and gestures were video recorded; and notes and sketches were recorded in real-time. A strategic theory approach

A number of theoretical explanations for the difficulties with representations identified in the research literature can be discerned, and some of these could be examined using the data collected in the study. We chose to explore a "strategic theory approach" to analysis (Aczel, 2006), in which learners are seen as having "concerns" (problems of special interest in a given context); they conjecture "strategic theories" (attempts to address the concerns); and then they subject these strategic theories to some kind of "error-elimination", typically a sifting or testing process. Learning then is portrayed in terms of processes of discontinuous trial-and-improvement of strategic theories under the selection pressures provided by concerns.

Application of the strategic theory approach

The data was analysed in an integrated way, with the aim of characterising participants' strategies. The results show that participants tend to use multiple strategies over the duration of task completion, and that the number and type of representation given influence the strategies used. For example, it was seen that participants may often choose a strategy dependent on the particular form of mathematical representation with which they have started (e.g. a line graph). Should this attempt fail, participants may attempt to improve this strategy by combining it with another form of representation (e.g. numbers). Participants were also seen constructing their own representations ("re-representing strategies"). In addition, the eye-tracking data showed that participants sometimes constructed representations with their eyes ("imagining strategies"). By identifying the different kinds of strategies being used at particular times, the points at which strategies were abandoned or refined, and the frequency of chosen strategies, a pattern of activity can be constructed for an individual participant over the duration of a task (e.g. Figure 1). By comparing such patterns between tasks and between participants, it might be possible to identify significant commonalities and differences. It was found that the relationships between performance, strategy and time spent on task are complex. It was also found that strategy choice can be influenced not just by the representations given but also by the participant's prior knowledge and concerns. The data hints that participants change strategies when they experience difficulty in using a strategy; when their attention shifts to a different mathematical form; when they experience difficulty in visualising mental images; when a strategy imposes excessive cognitive load; and when they fail to link multiple representations. Instantiation also appears to influence participants' use of strategies. For example, participants given Static instantiations tended to spend more time using imagining strategies than participants given Dynamic or Interactive instantiations. Static and interactive instantiations tended to encourage graphical strategies; dynamic instantiations tended to encourage algebraic strategies. Dynamic and interactive instantiations tended to encourage re-representation. More research is clearly needed to test the findings over a larger sample of participants and tasks. However we would suggest that this form of analysis offers a systematic way of understanding learning journeys.

References

- Aczel, J. C. (2006) "Learning from Interactions with Software: A Popperian Analysis", *International Journal of Learning Technology*, 2, 2/3, 159-184
- Ainsworth, S. (2006) "DeFT: A conceptual framework for considering learning with multiple representations", *Learning and Instruction*, 16 (3), 183-198
- Blake, C., & Scanlon, E. (2002) "Enriching accounts of computer supported collaboration by using video data", Paper presented at the ALT-J Conference
- Dunham, P., & Osborne, A. (1991) "Learning how to see: learners' graphing difficulties", *Focus on Learning Problems in Mathematics*, 13(4), 35-49
- Hansen, J. P., Hauland, G., & Andersen, H. B. (2001) "Combined analysis of verbal protocols and eye movements", In Smith, M. J., Salvendy, G., Harris, D. & Koubek, R. J. (eds.) "Usability Evaluation and Interface Design - Cognitive Engineering, Intelligent Agents and Virtual Reality", Lawrence Erlbaum Associates
- Mann, P., Aczel, J. C., Scanlon, E. & Cooper, M. (2008) "Supporting Computer-Supported Collaborative Work (CSCW) in Conceptual Design", *Proceedings of 24th ARCOM Annual Conference*, Cardiff, Wales

PAPER PRESENTATION

Social-problem Solving, Family Background and School Achievement at the ages of 8–18

Laszlo Kasik, University of Szeged, Hungary; Jozsef Balazs Fejes, University of Szeged, Hungary

The main aim of the research was to describe the developmental level of social-problem solving (SPS) at the age of 8, 12, 15 and 18 (N=1146). We also examined the relationship between SPS, social-interest realisation abilities (SIR: cooperation, competition, help and leadership), family background and school achievement. One questionnaire was adapted (SPS; for children, parents, teachers), and the investigation of SIR was assessed with a questionnaire developed by ourselves (for children, parents, teachers). These instruments proved to be highly reliable. We also used a list of variables of family background and school achievement. The relationship between the values of SPS-factors of children and parents is the strongest in all groups. Based on the total values, three factors (negative problem orientation, rational problem solving, avoidance) show increasing tendency with age, contrary to positive problem orientation and impulsivity. Gender differences can be found especially among children between 15 and 18. The relationship between SPS- and SIR-factors is significantly stronger with age (e.g. positive correlation between cooperation, help and positive problem orientation and between competition and impulsivity; negative correlation between leadership and avoidance). The SPS-factors are influenced the most by family type, less by mothers' educational level, and the least by net income. In the youngest group, school success (grade average) already shows high positive correlation with SPS-factors (with SIR-factors, too), and these values increase with age. In the two older groups, the highest values can be found between rational problem solving and mathematics and biology, between impulsivity and history and literature.

Background

International literatures agree that social competence is a very important factor for both individuals' inner balance and a satisfactory social co-existence. According to the well-established psychological view, social competence is a complex system of various social, emotional, cognitive (both inherited and learnt) abilities and motives (Rose-Krasnor, 1997). Within social competence social-problem solving and social-interest realisation (cooperation, competition, help, leadership) abilities are very important factors (Fylfj, 2009). On the basis of international research results, social environment (e.g. family, peer relationship, school) determines strongly the development of social competence and the correlation between social and cognitive development is very significant with age (Grusec & Hastings, 2007). Therefore, their improvement is a major task of institutionalised education. However, it is not known how social-problem solving and social-interest realisation abilities develop, and what kind of relationships are between the social abilities, cognitive area and family background in Hungarian context.

Aims

The main aim of the research was to describe the developmental level of social-problem solving (SPS) at the age of 8, 12, 15 and 18. We also examined the relationship between SPS, social-interest realisation abilities (SIR: cooperation, competition, help, leadership), family background and school achievement. Results are to be used as the basis for a complex development programme.

Methods

Sample, data collection

Subjects were 1146 children (and their teachers and mothers – only a few fathers sent back the questionnaire). The size of the age and gender subsamples was approximately the same. Data collection took place in Spring 2010.

Instruments

The questionnaire of the functioning of social problem solving was adapted from D'Zurilla, Nezu and Maydeu-Olivares (2002). This Likert-type questionnaire assesses the five factors of social-problem solving: positive and negative problem orientation; impulsivity; rational problem solving; avoidance. Social-interest realisation abilities were assessed with a Likert-type questionnaire developed by ourselves. Based on the theoretical background (socio-anthropological, human ethological, social psychological), some dimensions were defined within these abilities. Then factor analysis was done, on the basis of which the dimensions formed a lot of factors (e.g. interest, relation between give and take, time and winner, approach and rule). In the case of both questionnaires, besides children's own evaluations, teachers and mothers also evaluated the functioning of abilities. These instruments proved to be highly reliable (SPS: 0.86–0.94; SIR: 0.83–0.92). Furthermore, we had a list of background variables at our disposal about all participants (e.g. mothers' educational level; family size and type; net income; grade average as school achievement).

Results

Development of SPS and SIR

The correlations between the raters are very different on both SPS ($r=0.22-0.68$, p Based on the total SPS-values (mean of the three raters), positive approach to social problems is more typical of 8- and 12-year-old children than of older children. On the other hand, the interpretation of the solution of relations and situations problematic for oneself as a negative phenomenon is the most typical of the two older groups. Students belonging to the two older age groups show a bigger tendency to define problems, to decide before solving, to the rationality concerning realisation, to a multi-perspective interpretation, and to take into consideration more solution possibilities. Decisions and realisations based on emotions are characteristic of the 8- and 12-year-old children. Problem avoidance and postponement of solution is more frequent among the 15- and 18-year-olds than among younger children.

In the case of total SIR-values, 4 factors from 6 show increasing tendency with age (interest; contribution and share; period and winning; equal opportunity, conflict of interests, exclusion) and the difference between the two older and the two younger groups is significant (p

Relationship between the examined aspects

The relationship between the SPS- and SIR-factors is significantly stronger with age ($r=0.25-0.79$, p The SPS-factors are influenced the most by family type and family size, and less by mothers' educational level. Net income is the environment variable that has the smallest effect on the assessed components of social-problem solving.

In the youngest group, school success (grade average) already shows high positive correlation with SPS-factors (with SIR-factors, too), and these values increase with age. In the two older groups, the highest values can be found between rational problem solving and mathematics and biology, between impulsivity and history and literature.

Conclusion

According to our results (1) the inner correlations of the factors of social competence are already strong in the early years, and these correlations increase with age; (2) the family characteristics play a major role in the development of social-problem solving, and (3) correlation between the social and cognitive psychic areas is strong and gets stronger with age. These results strengthen unequivocally international research experience in the same domain. On the basis of these results, an experimental programme will be launched in 2011. Nevertheless it has to be taken into consideration that respondents were mothers. Numerous surveys show that mothers' opinions about cooperation and competition are different from those of fathers.

References

- D'Zurilla, T. J., Nezu, A. and Maydeu-Olivares, A. (2002): Social Problem-Solving Inventory–Revised (SPSI–R): Technical Manual. North Tonawanda, NY, Multi-Health Systems.
- Fýlßp, M. (2009) Socialization for cooperative and competitive citizen: a classroom observation study. Social Science Tribune. From a national identity to a European one. 55. 59–87.
- Grusec, J. and Hastings, P. (2007, Eds.): Handbook of Socialization. Guildford Press, New York.
- Rose-Krasnor, L. (1997): The nature of social competence: A Theoretical review. Social Development, 6. 111–135.

PAPER PRESENTATION

Home Learning Environment and Emotional Development in the Preschool Years:A Child Centered Approach

David Richter, German Institute for Economic Research, Germany; Simone Lehl, University of Bamberg, Germany

Although the preschool years are of great importance for children's cognitive and emotional development, up to now little is known if and how children's home learning environment promotes their socio-emotional development over typical background variables (e.g. gender). Therefore, the present paper focuses on the influence of child and family background variables as well as the home learning environment on the development of children's physical aggression. Data are drawn from the interdisciplinary German research study "BiKS-3-8". The sample comprised 547 children ($M = 3.7$ years) from 97 preschools. The developmental trajectory of children's physical aggression was rated by preschool-teachers in the first, second and third preschool year.

For data analyses, the recently developed growth-mixture modeling (GMM) method was used. GMM allows the identification of unobserved subpopulations and their different latent trajectories with longitudinal data. This approach was especially useful for the present study because recent research on the development of aggression clearly identified subgroups of children differing in their developmental trajectories (e.g., Joussemet et al., 2008).

The results show, that the development of aggression is not linear and displays not the same pattern for all children as three different latent classes were identified ("all-time-low", "all-time-high", and "declining"). In addition to the typical positive influence factors like being a girl, having an older mother, or growing up with siblings, positive influences of the home learning environment were identified.

The current educational climate in Germany focuses strongly upon preschool children's cognitive development and raises questions about how to promote emergent literacy and numeracy in preschools and families. Although these preacademic skills and their promotion are immensely important for children's academic success, emotional and social development requires equally careful nurturing. Especially the preschool years are of great importance for children's emotional development. At this age children learn in interaction with adults to regulate and to express their emotions appropriately.

Emotional competence is crucial not only in its own right but for positive outcomes in both social and academic domains (Denham, 2006). First, the components of emotional competence help children to ensure effective, successful social interactions which are crucial predictors of later mental health and well-being (Denham & Holt, 1993; Robins & Rutter, 1990). Second, emotional competence also supports cognitive development, academic achievement, and school adjustment through its contributions to social competence and self-regulation (Blair, 2002; Carlton & Winsler, 1999; Greenberg & Snell, 1997). Summing up, social and emotional factors often uniquely predict academic success, when other factors, including earlier academic success, are already taken into account (Carlton, 2000; Pianta, 1997; Shields et al., 2001). Promoting young children's social development seems therefore to be crucial for children's academic achievement.

Up to now, little is known if and how children's home learning environment promotes their socio-emotional development. Especially the influences of domain-specific, more cognitive, aspects of the home learning environment are rather unclear. Therefore, the present paper focuses on the influence of child and family background variables as well as the home learning environment on the development of children's physical aggression.

The interdisciplinary German research group "BiKS" deals in two longitudinal studies with the development and the educational career of children aged 3 to 12 years. The sample of "BiKS-3-8" comprised 547 children ($M = 3.7$ years; 48.3% female; 19.5% migration background) from 97 preschools. The developmental trajectory of children's physical aggression was rated by preschool-teachers at six different measuring points in the first, second and third preschool year. Items were derived from a German questionnaire, which measures socio-emotional behaviour of preschool children (Tietze et al., 1981), and from a German adaption (Göttert & Asendorpf, 1989) of the California Child Q Set (CCQ; Block & Block, 1980), which was used very successfully in the German longitudinal study LOGIK (e.g., Asendorpf, Denissen, & van Aken, 2008). Items were selected to measure children's actual behaviour (e.g., my child easily argues with other children). The response scale ranged from 0 (disagree) to 3 (strongly agree). Considering that only three items were aggregated, Cronbach's alphas were satisfactory (Cronbach's $\alpha \geq .70$). The project collected a wide range of data on the background of the children, their families and the preschool settings they attended in order to investigate the cognitive development of the children, the influences of their background, home and preschool as well as the formation of educational selection decisions.

For data analyses, the recently developed growth-mixture modeling (GMM) method was used. GMM allows the identification and prediction of unobserved subpopulations and their different latent trajectories with longitudinal data. Therefore, this approach was especially useful for the present study because recent research on the development of aggression clearly identified subgroups of children differing in their developmental trajectories (e.g.,

Joussemet et al., 2008). Specifically, GMM relaxes the single- population assumption of conventional latent-growth models. Instead of considering individual variation around a single mean growth curve, the growth-mixture model allows different classes of individuals to vary around different mean growth curves within each latent class (Muthéén, 2004). In addition, the conditional probability of an individual child belonging to a specific latent class can be estimated.

For the development of aggression analyses identified three different latent classes. The majority of the children (77.6%) belonged to a class with very low starting values ($mI = 0.34$, $p\ mI = 1.81$, $p\ mI = 2.23$, $p\ mS = -0.60$, p

The results show, that socio-emotional development (i.e. the development of aggression) is not linear and displays not the same pattern for all children. Depending on their family background, children show different developmental trajectories. In addition to the typical positive influence factors like being a girl, having an older mother, or growing up with siblings, positive influences of the home learning environment were identified. This evidence provides a positive view on early literacy and numeracy promotion.

PAPER PRESENTATION

The impact of teachers' judgments on primary school students' achievement

Gwenaëlle Joet, Université Pierre Mendès France, France; Nadia Leroy, UNIVERSITE DE GRENOBLE LSE, France; Pascal Bressoux, Université Pierre Mendès-France, France

According to the researches in the educational domain, teachers have a critical role, in part because they are asked to produce judgments about the abilities of their students. These judgments can be defined as inferences, made by the teacher, on the abilities of their students from several pieces of information (Bressoux & Pansu, 2003). They can be explicit or implicit, and seems to be strong predictors of students' achievement (Alvidrez & Weinstein, 1999). In our work on French fourth-grade children, we proposed to evaluate the effect of teachers' judgments (expressed at three different moments during the school year) on students' achievement (at the end of the year), taking into account a dynamic aspect that is the evolution of judgments during a school year. In other words, the main purpose of this research is to focus on the dynamic aspect of teachers' judgments and to estimate the effect of the variations of teachers' judgments on students' achievement (math and French language). Hierarchical linear modeling (HLM) and growth curve analyses (Singer & Willett, 2003) will allow to i) estimate the growth trajectory of teachers' judgments and ii) use these growth trajectories to estimate the impact of teachers' judgments variations on students' achievement.

Many researchers, educationalists or members of educational systems wonder long-past about academic learning determinants. Although several variables have been shown (for example, students' socioeconomic level, self-perceptions or gender) to be related to students' achievement, a better understanding of the reason why some students succeed academically while others fail is needed.

The purpose of this study is to assess the influence of teachers' judgments in mathematics and French (mother tongue) on students' academic performance. The teacher is the main referent for students and the best able to make a judgment on their abilities. Previous researches on self-fulfilling prophecies have shown that teachers' judgment about their students' abilities had an influence on students' performance through the influence of their behaviors towards them. This phenomenon is better known as "Pygmalion Effect" (Rosenthal & Jacobson, 1968), and many studies in educational domain agree that a more positive judgment provides more opportunities for learning and therefore, a better achievement (see Good & Brophy, 2000). Although many of these studies used varied methodologies, most of them have conceived teachers' judgments as fixed at a given point of time (generally at the beginning of the school year), rather than as a dynamic process meaning that teachers' judgments may vary over time during the school year.

The main purpose of this research is to focus on the dynamic aspect of teachers' judgments and to estimate the effect of the variations of teachers' judgments on students' achievement (math and French language). Using multilevel growth curve models (Singer & Willett, 2003), we will i) estimate the growth trajectory of teachers' judgments and ii) use these growth trajectories to estimate the impact of teachers' judgments variations on students' achievement.

Participants and procedure:

Participants in the longitudinal study were 373 students in fourth-grade (CM1). Students were from 24 classes in 18 schools in towns near Grenoble (France). All students remained in the same class during the school year. The teachers (19 women and 5 men) expressed their judgments about their students' abilities in mathematics and French three times during the school year (October, February and June). They completed items on a questionnaire for each student

for the three waves of data. We assessed how teachers perceived their students' capability asking them to indicate their opinion about students' behavior in the classroom, their performance level and their potential in French and mathematics. Each teacher has been asked to rate his/her judgments regarding the academic value of his/her students, on a Likert-type scale from 0 (very low) to 10 (very good), for each student in the classroom (e.g. please assign a score indicating the performance level of the student X in French). For each field, we then constructed a mean score from the three dimensions: behavior in classroom, performance level and potential. This mean score gives us an average measure of teachers' judgments about the abilities of each student (psychometrics properties of the scores were assessed).

Achievement:

We collected students' end-of-year achievement scores obtained at a French and mathematics test in grade 3 and grade 4. Students' test scores at the end of grade 3 were used as a control variable (initial achievement), while test scores at the end of grade 4 were used as "final" achievement. The participating classes had heterogeneous achievement levels both in French and mathematics, and students were not placed in any group or class according to their ability levels. We were thus able to compare the influence of teachers' judgments as a function of the students' academic level at the end of the previous school year to see if the average achievement level of individual classes was a factor that may have contributed to variations in students' achievement later in the year.

Statistical modeling of the data and preliminary results:

In a first step, we ran multilevel growth curve models (Singer and Willett, 2003) in order to estimate teachers' judgments growth trajectory over time. In other words, we first studied the variations in teachers' judgments over the time period under study. In a second step, we will evaluate the influence of these variations in teachers' judgments on students' achievement, in mathematics and French. As our sample consisted of heterogeneous fourth-grade classes across multiple school contexts, we use a multilevel statistical approach (Raudenbush & Bryk, 2002) to test in what extent variations in achievement could be explained by both individual-level student characteristics and classroom-level contextual factors. Controlling for individual variables, we will include in our models teachers' judgments variations (i.e., the intercepts and slopes estimated in the growth curve models).

The statistical treatments are in progress. Preliminary results showed that there is a positive and significant influence of average teachers' judgments expressed during the school year: more positive judgments provide a higher students' achievement both in mathematics and French. We also estimated that there are variations between teachers in judgment growth rate over the school year. We now have to test if these growth rate variations in teachers' judgments (i.e. whether judgments improve or declines over time) influence students' achievement.

PAPER PRESENTATION

Perceptions of the Learning Environment and Elements of Burnout Among Medical Students

Topi Litmanen, University of Helsinki, Finland; Kirsti Lonka, University of Helsinki, Finland; Sofie Loyens, Erasmus University Rotterdam, Netherlands

Medical students experience high levels of distress while studying, which has consequences for their well-being as well as academic performance. The goal of the present study was to explore which perceived aspects of the learning environment contribute to exhaustion and lack of interest (or cynicism), which are the key elements of burnout. Participants were 673 medical students, who filled in the MED NORD-questionnaire. A structural equation modelling approach was adopted to test the relationships between students' perceptions of the learning environment, lack of interest, and exhaustion. A satisfying fit of the model with the data was found. Results showed that exhaustion had the strongest relationship with workload. In addition, workload was an important determinant, and satisfaction acted as a protective factor for lack of interest. Interestingly, worry had a negative relationship with lack of interest, indicating that high levels of worry reduce lack of interest. Based on these results, student's well-being might be increased with focusing on their experiences of workload as well as their commitment with future work.

Studying in higher education requires long-term commitment and offers students extensive challenges. Those who are most likely to discontinue their studies are the ones who experience high levels of anxiety and lack of interest (Mäkinen et al., 2004). Compared to students in other academic fields, medical students experience higher levels of anxiety and depression. Among medical students, burnout is strongly related to dissatisfaction with the learning environment (Dyrbye et al., 2006). Exhaustion and cynicism are the core dimensions of burnout (Maslach & Jackson, 1981), with cynicism closely resembling lack of interest. The learning environment is hence an important factor, since it can either promote or protect for burnout and attrition. The goal of this study was to examine how students' perceptions of the learning environment are related to exhaustion and lack of interest in one's studies.

Methodology

Participants

Participants were 673 medical students (70% male, 30% female) from three medical faculties in Finland. The mean age was 24. 55% of the participants were in their pre-clinical stage (1st or 2nd year) and 45% were in their post clinical stage (3rd or 4th year).

Materials

The MED NORD (Lonka et al., 2008) questionnaire was used. It measures several aspects related to student well-being and orientation. Perceptions of the learning environment were measured by 15 items that formed the scales Disengagement, Receiving feedback, Workload, Worry, and Satisfaction (Dahlin et al., 2005). Exhaustion was measured by four items (Maslach & Jackson, 1981) and Lack of interest (the used items were very close to cynicism) by two (Mäkinen et al., 2004). Items concerning perceptions of the learning environment were rated on a 4-point Likert scale ranging from 1 (not at all true) to 4 (totally true), and the items concerning Exhaustion and Lack of interest were measured on a 5-point Likert scale with the same scale labels.

Statistical analysis

A structural equation modelling approach was adopted to test the relationships between students' perceptions of the learning environment, lack of interest, and exhaustion. Hypothesized structural relationships among the variables were established and the structural model was tested. The tested model included five latent variables concerning the perceptions of learning environment: Worry (with 3 observed variables), Satisfaction (4), Disengagement (4), Workload (2) and Feedback (2). The model included correlations between these variables and these five latent variables predicted the latent variables Exhaustion (4) and Lack of interest (2).

Results

Analysis of the hypothesized model resulted in a CFI of .92, a TLI of .90, and a RMSEA of .05. These indices indicated a rather good fit of the specified model with the data. The χ^2 analysis, $\chi^2(169, N = 673) = 440.2, p$

Table 2 presents the structural relationships between the latent variables. Workload appeared the only significant predictor of exhaustion, whereas lack of interest was significantly determined by worry, workload, and most strongly by satisfaction. These findings imply that perceived workload puts students at risk for exhaustion as well as a lack of interest, which may lead to burnout. Feelings of satisfaction can prevent students from losing interest in one's education. Interestingly, worry holds a negative relationship with lack of interest, meaning that high levels of worry reduce students' lack of interest. It seems that those students, who do care about their studies, have not become cynical. However, their feelings of worry and uncertainty still make them less satisfied, as reflected in the negative correlation between worry and satisfaction.

Theoretical and Educational Significance of the Research

On the basis of the current study, students' well-being might be increased by tackling their experiences of high workload. It also appears important to find ways to increase students' satisfaction with their program and how it prepares them for their future professions.

Future research will investigate whether these relationships vary for students in different stages of education. In addition, the influence of the instructional format (i.e., a Problem-Based Learning curriculum versus a traditional, lecture-based) will be further explored.

References

- Dahlin, M., Joneborg, N., & Runeson, B. (2005). Stress and depression among medical students: A cross-sectional study. *Medical Education*, 39(6), 594-604.
- Dyrbye, L. N., Thomas, M. R., Huntington, J. L., Lawson, K. L., Novotny, P. J., Sloan, J. A., & Shanafelt, T. D. (2006). Personal life events and medical student burnout: A multicenter study. *Academic Medicine*, 81(4), 374-384.
- Lonka, K., Sharafi, P., Karlgren, K., Masiello, I., Nieminen, J., Birgegard, G., & Josephson, A. (2008). MED NORD-A tool for measuring medical students' well-being and study orientations. *Medical Teacher*, 30(1), 72-79.
- Mäkinen, J., Olkinuora, E., & Lonka, K. (2004). Students at risk: Students' general study orientations and Abandoning/Prolonging the course of studies. *Higher Education*, 48(2), 173-188.
- Maslach, C., & Jackson, S. E. (1981). The measurement of experienced burnout. *Journal of Occupational Behaviour*, 2, 99-113.

PAPER PRESENTATION

Students' Attitudes Towards Modes Of Evaluation

Mordechai Miron, Tel Aviv University, Israel

The purpose of the study was to determine the attitudes of Israeli students toward different modes of evaluation. The sample consisted of 346 students who were enrolled in six different faculties at Tel Aviv University. Students reported the frequency at which they encountered three modes of evaluation: objective tests, essay-type tests and written papers. A 66-item questionnaire was devised to establish students' preferences for different testing methods. The data revealed that essay tests were the most common mode of evaluation and objective tests were encountered least often. The students expressed a favorable attitude toward each mode of evaluation. The analysis of the data indicated that significant differences were found among students enrolled in different faculties.

Since the mid-1960s, students' influence on decisions affecting university life has increased in many countries, particularly in the area of instruction. Their influence on academic decision-making was partially generated through standard questionnaires in which students rated the effectiveness of university instruction. However, these evaluation measures rarely included information on student perceptions of the relative merits of various test procedures (Mabry, 1997). Students have firm attitudes toward different modes of testing and evaluation. These attitudes should not be ignored, because there can be little doubt that test performance is influenced to some extent by students' positive or negative perceptions regarding the tests they take. Murchan (1989) concludes that the format of testing has a great impact on how and what teachers teach, and students learn. Research findings revealed that students' perceptions of assessment significantly influence their approach to studying (Struyven, Dochy, & Janssens, 2005). Different types of tests also tend to determine the students' approach to learning. Drew (2001) found significant differences in students' perceptions of essay tests as compared to their perceptions of multiple-choice formats. Zeidner (1987) found that students prefer the multiple-choice format to an essay type examination in almost all dimensions of his inventory (perceived difficulty, anxiety, complexity, success expectancy, feeling at ease). There was only one dimension in which students thought that essay exams were more appropriate; namely, for the purpose of presenting one's knowledge in the subject matter (Zeidner, 1987). The purpose of the present study was to determine the extent of use of different modes of testing on the university level and to explore the attitudes of Israeli students toward these modes. Three questions were examined empirically: 1. To what extent were different modes of tests used at the university? 2. What were the students' attitudes towards these modes? 3. Were the students' attitudes towards evaluation modes related to the academic faculties in which they were enrolled?

Method

Sample The population consisted of 346 undergraduate students enrolled in six different Tel-Aviv University faculties: Exact Sciences (N= 24), Medicine (N=57), Life Sciences (N=62), Social Sciences (N=68), Humanities (N= 100), and Law (N=35). **Instruments and procedure** The questionnaires used in this study aimed to investigate three different types of evaluation commonly used at the university: objective tests (multiple-choice questions), essay-type tests, and written papers. In order to ascertain the frequency of use, the students were asked to rate each of the three evaluation modes on a 3-point scale. In order to determine student preferences, a 66-item questionnaire was devised, consisting of three 22-item subscales (objective tests, essay-type tests, and written papers) rated on a 5-point Likert scale. The questionnaires were administered during class periods, and respondents were guaranteed anonymity.

Results

1. To what extent were different modes of tests used at the university? The data indicated that essay tests were the most commonly used mode of evaluation, whereas objective tests were the least frequently used.
2. What were the students' attitudes toward these modes? The results revealed a favorable attitude toward each of the three modes. Though students held favorable attitudes toward all three types of evaluation, papers scored the highest, objective tests were less preferred, and essay tests scored lowest.
3. Were the students' attitudes toward evaluation modes related to the academic faculties in which they were enrolled? The order of preferences differed from faculty to faculty. In the humanities, the order, from most preferred to least, was papers, objective tests, and essay tests, whereas in the social sciences, the order was papers, essay tests, and objective tests. Medical students preferred objective tests and did not strongly differentiate between the two other evaluation modes. In most faculties, essay tests were the least preferred mode of evaluation.

Discussion and Conclusions

The purpose of the study was to investigate the frequency of use of the three different modes of evaluation in an Israeli university and to examine the attitudes of university students toward these modes: essay tests, objective tests and written papers. Essay tests were reported to be the most common mode of evaluation encountered by the students, whereas objective testing was the mode experienced least frequently. The predominance of essay tests may reflect university professors' reliance on familiar evaluation modes, thus perpetuating testing practices to which they

were exposed during their own studies. Without specific training on grading and assessment, educators draw primarily on their own experiences as students in determining the grading policies and practices they employ (Stiggins, 2005). evaluation. Students in this sample indicated a favorable attitude toward each of the three modes of evaluation. More than thirty years ago, Shapira and Etzioni-Halevy (1973) noted that the Israeli student tended to conform and had a generally moderate approach toward the university. Students approved of the university's structure, functions, and instructional and evaluation methods. The present study substantiates these findings at least with regard to evaluation modes. Future research should investigate other samples and instruments in order to validate the current results. Though students favored all three types of evaluation, papers scored highest, followed by objective tests, and essay tests scored lowest. These results do not corroborate Zeidner's (1987) and Boud and Falchikov's (2007) findings that students preferred multiple-choice items. The differences may stem from the testing experiences to which students in the different samples had previously been exposed. The findings indicate that students in different faculties differ in their attitudes toward modes of evaluation. It seems that studying within the framework of a scientific discipline and of a certain professional orientation may influence students' attitudes and expectations, including their attitudes toward the different modes of evaluation (Kellaghan & Madaus, 2003). This study may offer university professors valuable information in the area of testing. Testing practices should receive further cautious exploration. Although students' perceptions may be erroneous, students are the consumers of our instructional processes and thus cannot be disregarded. Furthermore, our testing instruments and subsequent grading policies have far-reaching effects on future generations of students. [1] In this paper, evaluation, testing and assessment are used interchangeably.

PAPER PRESENTATION

Learning culture as a prerequisite for an institution-wide approach to educational development

Taiga Brahm, University of St. Gallen, Switzerland; Anja Gebhardt, University of St. Gallen, Switzerland; Tobias Jenert, University of St. Gallen, Switzerland

Over the last two decades, the discussion about innovating teaching and learning at higher education institutions (HEI) has concentrated on various core concepts: such as an increased focus on learning outcomes as competencies and more student-centered teaching. These concepts form part of what Barr and Tagg (1995) have termed the "shift from teaching to learning". However, very few approaches have been proposed so far in the scholarly literature on how to actually transfer such normative concepts into the practice of teaching and learning at HEI. In order to sustainably develop the practices of teaching and learning at HEI, it is necessary to comprehend the prerequisites for educational development. The construct of "learning culture" can be seen as a possible concept to explicate these prerequisites. The aims of this study are to propose an institution-wide approach to educational development at HEI and to present a comprehensive instrument to diagnose learning culture as a starting point for educational development. The findings of the study include a first version of the Learning Culture Inventory for HEI. The students' version of the instrument encompasses 12 scales for the individual, 12 for the pedagogical interactions and 5 for the organizational dimension. With the institution-wide approach to educational development and the Learning Culture Inventory, this study can provide the basis for sustainable developmental initiatives to innovate teaching and learning at HEI.

Currently, a number of discourses are going on about how to best organize teaching and learning at higher education institutions (HEI). Over the last two decades, the discussion about innovating teaching and learning at HEI has concentrated on various core concepts: such as an increased focus on learning outcomes as competencies and more student-centered teaching. These concepts form part of what Barr and Tagg (1995) have termed the "shift from teaching to learning": a call to alter the current instruction-centered practices and move towards innovative practices of teaching and learning. Students are expected to become active, motivated, and self-responsible learners who eagerly engage in learning processes rather than "consume" precast knowledge. Teachers are supposed to support student learning by acting as coaches who consult learners in their mostly self-regulated learning activities (Clifford, 1999; Zimmerman, 2002). However, very few approaches have been proposed so far in the scholarly literature on how to actually transfer such normative concepts into the practice of teaching and learning at HEI (for an exception see e.g. D'Andrea & Gosling, 2005; Blackmore, 2009). To accomplish large-scale (i.e. institution-wide) as well as sustainable change, the role of educational development at HEI has to change as well (Gosling, 2009).

In order to sustainably develop the practices of teaching and learning at HEI, it is necessary to comprehend the prerequisites for educational development. The construct of "learning culture" can be seen as a possible concept to explicate these prerequisites. The aims of this study are to (a) propose an institution-wide approach to educational development at HEI and to (b) present a comprehensive instrument to diagnose learning culture as a starting point for educational development.

The methodology of the study is twofold. In a first step, the institution-wide approach to educational development as well as the concept of learning culture as a three-dimensional construct has been elaborated. In a second step, the construct was operationalized to develop a quantitative instrument for diagnosing learning culture at HEI. Educational development as an institution-wide endeavor. While there is ample research on how engaging teaching and learning methods can be used within course settings (e.g. Biggs, 2003), little is known about the preconditions for sustainable and large-scale changes of the prevalent practices at HEI. Addressing individual teachers and innovative learning designs at the course level (as it is often the case nowadays, cf. Dany, 2007) may actually lead to innovative practices and showcases; often, however, their impact on student learning remains minimal compared to the total of learning experiences students undergo during their time of study. Additionally, changes on the course level can be overlaid by factors which are not within the scope of the individual teacher and tend to be discontinued after the innovation phase when initial funding is no longer provided (Hannan & Silver, 2000) or when the learning culture is not adequate. Therefore, we argue for an approach to educational development at HEI focusing not only on teachers and the course level but addressing the whole institution to arrive at more sustainable changes in the teaching and learning practices. Such an institution-wide approach includes (a) faculty development, i.e. the support of faculty in the design of and teaching in innovative learning environments, (b) curriculum development on the program level such the students' whole learning experience within a study program is considered, and (c) strategic development on an institutional level (Jenert & Brahm, 2010). As a starting point for such an institution-wide approach to educational development, we suggest to diagnose the existing learning culture at the HEI. It encompasses all the aspects within a HEI that impact on students' learning processes and includes (1) a personal, (2) a pedagogical interactions and (3) an organizational dimension. The personal dimension comprises individual characteristics of learners considered relevant for formal and non-formal learning processes, i.e. their motivation to study. The pedagogical interactions dimension focuses on teachers' and learners' actions in the context of (non)-formal learning settings at HEI, e.g. the tasks, methods, and roles defining the actual design of a learning environment. The organizational dimension focuses on how teaching and learning is positioned within a HEI (as compared to e.g. research as their other main activity besides teaching). Consequently, this dimension comprises all those factors that are subject to (strategic) decisions on the institutional level and at the same time impact student learning, e.g. socialization to higher education for both students and faculty.

The Learning Culture Inventory for HEI. Developing the instrument, we started out by gathering and developing items for the different dimensions of learning culture (see below). In a first screening, these items were shown four experts in order to evaluate comprehensibility of the wording as well as the suitability for HEI. Next, for the first validation of the instrument, 1001 students and 225 faculty members at a Swiss university were surveyed. Over the following 6 months, the questionnaires have been used with about 3000 students in three different universities in Germany, Austria, and Switzerland. To analyze the data, exploratory factor analyses, and reliability analyses were used.

The findings of the study include a first version of the Learning Culture Inventory for HEI. The students' version of the instrument encompasses 12 scales for the individual, 12 for the pedagogical interactions and 5 for the organizational dimension. The assumed basic factor structure of the instruments could be confirmed. The reliability of most scales was reasonable (Cronbachs Alpha can only be reported for some scales in this abstract), e. g. for extrinsic motivation to study $\alpha = .853$ and hope as a positive emotion $\alpha = .820$ on the personal dimension; competition between students $\alpha = .759$ and formative evaluation of students performance ($\alpha = .727$) concerning pedagogical interactions, and systematic student introduction to studying ($\alpha = .787$) on the organizational dimension.

Both, the institution-wide approach to educational development and the learning culture instrument, are relevant for research and practice. While the instrument provides a possibility to diagnose the learning culture at a HEI, the institution-wide approach can subsequently be used as a (theoretical) guideline for HEI on how to implement organizational structures for educational development. Taken together, this study can provide the basis for sustainable developmental initiatives to innovate teaching and learning at HEI.

PAPER PRESENTATION

Investigating tertiary education students' attitudes toward Statistics

Tasos Barkatsas, Monash University, Australia

Undergraduate and Postgraduate students' attitudes toward statistics were investigated by using the Survey of Attitudes Toward Statistics (SATS), along with a number of supplementary variables such as: gender, confidence in mathematics and confidence in statistics. Initially an exploratory Principal Components Analysis (PCA) with Varimax and Oblimin rotations was conducted and internal consistency reliability estimates were calculated, followed by various t-tests, correlations and a MANOVA. All correlations among subscales were low except for the correlation

between the Difficulty and the Value subscales. No statistically significant gender differences were found but there were statistically significant differences between the "mathematics confidence" variable and each of the four SATS subscales (Affect, Cognitive competence, Value and Difficulty) of SATS.

Several researchers (Araki & Shultz, 1995; Elmore & Lewis, 1991; Elmore, Lewis, & Bay, 1993; Elmore & Vasu, 1986; Harvey, Plake, & Wise, 1985; Onwuegbuzie, 1995; Roberts & Bilderback, 1980; Schau et al, 1995; Schutz, Drogosz, White, & DiStefano, 1998; Wise, 1985; Woehlke, 1991; Woehlke & Leitner, 1980; Zimmer & Fuller, 1996) have studied the factors which have an impact on students' performance in statistics courses, including attitudes toward statistics. Roberts & Bilderback (1980) developed the Statistics Attitude Survey (SAS). The instrument was designed to be one-dimensional comprising 33 homogeneous items. Since then two other well-known survey instruments regarding attitudes toward statistics have been developed: the Attitudes Toward Statistics Scale (ATS, Wise, 1985) and the Survey of Attitudes Toward Statistics Scale (SATS, Schau et al, 1995). The ATS was designed to measure two attitude components in contrast to the one-dimensional structure of the SAS. The first component measured students' attitudes toward the usefulness of statistics in their field of study. The second component measured students' attitudes toward the statistics courses they were attending. The SATS instrument incorporates 4 subscales which have been designed to measure negative and positive attitudes about statistics. The four subscales are the following: the Affect subscale, the Cognitive Competence subscale, the Value subscale, and the Difficulty subscale. Several studies have been conducted on the gender differences regarding students' performance and attitudes toward statistics. Schram (1996) published a meta-analysis of studies investigating the gender differences on achievement in statistics and reported that the average effect size $d = .08$, was in favor of the female students. Roberts and Saxe (1982) found significant differences when using SAS: the male students had more positive attitudes towards statistics than the female students (pretest, $r = .26$; posttest, $r = .19$). Araki & Shultz (1995) did not report significant gender differences when using the ATS subscale, whereas the aims of the study were to investigate: Undergraduate and postgraduate education students' affect, cognitive competence, value and difficulty toward statistics. Gender differences in the attitudes of undergraduate and postgraduate education students' attitudes toward statistics.

Method

Participants The scale (SATS) was administered to 247 undergraduate ($N = 155$) and postgraduate ($N = 92$) students enrolled in the 4-year Bachelor of Education and the 1-year Graduate Diploma in Education courses in a large Australian University. 13.4% of the undergraduate students were enrolled in a second year mathematics education unit and 49.4% in a fourth year unit. The composition of the final sample was 71.2% female and 15.8% male students (13% missing).

Instrument The SATS questionnaire used in this study consists of 28 items on a seven point Likert scale (1 = strongly disagree, 4 = neither disagree nor agree, 7 = strongly agree). After re-coding the negatively worded items, the highest values in the scale correspond to positive attitudes toward statistics. The questionnaire comprises four subscales: the Affect subscale (6 items), the Cognitive Competence subscale (6 items), the Value subscale (9 items) and the Difficulty subscale (7 items). Analyses Principal Components Analysis (PCA) with a Varimax rotation was conducted and internal consistency reliability estimates were calculated, followed by various box plots, t-tests, correlations and a MANOVA. The SATS internal consistency reliability estimates of this study were consistent with those reported by Schau et al. (1995). The reliability coefficients ranged from .636 to .904. The lowest estimate of Cronbach was obtained for the difficulty subscale, a result consistent with the subscale with the lowest estimates reported in both the Schau et al. (1995) and Cashin & Elmore (2005) studies.

Results and discussion

Schau et al. (1995) used CFA to support a four factor structure of the SATS. In a more recent study Cashin & Elmore (2005) suggested that the SATS might be an instrument with only two domains similar to the two domains of the ATS. In this study the results of PCA suggest that a three-factor solution could offer an alternative to that of the four-factor model. The components reflecting the Affective and Cognitive competence subscales in the three-factor model loaded on a unique factor, which could be perceived as representing a subscale congruent to the ATS Course subscale, as the two subscales could be conceptualised as a measure of students' attitude toward their achievement in a statistics course. Cashin & Elmore (2005) reported that the only significant change in attitudes measured by SATS - before and after the course - was in the scores from the Affect subscale. Affective measures like the Affect subscale of the SATS and self-efficacy confidence measures like the Cognitive Competence subscale of the SATS, are often treated as distinct constructs in educational theory and in research on attitudes toward statistics (Eccles & Wigfield, 1995; Harlow, Burkholder & Morrow, 2002). In this study all correlations among subscales were low except for the correlation between the Cognitive and the Affect subscales, a result confirming the original Schau et al. (1995) study's results. It was found that there were no statistically significant differences between male and female students' attitudes in any of the four SATS subscales. In addition, the results showed no evidence of statistically significant differences between male and female students in the expected statistics course achievement. This last finding is in agreement with the findings of a number of previously conducted studies (Bradley & Wygant, 1998; Waters et al.,

1988; Buck, 1985; Harvey et al, 1985; Schram, 1996; Ware & Chastain, 1991). NOTE: References not included due to word limit but they are available on request.

PAPER PRESENTATION

How teachers, students and experts rate a teaching approach and the connection to student learning

Christine Johannes, Technische Universität München, Germany; Tina Seidel, Technische Universität München, Germany

A commonly used self-report instrument for the assessment of teaching action is the Approaches to Teaching Inventory (ATI, Trigwell & Prosser, 2004, Prosser & Trigwell, 2006, Trigwell, Prosser & Ginns, 2005). Recent doubts about the connection between self-reported approaches and teaching action (Kane, Sandretto & Heath, 2002) raised the question how self-report measures can be validated by the perception of participating students or experts. In our study, we investigated this relationship for the ATI-R. Furthermore we used clarity/coherence and didactical methods as indicators of teaching action and explored their connection to students' learning characteristics such as students' learning strategies and motivation. As a method, a sample of N=17 university teachers from different disciplines and their students filled out a German version of the ATI-R (Trigwell, Prosser & Ginns, 2005) as well as ratings for clarity/coherence and didactical methods after a videotaped session of their teaching. Three experts per teacher rated the corresponding constructs. In addition, students rated their intrinsic and extrinsic motivation as well as deep-level and surface-level learning approaches. The results show that mean student ratings for teacher focus were higher than the corresponding teacher ratings. Compared to teacher ratings, experts were stricter, but both perspectives (teacher, external expert) were moderately intercorrelated. Students' perceptions and expert ratings were systematically correlated with student learning such as learning strategies and motivation. We conclude that teacher self-reports can be applied to compare teachers/ teaching action. In addition, measures such as expert ratings should be used to assess effects on student learning outcomes.

Summary The study explores how self-report measures of teaching action relate to correspondent measurement of participating students and experts. For this question, we focus on university teachers who were questioned and videotaped in one teaching session. The connection of these measures gives insight, how self-report measures of teaching action are related to the actual teaching situation and which restrictions could result from the exclusive assessment of the teacher's perspective. **Theoretical Background** Teachers' teaching approaches are characterized as teaching strategies with associated intentions (Kember, 1997) and seem to have a fundamental influence on learning. For example, Trigwell, Prosser and Waterhouse (1999) reported of more student surface learning approach when teachers describe their teaching approach as teacher-focused. In contrast, if teachers report a more student-oriented teaching approach, students report more deep-level learning. Despite the conceptual closeness of teaching approaches to the actual teaching situation, self-reported teaching action is not necessarily consistent with the concrete teaching action (Seidel, Schwindt, Rimmele, & Prenzel, 2008). To access concrete teaching action, it is necessary to look at the concrete teaching situation rather than a self-report measure (Kane, Sandretto & Heath, 2002), but this has not been done for well-established measurements close to teaching action such as the teaching approach. Above that, self-reports of clarity/coherence and didactical methods, as important features of effective teaching should be checked for connections to teaching action.

Research Questions

In our study, we relate different perceptions of the teaching approach and teaching action by connecting self-report measures to student and expert ratings for a concrete teaching situation. This analysis should shed light on the question, how self-reported teaching approaches relate to the perceived teaching action. Specifically, three research questions are explored: (1) How do self-reported teaching approaches relate to teaching approaches rated by students participating in a teacher's course? (2) How do self-reported teaching approaches relate to expert ratings gained in systematic video observations? (3) Which measures show tighter connections to student's learning strategies and motivation?

Methods & Design

N=17 university teachers (7 women, 10 men, M=28.7 years, SD=5.8) from different disciplines were questioned and videotaped in one teaching session within the winter term 2009/2010. Data collection took place during a qualification program for teaching. Above that, student and video ratings of experts (three ratings per teacher) were collected for this teaching session. Answers were given on a six-point Likert scale. Teachers filled out a German version of the revised Approaches to Teaching Inventory (Trigwell, Prosser & Ginns, 2005; $\alpha=.84$ teacher focus, $\alpha=.88$ student focus) and answered five questions regarding clarity/coherence ($\alpha=.72$) and five items regarding their didactical methods ($\alpha=.75$). These elements were independently rated by the three experts with acceptable interrater reliability

for the scales (.63?r?.84). Also, the students of the videotaped classes (N=338) rated teaching approach, clarity/coherence, didactical methods with equal or higher reliabilities. Above that, students rated their intrinsic motivation ($\alpha=.75$), extrinsic motivation ($\alpha=.72$), deep-level ($\alpha=.71$), and surface-level learning ($\alpha=.84$).

Results

Averaged student ratings of the teacher focus were higher than the corresponding self-reports ($t(16)=-2.58$; $p=.02$). In contrast, no differences between student ratings and corresponding self-reports could be found for student focus ($t(16)=0.51$; $p=.96$), clarity/coherence ($t(16)=1.29$; $p=.21$) and didactical methods ($t(16)=-0.45$; $p=.66$). Compared to expert ratings, teachers rated themselves more student-focused ($t(16)=6.09$, $p<.00$) more clear/coherent ($t(16)=3.00$, $p=.01$) and stated more didactical variety ($t(16)=3.26$; $p=.01$). No differences with respect to teacher focus could be observed ($t(16)=0.66$, $p=.52$). Interestingly, correlations for teacher focus ($r=.58$, $p=.02$) and student focus ($r=.67$, $p=.01$) were moderate. Also ratings of clarity/coherence ($r=.67$, $p=.01$) and didactical methods ($r=.50$, $p=.04$) show moderate intercorrelations. For the student learning approaches and motivation (N=17 sessions), students' perceived student focus connected to their intrinsic motivation ($r=.69$, $p=.02$) and, in tendency, to deep-level learning approach ($r=.43$, $p=.09$). Similarly, a marginal correlation between intrinsic motivation and expert-rating of student focus could be found ($r=.46$, $p=.07$). On the other hand, students' perception of a teacher focus were marginal connected to extrinsic motivation ($r=.45$, $p=.07$). No correlations with teachers' self-reports occurred. For students' perception of teaching action, a correlation between clarity/coherence and intrinsic motivation ($r=.63$, $p<.00$) as well as a deep-level learning approach ($r=.69$, $p<.00$) emerged. Above that, student's rating of didactical methods correlated with intrinsic motivation ($r=.83$, $p<.00$) and deep-level learning ($r=.72$, $p<.00$). In tendency, the expert ratings of didactical methods show similar connections to intrinsic motivation ($r=.45$, $p=.08$) and deep-level learning ($r=.44$, $p=.09$). As for the teaching approaches, no significant correlations with teachers' self-reports occurred.

Discussion

Our study focused on how self-reported teaching approaches and teaching action relate to correspondent measurement by students and experts. The current data indicate that (1) in general, teachers and students see their shared teaching situation quite similar. One exception is a teacher focus, which students rated higher. (2) Comparisons to expert ratings as stricter criterion showed that teachers were positively biased in judging of their own teaching. This effect seems to be a rather general bias: Moderate intercorrelations between expert ratings and self-reports indicate the same observational basis connected with an individual reference of frame in teachers. (3) Despite tight connections between self-reports, student and expert ratings, only students' perceptions and expert rating connect to student characteristics such as learning approaches and motivation. This leads to the conclusion that self-reports of teachers are a suitable indicator to compare teacher's teaching action. Other measures such as expert ratings should be used to make connections between teaching action and student's learning outcome. Video-based expert ratings, moreover, offer multiple possibilities for professional development by being able to directly target at the teaching action at hand. Students' perception of teaching action connects even tighter to their learning, but could be biased with respect to pre-knowledge or interest in the teaching subject matter.

References

- Kane, R., Sandretto, S. & Heath, C. (2002). Telling Half the Story: A Critical Review of Research on the Teaching Beliefs and Practices of University Academics. *Review of Educational Research*, 72 (2), 177-228.
- Kember, D. (1997). A reconceptualisation of the research into university academics' conceptions of teaching. *Learning and Instruction*, 7(3), 255 - 275.
- Seidel, T., Schwindt, K., Rimmele, R., & Prenzel, M. (2008). Konstruktivistische Überzeugungen von Lehrpersonen: Was bedeuten sie für den Unterricht? *Zeitschrift für Erziehungswissenschaft, Sonderheft 9*, 259-276.
- Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education*, 37, 57-70.

PAPER PRESENTATION

Apprentices at Risk: What Conditions Lead to Dropout in Vocational Education and Training?

Simone Berweger, University of Teacher Education St.Gallen, Switzerland, Switzerland; Patrizia Salzmann, University of Teacher Education St.Gallen, Switzerland, Switzerland; Samuel Krattenmacher, University of Teacher Education St.Gallen, Switzerland, Switzerland; Samuel Schoenenberger, University of Teacher Education St.Gallen, Switzerland, Switzerland

In a longitudinal design we are studying a cohort of 849 apprentices throughout their three-year training. They commenced their vocational training in health care or building construction in 2009. The objective is to identify conditions (characteristics of the individual, the in-company training, the vocational school training and the family of

origin) of successful vocational training. Borrowing from the self-determination theory (Ryan & Deci, 2000) and Krapp's (1998, 1999) person-object theory of interest, we are focusing specifically on motivation variables.

In this paper we compare those who dropped out during the first year ($n=63$, 7.4%) with those who made the transition to the second year ($n=786$, 92.6%) of training. We consider the identification, by vocational schools, of apprentices at risk due to poor academic performance during the probation period. This allows for the comparison of a first group of apprentices that had been correctly identified as being at risk, a second group that could not be identified in advance and a third group of adolescents – classified as a risk group – but who did not drop out. First results show that those who dropped out were less satisfied with their chosen apprenticeship from the beginning and that they had often declared that it did not correspond with what they desired. As expected, they started with weaker intrinsic motivation towards their training and agreed that they enjoyed work less since starting the course.

We are studying a cohort of apprentices ($N=849$), who entered vocational training in health care or building construction in 2009, throughout their three-year training (longitudinal design). The objective of the study is to identify conditions (characteristics of the individual, the in-company training, the vocational school training and the family of origin) of successful vocational training. Borrowing from the self-determination theory (Ryan & Deci, 2000) and Krapp's (1998, 1999) person-object theory of interest, we are focusing specifically on motivation variables. In this paper, apprentices who dropped out of vocational training by the end of their first year are compared with those who successfully managed the transition to second year. Additionally, to get a more differentiated insight, three groups of apprentices will be compared to each other: (1) dropouts who had been identified as being at risk by the vocational schools because of poor academic performance during the initial probation period, (2) dropouts who could not be identified in advance and (3) apprentices who had been classified into the risk group, but who did not drop out. We address the research questions on how these groups of apprentices and their training situation are characterized, what conditions lead to dropout and which factors might be protective. A special focus is set on the impact motivational variables have on dropout. We analyse if and how the groups differ in terms of the compromise they had to make when choosing their vocation and any special support received from their school and their company.

Theoretical background

In Switzerland, more than two out of three adolescents do an apprenticeship during this challenging period of their lives. Mastering the transition from obligatory school to vocational training, attending and completing this formation successfully, and the subsequent entrance into the labour market are important challenges for adolescence. Vocational training facilitates the entry into the labour market and the beginning of one's working career, and is seen as assuring integration into the world of work (OECD, 2000; Ryan, 2001; Bynner & Parsons, 2002; Imdorf, 2007). In general, the acquisition of theoretical knowledge and practical skills relevant to the occupation are important criteria for a successful course of formation. From the point of view of those learners who drop out, the decisive factors are an unfortunate choice of occupation, their relationship to the VET trainer, and aspects of learning at the workplace (Stalder & Schmid, 2006; Schmid, 2000). For many students from schools with basic requirements, the key question is not whether their interests fit the occupation, but (1) whether they can find an apprenticeship at all (Herzog, Neuenschwander & Wannack, 2006) and/or (2) whether they can attain a vocational qualification. Therefore, it seems particularly important to allow for situational interest in aspects of the occupation during training, in order to activate motivational processes, and, in the long run, develop more stable interests relevant to the occupation (see Krapp & Lewalter, 2001). Work motivation theories propose a strong connection between task-related (more intrinsic) motivation and notions of growth and autonomy (e.g. McGregor, 1960; Herzberg, 1972; Hackman & Oldham, 1976), which is very close to the self-determination theory (Ryan & Deci, 2000).

Method

We are collecting data from a cohort of 849 apprentices, that started their apprenticeship in the field of health care or building construction in 2009, as well as from their VET trainers throughout the three-year training (longitudinal design). As dependent variables we are surveying the apprentices' performance, satisfaction with the apprenticeship, intention to pursue the training and complete it. Among the independent factors, of greatest interest are those that foster motivation and are central to approaches such as the self-determination theory (Ryan & Deci, 2000), Krapp's (1998, 1999) person-object-theory of interest, as well as approaches from organizational psychology (e.g. Hackman & Oldham, 1976). Special attention is granted to attributes of the workplace (e.g. job characteristics, mentoring and working atmosphere) that are expected to have a positive influence on psychological states that support intrinsic motivation and satisfaction. Furthermore, attributes of support and learning atmosphere at the vocational school are considered. An additional questionnaire is sent to those apprentices who drop out. The reasons for dropout, the apprentices' situation after the dropout, their prospects, as well as, the experienced support are examined.

First results

In this contribution, we present selected results from the first two sets of data collection (in the middle of the initial probation period, and in the second half of the first year of training). The initial findings indicate that at the time of signing the apprenticeship contract, a majority of adolescents is confident or very confident that they have chosen the right vocation, and also expect to fit in well with the employer. The data show that 63 (7.4%) out of 849 apprentices dropped out during the first year of apprenticeship. This group was already dissatisfied with their chosen vocation at the beginning of the apprenticeship and had often declared that the vocation did not correspond with what they desired. About a quarter of those who dropped out, as well as those who did not, experienced difficult situations in the company during the probation period. As expected, the two groups differed significantly in their intrinsic motivation towards their course, with those who dropped out showing weaker intrinsic motivation. About three quarters of the apprentices agreed or rather agreed that during work, they often experienced feelings of boredom as well as overtaxation, and no difference was found between those who dropped out and those who continued. But the former agreed less that they had enjoyed work since entering the vocational training. This finding reinforces the assumption that intrinsic motivation is important for success with the initial qualification. The current integration of data concerning the identification of apprentices being at risk by the vocational schools is almost complete and will allow for an additional and more discriminating analysis that we expect to give important indications of what conditions lead to dropout and which factors might be protective.

PAPER PRESENTATION

Business Internship Advisors as Protagonists of Workplace Learning

Annette Ostendorf, University of Innsbruck, Austria, Germany; Markus Ammann, University of Innsbruck, Austria

Business internships as a type of experiential learning settings are supposed to foster students' abilities to connect theoretical and practical knowledge, to support their personal and emotional development, and to help them in finding the right career path. There are many hints that they do so but we also have to face that these - from an educational view of perspective highly desirable - outcomes are not guaranteed or in any sense achieved automatically. This may lead us to investigate structures and conditions for high quality in business internships more intensively. In this paper the focus will especially be on the workplace advisors of business internships. This group of 'educators' can be considered as the hidden ones. There is not much transparency on their involvement in workplace learning processes. In the present study we discuss results of a qualitative-empirical case study conducted in summer 2010 in a mid-sized, Austrian company in the public sector. Central issues are expectations, role interpretation and competencies of business internship advisors. We attempt to make a contribution to the development of a quality framework for counselling structures and processes in internships.

Introduction and aims

Business internships as a type of experiential learning settings are supposed to foster students' abilities to connect theoretical and practical knowledge, to support their personal and emotional development, and to help them in finding the right career path. There are many hints that they do so but we also have to face that these - from an educational view of perspective highly desirable - outcomes are not guaranteed or in any sense achieved automatically. This may lead us to investigate structures and conditions for high quality in business internships more intensively. The construct „quality“ in this context should be properly judged in terms of educational aims (as opportunities for personal development and learning) but also in terms of contributions to economic achievement. That attitude depends on the special definition of internships. One attribute of internships is that they are a combination of learning and working. If only one of these processes is exclusively stressed it cannot be called an internship any longer. A second attribute of internships is the existence of a sort of didactic framework. That means that there has to be a minimum of planning concerning learning outputs, work-related aims, processes, advisors and workplace conditions.

Our central issue is to find out quality features for counselling or advising business internships. That includes also a deeper discussion on quality criteria in cooperative educational settings. In this paper the focus will especially be on the workplace advisors of business internships. This group of 'educators' can be considered as the hidden ones. Research on their role, expectations or competencies is still rare in educational literature.

Methodology and methods

In the face of this lack of theories and empirical data a qualitative-empirical case study was conducted in summer 2010 in a mid-sized, Austrian company in the public sector. An interpretative approach seems to meet the research goals best. Business internships are very different depending on the type of business field, the company's size and location, its cultural surroundings, including the educational system etc.. Therefore comparison between different internships is difficult.

The explored firm with about 500 employees offered a total of 48 internships for pupils and students of higher educational institutions in technical fields and administration or service in the year 2009. The company investigated offered internships with a duration from one week to two months. In the classification of Stake (2005: 445) the investigation was designed as an instrumental case study. That means that the special case was investigated mainly to facilitate understanding of the issue and for generalization purposes. The mentioned case study is one component in a broader project on business internships funded by the Tyrolean Science Fund (2009-2010) at the University of Innsbruck.

Besides the document analysis and some effort to sum up the company's background four semi-structured qualitative interviews have been conducted at the firm. Criteria for the selection of the interview partners were on the one hand their direct responsibility for the intern and on the other hand their long-term experience in counselling internships. They have been questioned as experts on their living environment. With these four persons the most relevant protagonists of internship counselling in the focussed company have been covered.

Findings

In this short summarizing abstract we want to note only some special outcomes.

- o When the advisor's commitment to young people is highly valued by the leaders the additional and voluntary work as a advisor is not considered as strong a burden.
- o There is a close nexus between experiences in trainee supervision within the Austrian dual vocational system and their ability to deal with interns. Amazingly they refused an organizational link between the two types of learners within the company.
- o In the eyes of the internship advisors one of the most relevant personal attributes of a advisor should be his identification with the work and the company. That is considered as an indispensable attribute for facilitating interns' participation in the world of work.
- o Very important for the successful work as a advisor is an appreciating and respectful attitude towards the interns.
- o There is no link between schools, teachers and the advisors. Even though there is a strong wish for cooperation nobody cares about an initiative in that direction.
- o Internship advisors don't get any support concerning the design of educational situations.
- o Didactic support in the task arrangements for the interns dedicated by teachers would be seen as very helpful and not as constricting.

Theoretical and educational significance of the research

Business internships are strongly discussed in the Austrian school community in terms of their strengths in combining theoretical and practical settings of education. They are estimated as one powerful tool to improve the weakness of medium and higher vocational schools (outside of the dual system) in offering direct business experiences. In an international view there is also an old tradition and new revival of educational discussion on cooperative education (Howard 2004: 4) to which our research can contribute some aspects.

We found out that there is also a lack of 'sense making' on the positioning and design of business internships between companies and schools. Discussions often focus only on the role of teachers in accompanying internships of their students. Less strong attention is given to the 'other side of teaching' – the advisors. So our paper brings the view of in-company advisors more to the foreground and may open opportunities for the design of high quality cooperation in that field.

References

- Howard, A. (2004): Cooperative Education and Internships at the Threshold of the Twenty-First Century. In: Linn, P.L., Howard, A., Miller, E. (Eds.), Handbook for Research in Cooperative Education and Internships (pp. 3-10). Mahwah, N.J.: LEA.
- Stake, R. E. (2005): Qualitative Case Studies. In: Denzin, N. K. (Ed.), The SAGE handbook of qualitative research. 3rd ed. (pp. 443-466). Thousand Oaks, Cal.: Sage.

PAPER PRESENTATION

Training for transfer. A comprehensive evaluation study

Jan Ulrich Hense, Ludwig-Maximilians-University Munich, Germany; Stephanie Maite Gretsche, Ludwig-Maximilians-University Munich, Germany; Heinz Mandl, Ludwig-Maximilians-University Munich, Germany

The present evaluation study of trainings for Six Sigma, a methodology for organizational quality improvement, aimed to demonstrate how a theory-based multi-method approach comprising context, input, process and outcome analyses will generate valuable insights into the problem of training transfer. Method and results of four sub-studies are presented in detail: content analysis of the training concept, structured observations of training sessions, pre- and post-training surveys, and a transfer survey. Overall, these studies showed that the evaluated trainings already implemented many features to be expected from an effective transfer-oriented learning environment in the view of current learning research. However, it was also possible to identify a number of weaknesses which served as a source for recommendations for improving the trainings' concept and realisation. It is argued that approaches to training evaluation which focus only on outcomes would not be able to provide this kind of formative feedback.

Aims and theoretical background

Transfer of training to the workplace is a major and recurrent concern from educational as well as economical viewpoints. If learners are not able to apply the knowledge and skills they have learned in and between training sessions in their everyday work, valuable resources have been wasted. Drawing on the classical framework of Baldwin and Ford (1988), several possible reasons for the failure of transfer can be identified: Trainee characteristics (e.g. lack of preconditions, previous knowledge or motivation), training design (e.g. wrong choice of contents or learning approach), or work environment (e.g. lack of support or opportunity to apply contents). According to Laker (1990), transfer is not monolithic but has to be conceptualized as a two-dimensional construct. First, in regard to generalisability, transfer can be near, i.e. happen in contexts which are similar to the learning situation, or far, i.e. happen in other contexts which are distinctively different from the learning situation. Secondly, on a temporal dimension, distinct phases of transfer from initiation to maintenance have to be differentiated. From a learning theory viewpoint, it can be argued that there are two major preconditions for transfer of complex learning goals: a learning environment which fosters learners' active involvement with authentic problems (e.g. problem oriented or inquiry based learning), and instructional support, e.g. during self-directed and cooperative learning phases, and, in particular, after the training in the form of coaching at or near the workplace (Stark, Mandl, Gruber & Renkl, 1999). Accordingly, it was expected that for the trainings to be most effective in regard to enabling transfer, trainers are to provide authentic, cooperative and self-directed problem-solving contexts with well dosed direct instruction and guidance to enable learners to actively acquire, process, and exercise new knowledge and skills (e.g. Schmidt et al., 2009).

In many past training evaluations, the focus has been on measuring learners' acceptance and learning outcomes, while the complexities of analysing training transfer have often been neglected in the past. Therefore, in the current study which aimed at evaluating Six Sigma trainings in a corporate setting, a complex multi method evaluation design was applied to analyse training transfer within a comprehensive theory based framework. This framework incorporated context, input, process, and outcome variables to allow for a comprehensive analysis of training transfer.

Context of the study

The evaluation study was conducted in an international industrial gases and engineering company. The subject of the evaluation is the training for Six Sigma, a systematic, data-driven approach to quality improvement with the goal to achieve error free processes. The training concept comprises four training weeks with a 4-6 week interval in between each week, during which the participants work on their own authentic Six Sigma projects while receiving coaching by an experienced "Master Black Belt". The contents of the individual training weeks ideally run parallel to the progress of the participants' project work carried out in between the training weeks.

Research questions

The research questions addressed the following aspects in regard to the transfer-oriented theoretical model: (1) training concept, (2) training implementation, (3) participants' preconditions, (4) training outcomes, (5) transfer conditions at the workplace, and (6) actual transfer of learning contents.

Methodology

A multi-method approach comprising four studies was chosen. These used content analyses of training manuals to examine the training concept (question 1), structured participant observations of training sessions to study implementation (question 2), pre- and post-training surveys (questions 3-5), and transfer surveys and interviews (question 6).

Findings

The analysis of the trainer manuals (question 1) suggested that the training concept provided a mix of diverse teaching and learning methods, which basically conformed to central criteria for transfer-oriented learning environments (e.g. work-place related exercise, case studies). The observation of training sessions (question 2) revealed that the training was implemented mostly in accord with the trainer manuals. Accordingly, the training implementation applied

important elements of a transfer-oriented methodology (e.g. learners were actively engaged in individual (14% of overall training time) or group work (33%) while receiving support by the trainers). The pre-post-test surveys revealed that important preconditions favourable for transfer were met (question 3) (e.g. participant motivation; authentic, problem-oriented projects from participants' own workplace). It also demonstrated satisfactory training outcomes (question 4) (e.g. gains in knowledge and skills) and for most participants transfer conditions were favourable in particular in regard coaching at the workplace (question 5). Finally, the transfer study (question 6) illustrated that learners did actually apply not all, but a substantial percentage of the learning contents.

Theoretical and Educational Significance

Based on the empirical results, several recommendations for further improvements of the training concept and realisation were made at the context, input, and process levels. Among these were providing better transfer conditions at the workplace by guaranteeing line managers' support (context), making sure that participants' own projects which they bring to the training were actually suited for realisation within the training duration (input), and decreasing the percentage of lectures, interactive lectures and the usage of presentation slides during training sessions (process). The theory-based, multi-method approach demonstrates that for understanding and optimizing the transfer of training under real world conditions, a comprehensive perspective, comprising context, input, process, and outcome analyses, needs to be applied.

References

- Baldwin, T. T. & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology*, 41(1), 63-105.
- Laker, D. R. (1990). Dual dimensionality of training transfer. *Human Resource Development Quarterly*, 1 (3), 209-235.
- Schmidt, H.G., van der Molen, H.T., te Winkel, W. & Wijnen, W. (2009). Constructivist, problem-based learning does work. *Educational Psychologist*, 44, 227-249.
- Stark, R., Mandl, H., Gruber, H., & Renkl, A. (1999). Instructional means to overcome transfer problems in the domain of economics: Empirical studies. *International Journal of Educational Research*, 31, 591-609.

PAPER PRESENTATION

The Juice Factory; designing authentic learning in vocational education.

Loek FM Nieuwenhuis, IVA, university of Tilburg, Netherlands; Marjan Kat, IVA, university of Tilburg, Netherlands; Marijke Van Vijfeijken, IVA, university of Tilburg, Netherlands

In this paper the introduction of the Juice Factory is analysed. The Juice Factory is a simulated production line for training occupational and professional competencies. Based on curriculum theory (Van den Akker, 2003) and design principles for authentic learning environments (Zitter, 2010), teachers from Dutch colleges for vocational/professional education and training are interviewed on their instructional theories and practices. The teachers lack a theory of professional development, so they are not well equipped to use the Juice Factory as an instructional tool for preparing their students for the transition from school to work.

Workplace learning is seen essential in Dutch Vocational Education (VET), for developing occupational competences. Apprenticeships are seen as a strong system for school to work transitions (Mýller & Shavit, 1998; OECD, 2009). However, the effectiveness of workplace learning can be questioned for (early) instruction goals. Nijhof and Nieuwenhuis (2008) make clear that for developing occupational, theoretical knowledge the workplace is not effective, and for training skills other learning environments may be more effective. Billett (2004) argues that workers learn a lot in the workplace, but not always the right things: due to economic constraints the workplace is filled with short-cuts and wicked routines, which are bad learning examples for novices and apprentices. Dehnbostel (2001) state that off the job learning "bays" are effective for skill training, because production stress can be decreased, so opportunities emerge for instruction and rehearsal. Workplace learning should be sequenced in a vocational curriculum, in which a variety of practical learning environments are deliberately scheduled (Van Merriënboer a.o., 2004).

VET colleges and training companies are looking for alternative learning environments combining the attractiveness of realistic work environments and the effectiveness of simulated work environments. Zitter (2010) developed an analytical tool for designing authentic learning environments, based on two dimensions: 1) simulation versus authenticity and 2) acquisition versus participation. The latter dimension is based on the two metaphors for learning, developed by Sfard (1998): in the first metaphor, learning is targeted at the acquisition of knowledge and skills, whereas in the second metaphor learning is targeted at becoming a member of a community (cf. Wenger, 1998).

Simulated practice is favourable for acquisitional goals (skill development and knowledge acquisition), whereas realistic practice is enhancing socialisation processes (legitimate peripheral participation, becoming a member of the working community; Lave and Wenger, 1991).

In the paper a case study is presented on the design and use of the "Juice Factory" in a Dutch VET college. The Juice Factory is a complete and running production line for bottled juice, which is run by students from several higher and intermediate vocational and professional courses (business administration; process technology; mechanical/electronic engineering; sales and retail). Work masters from a neighbour factory and teachers from several colleges are responsible for supervision and coaching and for the delivery of in-company classes. On small scale, the Juice Factory is delivering juice to external clients, so a realistic production process is created. The case study focuses on the teachers of these courses: we were interested in the instructional theories and practices used in course delivery before and after implementation of the Juice Factory. In the case study we reconstruct the implementation process of the Juice Factory, and we interviewed teachers, students and managers of 8 courses (from different colleges involved and on different levels of educational attainments). Besides the analytical model of Zitter, we used the curriculum development theory of Van den Akker (2003) as an agenda for the interviews. Van den Akker discerns 1) the curriculum as designed by developers; 2) the curriculum as used by teachers; and 3) the curriculum as learned by the students. In the paper we will present the design principles used by the VET-teachers of these courses. Although the factory has been operational for three years, teachers hesitate to incorporate the Juice Factory into their teaching and instruction. They do not see the Juice Factory as an innovative educational tool; they use the Juice factory as a regular training company, which is out of their reach. They lack a theory of professional development, so they are not well equipped to use the Juice Factory as an instructional tool for preparing their students for the transition from school to work.

References

- Billett, S. (2003) Learning in the workplace : strategies for effective practice. Crows Nest: Allen & Unwin
- Dehnbostel, P. (2001). Learning bays in German manufacturing companies. In: Advances in developing human resources, 3 (4) 471-479.
- Lave, J. & E. Wenger (1991). Situated learning. Cambridge University Press.
- Muller, W. & Y. Shavit (1998) The institutional embeddedness of the stratification process. In: Y. Shavit & W. M  ller (eds) From School To Work: A Comparative Study Of Educational Qualifications And Occupational Destinations. Oxford University Press
- Nijhof W.J. & L.F.M. Nieuwenhuis (2008). The learning potential of the workplace. Rotterdam/Taipei: Sense Publishers.
- OECD (2009): Learning for jobs. Policy review of vocational education and training. Paris: OECD.
- Van den Akker, J. (2003) Curriculum perspectives: an introduction. In: J. Van den Akker, W. Kuipers e.a. (eds).
- Van Merri  nboer, J., R. Clark & M. de Croock (2004) Blueprints for Complex learning: the 4c/ID-model. In: ETR&D, 50 (2), 38-54
- Wenger, E. (1998) Communities of practice. Cambridge University Press.
- Zitter, I. (2010) Designing for learning; studying learning environments in higher professional education from a design perspective. PhD thesis, Utrecht University.

PAPER PRESENTATION

Unraveling characteristics of powerful learning environments for self-regulation in mathematics

Erik De Corte, University of Leuven, Belgium; Fien Depaepe, University of Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

There is today a broad consensus among researchers in mathematics education that the ultimate goal of mathematics education consists in students' acquisition of adaptive competence, i.e. the ability to apply meaningfully learned knowledge and skills flexibly and creatively in a variety of situations. Research has shown that self-regulation constitutes an important component of adaptive competence in mathematics, and is highly correlated with academic achievement. But there is also evidence that students do not become self-regulated learners spontaneously. Taking all this into account the challenging question is: What kind of learning environments needs to be designed in view of fostering in students the acquisition of good self-regulation skills as part of becoming competent in mathematics? This paper will review the available research relating to this important issue, starting thereby from the early studies in the 1980s and resulting in the identification of research-based major characteristics of effective learning environments.

Theoretical background and objective

There is broad consensus that the ultimate goal of mathematics education consists in students' acquisition of adaptive competence, i.e. the ability to apply meaningfully learned knowledge and skills flexibly and creatively in divers contexts. Research shows that self-regulation skills constitute an important component of adaptive competence in

mathematics and are highly correlated with achievement (De Corte & Verschaffel, 2006). However, there is evidence that students do not become self-regulated learners spontaneously. Taking this into account a challenging question is: What kind of learning environments needs to be designed and implemented for fostering in students the acquisition of good self-regulation skills as part of becoming competent in mathematics? This paper reviews the relevant research relating to this issue.

Data sources and results

Early studies in the 1980s investigated the impact of modeling, guided practice, and corrective feedback on primary school students' acquisition of self-regulation skills during mathematics instruction. They showed that using models during teaching can enhance students' self-regulation and achievement (Schunk, 1998). However, these studies were limited to teaching discrete computational skills instead of focusing on the effects of self-regulation on complex activities, especially problem solving. Furthermore, they mostly addressed discrete aspects of self-regulation (e.g., goal setting). Moreover, the interventions were short. De Corte, Verschaffel, and Op 't Eynde (2000) reviewed design experiments involving more extended and more comprehensive interventions focused on problem solving. These studies yielded also promising results that, moreover, converge well with respect to the crucial self-regulatory aspects as well as the instructional models underlying the interventions. Significant self-regulatory activities were: strategic behavior aiming at constructing an appropriate problem representation, and developing a solution plan. Important characteristics of the interventions included: (1) using a variety of teaching methods and learning activities; (2) creating an innovative classroom culture based on social norms that stimulate self-regulated learning. Building on that previous work a considerable series of new intervention studies were carried out over the past decade. We will selectively summarize this research based mainly on two meta-analyses (Dignath, Buettner, & Langfeldt, 2008; Dignath & Býttner, 2008) that cover studies in different subject-matter domains, among them a substantial number in mathematics. In the meta-analysis by Dignath et al. (2008) 17 studies pertain to mathematics at the primary school and report 47 effect sizes. The interventions included teaching of metacognitive strategies (e.g., planning, reflecting) besides cognitive strategies (e.g., heuristics). The results show that the interventions had a positive effect (mean effect size 1.00) on students' performance in mathematics but also on their motivation (1.04) and strategy use (0.77). Interestingly, in the second meta-analysis by Dignath and Býttner (2008) involving 28 studies on mathematics in primary and secondary school (reporting 132 effect sizes) the effect of self-regulation training on performance for secondary students was much smaller (0.23); for primary school the results were in line with the previous meta-analysis (0.96). Overall these meta-analyses show that self-regulated mathematics learning can be fostered in primary and in secondary school students. More recent studies by Mevarech and Amrany (2008), Perels, Dignath, & Schmitz (2009), and Kistner et al. (2010) yielded additional positive results. The important question is then: Which aspects of an intervention make it powerful for enhancing students' self-regulation skills and mathematics achievement? The findings from the meta-analyses and the most recent studies corroborate and complement the characteristics of the effective learning environments identified in the success stories mentioned above, namely interventions should (1) train in an integrated way self-regulation skills using a variety of teaching methods; (2) pay explicit attention to the usefulness and benefits of strategies; (3) create opportunities for practicing strategies and provide feedback about strategy use; and (4) install an innovative classroom culture that stimulates self-regulated learning, especially reflection. Implications for educational practice and directions for continued research This review documents not only that self-regulation has a significant impact on students' mathematics learning, but also that self-regulation of mathematics learning can be fostered by instructional guidance, already in primary school. The most obvious implication is that teaching of self-regulation skills should be appropriately implemented in mathematics classrooms, starting in elementary school. However, this represents a major challenge. Indeed, observation studies have shown that teachers spend little instruction time to strategy teaching (Depaepe, De Corte, & Verschaffel, 2007; Hamman, Berthelot, Saia, & Crowley, 2000). Therefore, a first condition for the large-scale implementation of teaching self-regulation is that policy-makers and school leaders stimulate the design and adoption of novel learning environments that focus on it. Furthermore, curricula, educational materials such as textbooks, and assessment instruments need to be revised accordingly. Whereas all this is necessary, it is not sufficient. Research shows that introducing textbooks based on a new perspective on learning and teaching does not easily and certainly not automatically result in a high-fidelity and sustained implementation of the innovative ideas. Indeed, teachers interpret – often unconsciously – the new ideas through their prior knowledge, beliefs, and experiences (see e.g., Depaepe et al., 2007; Depaepe, De Corte, & Verschaffel, in press). Therefore, an indispensable condition for success lies in the training of teachers, who should be intensively immersed in learning environments that embody the self-regulated learning approach they are expected to implement in their classroom practice. But this involves an appeal for further research focused on how learning environments that aim at improving students' self-regulation competence can successfully and sustainably be implemented in classrooms. As argued by Dignath and Býttner (2008), today scarce information is available about supporting teachers how to do so. Finally, although theoretical models emphasize the importance of motivational components in self-regulation of mathematics learning, until now interventions in the available studies focused almost exclusively on cognition and metacognition (Dignath et al., 2008; Dignath & Býttner, 2008). Lip-service should be

replaced by conducting research aiming at designing learning environments that pursue intentionally at developing students' motivational self-regulatory skills (e.g., keeping up one's motivation to solve a problem), their motivational meta-knowledge (e.g., becoming aware of one's fear of failure when confronted with a complex mathematical problem) and their motivational beliefs (e.g., positive self-efficacy beliefs).

PAPER PRESENTATION

Investigating strategies to develop self-regulated learning in young science students

Julie Moote, University of Edinburgh, United Kingdom; Joanne Williams, University of Edinburgh, United Kingdom; John Sproule, University of Edinburgh, United Kingdom

Self-regulated learning (SRL) is at the forefront of educational research today (Martin & McLellan, 2008). The optional Creativity in Science and Technology (CREST) Award scheme, a completely student-run science project supported by the Science, Engineering and Technology Network, is currently being implemented in schools throughout the United Kingdom. The central aim of this research was to explore the effectiveness of CREST as a strategy to develop SRL and related motivational constructs including self-efficacy, assessment anxiety, and intrinsic motivation. The study followed a quasi-experimental design and involved a 'control' group (N=34) and a 'CREST' group (N=38) of students between the ages of 11 and 12 from a school in Edinburgh, UK. The Motivated Strategies for Learning Questionnaire (MSLQ, Pintrich & DeGroot, 1990), the Modified Five Component Scale for Self-regulation (FCSSR, Maclellan & Soden, 2006), and the Science Motivation Questionnaire (SMQ, Glynn, Taasobshirazi, & Brickman, 2009) were administered to students before and after the CREST programme.

Significant differences were found between CREST and control groups in pre to posttest performance on the MSLQ (test anxiety); the FCSSR (goal setting, strategy implementation, strategy monitoring, and overall SRL); and the SMQ (intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination and career motivation). While the MSLQ is widely used to assess SRL interventions, it was found to be less sensitive in identifying intervention effects in the present study. In addition, as part of a larger intervention study, this research supports the curricular potential of the CREST programme for enhancing both SRL and science education.

Theoretical and Educational Significance of Research

Internationally, there is increasing interest in focusing educational initiatives toward developing effective, responsible learners. In the classroom context, responsibility involves perception of control and self-regulation. Self-regulated learning (SRL) is at the forefront of educational research today (Martin & McLellan, 2008). SRL is reflective learning that involves monitoring, regulating, and controlling cognition, behaviour, and motivation (Kaplan, Lichtinger, & Gorodetsky, 2009; Martin & McLellan, 2008).

While the concept of SRL is well developed in the literature regarding post-secondary students and adults, the picture of SRL in young students transitioning into adolescence remains unclear (Lewis, 2001). Understanding and developing SRL at a young age may help reduce the stress and frustration currently seen at the university level for all parties involved. In addition, the physical, mental, and educational changes experienced during adolescence highlight the importance of building the self-regulation literature in this age group (Cleary & Chen, 2009; Wigfield & Eccles, 2002). Current publications have stressed the need for self-regulation research to be context-specific (Kaplan et al., 2009). The present study focuses on SRL in science. Policy makers have documented concerns regarding the recent decline in engagement in school science and the decreasing number of students pursuing postsecondary study in science (Archer, Dewitt, Osborne, Dillon, Willis, & Wong, 2010). This is further supported by empirical findings which suggest that student interest in science is most threatened between the ages of 10 and 14, highlighting the need for further investigation in the development of SRL in this age group (Archer et al., 2010).

While researchers are not in agreement on definitions and conceptions SRL, there seems to be agreement as to how to improve SRL, shown through the trends in SRL interventions documented in the literature (Gaskill & Hoy, 2002). However, in practice, one of the major barriers to the uptake of SRL development programmes is the fact that the majority are run outside of classroom teaching time. The optional Creativity in Science and Technology (CREST) Award programme, a completely student-run science project supported by the Science, Engineering and Technology Network, is a SRL intervention currently being implemented in schools throughout the United Kingdom. The research presented here is a systematic evaluation of the impact of the CREST award scheme on SRL and science education.

Aims

The central aim of this research was to explore the effectiveness of CREST as a strategy to develop SRL in young science students. In addition, the impact of SRL on related motivational constructs including self-efficacy, assessment

anxiety, and intrinsic motivation were also assessed. In addition, this project aims to provide insight into the most effective way to administer the programme in schools throughout the UK. Method

The study followed a quasi-experimental design and involved a 'control' group (N=34) and a 'CREST' group (N=38) of students between the ages of 11 and 12 from one independent school in Edinburgh. The SRL questionnaire was administered prior to the intervention and after its completion. This study utilised three measures of SRL; the Motivated Strategies for Learning Questionnaire (MSLQ, Pintrich & DeGroot, 1990), the Modified Five Component Scale for Self-regulation (FCSSR, Maclellan & Soden, 2006), and the Science Motivation Questionnaire (SMQ, Glynn, Taasoobshirazi, & Brickman, 2009). Teachers' assessments of student SRL were also collected. This study is part of a larger intervention involving a number of schools across Scotland, UK.

Analysis

In order to verify that the two groups are matched at outset, t-tests were performed comparing CREST and control group on all pretest measures (Chularut & DeBacker, 2004). Following the methods of Chularut & Debacker (2004), split-plot analyses of variance were performed on each of the dependent variables with repeated measures of time (pretest and posttest) and with CREST as the independent variable. Main effects and three-way interactions were also tested (Chularut & DeBacker, 2004).

Findings

Findings showed an overall difference in the ability of the SRL measures to identify intervention effects. While the MSLQ identified a significant interaction effect for test anxiety ($F(1,70) = 5.12$, $p = 0.068$), no other group or interaction effects were found. However, the FCSSR identified differences between the CREST and control groups in terms of their pre to posttest change for goal setting ($F(1,72) = 5.21$, $p = 0.068$), strategy implementation ($F(1,71) = 5.19$, $p = 0.068$), strategy monitoring ($F(1,72) = 4.01$, $p = 0.053$) and the total SRL score ($F(1,71) = 8.17$, $p = 0.103$). The SMQ similarly found pre to posttest differences between the CREST and control group for intrinsic motivation and personal relevance ($F(1,70) = 4.93$, $p = 0.066$), self-efficacy and assessment anxiety ($F(1,65) = 10.01$, $p = 0.133$), self-determination ($F(1,72) = 6.20$, $p = 0.079$), and career motivation ($F(1,71) = 5.52$, $p = 0.072$).

Conclusions

Using an inter-disciplinary approach drawing from education, educational psychology, and science education, this research has potential to be published in a variety of peer-reviewed journals. The results of the present study found significant differences between CREST and control groups in pre to posttest performance on a range of constructs relating to SRL including self-efficacy, assessment anxiety, and intrinsic motivation. While the MSLQ is widely used to assess SRL interventions, in the present study it was less sensitive in identifying intervention effects. This study, as part of a larger intervention study, supports the curricular potential of the CREST programme for enhancing both SRL and science education.

PAPER PRESENTATION

A Design-Based Approach with Vocational Teachers to Promote Self-Regulated Learning

Helen Jossberger, University of Regensburg, Germany; Saskia Brand-Gruwel, Open University, Netherlands; Els Boshuizen, Open University, Netherlands; Margje van de Wiel, Maastricht University, Netherlands

In this design-based research study, we joined in with vocational teachers and investigated how we can diminish obstacles and optimise students' self-regulated learning in pre-vocational secondary education by better understanding the connection between teaching and learning in workplace simulations. The study consisted of two design circles: design of learning tasks and design of teacher feedback. First, authentic and challenging learning tasks were designed, which included a clear goal, a planning, visible assessment and performance criteria, and a reflection. Second, teachers were instructed to give feedback on process and self-regulation level to reduce the discrepancy between current understanding and performance of students and promote their self-regulated learning. Method triangulation was used for gathering data, including observations, logbooks of teachers, and questionnaires for students. This practice oriented approach, in which teachers were actively involved, revealed that changing learning tasks only is not sufficient to promote self-regulated learning. Only if teachers assess students' processes and performance thoroughly and give feedback on process and self-regulation level, a gain in students' self-regulation can be achieved.

Innovations in vocational education are important to meet the demands of the business community and to improve educational quality constantly. A great number of vocational schools has implemented workplace simulations (WPS), but this innovative implementation requires pedagogical content knowledge that is lagging behind. Little is known

about the way students learn in such learning environments, which instruction method is most suitable for teachers and learners, and how the learning environment can contribute to optimal learning. This lack of knowledge bears the risk that the innovation is doomed to fail before the pedagogical knowledge can be developed. Innovations in education directly influence the teacher, the student, and the learning environment. Therefore, it also seems self-evident that innovations will especially succeed, when they take into account the needs and wishes of teachers and students. In this study, we focus on the design of learning tasks and direct feedback from the teacher in order to improve students' self-regulated learning in WPS. Authentic learning tasks are the starting point in WPS to trigger students' interest, get them engaged in the learning process, and stimulate self-regulated learning. The tasks should have a clear goal that is specific and challenging, so that it focuses students' attention. During task performance supportive information should be available for students, because it can help them to integrate theoretical and practical knowledge. Performance and assessment criteria that are clearly stated can make the learning process more visible and learning needs become more transparent which should enable optimal learning (e.g., Kicken et al., 2008). Feedback has been identified to be the most powerful influence on learning and achievement and can help learners to learn to self-regulate their learning (Hattie & Timperley, 2007). Feedback aims to close the gap between the current level of performance and the desired level that needs to be reached. In order to reduce this discrepancy, three questions need to be addressed by effective feedback, including "Where am I going?" (What are the goals?), "How am I going?" (What progress is being made toward the goal?), and "Where to next?" (What activities need to be undertaken to make better progress?) (Hattie & Timperley, 2007). The three questions work together and have the power to trigger learners to initiate further actions. According to Hattie and Timperley, the effectiveness of feedback depends on its focus. Deep processing and mastery of tasks are especially promoted by feedback on process and self-regulation level, because this feedback is related to learning. In this design-based research study, we joined in with vocational teachers and investigated how we can diminish obstacles and optimise students' self-regulated learning in pre-vocational secondary education by better understanding the connection between teaching and learning. The central research questions are: 1) What changes need to be made in the learning tasks to promote self-regulated learning of students? and 2) To what extent can teachers promote students' self-regulated learning by providing direct feedback on process and self-regulation level?

Method

On the basis of integrated cycles of design and analysis, we systematically tested, evaluated, and improved the educational practice with regard to 1) the learning tasks and 2) teachers' feedback. Three teachers and 66 students participated. First, changes were made in the preparatory and practical part of a learning task. A clear task goal and learning goals were formulated, so that students immediately see what the task is about and what is expected from them. In the practical task three changes were made. We added a work planning, assessment criteria, and a reflection. Second, teachers were informed about giving and receiving feedback. The aim of feedback was explained and examples were provided to illustrate the different levels of feedback and their effects. Teachers were advised to give feedback on process and self-regulation level and to stimulate learners to explicate how it is going. Three questions were provided as support: 1) What are the learning goals of the student? 2) What is the progress in relation to the goals? and 3) How can you stimulate the progress? Method triangulation was used for gathering data. Process data (including design and evaluation sessions with teachers, short teacher evaluations after a WPS lesson, recordings of teachers' feedback, and observations) and outcome data (including a student questionnaire, students' task completions) were collected. The processes of designing and revising as well as teachers' feedback were recorded and documented carefully.

Some Results and Conclusions

The results with regard to the learning tasks revealed that the new structure was clear for teachers and students. According to teachers, students asked less questions and worked more independently. The goal setting and assessment criteria made the task and the requirements transparent and became the starting point for the evaluation. Planning ahead was difficult for students and they often did not use the planning during the practical task. The results regarding the feedback revealed that teachers started to take more time to trigger students' critical thinking by asking open questions about their processes. This interaction elicited students' reflection, which otherwise remained superficial. Task completions of students show that their self-regulation concerning planning, evaluating, and reflecting improved with the help of the teacher. Concluding, it is important that WPS turn into a place, in which learning tasks are carefully designed to stimulate self-regulation and providing feedback on process and self-regulation level becomes a daily practice in the interaction between teacher and student. The learning tasks were the starting point in promoting self-regulation and feedback helped students to become more actively involved in the learning process. The provided support raised teachers' consciousness of self-regulated processes and requirements for self-regulation, which helped them to realise the theoretical ambitions of self-regulation and independent working in WPS better. However, promoting self-regulation requires a lot of time and consistency.

References

- Hattie, J. A., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77 (1), 81-112.
- Kicken, W., Brand-Gruwel, S., & Van Merriënboer, J. J. G. (2008). Scaffolding advice on task selection: A safe path toward self-directed learning in on-demand education. *Journal of Vocational Education and Training*, 60, 223-239.

PAPER PRESENTATION

Relations between specific and global domains of self-concept. New tests of James' models

L. Francesca SCALAS, University of Cagliari, Italy; Herb Marsh, University of Oxford, United Kingdom

In this research, we investigate two crucial models about self-esteem determination dating back to James (1890): the Actual-Ideal discrepancy model–AID and the Importance-Weighted Average model–IWA. Although intuitively appealing, the models have weak support from rigorous empirical research. Thus, we use a stronger methodological approach to better evaluate AID and IWA models applied to a range of self-concept domains (physical self-concept, academic self-concept, spiritual self-concept) and subdomains (appearance self-concept, math self-concept, verbal self-concept) in young adolescents of two different countries (study 1: 402 adolescents from the United Kingdom; study 2: 250 adolescents from Italy). Support for the AID and IWA models was generally weak; the only exception was for spiritual self-concept. Overall, general components of self-concept are more determined by actual accomplishments than ideal standards. Moreover, the contribution of specific areas of self-concept to self-esteem did not vary systematically with the importance placed on each specific component of self-concept. Finally, results from a MonteCarlo study provide an explanation to the elusive nature of the models. Only advanced methodologies and big samples can detect the critical effects. These outcomes are relevant to self-concept theory and research, but also to the development of self-concept enhancement programmes that should be focused mainly on actual accomplishments.

Background and aims

Our research investigates how effects of multidimensional, specific components of self on global self-esteem depend on framing factors such as ideal standards and the importance of specific components. Two mechanisms dating back to James (1890) have been hypothesized to affect global self-esteem: 1) the discrepancy between the perception of actual self and ideal standards in specific domains (Actual-Ideal discrepancy model–AID), 2) and the interaction between the actual perception and the importance that particular components of self have for an individual (Importance-Weighted Average model–IWA).

Since rigorous empirical research has provided weak support for both models (e.g., Farmer, Jarvis, Berent, Corbett, 2001; Marsh, 1986, 1993, 2008; McDaniel & Grice, 2008), we use a stronger methodological approach based on latent variables and multiple items (Scalas & Marsh, 2008) to better evaluate AID and IWA. The principal aim of the study is to extend the models to a range of various self-concept domains (physical self-concept, academic self-concept, spiritual self-concept) and subdomains (appearance self-concept, math self-concept, verbal self-concept) in young adolescents of two different countries (United Kingdom, Italy). Specifically, appearance and physical self-concept have been considered in order to favor comparability with the previous studies (Lindwall, Asci, Palmeira, Fox, Hagger, accepted paper; Scalas & Marsh, 2008). The academic selves have been examined since this is an area quite important for self-worth during adolescence. The spiritual self-concept has been used since this is a domain that can be very important for some people but not important at all for others. Therefore, this might be a critical domain to test in particular the IWA model.

Methodology

We conducted 3 studies. Study 1 was designed to extend and generalize the multiple-item methodology for both the AID and IWA models to various self-concept domains (physical, academic, spiritual) and subdomains (appearance, math, verbal) from different perspectives (actual, ideal, importance). A sample of 402 adolescents (age range: 13-15) from the UK anonymously completed an electronic version of the questionnaire. Items of the questionnaire were based on the Self-Description Questionnaire (Marsh, 1992) and the Rosenberg scale of self-esteem (Rosenberg, 1965). Study 2 was designed to generalize results from study 1 over country (UK; Italy). A group of 250 adolescents of the same age completed a paper and pencil version of the questionnaire. Special attention was given to the physical area, since previous research supported the AID model for the relation between appearance, physical self-concept and self-esteem in Italian adolescents and young adults (Scalas & Marsh, 2008).

Study 3 was a MonteCarlo study and it was added subsequently to explore some power issues connected to results associated to the physical appearance domain. Indeed, as noted by Muthen and Muthen (2002) "a sample may be

large enough for unbiased parameter estimates, unbiased standard errors, and good coverage, but it may not be large enough to detect an important effect in the model" (p.600).

Results

AID and IWA models for different domains (physical self-concept, academic self-concept) and self-domains (appearance, math, verbal self-concept) were not supported in studies 1 and 2. Moreover, these poor results generalized over countries (UK; Italy). The only exception was related to the spiritual self-concept. In both samples, for this domain, AID assumptions of a positive effect of actual self on self-esteem (UK: .32, t-value = 4.12; Italy: .26, t-value = 2.59) and of a negative effect of ideals on self-esteem (UK: -.24, t-value = -3.04; Italy: -.22, t-value = -2.15) were supported. Also in relation to the IWA model, a significant and positive interaction between actual self and its importance was found only for the spiritual self-concept in the UK sample (.16; $t=2.55$).

A special interest of study 2 was on results from the physical area. Although, the estimates were not significant, in both the UK and Italian samples, the confidence intervals (CI) for ideal appearance betas on physical self-concept (UK, CI: from -.164 to .012; Italy, CI: from -.215 to .045) included the value found by Scalas & Marsh (2008) in their study (-.11).. This pattern suggests that a power issue might have prevented results from being significant.

Therefore in study 3, we performed a MonteCarlo study for power purposes (Muthen & Muthen, 2002). Results suggest that a sample of at least 800 cases is needed to provide sufficient power (.80) to detect a significant effect from ideal appearance to physical self-concept (assuming that the population value is -.11).

Discussion and conclusion

Support for the AID and IWA models was generally weak; the only exception was for spiritual self-concept. Overall, general components of self-concept are more determined by actual accomplishments than ideal standards. Moreover, the contribution of specific areas of self-concept to self-esteem did not vary systematically with the importance placed on each specific component of self-concept.

The weak support for AID and IWA models generalized reasonably over country (UK, Italy).

A special focus of this research was on physical area. We have found that for the majority of the people the contribution of ideal appearance is low; thus only with big samples it will the result be statistically significant as confirmed by our MonteCarlo study. This outcome is particularly relevant since it enlightens the elusive nature of the AID-model in the literature. Indeed studies in this are typically considered samples of few hundreds of subjects.

In summary, results provide an explanation to the elusive nature of both AID and IWA models. Only advanced methodologies and big samples can detect the critical effects. These outcomes are relevant to self-concept theory and research, but also to the development of self-concept enhancement programmes that should be focused mainly on actual accomplishments.

PAPER PRESENTATION

Listening and audio-visual comprehension in L2 - Empirical evidence for the two constructs?

Raphaela Porsch, Westfaelische Wilhelms-Universitaet Muenster, Germany; Ruediger Grotjahn, University of Bochum, Germany; Bernd Tesch, Humboldt-University of Berlin, Germany

According to the "National Educational Standards for the First Foreign Language" enacted by the Standing Conference of the Ministers of Education and Cultural Affairs of the Federal States in Germany (KMK, 2003, 2004) listening comprehension and audio-visual comprehension in the first foreign language (in Germany: English or French) are competencies that need to be acquired until the end of lower secondary education. However, the Standards and the Common European Framework of Reference (Council of Europe, 2001) - on which the Standards are based - have not provided two separate construct descriptions for developing tasks for teaching and testing the understanding of audio and audio-visual material. The study to be presented aims at answering the question of whether one can differentiate empirically between these constructs by assessing German ninth-graders ($N = 156$) by means of an experimental design with either a listening or an audio-visual comprehension test in French as a foreign language using the same items. Results show that if the pictures of the authentic videos in French provide help, learners are significantly better in the audio-visual condition. In addition, the challenges posed for defining a construct of audio-visual comprehension in a foreign language are explored, and a discussion about consequences for further research along with recommendations for teacher training is provided.

Introduction

According to the "National Educational Standards for the First Foreign Language" enacted by the Standing Conference of the Ministers of Education and Cultural Affairs of the Federal States in Germany (KMK, 2003) listening comprehension and audio-visual comprehension in the first foreign language are competencies that need to be acquired until the end of lower secondary education. However, the Standards and the Common European Framework of Reference (CEF; Council of Europe, 2001) on which the standards are based have not provided separate construct descriptions for developing tasks for teaching and testing the understanding of audio and audio-visual material. Much research in processing text and pictures has been undertaken by media psychologists. Paivio (1986) introduced the theory of dual coding stating that information is processed and stored by two interconnected systems: one verbal and one visual. Picking up this idea, Baddeley (1992, 2006, 2007), Mayer (2001) and Schnotz (2005), for example, have developed models that describe the cognitive processes of text and picture comprehension and studied factors that facilitate or hinder learning from texts and pictures. Results from empirical work in the context of foreign language learning with the focus of processing audio-visual information is summarized by Wagner (2008) stating that there are no clear results whether texts combined with pictures support learning. Some studies have found that the additional visual input increases learning (see, e.g., Gruba, 1993, 1997, 1999; Brett, 1997, 2001; Coniam, 2001; Ginther, 2001, 2002), others could not confirm this (see, e.g., Parry & Meredith, 1984; Chung, 1994; Sueyoshi & Hardison, 2005). Most studies have been conducted with participants speaking English as a second language focusing on the question of what type or combination of input improves learning. Recently, especially in the context of computer and web based testing, standardized foreign language tests have used audio-visual material (see, e.g., Ockey, 2007; Wagner, 2008) but mostly static images (e.g. TOEFL iBT).

Research Aims

The study was carried out to investigate whether one can differentiate empirically between the constructs of listening and audio-visual comprehension in a foreign language. Accordingly, the research question was: Do foreign language learners of French show higher scores in a standardized listening comprehension test if additional visual aids are offered? Understanding an audio text and related items can be described as a result of an interaction between text and task features and the recipient's competence. Determinants of listening comprehension difficulty have been widely researched (see, e.g., Brown, 1995; Freedle & Kostin, 1999; Grotjahn, 2000; Buck, 2001). Therefore, three task-specific hypotheses were formulated whether the visual input produces significant enhancement of performance or not.

Method

156 ninth-graders learning French as a foreign language at higher secondary schools ("Gymnasien") in Germany in 2009 took part in the study. Randomly, the complete learning groups/classes were assigned to two groups: 1 = audio-visual comprehension (AV; N = 68) and 2 = listening comprehension (LC; N = 88). The following instruments were applied: (1) Pretest: Students of both groups received the same listening comprehension test in French. (2) Testing in two conditions: Group 2 as the control group listened to audio texts (sound), group 1 as the experimental group watched video sequences (sound and pictures). In both conditions students had to answer the same items and listened to the same audio texts.

Results

First, it was tested whether both groups did not differ significantly in their French listening comprehension abilities, answering the question "Is the assignment of the students done randomly?" The total score of group 1 (AV) in the listening comprehension test was only slightly lower than that of group 2 (LC). However, the difference was not statistically significant. Second, all items for each task were considered (sum score on the basis of ten dichotomously scored items). Students from group 1 (AV) had, on average, significantly higher scores than those receiving an aural input only. The effect size was large ($d = .40$). Beforehand, the videos have been analyzed whether the visual information provides help for understanding the items while listening to the audio texts. The hypotheses – regarding the support of the pictures – are related to one item per task/video. Thus, in a third step, the mean scores of these items in each group were compared using one-factor ANOVA. As predicted for two items, students performed significantly better with pictures providing visual aid ($F[1, 156] = 8.908, p = .003$; $F[1, 156] = 12.426, p = .001$). In both cases the effect was highly significant and large ($d = .49$ and $.57$). Finally, the scores of all other items of each task were examined assuming that the pictures do not provide an additional aid in understanding the information given by the audio texts. With two exceptions the results were confirmed. They can be explained by the difficulty of the language and the condition that additional pictures were presented, which contextualize the information and thus may facilitate understanding.

Conclusion

The results clearly suggest that one can differentiate between listening and audio-visual comprehension when testing German students learning French as their first foreign language. Consequently, in order to develop adequate test and teaching materials, one needs to establish a construct definition for both competencies. This presents quite a challenge as the ongoing international discussion shows (see, e.g., Gruba, 1997, 2006; Buck, 2001; Choi, Kim & Boo, 2003; Wagner, 2007, 2008). The question is "How can one differentiate between foreign language competence and media competence when testing L2-learners with audio-visual material? Furthermore, future studies should examine in detail the factors determining the difficulty of understanding video material. The study to be presented used authentic texts based on the descriptors of the CEF. This makes it difficult to draw general conclusions but is in line with modern foreign language teaching principles demanding the use of authentic texts in the foreign language classroom (see, e.g., Higuchi, 1998; Murdoch, 1999; Mishan, 2005).

PAPER PRESENTATION

Differences in Reported Foreign Language Learner Strategy Use Across Educational Levels

Katerina Vlckova, Masaryk University, Czech Republic; Marie Daskocilova, Masaryk University, Czech Republic

Learning strategies constitute an important concept in the theory of foreign language acquisition. The use of foreign language learning strategies and its contexts were investigated at the end of primary education, lower secondary education, and higher secondary comprehensive education (according to ISCED 97) in the Czech Republic. Adopted Strategy Inventory for Language Learning – SILL (Oxford 1990) was applied in a cross-sectional research which focused on how the reported use of strategies differs and what specific characteristics of the three groups of learners were. The research concentrated on both direct (memory, cognitive and compensatory) and indirect (metacognitive, affective and social) strategies and also examined variables potentially influencing strategy use as well as variables influenced by strategy use. The differences in strategy use among the groups were significant in many aspects. The relation between strategy use and the variables that influence strategy choice and use (gender, strategy instruction etc.) or variables that are influenced by the strategy use (achievement) seems to be predominantly stable across the groups.

Learning strategies present a crucial concept of many disciplines; since the 1960s, they have been gaining an important place in the theory of first and second language acquisition. Nowadays, learning strategy is a concept that captures a wide range of linguistic behaviours. Strategies are defined as sets of "conscious thoughts and actions that learner takes to achieve a learning goal" (Chamot 2004), or as operations to acquire, retain, retrieve or perform (Rigney 1978). The concept is connected with self-regulation, metacognition, learning and cognitive styles. Strategies are most often classified according to psychological functions – cognitive, metacognitive, socio-affective (O'Malley, Chamot 1990), or 4 language skills (Cohen, Weaver 2006). Strategy choice and use is influenced by different variables (gender, experience, educational level, proficiency, age, motivation, language aptitude). Strategy use influences variables such as school grade, knowledge or development of language skills which are the focus of our research based on Oxford's language learning strategy classification (1990) and adapted, enlarged inventory SILL (Oxford 1990). Strategies are divided into direct (memory, cognitive, compensatory) and indirect (metacognitive, affective, social) ones. The research questions are: Do pupils at 3 levels of comprehensive education in the Czech Republic differ in their perceived strategy use? Do the variables affecting the strategy use and variables influenced by strategy use differ at the 3 levels?

Methods

Research sample (non-random sampling) comprised 1482 pupils of 5th grade at 56 elementary schools (i.e. at the end of primary level), 2384 pupils of 9th grade at 54 elementary schools (i.e. at the end of compulsory education) and 1038 students of the one before last year at 22 upper secondary schools – grammar schools (i.e. 12th grade/near the end of comprehensive education). The strategy inventory for the 5th grade pupils consisted of 28 items with a 3-point frequency scale ($\alpha = 0.74$). The inventory for 9th ($\alpha = 0.90$) and 12th ($\alpha = 0.796$) grade used 5-point scale for 67 items. In the 5th grade, knowledge tests of English ($\alpha = 0.81$) and German ($\alpha = 0.78$) were used. Students were asked to report their strategy use in a preferred foreign language which was mostly English.

Results

In the 5th grade, not all the strategies in the inventory for the 9th and 12th grade were investigated because of the cognitive limits of younger learners. Therefore some comparisons were only conducted with the 9th and 12th grade pupils and an average use of strategies on all educational levels was calculated on 18 strategies. Pupils in the 5th grade used strategies ($x = 3.28$, $SD = 0.63$ at the adapted 5-point scale) significantly more often than students in the 12th grade ($x = 3.01$, $SD = 0.45$). The lowest strategy use was revealed in the 9th grade ($x = 2.81$, $SD = 0.51$). Cognitive, compensatory, metacognitive and social strategies were used in the 12th grade more than in the 9th. Affective

strategies were used more in the 9th grade. No significant differences were found in memory strategies, they were generally scarcely used. The order of use of the six strategy groups was the same at the 9th and 12th grades (compensatory – cognitive – metacognitive – social strategies). In the 9th grade, memory strategies were the least used group, while in the 12th grade those were affective strategies.

Cognitively more demanding memory strategies (association, contextualisation, phonetic representations) were used more in the 12th grade than in the 9th. Grouping, mind maps and physical response were used in the 9th grade more than in the 12th. In the 5th grade, students used more mechanical techniques such as cards. Practising phonetics and orthography was more frequently used in lower grades. Practising in natural settings was used in the 12th grade more than in the 5th or 9th grades. Pupils of the 5th grade reported less co-operation with their schoolmates.

Age, gender, self-efficacy, perceived language aptitude, instruction (both informing about strategies, and practising) played a consistent role in the strategy use at all educational levels. Number of learned languages only affected strategy use in the 9th and 12th grades (the 5th grade pupils only learned 1 language at schools). The differences between the types of acquired languages were only found in the 5th grade where learners of English used strategies more than those of German. Girls used strategies significantly more at all three educational levels. The 5th grade pupils answered more often that they knew how to learn than the 9th and 12th grade pupils. The perceived language aptitude was the smallest in the 9th grade (maybe because of early selection for academic schools in the 6th grade). Younger pupils were more often told how to learn. Learner training was most often conducted by teachers in the 9th grade. There was a significant but weak connection found between the school grade as well as perceived knowledge and strategy use in the 9th and 12th grades. Cognitive strategies were relatively strongly correlated with the school grade in foreign language. In the 5th grade the score in the knowledge test was not correlated with strategy use.

Discussion

Pupils at all education levels were using learning strategies in a way. Children at the primary level use simpler strategies than pupils at higher levels. Many results seemed to reflect demographic composition of the groups. Compensatory strategies seemed to have a specific role in the school learning, they were used when pupils didn't know something therefore these were not expected by teachers to be used in the classrooms. Affective strategies were used when pupils experienced stress mostly when they were not "efficient" language learners, in the 9th grade more often than in the 5th or 12th grades.

At all levels, two thirds of pupils stated they didn't know or only partly knew how to learn foreign language, around one third of pupils thought they didn't have language aptitude. Nevertheless, two thirds of pupils have never or scarcely had strategy instruction. We might assume that there is a gap between pupils/ needs and instructional opportunities, and pupils should be taught how to learn foreign language at all educational levels.

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PAPER PRESENTATION

Enhancing Chinese Character Learning of Non-Chinese Speakers using the learning Theory of Variation

Wai Ming CHEUNG, University of Hong Kong, Hong Kong; Wing Yee W.Y. WONG, The University of Hong Kong, Hong Kong

Purpose: Emerging interest in China in western countries has led to a corresponding surge in the study of Chinese. Due to the huge number of Chinese characters and words, it is impossible for learners, regardless of their native languages, to master the language by rote memorization. The acquisition and processing of the Chinese language has therefore become a popular area of study for non-Chinese speakers. This study investigates the possibility of using "Variation Theory" in learning Chinese character for non-Chinese speaking (NCS) students in Hong Kong and its effectiveness. Methodology: Fifty-two Grade 7 South Asian girls aged 12 and 2 teachers from a girl's college in Hong Kong were recruited to join the empirical study for one year. Teachers taught students Chinese characters and Chinese Language using pedagogy developed from Variation Theory. Pretest and posttest were administered at the beginning and end of school year to assess students' learning. Result: After a year of study using the new approach, the post-test scores of participants have shown significant improvement compared with the pre-test. The effect size of improvement in total score is 1.47, showing that students' general improvement has achieved a standard of extremely high level. Significance: This study shed light on Chinese character learning for NCS learners all over the world. Participants showing success of learning Chinese character using Variation Theory will be anticipated to transfer this knowledge of character to their future learning of Chinese reading and writing.

The current trend of globalization has enabled high mobility of people with ease from country to country for various purposes. Emerging interest in China from the western world has led to a corresponding surge in the study of Chinese. Due to the huge number of Chinese characters and words, it is impossible for learners, regardless of their native language, to master the language by rote memorization. The acquisition and processing of the Chinese language has therefore become an area of interest for non-Chinese speakers. Approximately 5% of the population in Hong Kong comes from countries of ethnic minority (EM). The EM students come from diverse cultural and language backgrounds. Effective strategies in learning Chinese as second language thus deserve more attention. NCS students always find learning Chinese difficult as their own languages usually belong to the alphabetic language system, whilst Chinese is an ideographic language. The Variation Theory (Marton, Runesson & Tsui, 2004; Runesson & Marton, 2002) has been proved to be a powerful tool in enhancing the Chinese learning for first language learners (Marton, Tse & Cheung, in press). We explore how the Variation Theory can be put into practice to inform teachers in handling the teaching of Chinese characters for NCS students. This study also investigates its effectiveness on student learning. A total of 52 Grade 7 South Asian girls and 2 teachers from a girls' college in Hong Kong were recruited and joined the empirical study in the academic year 2009-10. We chose to implement this study at a girls' school because researchers have reported that traditional family values downplay the importance of second language acquisition and creates linguistic barriers particularly for female South-Asian immigrants (Cumming & Gill, 1991). Students mainly came from Pakistan, India, the Philippines, Nepal, and Indonesia. Six modules of Chinese characters learning were developed based on Variation Theory and the Comprehensive and Integrative Perceptual Approach (Tse, Marton, Ki and Loh, 2007). Teachers taught students Chinese characters and Chinese Language by simultaneous discernment of the shape, sound and meaning of the characters (Chan & Nunes, 2001; Marton, 2006). Tzeng et al.'s study (1986) indicated that Chinese characters are processed as symbols that carry structures possessing different levels of graphic complexity. Target character is shown on the blackboard (structure), with teacher pronouncing the word (sound) and presenting picture (meaning) simultaneously. Teachers would systematically use variation and invariance to help students identify the components of the characters. Variation patterns such as separation and fusion were used in lessons to facilitate acquisition of target characters with the same component. Six meaningful texts were developed in accordance to the features and needs of EM students so as to foster association between Chinese learning and students' funds of knowledge. Target characters were embedded in the texts that could help establish the whole-part relation that meaning is revealed as a whole to NCS students. The Word Test was modified from test developed by Tse, Marton, Ki and Loh (2007). It consisted of six sections and took 60 minutes to complete. The assessments included: Identify the common component of the words: This section assessed whether students could discern the same component of the five characters given; Writing down words related to the pictures: This section assessed the number of words the students were able to write down from memory; Identify characters with correct pictures: In this section students were asked to choose the picture that represented character given in each question; Identify characters with correct structure: This section assessed the students' ability to discern the differences in similar characters and choose the only correct word; Matching correct characters with sounds: This section assessed students' sensitivity to the pronunciation of characters. Students listened to the teacher read aloud the correct answer then picked out the correct pronunciation from five options. Writing: In this section students have to write 100 words with reference to four related pictures given. Pretest and posttest were administrated at the beginning and end of school year to assess students' learning. To see whether the class performed significantly better in the post-test, we conducted a paired-sample t-test. Data analysis on comparison between pretest and posttest result showed positive changes in all six sections. The positive t values in paired-sample t-test were all significant (See Table 1 in the Appendix). The mean of total score has increased from 50.99 to 74.95 with an effect size of 1.47 (n=52). According to Cohen (1977), the extremely high effect size of 1.47 indicated that students' improvement was of high standard. Hong Kong teachers tend to use the traditional way of teaching Chinese to teach NCS students, students learnt characters and vocabulary separated from context, copied the structural pattern and repeated until they could memorize the structure of the characters. However second language learners could not start from the characters solely but from a context which makes the learning meaningful to them. The positive findings indicated a change from traditional Chinese curriculum to a new approach in teaching Chinese as second language necessary. Improvement of Chinese character learning voiced out the significance of using the Theory of Variation in teaching Chinese as second language. Further development on learning Chinese as second language beyond characters using the theory deserves more research efforts in the future. In addition, to equip NCS female learners with competence in the immigrant city, effective educational intervention to improve language acquisition of NCS students and thus their academic achievement is of paramount importance to the students and their family.

PAPER PRESENTATION

Vocabulary learning from reading: Examining interactions between task and learner-related variables

Xiaoli Wu, Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium

In the field of second and foreign language learning, how various task characteristics affect language learning has been the focus of many recent studies. Much of this research has examined the relationships between task complexity, task sequence and task performance without fully taking into account learner-related variables. The present study aimed to assess task complexity and sequence in relation to the learner-related variables drawn from the social-cognitive perspective of self-regulated learning, i.e. self-efficacy beliefs and frequency of learning strategy use as they were applied to two versions of vocabulary learning from reading tasks. The tasks designed for the present study were based on the componential framework for second language task design. With tasks and task sequence counterbalanced, 146 first-year university students (mean age = 18.59 years) were randomly assigned to one of the four groups. Results revealed a significant effect of task complexity on frequency of learning strategy use; a significant effect of task sequence on vocabulary learning self-efficacy belief, frequency of learning strategy use and task performance; and a significant interaction effect of sequence with task complexity. Findings are discussed in terms of complex interactions between task and learner factors.

In the field of second and foreign language learning, how various task characteristics affect language learning has been the focus of many studies (Skehan, 2001; Robinson, 2001; 2005). In these studies, task complexity is seen as an important construct to both second language acquisition researchers and language teachers. Although relationships between task complexity, task sequence and task performance have been examined (Robinson, 2001; 2005), previous works did not fully take into account the interactions between task complexity and learner-related variables. Given the importance assigned to learners' task interpretations in current instructional design research (Lowyck, Elen & Clarebout, 2004) and the strong predictive power of learner-related variables, e.g. self-efficacy belief, in relation to academic outcome (Pajares, 2002) in mainstream educational psychology research, it is important to better understand the interactions between task and learners' perceptions of designed tasks, and how their perceptions affect learning behaviours and performance. In the present study, we examined task complexity and sequence in relation to the major constructs drawn from the social-cognitive perspective of self-regulated learning, i.e. self-efficacy beliefs and learning strategy use, as they were applied to English vocabulary learning from reading tasks.

Research questions The following questions are addressed in the present study. First, what effect does the designed task at different levels of complexity have on learners' perceived self-efficacy, learning strategy use and task performance? Second, we are also interested to know if there is a main effect of task sequence and any interaction effect of task complexity and task sequence on learners' perceived self-efficacy, learners' use of learning strategies and task performance.

Research method

Participants The sample consisted of 146 first-year university students (137 females and 9 males, mean age = 18.59 years) from a Belgian university. The students were native-born Belgians who had Dutch as their first language. They volunteered to participate in the study and were awarded extra course credit for their participation. **Tasks** The tasks designed for the present study are based on the componential framework for second language task design (Robinson, 2005). In terms of the elements of complexity listed by Robinson, the vocabulary learning task was manipulated along the dimension of +/- single task demand. Two texts describing the profile of two modern artists were chosen for the experiment. Two versions of the tasks (i.e. with/without the provision of a gloss) were created with each text. Therefore, altogether four tasks were used, i.e. two simple tasks, which includes Text 1 + gloss and Text 2 + gloss; two complex tasks, which includes Text 1 - gloss and Text 2 - gloss.

Design and procedures

The experiment used a repeated measures design. The counterbalanced design included four task sequences, i.e. Task simple to Task complex; Task simple to Task simple; Task complex to Task simple; and Task complex to Task complex. Participants were randomly assigned to four groups, and executed two vocabulary learning tasks that were presented separately during two experimental sessions. At the beginning of each session, participants received a booklet with experimental task materials and a self-efficacy scale ($\alpha = .86$). After completing the task, participants were asked to fill in a vocabulary learning strategy questionnaire ($\alpha = .73$). A vocabulary test was administered after the task booklet had been handed in.

Results A 2×2 MANOVA with text as a within-subject variable and task complexity as a between-subject variable showed a significant effect of task complexity (Wilks's Lambda = .89, $F(4, 275) = 8.16$, $p F(1, 275) = 31.83$, p To examine the effect of sequence in more detail, the factor task order was entered into MANOVA. Results showed significant univariate effects for task order on vocabulary learning self-efficacy ($F(1, 275) = 3.80$, $p F(1, 275) = 4.43$, $p F(1, 275) = 21.79$, $p F(1, 275) = 6.08$, $p F(1, 275) = 5.25$, p **Discussions and conclusions** Regarding the first research question, a significant negative effect of task complexity was only found for learning strategy use. Our results do not support the claim from previous works on task complexity (Robinson, 2001; 2005). Differences in the

cognitively defined complexity of tasks were not reflected in learners' perceptions of task and their learning outcomes. Regarding the second research question, our results show that the order in which tasks were performed had a significant effect on students' learning results. What is even more interesting here is the interaction effect of task complexity with task order. These results seem to indicate that learners' perceptions of task evolve along the learning process. What is, from a designer's point of view, an important task complexity dimension may not be perceived by learners as such at the very outset of learning. However, learners' perceptions and judgements develop gradually, and they can get more calibrated with the designer's intention along the process. It means that, in practice, the accuracy of learner task perceptions and efficacy judgements can be trained by manipulating task complexity and task sequence. In the context of our objective to further our understanding of the effectiveness of instructional tasks for language learning, we believe more studies are needed to further explore and validate the complex interactions between task factors and learner-related factors.

PAPER PRESENTATION

In what ways are spelling difficulties related to text quality?

Asa Wengelin, Lund University, Sweden; Victoria Johansson, Lund University, Sweden; Roger Johansson, Lund University, Sweden

In this paper we explore how spelling difficulties, as measured in a standardized test, spelling errors in written texts and spelling revisions during the production process are related to each other, and to text quality in writer with reading and writing difficulties. Spelling test data and text production data were collected from both 15-year-olds and university students. The writing processes were analysed for spelling errors, revisions and temporal distributions. Qualitative analyses of the spelling errors and the revisions are currently being carried out. Not surprisingly the 15-year-olds produced texts with lower quality and more spelling errors than the university students. More interesting was that the quantitative results of the spelling test and the percentage of spelling errors in the text did not correlate at all. In addition, whereas the spelling test predicted text quality, this was not the case for the percentage of spelling errors in the texts. Preliminary results of the qualitative analysis of the spelling errors further indicate that the participants produce different types of spelling errors in the test situation and during text production. Concerning the process data a weak negative correlation between percentage of reading time and spelling errors and a weak positive correlation between reading and text quality was found. The differences between the results of the spelling test and the spelling errors in the texts indicate that in order to get as complete a picture as possible of children's spelling difficulties they need to use both spelling tests and free writing.

Writing by children and adults with reading and writing difficulties is typically associated with spelling problems. In addition their texts frequently receive lower quality ratings than the texts of writers without reading and writing difficulties. The explanation usually given for this is that poor lower-level writing skills of the writers with reading and writing difficulties limit cognitive resources for higher-level production processes such as planning and reviewing (e.g. McCutchen 1994). However, the relations between spelling difficulties, higher level processes and the mechanisms behind these relations are not clear. Moreover, spelling difficulties is an ambiguous concept. To a certain extent they are represented by spelling errors made by the writer. However, during the text production process a writer may have encountered more spelling difficulties than the errors found in the finally edited texts. The questions of this presentation are: How are spelling difficulties, as measured in a standardized test, spelling errors in written texts and spelling revisions during the production process related to each other, and how are these measures related to text quality?

Two groups of writers with reading and writing difficulties – thirteen 15-year-olds and ten university students – were recruited by means of a screening process involving a spelling test and a word decoding test. Data from two control groups were also collected. Each participant produced an expository text elicited by means of a video clip showing different scenes from a school setting, such as cheating, bullying and theft, all chosen to inspire discussion (Berman & Verhoeven 2002). All text production was recorded by means of keystroke logging (ScriptLog) and eye tracking (SMI iView X Hed). Finally all writers were interviewed about their attitudes towards writing. The text products were analysed for spelling and text quality as well as for text length, lexical diversity and syntactic complexity, but only the spelling errors and the text quality will be reported here. The writing processes were analysed for revisions and temporal distributions. The revisions are currently being categorized. In addition, two types of qualitative analyses of the spelling errors are also being performed at the moment: (a) surface analyses categorizing errors into insertions, omissions, substitutions and transpositions, and (b) a linguistic analysis categorizing errors as phonological, morphological or lexical and as either phonologically acceptable or unacceptable.

As expected the two groups with reading and writing difficulties produced shorter texts with more spelling errors and less quality than the control groups. In addition, they made more pauses and more revisions. Since the control groups produced very few spelling errors and this paper focus on spelling difficulties only data from the two groups with reading and writing difficulties will be further reported. Not surprisingly the 15-year-olds produced texts with lower quality and more spelling errors than the university students. However, the individual variation was quite large. More interesting was that the quantitative results of the spelling test and the percentage of spelling errors in the text did not correlate at all. Moreover, whereas the spelling test predicted text quality, this was not the case for the percentage of spelling errors in the texts. Preliminary results of the qualitative analysis of the spelling errors further indicate that the participants produce different types of spelling errors in the test situation and during text production. These results agree with for example Wengelin (2002). Concerning the process data a weak negative correlation between percentage of reading time and spelling errors and a weak positive correlation between reading and text quality was found. Neither percentage of spelling errors, nor text quality correlated with number of revisions. However, another picture may emerge once the revisions have been categorized.

Despite the case that the number of spelling errors in the finally edited texts did not correlate with text quality, the result that the spelling test predicted text quality indicate that spelling difficulties is indeed can indeed influence text quality. One possibility is that poor results of a spelling test are due to general processing difficulty. Another possible explanation is that only certain types of spelling errors influence the judgements of the raters. We will have a clearer picture of that after the categorization of the errors. A third possibility is that the writers put a lot of effort into strategies for correcting and avoiding spelling errors. This explanation is supported to a certain extent by the weak correlation between reading and number of spelling errors. It could possible also be supported by the interviews in which the participants state that they find spelling to be the most difficult part of spelling. This would also explain the different types of spelling errors in the test and the texts. The differences between the results of the spelling test and the spelling errors in the texts indicate that in order to get as complete a picture as possible of children's spelling difficulties they need to use both spelling tests and free writing. Moreover, the more detailed analysis of errors and revisions will contribute towards both our theoretical and practical knowledge about writing difficulties.

PAPER PRESENTATION

Teaching Struggling Writers Argumentative Writing: An Intervention Study

Carmen Gelati, University of Milano Bicocca, Italy; Lerida Cisotto, University of Padova, Italy; Pietro Boscolo, Università di Padova, Italy

Writing an argumentative text is a very demanding task for young students because many cognitive processes are implied (Coirier & Golder, 1993). Children of primary and middle school often write unpersuasive argumentative texts (Applebee, Langer, Mullis, Latham, & Gentile, 1994). Writing argumentative essay is difficult in particular for struggling writers that, compared with their peers, have more troubles to simultaneously carry out several cognitive processes (Bereiter & Scardamalia, 1987). Usually these difficulties have also motivational consequences, particularly in primary school where children's will to express and communicate ideas and feelings in written form may be restricted by their concern to avoid mistakes in written texts and poor teacher evaluation. This study was aimed at analysing the effects on struggling writers in grades 5 and 7 of an instructional intervention focusing on argumentative writing. Primary and middle school struggling writers were randomly assigned to the experimental and control conditions. In the experimental group six 90-minute workshops were realized. Activities of writing and analysis/revision of argumentative texts were proposed to children.

Analyses of covariance revealed that the intervention proved to be successful in improving the ability to write argumentative text. In fact, after the intervention, experimental group children wrote better, longer, and more complete argumentative texts than control group children. Independently of the intervention, middle school students wrote longer texts than elementary school children, and girls better than boys. The second objective regarded the motivational aspects. No difference emerged for the liking of writing and for the self-perception of competence.

Writing an argumentative text is a demanding task for young students. This activity, in fact, involves many cognitive processes such as combining arguments together, refuting, generalizing, considering other points of view and opposing arguments (Coirier & Golder, 1993), as well as, of course, planning, translation, and revising (Hayes & Flower, 1980). The researchers found that the ability to write an elaborated argumentative text develops with age: at 7-8 years a position is stated and it is supported by one argument; progressively, the argumentative structure becomes more complex thanks to the addition of other supporting arguments, and, by age 13-14, of counterarguments (Brassard, 1990; Golder & Coirier, 1994; Schnewly, 1988). However, as Applebee and collaborators showed (Applebee, Langer, Mullis, Latham, & Gentile, 1994), the argumentative writing of most students

is often unpersuasive: many students of 4th and 8th grades write undeveloped or minimally developed responses for presenting their opinion, few reasons without support, and rarely they consider different points of view. Writing argumentative text is difficult in particular for struggling writers that, compared with their peers, have more troubles to simultaneously carry out several cognitive processes (Bereiter & Scardamalia, 1987). In general, struggling writers do little spontaneous planning, tend to use knowledge telling (Bereiter & Scardamalia, 1987), have limited knowledge of the structure of genres, revise superficially, and have limited metacognitive awareness. These difficulties usually have motivational consequences, particularly in primary school, where children's will to express ideas in written form may be restricted by their concern to avoid mistakes and poor teacher evaluation. The intervention studies have privileged the cognitive component of writing, while the motivational component has been given less importance. Recently, several scholars have considered the motivational aspects of writing (Boscolo & Gelati, 2007, 2008; Bruning & Horn, 2000; Hidi & Boscolo, 2006, 2007; Pajares & Valiante, 2006), in particular the relationship between interest in writing, on the one hand, and self-perceptions of writing competence, on the other. The present study analyzed the effects on struggling writers in grades 5 and 7 of an instructional intervention focusing on argumentative writing. The intervention was planned and conducted with a dual objective. The first was to improve students' ability to organize and write argumentative texts. The second objective was to modify students' attitude to writing, thanks to a collaborative writing environment, in which struggling students were not concerned with teacher evaluation.

Method

Preliminary phase Three hundred and sixty-one students participated in the study: 186 5th graders (M = 82, F = 104) and 175 7th graders (M = 88, F = 87). The classes were randomly assigned to the experimental condition. Since the intervention was focused on struggling writers only, we selected students with writing difficulties by evaluating on a 5-point scale a text written by the students before the intervention. The language skills teachers were also asked to rate students' writing ability on a 5-point scale. Students rating below the 33rd percentile in written text and in teacher evaluation were considered to be struggling writers.

Participants There were 74 struggling writers in the experimental group - 38 5th graders (M = 21, F = 17) and 36 7th graders (M = 21, F = 15) – and 65 struggling writers in the control group - 34 5th graders (M = 14, F = 20) and 31 7th graders (M = 18, F = 13). Measures before the intervention1. Children were asked to write an argumentative text.2. Writing self-efficacy questionnaire: 10 items on a 10-point scale. 3. Liking of writing questionnaire: 10 items on a 4-point scale. The interventionSix 90-minute workshops. Basic principles:a) Close connection between reading and writing by analysing exemplar texts for enriching repertory of ideas and lexicon, and identifying the elements of the argumentative text (Toulmin, 1958).b) Writing workshops for making students more aware of planning and revising processes, using "cognitive tools" such as notes, maps etc. c) Alternation of individual, collective, and group work.Activities for improving the ability to take a position, justify a thesis, support it, analyze other points of view and opposing arguments were realized.Measures after the intervention1. Children were asked to write an argumentative text.2. Writing self-efficacy questionnaire.Liking of writing questionnaire.

Data analysisLength: number of T-units. Text quality: holistic score on a 5-point scale.Text structure: the structural level of each text was analysed using Toulmin's model (1958).ResultsArgumentative text. A MANCOVA revealed that, after the intervention, experimental group children wrote better texts than control group children, $F(1, 114) = 4.43$, $p = .05$. Moreover, they wrote argumentative texts with a more complex structure: both 5th and 7th graders reported more reasons to support their thesis and many 7th graders used also counterarguments. Independently of the intervention, girls outperformed boys, writing texts with higher quality, $F(1, 114) = 8.52$, $p = .01$. Middle school students wrote longer texts than primary school children, $F(1, 114) = 59.33$, $p < .001$. Writing Self-Efficacy. From an ANCOVA no significant difference emerged between the experimental and control groups.Liking of writing. From an ANCOVA no significant difference emerged between the experimental and control groups.

Discussion

This study was carried out with two objectives. The first was to improve students' ability to organize and write argumentative texts. The intervention proved to be successful in improving the ability to write argumentative text. In fact, after the intervention, experimental group children wrote better, longer, and more complete argumentative texts than control group children. Independently of the intervention, middle school students wrote longer texts than elementary school children, and girls better than boys. The second objective regarded the motivational aspects. No difference emerged for the liking of writing and for the self-perception of competence. The result may depend on the difficulty for struggling writers of modifying their attitude to writing - which have developed over years of unsuccessful writing experiences - with a relatively short intervention. This is a problem which should be explored in greater depth in future studies on writing difficulty.

PAPER PRESENTATION

Cognitive benefits of expressive writing

David Galbraith, Staffordshire University, United Kingdom; Norma Sherratt, Staffordshire University, United Kingdom

Previous research has suggested that expressive writing can have beneficial effects on cognitive functioning and subjective well being. In the present study, we tested whether this is mediated by increases in working memory (WM) capacity, and whether this varies as a function of self-monitoring and individual differences in emotional expressivity. We also examined whether it is specific to verbal WM, or whether it also occurs for non-verbal measures of WM capacity. 84 undergraduates completed measures of self-monitoring and emotional expressivity. They were then randomly assigned to either an expressive writing condition - in which they wrote about past traumatic events - or a control condition - in which they wrote descriptively about the events of the day - on three separate days over a two week period. Measures of verbal and spatial WM capacity, and of general health, were taken immediately before the first writing session, and two weeks after the final writing session. Results showed that expressive writing led to an increase in verbal WM capacity but not in spatial WM capacity. These effects were moderated by individual differences in emotional expressivity: individuals who habitually express their positive and negative emotions in their everyday lives showed smaller effects, while individuals who typically mask their emotions in their everyday interactions showed stronger effects. These results suggest that expressive writing may be a valuable tool for improving academic performance at university, and provide an important argument for including expressive writing as well as functional writing within the school curriculum.

Research by Pennebaker and others (e.g. Pennebaker, 1997; Frattaroli, 2006) has suggested that expressive writing about past traumatic events can lead to beneficial effects on health and cognitive functioning. Klein and Boals (2001) suggested that expressive writing leads to a reduction of intrusive thoughts, and that this should lead to a freeing of working memory resources. This was supported in an empirical study suggesting that expressive writing leads to an increase in working memory capacity after writing. In the present study, we aimed to replicate this effect, and to investigate whether it varied as a function of self-monitoring and individual differences in emotional expressivity. We also examined whether it is specific to verbal working memory, or whether it also occurs for non-verbal measures of working memory capacity. All participants were asked to complete an emotional expressivity questionnaire (Gross and John, 1998), measuring five facets of emotional expressivity: Expressive Confidence, Positive Expressivity, Negative Expressivity, Impulse Intensity, and Masking. They were also asked to complete a Self-monitoring scale (Snyder and Gangestad, 1986). 84 low and high self-monitors (categorised using a median split of scores on the self-monitoring scale) were then randomly assigned to either an expressive writing condition or to a control condition. In the expressive writing condition, participants wrote about a past traumatic event for 20 minutes on 3 separate occasions spread over a two-week period. In the control condition, participants wrote descriptively, on the same occasions, about the events of the day. Before writing, all participants completed the operation span test of working memory capacity (Unsworth, Heitz, Schrock and Engle, 2005) and the General Health Questionnaire (GHQ). Two weeks after the final writing session, they completed the same measures again, and also a non-verbal test of working memory capacity (symmetry span). The results showed a significant effect of expressive writing on operation span scores, with writers in the expressive writing condition, but not the control condition, showing increases in working memory capacity. This replicates Klein and Boals' findings. By contrast, there were no differences in symmetry span as a function of writing condition. This suggests that the effect of expressive writing is specific to the verbal component of working memory, and is compatible with the assumption that the effect is related to the reduction of intrusive thoughts, which are assumed to be verbal in form. Individual differences in emotional expressivity affected the size of this effect: individuals who habitually express their positive and negative emotions in their everyday lives showed significantly smaller effects of expressive writing, while individuals who typically mask their emotions in their everyday interactions showed significantly stronger effects of expressive writing. Although effects on health were in the same direction, they were not statistically significant, possibly because of a lack of statistical power. Working memory capacity is strongly associated with tests of cognitive ability and with performance on a wide range of tasks involving higher level mental processes. The present results strongly support the use of expressive writing in educational contexts. Pennebaker and his colleagues have found that, when new undergraduates are asked to write about their anxieties about coming to university, they subsequently achieve better grades in their academic work than students assigned to a control condition. Less directly, these results also imply that intrusive thoughts have a chronic influence on working memory capacity. The results provide an important argument in favour of a less instrumental writing curriculum, one in which pupils learn how to make meaning out of their personal experience. In future research we plan to investigate whether creative writing has similar effects on cognitive functioning and subjective wellbeing.

Frattaroli, J. (2006). Experimental disclosure and its moderators: A meta-analysis. *Psychological Bulletin*, 132, 6, 823-865.

Gross, J. J., & John, O.P. (1998). Mapping the domain of expressivity: Multimethod evidence for a hierarchical model. *Journal of Personality and Social Psychology*, 74, 1, 170-192

Klein, K., & Boals, A. (2001). Expressive writing can increase working memory capacity. *Journal of Experimental Psychology: General*, 130, 3, 520-533.

Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science*, 8, 162-166.

Snyder, M., & Gangestad, S. (1986). On the nature of self-monitoring: Matters of assessment, matters of validity. *Journal of Personality and Social Psychology*, 51, 125-139.

Unsworth, N., Heitz, R.P., Schrock, J.C., & Engle, R.W. (2005). An automated version of the operation span task. *Behavior Research Methods*, 37, 498-505.

PAPER PRESENTATION

Aspects of Hungarian undergraduates' writing skills

Zsuzsanna Balazsne Nagy, University of Szeged, Hungary; Tamas Barassevich, Graduate School of Educational Sciences, University of Szeged, Hungary

This study focused on prospective Hungarian teachers' writing skills development. The research questions included (1) the text quality and communicative value of students' writing; (2) the application of critical thinking and argumentation strategies involved in the writing process; and (3) the mapping of the influence of self-concept as a background variable. The process of writing, as described in the classic cognitive models is a metacognitively triggered, complex self-regulatory activity. Hence, the approach of process writing places the emphasis on the goal setting and regulation of the communication process, as well as on the social environment of the task (Rijlaarsdam and Bergh, 2006). The sample consisted of BA students from a Hungarian university, attending a preparatory preparatory course for teacher training. The analysis presented is based on a total number of 49 respondents. In order to assess the development and quality of their writing skills, participants had to complete three realistic tasks, (a) write a job application letter, (b) evaluate two texts and formulate their advice and (c) do the Hungarian adaptation of the Ennis-Weir test of critical thinking. (n=35 completing all three tasks). The results indicate that the undergraduates in the sample are rather egocentric thinkers and communicators. The findings provide information for the development of curricular and methodological interventions.

This study raises issues regarding prospective teachers' writing skills development. The research questions were formulated in a Hungarian context and aimed at (1) the text quality and communicative value of students' writing; (2) the application of critical thinking and argumentation strategies involved in the writing process; (3) the mapping of the influence of self-concept as a background variable.

Theoretical background

The process of writing, as described in the classic cognitive models is a metacognitively triggered, complex self-regulatory activity. Hence, the approach of process writing places the emphasis of the goal setting and regulation of the communication process, as well as on the social environment of the task (Rijlaarsdam and Bergh, 2006). The means of development is then found in teaching strategies to students, enhancing their metacognition (Jenks, 2003). According to Reimer (2001), those who master the elements of the process will become more successful writers.

The Hungarian National Core Curriculum requires the secondary school leavers to have the skills of a successful communicator in writing as well, to be able argue in writing in a sophisticated manner, to think critically about their subject matter and to be conscious writers, yet previous research revealed that this is not a target attained in the secondary school leaving population. However, we know little about the well-achieving population that enters higher education with the prospect of becoming teachers themselves. At the same time, if they enter this profession, they will have to facilitate their students' development in their mother tongue skills.

Methods

The sample consisted of BA students from a Hungarian university, attending an introductory preparatory course of education, which is a preparatory course for teacher training. The number of full responses in study 1 was 39, in study 2 it was 47. A total of 35 students participated in both studies. In spite of the small size of the sample, it reflects gender ratios among students in teacher training, with women (21) outnumbering men (14), and also a wide variety of majors were represented from arts to sciences.

In order to assess the development and quality of their writing skills, participants had to complete three realistic tasks. They were asked (a) to produce a job application letter, and (b) to evaluate two such texts and formulate their

advice to the authors of these two letters. The resulting texts were analysed with regard to conceptual, linguistic and coding aspects. The standards of evaluating the responses to task (a) were based on the 1990 IEA study of written composition. Subjects were also administered (c) the Hungarian adaptation of the Ennis-Weir test of critical thinking, which required them to write a letter to the editor of a local newspaper in response of a public letter. The texts were analysed with regard to characteristics of critical thinking and argumentative strategies. The genre-specific communicative features of tasks (a) and (c) were identified and analysed.

Results

Average text quality was found, while critical thinking and the communicational features of the texts were poor. However, students performed rather well when evaluating the sample texts. Measures of text quality for tasks (a) were rated on 6 point scales for six analytical and one holistic score. All of these correlated significantly with each other ($r=.181$, $p<.05$ – $r=.785$, $p<.01$), however, none had a significant correlation with performance on the critical thinking task (c). The content analysis showed that the texts contained mostly writer-centered information and betrayed a neglect of the awareness of the participants' positions in the given situation.

As regards judging others written communication, Kendall's test of concordance reflected very high level of agreement (.920 – 1.000) with the expert's rating in the case of the first letter of task (b), which was a poor text, yet the index is much lower (.500 - .929) in case of the second sample letter, a text with several good qualities to it. In giving advice to the writer of the evaluated texts, students had rather diverse performances (.13 – 1.00). They were most inclined to give a list of the mistakes the writer made without offering the means of possible development.

The critical thinking achievements were poor (6.54, $sd=5.45$) in the Ennis-Weir essay test. Subjects tended to use fictional data or their beliefs about social justice as counterarguments for the false syllogisms of the test, and they were not sensitive to the mistakes made in the original argumentation. In responding to the task, students failed to connect their text to the original arguments or to do so consistently. Also, only one fourth gave a proper introduction to the text. The existence of introduction here seems to be an indicator of audience awareness, with significant correlations ($r=.388$, $p<.05$) with the total critical thinking score and indicator of the quality of advice offered ($r=.381$, $p<.05$) in task (b).

General, verbal, and emotional self-concept as well as problem solving had strong, significant correlations with relevant aspects of the texts (r values around $\pm .35-.45$).

Discussion

The above results conformed to those of previous studies among Hungarian secondary students. The results above indicate that even well-achieving university students are egocentric communicators in writing. Yet, given the viewpoints, and given the role of detached evaluators, they are able to spot mistakes, which knowledge they do not transfer to text production.. The findings provide information for the development of curricular and methodological intervention.

PAPER PRESENTATION

Multidimensionality of Reading Comprehension Variables: Topics in Theory and Methodology

Jonna Kulikowich, Penn State, United States; Danielle McNamara, The University of Memphis, United States;
Art Graesser, The University of Memphis, United States; Patricia A. Alexander, University of Maryland, United States

The topic of multidimensionality is an important one in both learning theory and psychometric theory. Many variables in reading comprehension research are theoretically multidimensional. Further, scores for these variables are likely best studied assuming more than one dimension or trait establishes how best to study their reliability and validity. In this presentation, intentionality to read in an academic domain and text complexity are studied as two important reading comprehension variables that differ in how they must be studied psychometrically given their multidimensional characteristics. Implications for both reading comprehension and psychometric theory as well as for quantitative methodology are discussed. Recommendations are provided given applications of Item Response Theory, multilevel modeling, and Structural Equation Modeling in the study of these important reading comprehension variables.

The ability to comprehend complex texts nested within a variety of media (e.g., Internet, newspapers, or textbooks) is important in today's world for students to learn and communicate in a globally networked society (Wiley, Goldman, Graesser, Sanchez, Ash, & Hemmerich, 2009). In this theoretical presentation, the multidimensionality of variables is examined as well as theoretical components and methodological frameworks required to study reading comprehension. Two variables included in the discussion are the intentionality to read in an academic domain (e.g.,

Kulikowich & Alexander, in press; McCrudden, Magliano, & Schraw, 2010) and text complexity (e.g., Graesser & McNamara, 2010; McNamara, Graesser, & Louwerse, in press). With regard to reading comprehension, each variable needs to be grounded theoretically, with reasonably reliable and valid operational definitions. This requires some complexity and uniqueness to the variables associated with different comprehension levels. A one-size-fits all quantitative framework may not offer the opportunity to make advances in the fields of cognitive and educational psychology and to introduce what Marsh and Hau (2007) refer to as methodological-substantive synergies. A methodological-substantive synergy occurs when each theoretical and methodological viewpoint reinforces each other well beyond what each can do alone.

To work toward methodological-substantive synergies, variables must be understood given their complex and unique characteristics, and variables can differ in many ways. Variables can differ with respect to whether they are latent (e.g., Borsboom, 2005) versus directly measured. Latent constructs have values that vary randomly in a statistical sense and are assumed to cause responses or behaviors given what readers know or how they process information. Intentionality to read in an academic domain is a latent random variable that refers to a mental state, but it is also important to consider observed behaviors or responses (selections of texts to solve problems, use of references to support a claim) that result from these intentions. By comparison, text complexity, which can be measured using computer programming tools such as Coh-Metrix (Graesser & McNamara, 2010 ; McNamara et al. in press), is arguably a manifest, multidimensional variable because it can be defined using indices in computational linguistics that belong to texts as the units of analysis. The text characteristics are directly observable and are most often measured using ratio scales such as the frequencies of modifiers, nouns, and verbs included in the text. Whereas latent traits are often studied using statistical techniques such as exploratory and confirmatory factor analysis, text complexity defined by indices in computational linguistics is often analyzed using principal component analysis techniques. Intentionality to read to learn also includes several latent elements that involve goal-setting, planning, execution of plans, and evaluation of plans that operate within a processing network. This network includes temporal and recursive properties as goals can change, plans can be modified or abandoned altogether relative to one's initial intentional set. By comparison, text complexity as measured by Coh-Metrix indices may also have several components or dimensions; however, these multiple dimensions serve to summarize the computational linguistic variables rather than define how they are inter-related in a network that attempts to describe how readers process information. Multidimensional variables may also differ given how best they are studied statistically in relation to other variables. This difference is essential in knowing how to specify and test complex statistical frameworks to address empirical research questions. Contextual variables, such as those of classroom or school settings, may alter the dimensionality of any theoretically-defined multidimensional variable. Students may be assigned to read or select to read texts that vary in complexity, for example, and this relation between students and texts may change given: a) classroom or school setting; b) by reading offline versus online; or, c) with reference to state, national, or international standards given the assessment of comprehension. In this 20-minute presentation, the need to study multidimensionality of variables theoretically and methodologically is introduced. Brief definitions of intentionality to read to learn in an academic domain and text complexity are provided with review as to how these variables have been assessed in the literature. The presentation closes with demonstrations of how IRT, HLM, and SEM models can be specified differentially given the theoretical premises associated with each multidimensional variable.

References

- Borsboom, D. (2005). *Measuring the mind: Conceptual issues in contemporary psychometrics*. Cambridge, UK: Cambridge University Press.
- Graesser, A.C., & McNamara, D.S. (2010). Computational analyses of multilevel discourse comprehension. *Topics in Cognitive Science*.
- Kulikowich, J. M., & Alexander, P. A. (in press). Intentionality to learn in an academic domain. *Early Education and Development*.
- Marsh, H. W., & Hau, K-T. (2007). Applications of latent-variable models in educational psychology: The need for methodological-substantive synergies. *Contemporary Educational Psychology*, 32, 151-171.
- McCrudden, M. T., Magliano, J. P., & Schraw, G. (2010). Exploring how relevance instructions affect personal reading intentions, reading goals, and text processing. A mixed methods study. *Contemporary Educational Psychology*, 35(4), 229-306.
- McNamara, D. S., Graesser, A., & Louwerse, M. (in press). Sources of text difficulty: Across the ages and genres. To appear in J. P. Sabatini & E. Albro (Eds.), *Assessing reading in the 21st century: Aligning and applying advances in the reading and measurement sciences*.
- Wiley, J., Goldman, S. R., Graesser, A. C., Sanchez, C. A., Ash, I. K., & Hemmerich, J. A. (2009). Source evaluation, comprehension, and learning in Internet science inquiry tasks. *American Educational Research Journal*, 46, 1060-1106.

PAPER PRESENTATION

SimScientists: Using Simulations to Assess Complex Science Learning

Edys Quellmalz, WestEd, United States; Barbara Buckley, WestEd, United States; Matt Silbergitt, WestEd, United States

The SimScientists research and development program at WestEd combines a model-based learning approach with evidence-centered design into a powerful framework for transforming science assessment. This paper describes a large-scale field test of simulation-based assessments for two middle school topics in three states with 55 teachers and 5500 students. Findings document the feasibility, utility, and technical quality of science simulations for formative, curriculum-embedded assessment and summative, end-of-unit benchmark assessment. SimScientists projects contribute to the research base on the design and validation of the next generation of innovative assessments and their articulation throughout levels of an educational assessment system.

Aims

This paper presents research funded by the U.S. National Science Foundation and the U.S. Department of Education on the feasibility, utility, and technical quality of science simulations designed as formative, curriculum-embedded assessments and as summative, end-of-unit benchmark assessments. The SimScientists program at WestEd seeks to provide evidence that simulation-based assessments can gather and document evidence of students' understanding of connected science knowledge and extended inquiry not often or well measured in the U.S. by conventional tests (See simscienists.org). Curriculum-embedded assessments provide feedback and coaching to advance the learning. Unit benchmark assessments test proficiency and report it for teaching and accountability purposes.

In addition, these assessments are envisioned as components of multilevel, balanced state science assessment systems. The assessments test U.S. national science standards at the middle school level (grades 6-8) for life science (e.g., ecosystems), physical science (e.g., climate), and physical science (atoms and molecules).

Methods

The SimScientists research and development program combines a model-based learning approach with evidence-centered design into a powerful framework for transforming science assessment and learning (Buckley, in preparation; Mislevy et al, 2003). The SimScientists projects proceed through phases of design, expert review, programming, small scale feasibility testing, and classroom testing. The design process involves analyses of learning research, national science standards, and curriculum materials to specify grade-appropriate system components, interactions, and emergent behavior. For example, ecosystem components consist of organisms in the roles of consumers, producers, and decomposers. Interactions involve transfer of energy and matter through the ecosystem, represented in food webs. Emergent system behaviors involve population levels of organisms and changes in them due to varying conditions. Inquiry practices, as specified in the 2009 NAEP Science Framework, include designing, conducting, interpreting, and evaluating. Simulation shells specify the representations of science phenomena to be modeled by the simulation environment. Model-based progressions proceed from observations of organisms, inferences of interactions, and predictions, observations, and explanations of varying population levels. The paper will present examples of the assessment design documents.

In 2010, the U.S. Department of Education funded a large-scale pilot of simulation-based assessments for two middle school topics to investigate the feasibility, utility, and technical quality of the simulation-based formative and summative assessments. Fifty-five teachers, 5,500 students, in 28 districts in three states participated. Data included expert reviews of the alignments of the assessments with national science standards, quality of the science, items, and tasks, cognitive labs in which students think aloud as they respond to the assessments, classroom observations, teacher surveys and interviews, and psychometric analyses. An external evaluation of the project was conducted by UCLA's Center for Research, Evaluation of Students and Standards (CRESST). A Design Panel of representatives of six state departments of education science assessment directors reviewed the pilot test findings and a policy brief summarizing the pilot test and offering alternative models for integrating science simulations into state science assessment systems.

Findings

The paper will summarize qualitative and quantitative data from the pilot test in the three states and the recommendations in the Policy Brief for using science simulations in a balanced state science assessment system. Feasibility and utility were indicated by evidence that the students were engaged in the simulation-based assessments and that the teachers found the reports of student progress useful for understanding student learning and for adjusting instruction. Across the 28 school districts and 55 classrooms, teachers were able to implement the simulation-based assessments in computer labs. Psychometric analyses of the benchmark assessment data indicated

that they were reliable and valid. The Policy Brief describes alternative models for using benchmark data in balanced multilevel state science assessment systems.

Theoretical and Educational Significance. A growing body of research shows model-based reasoning to be a signature practice of the sciences, as scientists create insights and understandings of nature through conceptual, physical, and computational modeling. Further, cognitive research shows that learners who internalize schemas of complex system organization – structure, functions, and emergent behaviors – can transfer this heuristic understanding across systems. Simulations can represent dynamic science systems "in action", making visible the causal, temporal, and spatial phenomena that are invisible and making models available for extended, active investigations of authentic problems. A technical infrastructure that captures and analyzes students' actions and answers can yield cognitively rich evidence of learning in reports for teachers and school systems and can also provide feedback and customized, graduated coaching. The multiple physical and symbolic representations in simulations can also reduce language demands.

In large-scale assessments, the area of science is leading the way in exploring complex, multi-faceted problem types and assessment approaches. The 2006 Programme of International Student Assessment (PISA) pilot tested a Computer-based Assessment of Science specifically to test knowledge and inquiry processes not assessed in the paper-based test booklets. Topics included the functions of a nuclear reactor and genetic breeding of plants. The 2009 National Assessment Educational Progress (NAEP) for Science administered Interactive Computer Tasks (ICT) to test students' inquiry practices. The 2014 NAEP for Technology and Engineering Literacy will be entirely computer delivered and will administer interactive, scenario-based tasks (See www.naeptech2014.org). States such as Minnesota have online science tests with simulated laboratory experiments or investigations of phenomena such as weather or the solar system. The SimScientists projects described in this paper contribute to the research base on the design, development, and validation of the next generation of innovative assessments and their articulation throughout the levels of an educational assessment system.

References

- Buckley, B. C. (in preparation). Model-Based Learning. In N. Seel (Ed.), *Encyclopedia of the sciences of learning*. New York: Springer Science.
- Mislevy, R. J., Steinberg, L. S., & Almond, R. G. (2003). On the structure of educational assessment (with discussion). *Measurement: Interdisciplinary Research and Perspective*, 1(1), 3–62.
- Quellmalz, E.S., Timms, M.J. & Buckley, B.C. (in press). 21st century dynamic assessment. In J. Clarke-Midura, D. Robinson, M Mayrath (Eds.) *Technology-Based Assessments for 21st Century Skills: Theoretical and Practical Implications from Modern Research*.
- Quellmalz, E.S. (2010). Assessing new technological literacies. In F. Scheuermann, (Ed). *Assessing the Impacts of Information Communication Technology (ICT)*. Brussels, Belgium, Organization of Economically Developed Countries (OECD).

PAPER PRESENTATION

Reliability and validity analyses of a test to assess learning strategy knowledge

Katharina Maag Merki, University of Zurich, Switzerland; Yves Karlen, University of Zurich, Switzerland; Erich Ramseier, PHBern – University of Teacher Education, Switzerland

The competence of self-regulated learning is considered to be important for student learning. Yet, analyses of the impact of self-regulated learning show that this is only partially true. Methodological problems in the measurement of self-regulated learning have been discussed in the literature as one possible explanation. A recently introduced approach focuses on developing tests to measure knowledge of learning strategies (e.g. Schlagmýller & Schneider, 2007). Up to now, such tests have only been applied in reading, mathematics, and natural science experiments. However, testing procedures capable of measuring learning strategy knowledge for tackling complex and difficult assignments or projects at school are still lacking. This paper aims to study the reliability and validity of such a test that was developed in a Swiss longitudinal study. Additionally, we used a standardized questionnaire to measure habitual cognitive and metacognitive learning strategies as well as motivational self-regulation. Reliability and validity analyses taking into account the multilevel structure of the data indicate satisfactory goodness-of-fit of the instruments. The analyses show that knowledge of learning strategies is especially crucial in mathematics, but less so in German and in-depth subjects since in these subjects motivational regulation is more important than knowledge of learning strategies. In conclusion, we discuss the implications for future research.

PAPER PRESENTATION

The Mechanism of Washback (test impact) - Revisited

Satomi Mizutani, University of Auckland, New Zealand

The current study investigated the mechanism of the phenomenon known as washback in the context of the national assessment for senior students at secondary schools in New Zealand. Washback refers to the impact that assessment has on teaching and learning in the field of language testing. There have been a few attempts to describe how assessment influences teaching and learning in the field. However, such models failed to articulate exactly how the mechanism of washback works. Washback was previously thought to be unpredictable because of mixed results of educational reform through assessment change. The current study specifically looked at the role of beliefs held by teachers and students, and their contextual factors (e.g., subject and the socio-economic status of school) in the process of washback. The results suggested that at least part of the mechanism of washback could be predicted as the research demonstrated patterns of the ways certain washback effects were brought about by certain types of contextual factors and beliefs. Based on the findings, a new model of washback was proposed, describing how intended positive washback effects are promoted or hindered by certain contextual factors and beliefs held by teachers and students. It is argued that this washback model can help us further understand the mechanism of washback and can potentially help promote intended positive washback while minimising undesirable negative washback.

The current study investigated the mechanism of test impact on teaching and learning in the New Zealand context. High-stakes assessment has often been used not only as a measurement of educational achievement, but also as a strategy to bring about desired teaching and learning as part of educational reform around the world (Linn, 1992; Petrie, 1987). New Zealand is not an exception. In 2002, the government introduced the National Certificate of Educational Achievement (NCEA), a new standards-based assessment where students' performance is evaluated against pre-described criteria (Donnelly, 2000), in an attempt to motivate students of all abilities to strive for higher levels of achievement by emphasising self-comparison and providing them with a clear focus on the standards to achieve (Fancy, 2001).

However, such education assessment reform efforts including the recent case in New Zealand have led to mixed results (e.g., Alison, 2005; NZQA, 2006). It is argued that this may be a reflection that the mechanism of test impact is complex and the link between assessment and desired outcome has not been well understood. Chapman and Snyder (2000) argued that policy makers who advocated educational reform through assessment change failed to see that explicit catalysts were required between the testing strategies they used and the outcomes they hoped to see. Chapman and Snyder (2000) stressed that policy makers were responsible for clarifying and elaborating the link between testing and improved teaching and learning. They also suggested that success in educational reforms could not be guaranteed because it was not the test itself that influenced teachers' behaviour, but rather it was teachers' beliefs about the test that influenced their behaviour. Fullan (2001) also suggested that beliefs would play an important role in promoting desired test impact. Therefore, it can be argued that for a successful educational reform, one of the embedded assumptions is belief change.

The concept of assessment influencing teaching and learning is often referred to as washback in the field of language testing. As was the case in the field of education, studies in the field of language testing have found mixed results of efforts to bring about desired washback (e.g., Alderson & Wall, 1993; Andrews, Fullilove & Wong, 2002; Cheng, 1997, 1998; Watanabe, 1996). There have been a few attempts to create washback models which illustrate how assessment influences teaching and learning in the field (e.g., Alderson & Wall, 1993; Bailey, 1996; Shih, 2007). Such models indicated that many factors such as subject, school setting, personal background of teachers and students as well as beliefs held by them influenced the nature of washback. However, the models failed to articulate exactly how washback effects were mediated by such factors. Thus, the research question was as follows: What is the role of contextual factors and beliefs in the mechanism of washback?

The current study involved teachers and students of four subjects at secondary schools: Japanese, French, History, and Mathematics in order to compare foreign language subjects and non-foreign language subjects. Data were collected through questionnaires. The questionnaires were designed to tap into the nature of washback of NCEA and beliefs held by teachers and students. The questionnaires also collected information on the following contextual factors: subject, socio-economic status of the area where schools were located, gender, the length of teaching career (teachers only), expected achievement level (students only).

Questionnaires were sent to schools throughout New Zealand and a total of 161 teachers and 845 students responded. The data from the participants were then analysed with the use of a series of exploratory maximum likelihood factor analyses to identify the underlying structure of the items for both teacher and student

questionnaires. In order to investigate how washback effects of NCEA and beliefs held by teachers and students varied depending on contextual factors, a series of multivariate analyses of variance (MANOVAs) were conducted. Where there was a statistically significant difference, a post hoc Scheffe test was carried out to identify where the difference lay. Effect sizes were calculated in order to indicate the magnitude of differences. Multiple regressions were also carried out to explore how certain types of beliefs held by teachers and students contributed to various types of washback effects of NCEA.

The results suggested that contextual factors and beliefs played a role in bringing about certain types of washback. For example, where subject was a factor, whether it was a verbal (i.e., Japanese, French, or History) or numeric (i.e., Mathematics) subject made a difference in the way teachers and students interpret washback of the assessment on student motivation and on variability of marking practice. While socio-economic status was rarely a factor for teachers which influenced washback of NCEA and their beliefs, it was often a factor for students, indicating a clear difference between lower and higher socio-economic status. The results also indicated that gender, the length of teaching career, and students' expected achievement level played only a small part in mediating the impact of NCEA and beliefs held by teachers and/or students.

This study also clearly demonstrated a link between washback effects and beliefs held by teachers and students. The results suggested that positive washback was mediated by positive beliefs and negative washback was mediated by negative beliefs. The study also indicated that positive beliefs had another function, which is to mitigate negative washback. This highlighted the important role of positive beliefs in bringing about desired positive washback.

To my knowledge, the current study is the first empirical study which demonstrated exactly how washback effects were mediated by beliefs and contextual factors. A model is proposed to describe the mechanism of washback, showing how washback could be mediated directly and indirectly by contextual factors and beliefs. The links established between teachers' and students' beliefs, their contextual factors, and washback in the proposed model are arguably useful to increase understanding of the mechanism of washback of an assessment on teaching and learning. By clarifying the link between assessment and desired outcomes, the model can potentially help promote intended positive washback while minimising undesirable negative washback.

PAPER PRESENTATION

Silencing socialization of religious Girls in Israel

Zehavit Gross, Bar-Ilan University, Israel

The aim of this paper is to analyze the silencing processes in the socialization of religious girls brought up in a transitional society between traditionalism and modernity. Using qualitative in-depth interviews, 20 girls (5 Jewish, 5 Muslim, 5 Christian-Arab and 5 Bedouin) aged 18-25, were examined. The findings show that silencing is embedded in the ideal school graduate. The girls are situated in an ambiguous dichotomic world where they are expected to be confident, proud of their religion and ethnic origin, yet submissive and silenced religious women who repress their "thick desires" (Fine, 1988; Fine & McClelland, 2007). Though the ideal model of school socialization is the silenced modest woman, their voice is enlisted for collective and political religious purposes in the public sphere. This is especially apparent among Muslim girls and is echoed in the discourse of Jewish, Christian and Bedouin girls. The Muslim girls perceive the veil, which represents Islam and Allah, as a means to enter the public sphere. For all the girls, literacy and education allow them to "bargain with the patriarchy" (Kandiyoti, 1988) and to enter the public sphere as equals.. The discourse reflects school priorities and policy. Arab girls view literacy and knowledge as a key to their future; among the Jewish girls, this issue is less prominent. While the discourse of Arab Christians and Jewish girls was more individualistic in nature, the discourse of the Muslims and Bedouin girls was more collective in nature. Whereas the discourse of Muslim and Bedouin girls was feministic discourse of rights, the discourse of Arab Christians and Jews was more a feministic discourse of identity (see also Gross, 2006).

Introduction

The aim of this paper is to analyze the silencing processes in the socialization of religious girls brought up in a transitional society between traditionalism and modernity. Van Manen (1990) distinguishes between three categories of silence: literal, epistemological and ontological. Literal, namely, the space between the words that can be awkward or poetic, chilling or rebellious; epistemological, namely, tacit information – knowing without being able to articulate what we know; the ontological approach is the "silence of being" that instills a sense of inspiration into life. To these categories, Clair (1998) added a fourth category dealing with the ideological perspective, namely "the silencing of marginalized groups of people".

In Israel

The feminist revolution is connected to literacy. The more access women have to knowledge the more empowered they are. In his power/knowledge theory, Foucault (1980) explained that knowledge generates power and that there is a high correlation between them. This is not true of women in Israel. Religious schools for Arab and Jewish Girls
In the case of both Arab and Jewish women in Israel, religious schools constrain the woman's sphere of activity to the domestic environment.

Data Collection

Using qualitative in-depth interviews, 20 girls (5 Jewish, 5 Muslim, 5 Christian-Arab and 5 Bedouin) aged 17-25, were asked about the silencing they had experienced in school.

Analytical Method

The interviews were analyzed according to the constant comparative method (Strauss, 1987).

Findings

The voice of the woman is considered impure Among all the Arab girls, not only is a loud voice forbidden but loud laughter is forbidden also. While they said that laughing aloud was a terrible thing that school fought against, this was not mentioned at all by the Jewish girls. All the Arab girls said that a loud laugh was considered a misdemeanor.

Sanctions

The school silencing process was accompanied by a specific system of sanctions. silencing through shouting was the main sanction used by all the schools. Christian and Jewish girls emphasized that their silencing socialization was rooted in endless preaching. The Muslim system more frequently sent letters to the parents. The Bedouin and Muslim system sent the girls home as a punishment Only Jews used lowering the grades as a silencing weapon which was extremely effective. All used public humiliation but only the Muslims ignored the girls, and this psychological threat was extremely effective.

The most prominent feature among the Jewish and Muslim girls was the ideological silence.

The prominent words among the Bedouins and Christians were 'respect' and 'honor'.

The power of silence

Women are socially constructed. They are socialized in a male dominated culture. De Beauvoir talks about the ironic interplay between presence and absence.

All the girls said that the most important tenet and instruction in education was not to talk with the boys. This was especially apparent in Christian schooling.

The silencing power of the discussions

Silencing was perceived by all the participants as an integral part of religious education. In retrospect, the graduates talked about the religious leadership as a controlling and coercive body because they represented the religious hegemony had the power to control. The girls felt that their future was in the hands of the religious leadership that had a castrating and silencing power.

Discussion

This paper attempted to analyze the silencing processes in the socialization of religious girls brought up in a transitional society between traditionalism and modernity. The findings show that silencing is embedded in the ideal school graduate. The girls are situated in an ambiguous dichotomic world where they are expected to be confident, proud of their religion and ethnic origin, yet submissive and silenced religious women who repress their "thick desires" (Fine, 1988; Fine & McClelland, 2007). Though the ideal model of school socialization is the silenced modest woman, their voice is enlisted for collective and political religious purposes in the public sphere. This is especially apparent among Muslim girls and is echoed in the discourse of Jewish, Christian and Bedouin girls. Knowledge acquisition is viewed as the key to their future progress and religious strengthening, but more prominently among Arab girls than among Jewish girls. While Arab girls indicate that the most important goal of their school was academic achievement, the religious Jewish girls claim that the most important goal of their school was education to values. The discourse reflects school priorities and policy. Arab girls view literacy and knowledge as a key to their future; among the Jewish girls, this issue is less prominent. While the discourse of Arab Christians and Jewish girls was more individualistic in nature, the discourse of the Muslims and Bedouin girls was more collective in nature. Whereas the discourse of Muslim and Bedouin girls was feminist discourse of rights, the discourse of Arab Christians and Jews was

more a feministic discourse of identity (see also Gross, 2006). The research findings attest to a quiet feminist revolution that is occurring among religious Arab and Jewish girls in Israel, through modern knowledge acquisition and traditional religious strengthening.

The Muslim and Christian woman are trained to be autonomous and assertive, yet they are encouraged to be silent – to speak quietly, which they are socialized to believe is a sign that they are more religious and more feminine. This too is a relatively small price to pay for the security, stability and presumed respect this promises them. School uses a wide range of sanctions for social control purposes. Young religious girls in Israel are brought up in the religious education system (both Jewish and Arab) to be invisible and voiceless. This is justified by religious reasoning as they are told if you are voiceless and invisible you are considered more modest, more feminine and more religious. This has to be abolished because this is exactly what fosters and nourishes discrimination, which is meant to strengthen and continue the hegemony of patriarchy and male chauvinism. However in Israel a velvet revolution is occurring in Israel among religious Jewish and Arab Christian, Muslim, and Bedouin girls who are exposed to higher education and literacy and target themselves to bargain with male chauvinism and patriarchy through silencing, using silencing as a tool for resistance and emancipation. The interviewees indicate that men interpret female delicacy and voicelessness as a weakness and thus abuse and manipulate women. In order to combat this, education should draw a line between how to equip the girls with assertiveness to resist victimization and yet preserve the beauty of this delicacy which is a gift that God bestowed on the world to improve and humanize it.

PAPER PRESENTATION

Extrinsic and Intrinsic Values among adolescents in Israel

Zehavit Gross, Bar-Ilan University, Israel

The aim of this research is to investigate which values are considered more important to Arab and Jewish students (N=586) in state schools in Israel and how these choices differ by nationality, gender and religion. The questionnaire used in this research (Zieberts & Kay, 2005) consisted of eight value scales in two groups. The first group included the extrinsic values and consisted of three scales: modernity, attractiveness and. These scales represent concepts that are described as trendy and are aggressively portrayed in advertising. The second group of intrinsic values consisted of five scales. Three represent civil values: family orientation, professional orientation, and self-management. The findings show that whereas Jews endorse more auto-centric intrinsic values, the Arab students endorse nomo-centric extrinsic values. However, differences in gender and religiosity are apparent. As a minority group that belongs to a traditional society that strives to adapt to neo-liberal Israeli society, Arab students endorse the extrinsic values, which are functional and have the potential to help them to achieve, succeed and survive. The results of the research corroborate literature findings that show that people are not born with values but are educated to values. People are not born extrinsic or intrinsic; they become one or the other in a process of socialization, mediated by intervention programs and the environment in which they live.

The goal of this research was to examine which values are considered most important by students attending Arab and Jewish schools in Israel. While Jewish education in Israel views value education as a core part of its curriculum and is in fact anchored in the State Education Law, Arab schools in Israel, for various reasons that are described here, educate solely for achievements but not for values. Therefore, it is worth asking whether differences will be found in the emphasis given to values, between students of Arab schools and their peers attending Jewish schools. We will analyze the central definitions dealing with value education, describe its status in the Jewish and Arab school systems in Israel, and finally present our findings and attempt to explain them in view of the special context in which they occur. Value education

A value is defined as the belief that one type of conduct or state of existence is preferable to others (Rokeach, 1976). Klages (1988) distinguishes between auto-centric values represent a modern approach, whereas the nomo-centric values represent a more traditional approach.

The intrinsic or extrinsic dimension of a value

In his book *Protagoras*, Plato distinguished between intrinsic values – those that the individual is interested in because of their self-value, and extrinsic values, in which the individual is interested in order to achieve another goal.

Value education in Israel

In Israel, value education is perceived as a basis of the education system; the goal of education is teaching as well as educating for values.

Value Education in Israel's Arab population

The Arab citizens of Israel are a minority group. Minority groups are generally typified by a stronger orientation to achievement, to assist in the goal of survival. And indeed, Arab schools in Israel focus specifically on educating toward achievements, more than on educating for values (Abu abasa, 2001).

The Study

The goal of the study was to identify the variables that influence the personal values of Arab and Jewish high school students in Israel, and which values they perceive as admirable and preferable.

Population

The population included 586 twelfth graders in Jewish (N=293) (Female N= 191 (65.2%), Male N= 102 34.8%) and Arab (N=293) (Female N= 191 (65.2%), Male N= 102 34.8%) high schools in Israel.

Two groups of values were examined: extrinsic (that deal with external considerations, which are means to achieve something else) and intrinsic (values that represent ends in themselves). These values were examined according to three variables: ethnic affiliation (Arab/Jewish), gender, and degree of religiosity (secular, traditional or religious).

The research tools

The questionnaire used in this research (Zieberts & Kay, 2005) consisted of eight value scales in two groups (extrinsic and intrinsic).

The results

A MANOVA analysis was performed on the values by ethnic affiliation (Jewish/Arab), gender, and degree of religiosity (secular, traditional, orthodox). In the variance analysis performed for each parameter separately, significant differences were found between Arabs and Jews for all the values examined. In the intrinsic values, the Jewish students scored higher, and in the extrinsic values, the Arab students scored higher.

Significant differences on all values were also found for levels of religiosity. Furthermore, a significant interaction was found between ethnic affiliation and gender. In the three levels of religiosity, the values of attractiveness, modernity and authenticity were more important for the Arab students than the Jewish ones. Among religious students, the differences between Arab and Jewish students are larger and more prominent than for the two other groups.

Discussion

The variables of gender, religiosity, and ethnic affiliation have an impact on the way in which students endorse certain values over others. However, to base this analysis only on these variables may lead to stereotypes and prejudice as, according to current literature (Bar-Tal, 2003) preference is principally influenced by the context and character of the educational framework where the socialization process occurs de facto. The results of the research show that the Jewish students who studied in an education system where value education is widely applied are characterized by intrinsic values. The Arab students who studied in a framework that focuses on education toward achievements and does not engage in value education, were characterized as having extrinsic values. It transpires that the context in which the process of socialization for values takes place has a far-reaching effect. Bronfenbrenner's (1979) ecological theory maintains that the surroundings where individuals live exercises an influence on their psychological development. Socialization is aimed at enabling the individual to adapt to the environment where s/he lives and functions, and at the same time to change the environment and impact on it, in order to meet his/her needs. According to Vygotsky's ([1934] 1978) socio-cultural theory, socialization for values takes place by a process of intersubjectivity, in which the teacher and student begin a discussion with different conceptualizations and can ultimately reach a shared understanding. This is made possible by a process of adjustment to the perspective of the other, and scaffolding that involves the social support given by the adult in any learning process.

Shannon (2000) maintains that the social context has a far-reaching impact on the shaping of intrinsic or extrinsic motivation. "The social context can influence the goals adopted in a given situation, and can also create a more enduring climate that results in internalization of values ... which includes values as to what is interesting and worth pursuing" (p. 451).

The technological changes and the modernization process that Arab society has undergone in Israel since 1948 have been intensive and rapid. Arab society could not absorb such sweeping changes and did not manage to internalize them. Therefore it principally experienced them in the extrinsic stratum,

The results of the research corroborate literature findings that show that people are not born with values but are educated to values (Oser, 1999 Tirri 2007). People are not born extrinsic or intrinsic; they become one or the other in a process of socialization, mediated by intervention programs and the environment in which they live. Implications

The results of the research corroborate that the value world of students is the outcome of the social climate in which they were raised. In the neoliberal world where study achievements are perceived as the main issue, it is important to allocate defined time in the curriculum for value education. When this does not happen, the graduates of that sort of education will focused on extrinsic goals alone. Educational intrinsic values are likely to provide a significant source for developing students who are human beings – not just knowledgeable robots.

PAPER PRESENTATION

Students' negotiations of moral issues related to socially constructed family patterns

Catherine Dimitriadou, University of Western Macedonia, Greece

The changes that occur in the structure of nuclear families give rise to a reconsideration of the student's normative conceptual view of traditional family patterns. Educational approaches to these representations should focus on moral aspects with regard to the essential children's needs, as they are clarified in the Children's Rights. On the occasion of Brecht's *The Caucasian Chalk Circle* teaching in Literature, twelve-year-old students from a Greek primary school classroom were engaged in a six-month participatory research study in order to address moral issues deriving from the tug of love between the natural and the foster mother of a child. The project included the approach contained within five further literary texts on the same topic, which created opportunities for a flexible learning environment open to discussions, narratives and activities focused on relevant moral dilemmas. The application of a pre- and a post- questionnaire revealed a change in the students' beliefs and attitudes concerning the concept of 'belonging' to a genetic family and the stigmatization of adoption. Moreover, the entries written in the teacher's diary testified to students' discourses on moral versus normative values justification on the subject. According to the results, students' engagement in critical responses to real life situations reflected in Literature help them to negotiate difficult moral dilemmas and to adopt ethical priorities which depart from stereotypical representations of family social construction.

AIM

The current changes characterising the New Age have a justifiable impact on the traditional family patterns, thus creating scepticism on the social circumstances under which children are supposed to be brought up in the future. Moral dilemmas (Kohlberg, 1985) concerning children's abandonment or adoption can be introduced in the school curriculum and provide a field for discourses on moral versus normative values justification (Oser, 1996; Mihalakopoulos, 2007) pertaining to family social constructions. In this respect, our study aims to help students elaborate, interpret and change their beliefs about ethical priorities corresponding to the social construction of a family, thus forming their own meaningful criteria for the concept of motherhood and linking them to the essential needs of a child (Wegar, 2000).

RESEARCH QUESTIONS

The following research questions were posed:

- How do students perceive the concept of 'belonging' in a child – mother relationship?
- What are the students' views on the social norms concerning adoption?
- To what degree can Literary based instruction change students' representations of family patterns regarding moral aspects of motherhood?

CONTEXT

The study was conducted in an urban state primary school in Thessaloniki, Greece, with a multicultural student population from mainly low socio-economic classes. It concerned the application of a project in Literary and took place from October 2007 to March 2008. Bertold Brecht's *The Caucasian Chalk Circle* and five further literary texts posing dilemmas and raising ethical questions on the concepts of motherhood and family were used as 'vehicles' for the consideration of moral aspects concerning family patterns. Having adopted a constructive perspective, the study was built on the assumption that students' engagement in Literary based moral problem solving situations of the nature described above could possibly cause changes in their conceptual representations of nuclear families.

PARTICIPANTS

The sample consisted of twenty 12-year-old students, 8 boys and 12 girls, attending the 6th form in a primary school. It is worth noting that none of these children came from an adoptive or one-parent family.

DATA & DATA COLLECTING METHOD

The data were collected from multiple sources: a) the students' responses to a questionnaire they were given in the beginning and at the end of the project, b) the texts and the pictorial material students produced during the project, and c) the notes the students' teacher kept in her journal. The students were initially exposed to a moral dilemma

arising from the Brechtian text. A second story (The Lost Doll) provided material for the compilation of a pre- and a post-questionnaire as tools for data collection on students' responses to an equivalent dilemma: 'Which of the two girls is actually the owner of the doll?'. Four more stories on the same topic raised discourses and reactions: Solomon's Story of the Two Women, The Girl with the Two Mothers, A Home for Five, and Xoot. The students were involved in text writing, discussions, open ended stories, role play and picture depictions. This data highlighted and supported the information provided in the teacher's diary. The students also created comics, notebook covers with symbolic pictures and a poster, which they exhibited at school after the end of the project.

THEORETICAL FOUNDATION

The study had a broad theoretical grounding on Socio-psychology, Pedagogy and Literary Theory, since the project unfolded on the basis of different ontological and epistemological points of departure, complementary to each other. Participatory research methods (Hughes & Seymour-Rolls, 2000) and flexible child-centred procedures were applied drawn on the theory of Social Constructivism (Hua Liu & Mattheus, 2005), thus providing liberating, empowering and educative learning opportunities.

FINDINGS

Comparison of the data between the two questionnaires revealed a change in the students' responses to the same dilemma (pre-questionnaire: 'The doll belongs to Lolita'; post-questionnaire: 'The doll belongs to Paca'). This shift testifies an impact of the project on the students' beliefs and the forming of conceptual representations about family structures which subvert stereotypical patterns. More precisely, the students defined their own criteria for a mother's love and care for her child; they renounced abandonment of a child and approved of adoption as an action of morality; they criticised the ethical codes which give priority to the concept of 'belonging' to a mother instead of essential mother care; and they disagreed and argued about individual rights and responsibilities, as well as on the optimal responsive styles for a child's happiness and social competence. Their latter perceptions were construed following an open discussion held between the students and a lady who had been brought up by a foster mother and who had been invited to the classroom especially for the purpose of this exercise.

The students concluded that adoption is another way that families are created: that a child can be safe and happy even if it is not related to its mother by blood; and that alternative solutions can be found to claims on the ownership of an adopted child on the basis of moral versus social conventional considerations.

SCIENTIFIC ORIGINALITY & CONTRIBUTION

The study appears to set a methodological framework for teaching approaches concerning both aspects of the double assignment of school: the achievement of content knowledge and the negotiation of moral aspects. With regard to teacher training, it underpins the value of teachers' knowledge creation on how to communicate difficult moral issues to the classroom, setting a scene of empathy out of collaborative research strategies (Dimitriadou & Solachidou, 2010). With regard to individual learners and teachers, it indicates how a constructive perspective of teaching arising from Literary texts can help students to think critically while addressing difficult moral dilemmas usually confronted in real life situations; and furthermore, how this perspective can influence students' stereotypical beliefs within a climate of assertiveness and responsive behaviour.

PAPER PRESENTATION

Does religious learning through physical activity lead to a better ability to empathize with actors?

Ulrich Riegel, Chair of Religious Education, Germany

Does learning through physical activity increase the students' ability to empathize with actors of a story? This hypothesis is backed up by neurophysiological theory as well as by empirical evidence from outside the field of religious education. Within this field, the didactic approach of "performative" religious education combines mere knowledge about religion with the experience of religion. In this setting, physical activity becomes a basic method of learning. However, the performative approach has not as yet been subjected to empirical evaluation. Does learning through physical activity make a difference in religious education, especially with regard to increasing the ability to empathize? The ELLRU-Project analysed this question in a quasi-experimental design. In 2008, 624 4th-graders (age: 9.16 years; denomination: 81% Protestant, 8% Roman Catholic, 11% without religious affiliation) in 31 Bavarian classrooms were introduced to a learning module about Moses and one about Martin Luther, half of them being taught using physical methods, half of them using methods based only on the children's imaginations. A pre-test and a post-test after each module checked the effects on the ability to empathize with the main actors of teaching units; another test at the end of the school year checked the sustainability of this ability. The analysis using a dichotomous Rasch model does not show an overall effect on the students' ability to empathize. Learning through physical activity can, however, prove to be an asset in some circumstances as an analysis of differential item-functioning shows.

Does learning through physical activity increase the students' ability to empathize with actors of a story? This hypothesis is backed up by neurophysiological theory as well as by empirical evidence from outside the field of religious education. Within this field, the didactic approach of "performative" religious education combines mere knowledge about religion with the experience of religion. For instance, "performative" religious education invites the students to take part in a prayer and discusses relevant individual experiences afterwards. Or, the pupils express with their body possible feelings of Martin Luther living as monk before discovering the love of God. In this "performative" setting, physical activity becomes a basic method of learning.

However, the performative approach has not as yet been subjected to empirical evaluation. Does learning through physical activity make a difference in religious education? The ELLRU-Project analyzed this question in a quasi-experimental design. In 2008, 624 4th-graders (age: 9.16 years; denomination: 81% Protestant, 8% Roman Catholic, 11% without religious affiliation) in 31 Bavarian classrooms were introduced to a learning module about Moses and one about Martin Luther, half of them being taught using physical methods, half of them using methods based only on the children's imaginations. A pre-test and a post-test after each module checked the effects of teaching units; another test at the end of the school year checked the sustainability of these effects.

In the EARLI-paper we will concentrate on the ability to empathize with the persons being portrayed in the two teaching units. Therefore the students filled in seven multiple-choice-questions regarding the feeling of Moses or Luther in distinct situations. Each of these situations had been elaborated in the teaching units explicitly. In a first step, the answers will be analyzed by using a dichotomous Rasch model. This analysis does not show an overall effect on the students' ability to empathize. Students who have elaborated the Moses-topic or the Luther-topic respectively by physical methods are not generally better in reproducing correct feelings than students who had elaborated both topics by imagination only. In a second step we analyzed the answers by differential item functioning. This analysis identifies three didactical settings showing significant differences. In two settings physical learning is better than imaginative one, in one setting imaginative learning is better than physical one.

Going into details, the two didactical constellations of the physical teaching unit, which do better than the imaginative counterpart, are characterized by a smooth atmosphere. The students deal with their own feelings and body movements, having time to explore them without being distracted by social interaction. In both settings learning through physical activity does lead to a better reproduction of correct feelings. In the physical teaching unit, which did worse than the imaginative counterpart, the students have been busy with a symbolic role play. They had to perform complex body movements, joined by a lot of social interaction. Obviously learning through physical activity is a powerful mean of religious education, when the student is able to center on himself and has the time to explore the internal effects of physical motions and sensations. Then learning through physical activity is increasing the ability to empathize with other persons.

This exploration of physical learning as a way of enhancing the learned effects of religious and spiritual content fits well with the common theme being explored in this SIG 19 symposium which concerns the extent to which religious and spiritual education can be utilized for broader educational purposes and, in turn, how wider educational experiences can facilitate effective education in and around religious and spiritual knowledge.

PAPER PRESENTATION

Effective Use of Multiple Representations by Novices in Learning Chemistry

David Corradi, Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium

Theories on learning with multiple external representations (MER) claim that novices in science have difficulties using MER (e.g., Ainsworth, 2006). Nevertheless such MER are argued to be essential to understand scientific concepts. In contrast, some research does find that novices can use specific combinations of representations for learning (e.g., Carney & Levin, 2002). In this study we investigate the effect of MER on novices' learning gains in chemistry. Undergraduates (n=67) participated in a pre-post randomized experiment. Participants read texts, that were – depending on the condition – accompanied with symbols and/or pictures. Result found no significant differences in learning gains. Combining symbols and/or submicroscopic representations with text does not help novices learning with MER.

Aims

Understanding scientific concepts entails the ability to recognize and switch between multiple external representations (MER) of that concept (e.g., Rappaport & Ashkenazi, 2008). We focus here on texts, symbols (both descriptive representations) and submicroscopic representations (depictive representations). Symbolic

representations are part of the systematic language of chemistry that communicates for example the composition of matter. Submicroscopic representations provide information at the level of invisible and untouchable particles (Johnstone, 2006).

Comparisons between novice students and more knowledgeable students show that novices tend to have difficulties understanding and translating between MER (e.g., Seufert, 2003). If learning with MER is to be successful, research concludes, prior knowledge of the domain and its representations is required (Ainsworth, 2006). However, other research found successful use of MER with novices. The main difference was that text was the main representation and other descriptive and depictive representations (illustrations) had a supportive function (e.g., Levie & Lentz, 1982).

We want to know whether combining symbolic and submicroscopic representations with texts of chemistry increases the level of conceptual understanding for novices (i.e., chemical literacy; Schwartz, Ben-zvi & Hofstein, 2006). Adding representations to texts has a positive effect for novices on learning because it supports memory, guides attention, organizes information and structures learning behavior (e.g., Carney & Levin, 2002). Additionally, combining descriptive and depictive representations benefits learning since both are processed differently. Depictions interact with the picture's internal perception and the prior knowledge of the subject matter. A description's surface structure is first mentally represented. Its semantic content then generates a propositional representation. That representation is formed into a mental model (Schotz & Bannert, 2003).

Therefore we think that learner's chemical literacy increases significantly more when learning with texts, symbols and submicroscopic representations compared to when learning with only texts or with text and either a symbolic or a submicroscopic representation.

Methods

Participants

Participants were sixty seven undergraduates. 7% were male. Mean age was 18.61 (sd= 0.91).

Design

In a pre-post randomized experiment, participants were distributed over four groups. Group 1 (n=16) received texts about basic chemical concepts. Group 2 (n=17) received symbolic, group 3 (n=17) submicroscopic representations and group 4 (n=17) got both symbolic and submicroscopic representations about each concept (always with text; representations: Lagasse, 2007).

Instruments and procedure

Pre and post-tests were chemical literacy tests. One instrument in each test assessed recognition of chemical concepts (nominal literacy; self-report) and the second one the ability to correctly describe concepts (functional literacy; open questions) (Schwartz, Ben-Zvi, & Hofstein, 2006). The nominal literacy pre-test had Cronbach $\alpha = .89$; post-test: $\alpha = .91$. Coders scored the functional literacy test. Inter-rater agreement (kappa) scores for all tests were between .60 and .90. Coders compromised on the scores they did not agree on. Pre and post-test lasted 10 minutes each. The intervention was the assignment to read five texts (206 words average) on a computer. Only one representation was shown at the time and actions were logged. We used an ANOVA to measure difference in learning gains (posttest minus pretest results).

Results

Pre-test ANOVA did not find a difference between the conditions, $F(3,63) = 0.069$, $p > .05$, partial $\eta^2 = 0.003$ (i.e., successful randomization). Our hypothesis was that the condition with three representations per concept would have more learning gains compared to the other groups. Table 1 shows a higher mean for group 4. The ANOVA reveals no significant differences between the four conditions, $F(3, 63) = 0.949$, $p = .42$, partial $\eta^2 = .043$. Hence, our hypothesis that MER help learning is falsified. There is also no evidence that using MER negatively affects learning.

Discussion

That we found no significant difference between the groups can mean two things. First, combining text with other representations does not help novices more than when text is given without representations. Participants had low prior knowledge and this may have limited them in using the representations (Ainsworth, 2006). Second, even though some state that MER may cause negative learning gains (e.g., Schnotz & Bannert, 2003), using text combined with other representations does not lead to negative learning gains here. Based on these results we assume that representations had either a decorative function for learners (i.e., redundant) (Winn, 1993) or were ill conceived.

The value of these results is that it has shed light on an ambiguity of the literature concerning novice learning with MER. Conceptual understanding did not increase more than just with text. Hence, combining text with other representations does not seem to help novices make connections between them.

References

- Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and Instruction*, 16, 183–198.
- Carney, R. N., & Levin, J. R. (2002). Pictorial illustrations still improve students' learning from text. *Educational Psychology Review*, 14(1), 5–26.
- Johnstone, A. H. (2006). Chemical education research in Glasgow in perspective. *Chemistry Education Research and Practice*, 7(2), 49–63.
- Lagasse, P. (Ed.). (2007). *The Columbia Encyclopedia*. NY: Columbia University Press.
- Levie, W. H., & Lentz, R. (1982). Effects of text illustrations: A review of research source. *Educational Communication and Technology*, 30(4), 195–232.
- Rappoport, L. T., & Ashkenazi, G. (2008). Connecting levels of representation: Emergent versus submergent perspective. *International Journal of Science Education*, 30(12), 1585–1603.
- Seufert, T. (2003). Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13, 227–237.
- Schnotz, W., & Bannert, M. (2003). Construction and interference in learning from multiple representation. *Learning and Instruction*, 13, 141–156.
- Shwartz, Y., Ben-Zvi, R., & Hofstein, A. (2006). The use of scientific literacy taxonomy for assessing the development of chemical literacy among high-school students. *Chemistry Education Research and Practice*, 7(4), 203–225.
- Winn, W. (1993). Perception principles. In M. Fleming & W. H. Levie (Eds.), *Instructional Message Design* (pp. 55–126). NJ: Educational Technology Publications.

PAPER PRESENTATION

Comparing learning outcomes across different instructional approaches in preschool science education

Mirjam Steffensky, IPN, Germany; Eva-Maria Lankes, TU Muenchen, Germany; Claus Carstensen, University of Bamberg, Germany

Science learning in preschool aims at imparting usable everyday knowledge in the sense of scientific literacy. The main focus is often on hands-on activities which are not always sufficient for a deeper understanding of science. Therefore learning opportunities are helpful in which learners are cognitively engaged. This paper presents results from a research project which compares learning outcomes across different instructional approaches in preschool science instruction. Central issues are, 1. which effect has the direct support of children to relate concepts and everyday situations and, 2. which effect have hands-on activities on the understanding of science in preschool children.

In an experimental study with a total of four experimental groups, we studied the effects of (1) doing experimental activities (N=45), (2) the explicit supporting of children to relate everyday situations with scientific concepts (N=42), and (3) the combination of both (N=42) on preschoolers' scientific understanding. Group 4 (with none of the named factors) served as a control group on time on task effect (N=64). A further group served as a baseline group (N=64). The intervention was based on three instruction units. In a pre-, post- and follow-up-test we used structured interviews for assessment.

Results were modeled with a Rasch-type model. All five groups show an increase in the abilities. In the post test results controlling for pretest results and general cognitive abilities, only the third Group (combination of experimental activities and everyday situations) shows significantly higher results than the baseline group.

Recent studies show that preschool children are able to develop scientific knowledge in different content areas (Samarapungavan, Mantzicopoulos & Patrick, 2008). However, little is known about the support of science learning at preschool age. This paper presents results from SNAKE a research project which compares learning outcomes across different instructional approaches in preschool science instruction. In the presentation the assessment, the instructional approaches and the effects of the different approaches on learning outcomes will be reported.

Science learning in preschool aims at imparting usable everyday knowledge in the sense of scientific literacy (Gelman & Brenneman, 2004). This includes, for example, the ability of children to describe and predict what happens in a specific everyday situation in their own words and actual terms. However, in Germany as in many other countries, science instruction in kindergarten occurs only sporadically. The main focus is usually on hands-on activities that entertain and amaze children. However, research shows that hands-on activities are not sufficient for a deeper

understanding of science (Butts, Hofman & Anderson, 1994). For a deeper understanding learning opportunities are helpful in which learners are cognitively engaged and reflective thinking processes are fostered. Moreover, to foster a generalized knowledge students should be given the possibility of observing, recognizing and relating concepts in and to different (everyday) contexts, so that they are able to recognize patterns and relate pieces of information (Harlen, 1998).

Against this background central issues in the project described here are, 1. which effect has the direct support of children to relate concepts and everyday situations and, 2. which effect have hands-on activities on the understanding of science in preschool children. The conceptual contents of the instructional approaches were "melting and freezing", "evaporation and condensation" and "solving".

Method

In an experimental study with a total of four experimental groups, we studied the effects of (1) doing experimental activities (N=45), (2) the explicit supporting of children to relate everyday situations with scientific concepts (N=42), and (3) the combination of both (N=42) on preschoolers' scientific understanding. Group 4 (with none of the named factors) served as a control group on time on task effect (N=64). A further group received no intervention at all and served as a baseline group (N=64). General cognitive abilities of the students were tested and the children were distributed accordingly among the five groups.

The intervention was based on three instruction units (each for one content) which were preceded by a pretest and followed by a posttest shortly after the end of instruction as well as a follow-up test four months after the instruction had taken place.

For assessment we used the SNAKE-test, which was individually presented as a structured interview. The test consist of 29 items for each measurement point; 10 of those were anchor items whereas the others varied over the measurement points (WLE-Reliabilities are .75 (pre-test) and .80 (post-test)). The items were scored as 0, 1 and 2 for wrong answers, partly correct answers or correct answers respectively.

Description of the experimental variation

For the conception of the different instructional approaches we firstly defined for each content the relevant terms, like melting, warm /hot, cold, solid, liquid, and relevant concepts like "melting is the change from (solid) ice to (liquid) water" and "the speed of the melting process is influenced by the surrounding temperature". We then choose experimental activities in the three content areas and everyday situations in which they relevant concepts are observable.

In the first experimental group the children carried out hands-on activities. Afterwards the observations, results and conclusions were discussed and compared with other experimental activities; however, explicit references to everyday situations were not given and induced. In the second group the teacher talked (using supporting materials) with the children about situations in which the conceptual contents can be experienced. Activities such as watching a water boiler at work were performed. A combination of both (hands-on activities and everyday situations) activities was performed with the third group. In the fourth group we read picture books to the children, in which we incorporated the relevant terms and concepts.

Results

Results of the assessment were modeled with a Rasch-type model (a modified Partial credit model). All five groups show an increase in the abilities, on average by $d=0.58$ standard deviations. The baseline group increases by $d=0.49$ standard deviations, so solely the experience of test taking led to conceptual advances.

Differences in achievement gains between the four groups were analyzed in comparison to the baseline group controlling for general cognitive abilities using a covariance analysis design. For example, in the post test results controlling for pretest results and general cognitive abilities, only the third Group (combination of experimental activities and everyday situations) shows significantly higher results than the baseline group (p

Discussion

The major concern of this study was to contribute to the question of how to support preschool students' conceptual understanding of science topics. Our results show that only the combination of hands-on activities and the support of relating concepts to everyday situations leads to significantly higher achievement compared with a baseline group without any treatment. In typical science learning environments in kindergarten, hands-on activities are often not

combined with reflecting everyday situations, which means that the potential of learning possibilities is not used to its full extent.

Butts, D., Hofman, H., M., & Anderson, M. (1994). Is direct experience enough? A study of young children's views of sounds. *Journal of Elementary Science Education* 6(1), 1-16.

Gelman, R. & Brenneman, K. (2004). Science learning pathways for young children. *Early Childhood Research Quarterly* 19, 150–158.

Harlen, W. (1998). Teaching for understanding in Pre-Secondary Science. In: Fraser, B.J., Tobin, K.G. (Eds.). *International Handbook of Science Education*, Kluwer Academic Publishers: Dodrecht, 183-198.

Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning science through inquiry in kindergarten. *Science Education*, 92, 868–908.

PAPER PRESENTATION

Is science a belief?: Classrooms, controversy and contradictions

Berry Billingsley, University of Reading, United Kingdom; Keith Taber, University of Cambridge, UK, United Kingdom;

Fran Riga, Cambridge University, United Kingdom; Helen Newdick, University of Reading, United Kingdom

In this study we look at the messages that teachers present to pupils about the status and nature of scientific and religious ideas in the context of discussions about science and religion. Drawing on interviews with science and RE teachers from four English secondary schools, we notice that the culture in secondary schools is such that teachers of science and RE have little insight into the teaching that takes place in the other classroom. We suggest that this lack of joined up teaching has several unwelcome repercussions. One is that it reduces opportunities to make conceptual links where these might be helpful; secondly it means that teachers are sometimes answering questions that seem designed to challenge without the reassurance of knowing what a specialist from the other area would say. In our analysis, we report on the concerns that teachers raised in relation to the teaching of topics that are common to science and religion. We also highlight points where the terminology and explanatory frameworks used by science and RE teachers seem poorly matched and in places, conflicting.

Background

Science and religion are each about many things but when considering the relationships between them, the focus is frequently on what each say is 'true' and on whether those 'truths' can or should be compared. When discussing the relationships between science and religion, two precepts are commonly argued to be important. One is that science provides a relatively stringent and trustworthy method of discovering and testing knowledge (McComas, Clough, & Almazroa, 2002). The word relatively is important as there is no suggestion that science is a path to certainty. The second is less consensual but is widely held and is that science and religion are primarily concerned with different 'realms' (Poole, 2007). This means that when science and religion address similar questions, the explanations they produce may or may not be competing. In the secondary school context in England, science and religious education are generally taught by subject specialists in separate classrooms, each following a subject-specific scheme of work. While the curriculum guidance for RE makes many references to science, the curriculum guidance for science makes no overt references to religion. The expectation is that in the RE classroom pupils examine the nature of science alongside the nature of religion and so identify where ideas from science and religion do and do not compete (QCA, 2004). During this reflection, pupils are expected to consider the two precepts described previously (QCA, 2004). There are reasons to suggest that the compartmentalised nature of secondary school education in England potentially impedes teaching about these precepts.

Research questions

In this project we are interested in the terminology and conceptual links used by RE and science teachers when discussing beliefs, ideas and evidence. The aim is to assemble a picture of how this area is presented to pupils in the two classrooms to test the coherence of the bigger picture.

Methodology

This study reports on research in four diverse schools in different geographic areas of England. In each of these schools, one science and one religious education teacher were interviewed, after selection by the Head teacher. Contemporaneously, a convenience sample of three students from Year 9 were also interviewed. This paper primarily discusses the interviews with teachers. Interviews followed a semi-structured interview format (Patton, 2002). With participants' consent, they were recorded and transcribed. Participants' names were changed during the transcription process. Teachers were asked about their own ideas about the relationships between science and religion; they were also asked questions relating to their teaching with regards to the nature of science, the nature of religion and the relationships between them.

Two methods of analysis were used. Through content analysis, sections of the interview were selected in which teachers discussed any or all of the following terms: beliefs, facts, ideas, truth, claims, evidence, reasons. This enabled us to discuss and compare teachers' approaches and uses of terminology. In a parallel analysis process, descriptive narratives were produced for each teacher, describing their perceptions of the theme of science and religion in relation to their teaching (its relevance and importance) and their self-perceptions when teaching on the theme (their confidence, enthusiasm, experience and expertise.)

Findings

As might be expected, the RE teachers in our sample were generally better prepared to teach on this theme than the science teachers, in that, for example, they were able to describe conceptual models that enabled comparisons of ideas drawn from science and religion. Only one of the four science teachers had a ready conceptual model for this purpose. Having said this and on the basis of the teachers' comments, the theme of science-and-religion was presented or discussed in all the teachers' classrooms, prompted either by questions from pupils or because it was introduced by the teacher. The need to have a secure understanding of science and the nature of science emerged as an issue at several levels. For science teachers a point of tension was a perception that religion does not have a valid way to test and support claims. This tension was heightened by a tendency to see religion as methodologically in conflict with a scientific perspective. For RE teachers, tension arose where there was a self-perception of a lack of science subject knowledge on questions of Origins. The most striking finding was the lack of common ground and collaboration between the subject areas on the teaching of this theme, such that terminology and explanatory frameworks were disjointed and in places, conflicting.

References

- McComas, W. F., Clough, M. P., & Almazroa, H. (2002). The Role and Character of the Nature of Science in Science Education. In K. Tobin, D. Baker, B. Bell, R. Duit, M. Espinet, B. Fraser, O. Jegede, R. Lazarowitz, W.-M. Roth, T. Hsiao-lin & L. R. Herrera (Eds.), *The Nature of Science in Science Education* (Vol. 5, pp. 3-39): Springer Netherlands. Patton, M. Q. (2002). *Qualitative research & evaluation methods*. Thousand Oaks, CA: Sage Publications.
- Poole, M. (2007). *User's Guide to Science and Belief*. Oxford: Lion.QCA. (2004). *Religious Education: The non-statutory national framework*. London: Qualifications and Curriculum Authority.

PAPER PRESENTATION

Cognitive and Motivational Determinants of Science Achievement

Nele Nicole Kampa, Humboldt University Berlin, Germany

Despite the conceptual and operational fuzziness of terms such as competence, ability, achievement, aptitude or skill, they are prevalent and prominent in educational research. In order to dismantle the concept of science achievement and to determine the underlying constructs we examine the effect of cognitive aspects such as general cognitive ability and reading ability and also affective aspects such as motivation and self-concept on science achievement. A large sample of 6.084 ninth-graders worked – in a multi-matrix design – on a total of 998 items measuring science achievement. The used items were developed in the process of establishing national performance scales in sciences in Germany. According to didactical considerations two constructs were separated in the process of item construction: a) gaining knowledge in sciences and b) usage of domain-specific knowledge. Participants also completed a nonverbal cognitive ability test, two C-tests assessing reading ability, and newly developed scales assessing motivation and self-concept in sciences. We report to what extent science achievement covary across both constructs and within three different school subjects in Germany – Biology, Chemistry, and Physics. Main focus is to decompose the didactically motivated constructs by regressing on well-established cognitive and motivational constructs. Implications for curricular development in science and assessment of science achievement will be discussed.

Background

The concept of competence has become prominent in educational research throughout the last decades. In various competence fields, studies have investigated the relationship between cognitive and affective aspects influencing competence. Research tackling both cognitive and affective aspects of science competence is rare. There is varying evidence of relationship between competence (in science) and the cognitive aspects intelligence, reading and domain-specific knowledge as well as the affective aspects motivation and self-concept. Therefore, we seek to shed light on the dimensionalities of science and its association between cognitive aspects - prior knowledge, general cognitive ability and reading - and affective aspects - motivation and self-concept.

In the literature, intelligence is considered as one of the strongest predictors for inter-individual differences in school performance and knowledge acquisition processes (Weinert & Helmke 1997b). However, there is much debate concerning the relationship between intelligence and competence. Studies show that the relationship between intelligence and competence vary according to the nature of the science test (e.g.: $r_{\text{corr}} = .36$, (Klos et al. 2008), $r_{\text{corr}} = .24$ when controlling for prior knowledge, (Schroeders et al., in press)).

Another major predictor in the literature associated with competence is reading skills. In the PISA-studies, competence in science and reading are highly correlated ($r_{\text{corr}} = .80$ in 2000 and $.84$ in 2006). Klos et al. (2008) only found a moderate correlation of $r_{\text{corr}} = .26$ in their study focusing on Chemistry, using the verbal KFT as a proxy for reading ability.

Many authors agree that prior knowledge is a major determinant of competence (e.g. Brunner 2006). Schroeders et al. (in press) found that domain-specific knowledge highly correlates with their comprehension of science tasks ($r_{\text{corr}} = .78$). Klos et al. (2008) report the even higher correlations for 12th graders ($r_{\text{corr}} = .85$).

The academic self-concept is based on the academic success and a comparison to the average of a social group (Marsh 2001); but it can also influence school performance (Antunes et al. 2004). Another affective aspect that is highly associated with school performance outcomes is motivation (Jyoti & Devi 2008). Motivation here is conceptualized as an individual's energy and drive to achieve to their potential and the behaviors that follows from this energy and drive (Martin 2007).

The described findings regarding the relation of the cognitive and affective aspects of competence in science result in the following research questions:

1. How are the cognitive aspects intelligence, reading and domain-specific knowledge related to competence in Science and its sub-dimensions concept and process knowledge?
2. How are the affective aspects motivation and self-concept related to competence in Science and its sub-dimensions concept and process knowledge?

Methods

The Institute for Educational Quality Improvement (IQB), Germany tested 506 concept knowledge items and 492 process knowledge items in autumn, 2009 in 159 schools in eight states of Germany. We used a Multi-Matrix-Design for the construction of the test. We operationalized the construct of general cognitive ability with the 30 items of the non-verbal KFT for the ninth and tenth grade. Also tested were items, which addressed students' prior knowledge, creating an instrument of prior knowledge. We used two C-tests to examine reading ability. Of the 6084 ninth-graders, 49,1% were female. We stratified the sample between the three main tracks in the German school system: general secondary, technical general secondary, and university bound secondary education. All students answered the questionnaire, consisting of a 10-item motivation and a 12-item self-concept scale.

We scaled the items on all constructs applying multi-dimensional Rasch-modeling with the software ConQuest (2.0). In later calculations, we apply Structural Equation Models to shed light on the various dimensions of science competence with affective and cognitive aspects.

First Results

Initial results reveal that science competence is multi-dimensional (see Table One).. Of the six models calculated model six proves to fit the data best. This model has four dimensions with one content dimension and three process dimensions for Biology, Chemistry, and Physics.

The dimensions in model six prove to be highly correlated with one other (r_{corr} between $.73$ and $.86$). Based on this analysis of dimensionality, we use these dimension of science competence and examine their association with affective and cognitive aspects through Structural Equation Modeling.

Discussion and further research

The first results indicate that science consist of one content and three process dimensions. We hypothesize that these four dimensions will be highly associated with both cognitive and affective processes – especially with regards to the various process dimensions. This study has several implications for learning and teaching as well as curricula development.

Literature

Antunes et al. (2004). Adolescents' perceptions of their parents' attitude towards academic performance: Their relation with academic performance, academic self-concept and global self-esteem. *Hellenic Journal of Psychology*, 1(2), p. 203-220.

Brunner, M. (2006). Mathematische Schülerleistung: Struktur, Schulformunterschiede und Validität [Students mathematical performance: structure, differences of school types and validity] Doctoral Dissertation: <http://edoc.hu-berlin.de/dissertationen/brunner-martin-2006-02-08/HTML/front.html>.

Jyoti, P. , Devi, P. N. (2008). Achievement motivation and its impact on academic stress, study habits and academic performance among high school students. *Social Science International*, 24(1), p. 107-155.

Klos S. et al. (2008): Naturwissenschaftliches Experimentieren und chemisches Fachwissen – zwei verschiedene Kompetenzen [Scientific Experimentation and Knowledge in Chemistry – Two Different Competences]. *Zeitschrift für Pädagogik*, 54(3), p. 304-321.

Schroeders, U. et al. (in press). Modality specificity of individual differences in comprehension measures in science.

Weinert, F. E. & Helmke, A. (1997a). Bedingungsfaktoren schulischer Leistungen. Weinert, F. E. (eds.) *Enzyklopädie der Psychologie*, Band 3. Psychologie des Unterrichts und der Schule. Göttingen: Hogrefe.

Weinert, F. E. & Helmke, A. (1997b). Entwicklung im Grundschulalter [Development in basic school age]. Weinheim: Psychologie Verlags Union.

PAPER PRESENTATION

An Organizational Model for School Achievement

Anita Woolfolk Hoy, The Ohio State University, United States; Wayne Hoy, The Ohio State University, United States

Most discussions of teaching and learning in schools focus on the teachers and students. This inquiry, however, examines the school context and how it can facilitate student learning, achievement, and performance. In the past ten years two lines of research have emerged that are promising. Bryk and Schneider (2002) in a 10-year longitudinal study of urban school schools found that relational trust was a key factor in explaining academic achievement. At the same time, Hoy and his colleagues (Hoy, Tarter, & Woolfolk Hoy, 2006) found three school properties that are consistently related to school achievement: collective efficacy, collective trust, and academic emphasis. Academic optimism is an overarching construct to unite efficacy, trust, and academic press. We synthesize the body of work on school properties—relational trust and academic optimism—that facilitate student achievement by developing a theoretical (path) model that explains how school organization can influence teaching and learning in schools. The proposed model harnesses and synthesizes more than two decades of research in a heuristic way that will provide both researchers and reformers with an important agenda for years to come.

Most discussions of teaching and learning in schools focus on the teachers and students. This inquiry, however, will examine the school context and how it can facilitate student learning, achievement, and performance.

Aim: The objective of this paper is to review the research and synthesize the body of work on school properties that facilitate student achievement by developing a theoretical (path) model that explains how school organization can influence teaching and learning in schools.

Method: Because this analysis is primarily theoretical, our method is to review and synthesize the empirical and theoretical research on school characteristics that are related to student achievement after controlling for the socioeconomic (SES) conditions of the school student body. Our work in this area is one of the first attempts to develop such a model, but is supported by other researchers who have grappled with the same problem (Bryk & Schneider, 2002; Hoy, Tarter, & Woolfolk Hoy, 2006). The literature that is most relevant for our purposes is the theoretical and empirical work on the organizational constructs of collective efficacy, collective trust, academic emphasis, and academic optimism.

Findings: Since the Coleman report (1966) in the United States, researchers, educators, and policy makers have searched for school-level properties that are positively related to school achievement. The quest has been difficult because the negative power of low socioeconomic factors simply overwhelms most school properties by either dampening or eliminating their positive effects. Although a general pessimism gave way to cautious optimism with the work of Edmonds (1979), who found schools that apparently succeeded in spite of low SES, subsequent quantitative research on effective schools was not as encouraging as the initial promise.

In the past ten years, however, two lines of research have emerged that are promising. Bryk and Schneider (2002) in a 10-year longitudinal study of urban school schools found that relational trust was a key factor in explaining academic achievement in math and reading, even controlling for teacher background, student demographics, and other school contextual factors. They argue that such trust is only indirectly related to achievement, but the trust enables a set of organizational conditions that fosters achievement: teacher sense of responsibility and self efficacy, outreach to parents, professional learning community, and high expectations and standards.

At the same time, Hoy and his colleagues (Forsyth, Adams, & Hoy, 2012; Goddard, Hoy, & Woolfolk, 2004; Hoy, Tarter, & Woolfolk Hoy, 2006; Kirby & DiPaola, 2009; McGuigan & Hoy, 2006; Smith, & Hoy, 2007) found three school properties, that are consistently related to school achievement, even controlling for SES and other demographic characteristics: collective efficacy, collective trust, and academic emphasis. Optimism is an overarching construct to unite efficacy, trust, and academic press because each concept contains a sense of the possible; in fact, the three concepts form a latent construct called academic optimism (Hoy, Tarter, & Woolfolk Hoy, 2006), which is remarkably similar to the organizational conditions that Bryk and Schneider (2002) conclude produced higher student achievement.

What has been missing in both of the formulations, however, was an explanation of how these conditions produced higher student achievement. We address the question by building a model in which goal theory, motivation, and cooperation are key elements in the explanatory framework (See Figure 1--in Appendix).

Theoretical and Educational Significance: The proposed model harnesses and synthesizes more than two decades of research in a heuristic way that will provide both researchers and reformers with an important agenda for years to come.

References

- Bryk, A. S., & Schneider, B. (2002) *Trust in schools: A core resource for improvement*. New York: Russell Sage Foundation.
- Coleman J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., & York, R. B. (1966). *Equality of educational opportunity*. Washington, D. C.: U. S. Government Printing Office.
- Forsyth, P., Adams, K., & Hoy, W. K., (2012). *Collective trust*. New York: Teachers College Press.
- Goddard, R. D., Hoy, W. K., & Woolfolk Hoy, A. (2004). Collective efficacy beliefs: Theoretical developments, empirical evidence and future directions. *Educational Researcher*, 33(3), 3-13.
- Hoy, W. K., Tarter, C. J., & Woolfolk Hoy, A. (2006). Academic optimism of schools: A force for student achievement. *American Educational Research Journal*, 43(3), 425-446.
- Kirby, M., & DiPaola, M. (2009). Academic optimism and achievement: A path model. In Wayne K. Hoy & Michael DiPaola (Eds.), *Studies in school improvement* (pp. 77-94). Greenwich, CN: Information Age.
- McGuigan, L. & Hoy, W. K. (2006). Principal leadership: Creating a culture of academic optimism to improve achievement for all students. *Leadership and Policy in Schools*, 5(3), 203-229.
- Smith, P. A. & Hoy, W. K. (2007). Academic optimism and student achievement in urban elementary schools. *Journal of Educational Administration*, 45(5), 556-568.

PAPER PRESENTATION

Educational Attainment, Primary school, Reading

Louise Tracey, University of York, United Kingdom; Bette Chambers, University of York, United Kingdom; Pam Hanley, University of York, United Kingdom; Louise Elliott, University of York, United Kingdom

Success for All is a comprehensive literacy programme aimed at improving the literacy of those children most disadvantaged in our society. Evaluations in the US have found significantly positive effects on pupil achievement. This paper presents the findings of a large-scale longitudinal national evaluation of the Success for All programme in England. Using a quasi-experimental design 40 schools were recruited to the study and children entering Reception classes were pretested on measures of vocabulary, and letter and word identification. Children were re-tested at the end of Reception and, again, at the end of Year 1 using additional reading measures. Initial hierarchical linear model results showed statistically significant first-year school-level effects. Preliminary analysis of the second-year data also suggests positive impacts for pupils in the experimental schools. The project ties together two central themes of educational research and policy today: the scale up, or replication of school-based interventions, and the development of high-quality evidence of their causal effects. The outcomes have established that large-scale quasi-experiments involving replicated school-based interventions are both possible and desirable in the UK and can help establish a bank of research-proven programmes for children who live in deprived areas.

Educational outcomes for those children living in low-income households are often not as favourable as for those from other backgrounds. Such differences can be detected early in a child's school career, in particular through gaps in literacy attainment (Burroughs-Lange & Douetil, 2007; DfES, 2005). Under the National Literacy Strategy the literacy of disadvantaged children improved between 1997 and 2000, but since then it has remained static. With new policies providing primary schools with greater freedom to choose among different approaches to teaching reading, scientific evaluations are needed to enable educators to choose programmes and practices that have the potential to significantly reduce reading gaps. Success for All is a programme which has shown promising results in the US where it

began in 1987. The programme is a combination of research-proven practices in beginning reading instruction implemented primarily in deprived communities. It involves systematic instruction in phonemic awareness and phonics as well as vocabulary and comprehension and has been positively evaluated in more than 40 experimental-control comparisons in the US (cf: Borman, Slavin, Cheung, Chamberlain, Madden & Chambers, 2007). Success for All was introduced into British schools in 1997 and, adapted to the UK context, is designed to ensure children have solid decoding skills by the end of Key Stage 1. Studies involving small numbers of schools in England have found positive effects on Key Stage 1 and Key Stage 2 assessments (Hopkins, Youngman, Harris & Wordsworth, 1999; Slavin, Wordsworth & Jones-Hill, 2005). This paper presents findings from a large-scale quasi-experimental study that is evaluating the effects of the Success for All programme on the reading achievement of children in the UK. This presentation will report on the findings from the first two years of the study (Reception and Year 1).

This matched study initially recruited 20 Success for All schools and 20 control schools. Control schools followed their usual literacy instruction. Schools were in underprivileged urban communities throughout England and were matched on demographics and prior national test scores. Children entering Reception classes in September 2008 were individually pre-tested on the British Picture Vocabulary Scale (Dunn, Dunn & NFER-Nelson, 1997) and the Woodcock Reading Mastery Letter Identification and Word Identification Scales (Woodcock, 1987). They were post-tested at the end of Reception and again at the end of Year 1. Testers were independent testers, mostly undergraduate university students trained to administer the measures using standard procedures, who were blind to the condition of the schools. End of Reception and Year 1 measures included the Woodcock Reading Mastery Word Identification and Word Attack Scales (Woodcock, 1987). At the end of Year 1, the York Assessment of Reading for Comprehension (YARC) was added (Snowling, Stothard, Clarke, Bowyer-Crane, Harrington, Truelove, Nation & Hulme, 2009). This measures pupils reading accuracy, fluency and comprehension.

The first year results (end of Reception year) were analysed using a hierarchical linear model (HLM) with the school as the unit of analysis (Raudenbush & Bryk, 2002). Pre-tests were used as covariates. This showed that the Success for All condition produced statistically significant first-year school-level effects on the three measures for Reception students, controlling for the BPVS pre-test. The coefficient for school mean reading achievement indicated that the effect of Success for All on the Letter Identification post-test was equal to an individual-level effect size of +0.25 (p < .05). The pattern of treatment effects appears to be consistent with previous studies, the Success for All programme theory and more general research and theory on the development of young children's emergent literacy skills. As a large, longitudinal study, the results of this evaluation, now in its third year, have strong external validity and relevance for policy and practice. The project ties together two central themes of educational research and policy today: the scale-up, or replication of school-based interventions, and the development of high-quality evidence of their causal effects. The outcomes have established that large-scale quasi-experiments involving replicated school-based interventions are both possible and desirable in the UK and can help identify research-proven programmes for children who live in deprived areas.

References:

- Borman, G.D., Hewes, G.M., Overman, L.T., & Brown, S. (2003). Comprehensive school reform and achievement: A meta-analysis. *Review of Educational Research*, 73, 125-230.
- Burroughs-Lange, S. & Douetil, J., (2007). Literacy Progress of young children from poor urban settings: a reading recovery comparison study. *Literacy Teaching and Learning*, 12(1), 19-46.
- Department for Education and Skills (DfES) (2005). *Higher Standards, Better Schools for All*. More choice for parents and pupils. Norwich: TSO.
- Dunn L.M., Dunn L.M. & NFER-Nelson. (1997) *The British Picture Vocabulary Scale Second Edition*. NFER-Nelson, UK.
- Hopkins, D. Youngman, M. Harris, A., & Wordsworth, J. (1999). Evaluation of the initial effects and implementation of Success for All in England. *Journal of Research in Reading*, 22(3), 257-270.
- Raudenbush, S.W. & Bryk, A.A. (2002). *Hierarchical linear models* (2nd Ed.). Thousand Oaks, CA: Sage.
- Slavin, R.E., Wordsworth, J., & Jones-Hill, M. (2005). *Success for All in England: Implementation and outcomes of a comprehensive literacy reform for primary schools*. Baltimore, MD: Johns Hopkins University. Center for Research and Reform in Education.
- Snowling, M.J., Stothard, S.E., Clarke, P., Bowyer-Crane, C., Harrington, A., Truelove, E., Nation K. & Hulme, C. (2009). *York Assessment of Reading for Comprehension*. University of York, Centre for Reading and Language & GL Assessment.
- Woodcock, R.G. (1987). *Woodcock Reading Mastery Tests – Revised*. American Guidance Service.

PAPER PRESENTATION

Frequency and types of feedback interventions during classroom interaction in secondary education

Lia Voerman, Utrecht University, Netherlands; Paulien Meijer, Utrecht University, Netherlands; Fred Korthagen, VU University, Netherlands; P. Robert-Jan Simons, Utrecht University, Netherlands

During the last decades, several major review studies have been published to unravel which feedback interventions actually enhance learning. In this study, we firstly analyzed the types of feedback interventions that emerge from these review studies as being helpful for student learning. Second, we examined whether and to what amount teachers in secondary education use these types of feedback. Results show that in most cases, the teachers did not use these types of feedback interventions. The results did not differ for school type, grade level, school subject, gender, age or experience. We conclude that teachers do not automatically know how to provide effective feedback and also do not seem to learn this through mere experience. In order to improve teachers' feedback skills, in pre-service and in-service teacher education more attention should be paid to effective feedback interventions.

Introduction

Feedback is generally seen as an important tool for enhancing learning (Kluger & DeNisi, 1996; Black & William, 1998; Hattie & Timperley, 2007; Shute, 2008). Hattie (1999) showed that some types of feedback are more influential for promoting learning than others. We regard feedback as information from the teacher about the performance or understanding of the student, aimed at improving learning and/or retain or enhance motivation (Hattie & Timperley 2007; Shute 2008).

Our main research question is: Which of the feedback types that have been shown to enhance learning, are actually used by teachers in their interaction with students? We focus on feedback that is orally provided for by the teacher in a classroom setting.

Theoretical framework: features of feedback interventions that enhance learning

Our study is based mainly on three major and influential review articles that have drawn conclusions about the features of feedback that enhances learning (Kluger & DeNisi, 1996; Hattie & Timperley, 2007; Shute, 2008).

The frequency of feedback interventions appears very influential in student learning (Hattie, 2009). According to Hattie (1999), the incidence of feedback in a classroom is at best only measurable in seconds per day. Pauli (2010) found that a large part of teacher statements (46%) does not have any feedback components. Instead, she found that teachers often ask new questions or explain further, without explicitly reviewing the answers or statements of the students. If feedback occurred, it was in most cases non-specific ("yes", "that's right").

Shute (2008) stated that feedback should preferably be specific and goal-related, and presented in manageable units. Non-specific feedback may cause students to view the feedback as useless. On the other hand, feedback that is too elaborated may cause a cognitive overload or may direct the attention from the receiver away from the task (Kluger & DeNisi, 1996; Hattie & Timperley, 2007).

Another distinction is made between positive and negative feedback (Bracksick, 2001). Positive feedback shows support, encouragement or appreciation, negative feedback shows disapproval, or even sarcasm (Losada, 1999). Baumeister et al. (2001) showed that negative feedback has a greater impact on memory and self-esteem than positive feedback. This might lead to the conclusion that to overcome the impact of negative feedback, experiences of positive feedback need to outnumber experiences of negative feedback. A study by Losada and Heaphy (2004) on positive and negative feedback showed that a ratio of at least 3:1 is linked with broader behavioral repertoires and more optimal functioning.

Combining these features of feedback interventions, we can discriminate between four types of feedback interventions, namely non-specific positive and non-specific negative feedback interventions, and specific positive and negative feedback interventions.

Design

We videotaped lessons from 78 teachers working in eight different schools for secondary education in the Netherlands. Schools ranged from very traditional to very innovative in their way of teaching. We selected ten minutes per teacher during classroom interaction and made an analysis using five categories: non-specific positive and negative feedback, specific positive and negative feedback and "other interventions", for example questions or brief instructions. Cohen's Kappa was used to determine inter-rater reliability. The paper describes the scheme of categories we developed in this study in greater detail, and contains examples of the feedback categories provided by the teachers in this study.

In addition, we collected background information regarding school type, grade level, school subject, gender, age and experience. This information was used to examine whether teachers' feedback interventions might be in part explained by these background variables. MANOVA's and ANOVA's were used to establish statistical relations.

Results

Regarding our research question, we found that specific positive feedback as well as specific negative feedback was seldom given by the teachers. Less than 20% of all teacher interventions was a feedback intervention. The feedback interventions that research has shown to be effective, formed only 6% of all the teacher interventions. About 56% of the teachers did not show a 3:1 ratio of positive and negative feedback. Frequency, types of feedback and the positive-negative ratio did not differ for school type, school subject, grade level or gender. Even more fascinating and quite unexpected is that neither frequency nor feedback type differed for age and experience. It seems that teachers do not learn to provide the effective types of feedback in the appropriate ratio through aging or experience.

These results suggest that the quality of the feedback teachers provide should be improved. This might be done by teaching them how to provide more specific (including goal-related) feedback as frequently as possible, in an appropriate ratio. Hence, teacher education and programmes for teacher professional development should focus more on how to provide feedback that research has shown to be effective.

References

- Black, P. & William, D. (1998). Assessment and classroom learning. *Assessment in Education*, 5(1), 7-75.
- Bracksick, L.W.(2000). *Unlock Behavior, unleash profits*. New York: McGraw-Hill.
- Frederickson, B.L., Losada, M.F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist*, 60, 678-686.
- Hattie, J. (1999). Influences on student learning. Inaugural lecture, University of Auckland.
- Hattie, J. & Timperley, H. (2007). The power of feedback: Review of educational research. *Review of Educational research*, 77(1), 81-112.
- Kluger, A.N. & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, 119(2), 254 – 284.
- Losada, M. & Heaphy, E. (2004). The role of positivity and connectivity in the performance of business teams: A nonlinear dynamics model. *American behavioral Scientist*, 47 (6), 740-765.
- Pauli, C. (2010). Fostering understanding and thinking in discursive cultures of learning. Paper presented at the meeting of EARLI SIG 10 and 21. Utrecht, The Netherlands.
- Shute, V.J. (2008). Focus on formative feedback. *Review of Educational Research*, 78(1), 153–189.

PAPER PRESENTATION

Dropout in Secondary Education: A Multilevel Discrete-time Hazard Model, Accounting for School Change

Carl Lamote, K.U.Leuven, Belgium; Jan Van Damme, K.U.Leuven, Belgium; Wim Van Den Noortgate, K.U.Leuven, Belgium

The present study addresses the effect of student background variables and school-level variables on dropout in secondary education in Flanders, Belgium. This study is based on data from the LOSO-project, a longitudinal study in Flemish secondary education. We conducted a multilevel discrete-time hazard analyses, where we incorporate a multiple-membership on the school-level. These models extend the methodological approach of studying dropout, by taking into account the mobility of students. We compare these models with more traditional approaches in studying dropout. Initial results indicate a significant variation between schools and between grades, on the proportion of dropouts. Dropout can be (partially) explained by grade retention, age, gender, socio-economic status of the student and the average SES of the school. Discrete-time hazard models, with a multiple membership structure, give better fit-values compared to more traditional approaches.

Objectives

The present study addresses the effect of student background variables and school-level variables on dropout in secondary education in Flanders, Belgium. These variables are integrated in a multilevel discrete-time hazard model (DTHM) with multiple-membership structure. Bearing in mind often cited arguments and critiques on dropout research, we propose some methodological recommendations by applying a survival model with multiple membership, and compare this model with more traditional approaches.

Theoretical framework

During the past decades, numerous student background variables were considered in search of an explanation for dropout. In this study, we will consider the most widely investigated variables: grade retention, socio-economic status

(SES) of the student, gender and (prior) achievement. Especially the strong relation with grade retention in primary and secondary school received a lot of attention (e.g. Alexander, Entwisle, & Horsey, 1997). In their review, Jimerson, Anderson, and Whipple (2002) pointed at the strong predictive power of (early) grade retention on dropout. SES, especially the educational level of (one of) the parents and their income, remains an important contributor to success in school. Even when controlling for other individual background variables, students with a low SES have a higher dropout probability, compared to students with a high(er) SES (Alexander, Entwisle, & Kabbani, 2001). Another often investigated demographic variable in dropout research is gender, where boys tend to have higher odds of leaving school early (Marks, 2007). Besides grade retention and the (socio)demographic variables, low-achievers are often at higher risk for dropout. Alexander et al. (2001) concluded that low achievement in first grade, was one of the major predictors of dropping out. Only a few studies integrated school characteristics in a multilevel model. Studies who did take into account the school level, showed an effect of socioeconomic composition of the school on dropout rates. Rumberger and Thomas (2000) concluded that low-SES schools had 60% higher dropout rates than an average SES school. Taking into account this summary of the research literature, we consider the following research questions: - Does a model, which takes into account the longitudinal and multiple-membership structure, give a better fit to the data compared to more traditional models? - Which grades are more hazardous for dropout in secondary education, taking into account the background characteristics of students? - In line with past research, we expect the highest risk to dropout for male students, which are retained in grade, with low SES and low achievement scores.

Method

To answer these questions, we opt for a discrete-time multilevel hazard analysis, where we incorporate a multiple-membership on the school-level. This multiple-membership structure, combined with a hazard analysis, is the strength of our model for several reasons. First, as Singer and Willett (2003) mentioned, DTHM makes use of censoring instead of treating graduating students as missing. Second, DTHM solves the problem of tied observations, which is common in educational research. Third, since not every student remains in the same school, and our data has a longitudinal character, it would be incorrect to account for school effects based on the first school attended. Therefore, we incorporate a multiple membership where students are members of more than one higher level unit (school) by assigning weights to every school attended, proportional to the time spent in a specific school (see e.g. Goldstein, 2003; Leckie, 2009). These discrete-time hazard models were estimated with logistic regression techniques, with the MCMC-algorithm in MLwiN, accounting for the multiple membership (Rasbash, Steele, Browne, & Goldstein, 2009). We compare these multiple membership models with 'traditional' DTHM's by comparing the DIC-values (Spiegelhalter, Best, Carlin, & Linde, 2002).

Data Sources The data were drawn from the Flemish 'LOSO'-project (i.e. the Dutch acronym for Longitudinal Research Project in Secondary Education) (Van Damme et al., 1997). This longitudinal research project started in 1990 and followed a cohort of 6411 students through secondary education. In this study, we selected a subsample of 5334 students in 55 secondary schools, who started in 1990 in the first year of secondary education. For every student, we collected data on grade retention, gender, age, school trajectory and the moment of dropout. Grade retention is implemented as a time-varying variable. Furthermore, the SES variable was constructed from information on educational level, occupational level, income and cultural capital of both parents. At the start of grade 7, achievement tests for math and (Dutch) language were administered. Math achievement, language achievement and an intelligence score are combined into one variable: 'initial cognitive level'. School compositional variables are equal to the school means of the SES-variable and cognitive level variable. Results Male students who started secondary education older and were retained in grade during secondary education, have the highest risk of dropout. These results are in line with the conclusions of Alexander et al. (2001) and Bowers (2010). At the school-level, the average socio-economic composition has a significant effect on dropout; schools with a low socio-economic composition tend to have higher dropout rates, compared to schools with a higher socio-economic composition. The discrete-time hazard model provides information on more or less hazardous years in secondary education. Our results indicate a significant variation between schools on the proportion of dropouts. These results also indicate some differences between grades, with a low risk of dropout in grade 7 and 8. Starting from grade 9, the risk of dropout increased, with grade 11 as the most hazardous year. When we take into account the multiple membership structure, our models show a better fit to the data, favoring multiple membership models instead of models based on the first school. Importance The main contribution of this study is to extend (the methodological approach for) dropout research, making use of a DTHM, with a multiple membership structure. Our model takes into account the different schools attended, and focuses on the longitudinal character of the dropout decision. Our results indicate an effect of the socio-economic composition of the school and an effect of several student-level variables. These findings stress the importance of a longitudinal, multilevel approach when studying dropout and provide evidence for the negative impact of grade retention on dropout.

PAPER PRESENTATION

Effects of increased SRL opportunities on students' motivation and metacognition

Emmy Vrieling, IJsselgroep, Netherlands; Theo Bastiaens, Open University, Netherlands; Sjef Stijnen, Open University, Netherlands

This intervention study focused on the relationships between primary student teachers' (STs) self-regulated learning (SRL) opportunities and their motivation for learning and use of metacognitive learning strategies. A mixed methods pre- and post-test design was used in an authentic primary teacher education class setting. The participants were 11 teacher educators (TEs) and 257 first- and second-year STs of 5 different institutes. During one semester, TEs and STs were monitored by questionnaires measuring SRL opportunities offered by the program. Questionnaires were also administered monitoring STs motivation for learning and use of metacognitive learning strategies. During data collection, TEs participated in a training course and tutorial conversations aimed at increasing STs SRL opportunities in the educational pre-service program. At the end of the research period, all TEs and a sample of STs were interviewed. All instruments and materials used were specifically developed for this study. Results indicated that STs use of metacognitive skills increased significantly in a learning environment with increased SRL opportunities. Although STs motivation for learning correlated significantly with SRL opportunities, there was no significant increase of STs motivation for learning during the research period. Also, significant correlations were found between the metacognitive and motivational constructs measured.

Aims

The present study searched for relationships between primary STs SRL opportunities and their motivation for learning and use of metacognitive skills. The research questions central to the study were: Does STs use of metacognitive learning strategies change in a learning environment with increased SRL opportunities? Does STs motivation for learning change in a learning environment with increased SRL opportunities? What relationship exists between STs motivation for learning and use of metacognitive learning strategies in a learning environment with increased SRL opportunities?

Methodology

From January 2010 until June 2010, the exploration of the effects of STs increased SRL opportunities on STs use of metacognitive learning strategies and motivation for learning was conducted with 11 TEs and 257 first- and second-year STs in 5 primary teacher education institutes in the Netherlands. The research was conducted in educational theory courses containing lectures, lessons and moments of guidance.

In a former study (Vrieling et al, 2010), two instruments were developed: (1) the 'SRL Opportunities Questionnaire' (SRLOQ) that enables TEs to measure the degree of SRL opportunities they provide to STs, and (2) the 'Motivation and Metacognition Questionnaire' (MMQ) that measures the level of STs use of metacognitive learning strategies as well as their motivation for learning.

In order to answer the research questions of the study, intervention research was conducted using a mixed methods one-group pre- and post-test design (O1 X O2 X O3). The degree of STs SRL opportunities was measured with the SRLOQ. STs use of metacognitive learning strategies and their motivation for learning were measured by the MMQ. TEs and STs were qualitatively tracked by depth interviews (TEs) and retrospective interviews (STs).

The pre-test (filling in both questionnaires) was performed at the end of the third lesson. At that time, TEs and STs were expected to be unaware of the increased SRL opportunities that would be applied in the intervention-period. By monitoring both TEs and STs on self-regulated learning opportunities (SRLOQ) rather than TEs alone, the statements of TEs and STs could be compared to obtain better interpretable data. After the pre-test, two kinds of treatments were carried out with TEs aimed at increasing STs SRL opportunities: (1) a training course (after lesson 3) and (2) individual tutorial conversations (after lesson 4). The tutorial conversations were based on the analysis of the pre-test. At the end of the sixth lesson, both questionnaires (SRLOQ and MMQ) were administered again (intermediate-test).

Based on the analysis of the intermediate-test, tutorial conversations were carried out again (after lesson 6) aimed at a further increase of STs SRL opportunities. At the end of the last lesson, the post-test (filling in both questionnaires) was conducted. Within a week after the post-test, all TEs were interviewed in depth and a sample of STs was interviewed retrospectively.

Theoretical importance

The use of metacognitive learning strategies is a quality of SRL that is stressed in constructivist views of learning (Zimmerman and Schunk, 2001). Such active and self-regulated strategy use is found to be positively related to achievement (e.g. Pintrich & De Groot, 1990).

Several researchers demonstrate that (meta) cognitive strategy use mediates the relationship between motivation on the one hand and achievement on the other (e.g. Eccles & Wigfield, 2002). At any particular time, students have a level of motivation that they experience and that influences their choice, effort and persistence regarding a particular activity (Wolters, 2003).

In order to transform this motivational drive into academic achievement, students have to use metacognitive skills. In this way, they become aware of and monitor their progress towards their goals, monitor their learning and comprehension, in order to make any adaptive changes in their learning. So, it is important to include metacognitive processes in research concerning motivation and successful learning (Zimmerman & Moylan, 2008).

Empirical importance

The present study shows the relationships between primary STs SRL opportunities and STs use of metacognitive learning strategies and their motivation for learning, both important constructs for STs successful learning.

Findings

Correlation analyses, regression analyses and independent-Samples T-tests indicated that STs use of metacognitive skills increased significantly in a learning environment with increased SRL opportunities. This indicates that TEs can influence STs use of metacognitive learning strategies in one semester. In addition, a major need was identified for more explicit metacognitive strategy instruction in primary teacher education.

STs motivation for learning was also enhanced in a learning environment with increased SRL opportunities. However, with exception of the motivational expectancy part, this relationship was not shown to be significant. STs indicated to appreciate the increased SRL opportunities in the educational program, but also stressed the importance of TEs providing an adequate knowledge base to avoid uncertainty.

The relationship between STs use of metacognitive skills and their motivation for learning was shown to be significant in the present study.

In conclusion, this study revealed that the degree of SRL opportunities provided in a pre-service learning program is strongly related to primary STs use of metacognitive skills and also enhances their motivation for learning, both important constructs for STs academic career.

References

- Eccles, J.S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, 53, 109-132.
- Pintrich, P.R., & De Groot, E.V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 13-40.
- Vrieling, E.M., Brouwer, N., Bastiaens, T.J., & Stijnen, S. (2010). Effects of increased SRL opportunities on Student teachers' motivation for learning and use of metacognitive skills. Paper presented at the annual meeting for the ORD, May 23 – May 25, in Enschede, the Netherlands.
- Wolters, C.A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist*, 38, 189-205.
- Zimmerman, B.J., & Moylan, A.R. (2008). Self-regulation: Where metacognition and motivation intersect. In D.J. Hacker, J. Dunlosky, & A.C. Graesser [eds.], *Handbook of metacognition in education* (pp 299-315). New York: Routledge.
- Zimmerman, B.J., & Schunk, D.H. (2001). Reflections on theories of self-regulated learning and academic achievement. In B. J. Zimmerman, & D. H. Schunk [eds.], *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 289-307). Mahwah, NJ: Lawrence Erlbaum.

PAPER PRESENTATION

Self-Regulated Learning of Texts Presented on Screen With and Without Time Constraints

Rakefet Ackerman, Technion--Israel Institute of Technology, Israel

People tend to attribute their reluctance to study lengthy texts on screen to technology-related factors. However, Ackerman and Goldsmith (in press) proposed that screen inferiority is rooted not in such factors, but rather, in less effective metacognitive regulation of screen learning relative to paper learning. In support of this proposal, they found screen inferiority only under free study time regulation, but equivalent test scores for screen and paper learning under fixed and insufficient study time. The present study examined an alternative explanation for these results, suggesting that when screen learners knew they would be working under time constraints, they perceived this study environment to be challenging and took compensatory actions, recruiting cognitive resources that enabled them to

overcome technology-related barriers to learning. In the present study, undergraduate students (N=96) studied texts on screen or on paper. Time condition was manipulated within participant and included free regulation, a fixed and insufficient study time, and interrupted study where study was unexpectedly stopped after the same insufficient study time. The alternative explanation was rejected: No difference was found between fixed and interrupted study on screen, suggesting that no compensatory action was taken when the time constraint was known in advance. Further, as more control over study was given, screen learners exhibited reduced study efficiency and less accurate metacognitive monitoring relative to paper learners. The findings reinforce the conclusion that metacognitive regulation of text learning on screen is less effective than on paper.

Learning from textual material is one of the most important skills in the modern society. In computerized environments, however, people are reluctant to study lengthy texts and often attribute their preference for print to discomfort associated with the screen display medium (Spencer, 2006). Ackerman and Goldsmith (in press) compared screen and paper learning in an attempt to differentiate technology-related and study regulation factors. They found lower performance for screen than for paper learning only under free study-time regulation condition (FreeRC), with equivalent performance under fixed and insufficient study-time condition (FixedTC). At the end of each study period, but before taking the multiple-choice test, the participants provided a metacognitive Prediction of Performance (POP). Surprisingly, in view of participants' overall reluctance to study on screen, comparing the POPs to the participants' test scores revealed a consistently larger upward calibration bias (overconfidence) for the screen learners compared with the paper learners. An upwardly biased POP is expected to produce misguided study regulation decisions, such as whether to invest more study time, restudy difficult material, apply learning strategies, or seek help (Aleven & Koedinger, 2000; Winne, 2004). Ackerman and Goldsmith concluded that technology-related factors are not the main source for study difference, but metacognitive factors. The present study examines an alternative explanation for Ackerman and Goldsmith's (in press) results. People have flexibility in the allocation of cognitive resources depending on their motivation (Pintrich, 2003). It is possible that under FixedTC, screen learners—but not the paper learners—perceived their study environment to be challenging, and recruited cognitive resources that allowed them to engage in qualitatively improved processing (Csikszentmihalyi, 1996) relative to the FreeRC. This could have helped these participants to overcome technology-related barriers and perform at the levels achieved by paper learners. If this interpretation is correct, it means that the screen participants showed improved metacognitive regulation under FixedTC, in contrast to the interpretation suggested by Ackerman and Goldsmith (in press). To examine this possibility, the present study employed the same materials (5 texts, 1000-1200 words each) and a similar procedure to that of Ackerman and Goldsmith (in press) with two key differences. First, the time conditions, FixedTC (7 min.) and FreeRC, were manipulated within participants. Second, an interrupted study condition (InterruptedSC) was added. Under this condition, the participants began studying a text under FreeRC instructions, and were interrupted after the insufficient time allotted learning under FixedTC. Immediately after studying each text, the participants provided POP and got tested. If improved study regulation was responsible for the performance achieved by screen learners under FixedTC, those participants who knew in advance that they would have limited study time should perform better than those whose study was interrupted. The participants were 96 undergraduate students. The measures were study time under FreeRC, test score, and POP. Calibration bias is the difference between mean POP and mean test score reflecting over- or underconfidence. Study efficiency is derived from test scores divided by invested study time reflecting knowledge gain rate. Study time under FreeRC (8.8 min.) was indeed longer than the FixedTC with no significant difference between the screen and paper learning. Figure 1 presents the test scores and POPs for screen and paper learners under the three time conditions. The present study's main question was whether screen learners benefited from planning ahead when studying under known time constraints. No difference was found between the InterruptedSC and the FixedTC conditions on screen. This finding is important in rejecting the alternative explanation for Ackerman and Goldsmith's (in press) findings. Only paper participants succeeded in improving their test scores under FixedTC, leading to a significant difference between the media. The equivalence of all measures between the paper and screen groups under the InterruptedSC reinforces the conclusion that technology-related factors are not the main source for screen inferiority, because these factors should have been as relevant in this condition as in the others. The results suggest that for screen learners, metacognitive monitoring accuracy (calibration) and study efficiency both fell as the learner's control increased. Their ability to plan effectively seems to have enabled the paper learners to achieve higher test scores without investing redundant time. We can conclude that study regulation is an important factor in explaining learning differences between screen and paper.

To summarize, numerous studies have questioned the effectiveness of computerized environments for learning, and pointed to a variety of features that may contribute to limiting their value (Sancho, 2009). The present study reinforces the intriguing proposal that screen inferiority is rooted primarily in psychological factors, rather than aspects of technology per se. This understanding is of critical importance, because it is clear that the integration of computers in study environments is already a fact. The current findings shift our attention away from technology, and

invite educational practitioners to consider ways to enhance metacognitive monitoring and study regulation in computerized environments.

References

- Ackerman, R., & Goldsmith, M. (in press). Metacognitive regulation of text learning: On screen versus on paper. *Journal of Experimental Psychology: Applied*.
- Aleven, V., & Koedinger, K. R. (2000). Limitations of student control: Do students know when they need help? In G. Gauthier, C. Frasson, & K. VanLehn (Eds.), *Proceedings of the 5th International Conference on Intelligent Tutoring Systems, ITS 2000* (pp. 292-303). Berlin: Springer-Verlag.
- Csikszentmihalyi, M. (1996). *Creativity: Flow and the Psychology of Discovery and Invention*. New York: HarperCollins.
- Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology*, 95, 667-686.
- Sancho, J. M. (2009). Digital technologies and educational change. *Second International Handbook of Educational Change*, 433-444.
- Spencer, C. (2006). Research on learners' preferences for reading from a printed text or from a computer screen. *Journal of Distance Education*, 21, 33-50.
- Winne, P. H. (2004). Students' calibration of knowledge and learning processes: Implications for designing powerful software learning environments. *International Journal of Educational Research*, 41, 466-488.

PAPER PRESENTATION

Think peer! The potential of reciprocal peer tutoring in promoting students' metacognition

Liesje De Backer, Ghent University, Belgium; Hilde Van Keer, Ghent University, Belgium; Martin Valcke, Ghent University, Belgium

It is widely recognized that metacognition is an important mediator for successful and high-level learning, especially in higher education. Nevertheless, few higher education programs succeed in effectively preparing students for metacognitive self-regulation. The present study explores the potential of reciprocal peer tutoring (RPT) to promote both university students' metacognitive knowledge and their metacognitive regulation skills. The study was conducted in a naturalistic higher education setting, involving 67 students tutoring each other during a complete semester. A multi-method pretest-posttest design was used combining a self-report questionnaire (assessing students' metacognitive knowledge and their perceived metacognitive skilfulness) with the analysis of think-aloud protocols (revealing student's actual use of metacognitive strategies). Results indicate that RPT has no significant impact on students' metacognitive knowledge nor on their perception of metacognitive skilfulness. In contrast, RPT significantly influences students' actual metacognitive regulation. After the intervention, students demonstrate significantly more frequent and a more varied use of metacognitive regulation skills and strategies, especially during the orientation, monitoring, and evaluation phase. Furthermore, results point at an increase in more profound and higher-quality strategy use after participation in the tutoring programme.

Theoretical framework

Since high quality learning requires metacognition, its promotion is assumed to be a worthwhile objective in current education (Meijer, Veenman, & van Hout-Wolters, 2006). In line with Brown (1987) we conceptualise metacognition as being comprised of metacognitive knowledge and metacognitive regulation. Metacognitive knowledge refers to learners' understanding about the way they process information when performing academic tasks. Metacognitive regulation involves a set of self-regulatory skills that are used by learners to orchestrate their learning. Brown (1987) distinguishes orientation, planning, monitoring, and evaluation as the major regulation skills. Especially in higher education, learners' metacognitive awareness and skilfulness are crucial for academic success (Cornford, 2002). However, few students possess sufficient metacognitive competence to self-regulate their learning adequately (Maclellan & Soden, 2006). The present study makes an important contribution to both theory and practice by exploring the promotion of university students' metacognition from the theoretical perspective of metacognition as a socio-cognitive construct (Volet, Vauras, & Salonen, 2009). According to this view, metacognition has a social dimension by nature and can best be stimulated through social interactions, in which metacognitive strategies can be modelled and internalised. More specifically, we examine the potential influence of reciprocal peer tutoring (RPT), as a particular type of collaborative learning. The following research questions are put forward: What is the impact of RPT on higher education students' (1) metacognitive knowledge; (2) perceived metacognitive regulation; and (3) actual metacognitive regulation?

Method

Participants and setting

Sixty-seven students Educational Sciences participated. Students were randomly assigned to twelve small and stable tutoring groups (5-7 students). The face-to-face RPT-program was a formal component of students' curriculum and consisted of nine weekly sessions (each taking 90 minutes).

Intervention

The RPT-program was same-age and reciprocal, for literature shows that especially tutors gain numerous academic, affective, and metacognitive insights (Falchikov, 2001). Since the tutor role is exchanged among participants in RPT, all students got equal opportunities to gain from the tutoring environment. During the sessions, students worked on authentic assignments, demanding high levels of cognitive processing. The entire RPT-program was designed taking into account research-based guidelines promoting effective tutoring (Topping, 2005). We structured peer interactions by developing a tutor curriculum script for each session (King, 1998). Furthermore, all students participated in a compulsory preliminary training in generic tutoring skills and received ongoing support in interim feedback and reflection sessions (Falchikov, 2001).

Design and instruments.

A multi-method pretest-posttest design was used, combining off-line self-reports with concurrent think-aloud protocol-analysis. All students completed the 'Metacognitive Awareness Inventory' (MAI) (Schraw & Dennison, 1994) before and after the RPT-intervention. The subscale 'knowledge of cognition' assessed students' metacognitive knowledge. Cronbach's α was .78 (pretest) and .81 (posttest). The subscale 'regulation of cognition' measured students' self-reported use of metacognitive skills. Cronbach's α was .90 (pretest) and .89 (posttest). Additionally, students individually performed a think-aloud task (Meijer et al., 2006). By analysing the verbal protocols, students' actual metacognitive skills underlying performance could be identified. Based on the literature, a coding scheme was developed. The scheme represents a hierarchical model of metacognitive regulation, in which orienting (task analysis, content orientation, structuring task instructions), planning (planning in advance, interim planning), monitoring (monitoring of strategy use, comprehension monitoring, monitoring of progress), and evaluating (product and process evaluation) are situated as the main categories.

Data analysis

Pretest and posttest scores on the MAI were compared by means of paired-samples t-tests. Two trained coders independently double coded 23% of the think-aloud protocols. Cohens' kappa ($\kappa=.80$) indicated high interrater reliability. After coding, the occurrence of metacognitive skills at pretest and posttest was compared quantitatively by means of paired-samples t-tests.

Results

Results of the paired-samples t-tests on students' self-reported metacognitive knowledge and regulation reveal no significant difference between pretest and posttest scores (respectively $t = -1.25$, $df = 58$, $p = .215$ and $t = -0.65$, $df = 58$, $p = .515$). However, results of the think-aloud protocol analysis on students' actual metacognitive regulation show differing outcomes. First, students orientate themselves significantly more on task execution after the RPT-intervention, by paying significantly more attention to task-analysis ($t = -14.76$, $df = 58$, $p = 2.55$), structuring task instructions ($t = -3.02$, $df = 58$, $p = 0.75$), and orientating themselves on the content of the task ($t = -7.81$, $df = 58$, $p = 1.52$). Second, students are significantly more active in monitoring both their comprehension ($t = -9.88$, $df = 58$, $p = 1.72$) and their progress ($t = -8.78$, $df = 58$, $p = 1.67$). A significant effect on students' monitoring of strategy use could not be distinguished ($t = -1.64$, $df = 58$, $p = .106$). Third, students engage significantly more in metacognitively evaluation of both learning outcomes ($t = -12.15$, $df = 58$, $p = .001$, $d = 2.46$) and their problem solving process ($t = -5.00$, $df = 58$, $p = 0.92$). In contrast, RPT did not yield a significant effect on students' metacognitive planning ($t = -2.14$, $df = 58$, $p = .063$). In sum, after the RPT-intervention, students apply metacognitive skills more frequently and show a more varied use of specific metacognitive strategies, particularly when orientating, monitoring, and evaluating. Results of the more detailed analyses on specific metacognitive strategies will be presented at the conference.

References

- Brown, A.L. (1987). Knowing when, where and how to remember: A problem of metacognition. Retrieved from http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/32/8c/0d.pdf
- Cornford, I. (2002). Learning to learn strategies as a basis for effective lifelong learning. *International Journal of Lifelong Learning*, 21, 357-368.
- Falchikov, N. (2001). Learning together. Peer tutoring in higher education. London: Routledge Falmer.
- King, A. (1998). Transactive peer tutoring: Distributing cognition and metacognition. *Educational Psychology Review*, 10, 57-74.
- MacLellan, E. & Soden, R. (2006). Facilitating self-regulation in higher education through self-report. *Learning Environments Research*, 9, 95-110.

Meijer, J., Veenman, M.V.J., & van Hout-Wolters, B.H.A.M. (2006). Metacognitive activities in text-studying and problem-solving: Development of a taxonomy. *Educational Research and Evaluation*, 12, 209-237.

Schraw, G. & Dennison, S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, 19, 460-475.

Topping, K.J. (2005). Trends in peer learning. *Educational Psychology*, 25, 631-645.

Volet, S., Vauras, M. & Salonen, P. (2009). Self- and social regulation in learning contexts: An integrative perspective. *Educational Psychologist*, 44, 215-226.

PAPER PRESENTATION

The relationship between metacognition, intelligence and text-learning performance.

Seda Sarac, yildiz technical university, Turkey; Alev Onder, Marmara University, Turkey; Sema Karakelle, Istanbul University, Turkey

Metacognition and intelligence are both important predictors of learning outcomes. However, the nature of the relationship between these two constructs has not been clarified, yet. Considering inconsistent results from several studies, we wanted to test the hypothesis that whether these discrepancies are due to issues related to measuring metacognition. If this is the case, we expected that different metacognitive measures would lead to different relational patterns among metacognition, intelligence and learning performance. For testing our hypothesis, we used three measures for assessing metacognition namely, accuracy ratings, think aloud protocols and a self report questionnaire. The Raven's Standard Progressive Matrices was used for assessing intelligence. The participants were fifth grade elementary students (N= 91, 47 girls, 44 boys, Mage = 10.04 years, age range: 9-11 years). The results of the study indicated that intelligence do not correlate significantly neither with the scores from the self-report questionnaire nor with the scores from think aloud protocols. On the other hand, there is a significant correlation between accuracy ratings and intelligence scores. The results, also, showed that the scores from the self-report questionnaire do not contribute to students' text-learning performance. Accuracy ratings, together with intelligence predict text-learning performance and both predictors have their own unique contribution. The scores from the think aloud protocols, together with intelligence contribute to text-learning performance but think aloud protocols do not have predictive value independent of intelligence. In conclusion, the findings of the study showed that when we use different metacognitive measures, we get different results.

Metacognition and intelligence are both important predictors of learning outcomes. However, the nature of the relationship between these two constructs has not been clarified, yet. Current conceptions of intelligence strongly support the relationship between metacognition and intelligence (e.g., Binet & Simon, 1916; Naglieri & Das, 1997; Sternberg, 2003, 2005), but several studies has revealed inconsistent results. Some researchers have reported significant positive correlations between metacognition and intelligence (e.g., Schneider, Körkel & Weinert, 1987; Swanson, 1990, 1992; Alexander & Schwanenflugel, 1994). On the other hand, some studies have revealed that there is no substantial correlation between the two (e.g., Allon, Gutkin & Bruning, 1994; Coutinho, 2006; Yalçın & Karakas, 2008). Also, there are studies showing negative significant correlation between metacognition and intelligence (e.g., Dresel & Haugwitz, 2005). Veenman and colleagues, also, focused on the relationship between metacognition and intelligence but extended their research to the relation of both variables with learning performance (e.g., Veenman, Elshout ve Meijer, 1997; Veenman & Verheij, 2003; Veenman & Beishuizen, 2004; Veenman, Kok ve Böste, 2005; Veenman & Spaans, 2005; Van der Stel & Veenman, 2008). The researchers introduced three models for explaining the relationship between metacognition and intelligence as predictors of learning performance. The mixed model suggests that metacognition and intelligence are related but metacognition has a surplus value on top of intelligence for the prediction of learning. According to the intelligence model, metacognition cannot predict learning independent of intelligence as metacognition is a manifestation of intelligence. The independency model suggests that the two variables are entirely independent predictors of learning. Considering these inconsistent results from several studies, we wanted to test the hypothesis that whether these discrepancies are due to issues related to measuring metacognition. If this is the case, we expected that different metacognitive measures would lead to different relational patterns among metacognition, intelligence and learning performance. Results from several other studies using multiple metacognitive measures discredits the measures that are frequently used in metacognitive research and compels researchers to scrutinize what these measures are really measuring (e.g. Desoete, 2008; Cromley & Azevedo, 2006; Saraç & Karakelle, 2010). For testing our hypothesis, we designed a multi-method study, to investigate the relationship between metacognition and intelligence as predictors of learning performance. We used three measures for assessing metacognition namely, accuracy ratings, think aloud protocols and a self report questionnaire. The participants were presented a text-learning task. They were requested to think aloud while they were studying the text. After the participants finished studying the text, they were asked to rate how well they think they understood the text on a rating scale. Their learning performance was assessed by a post-test consisting of 15 multiple choice questions (a=.77). The Raven's Standard Progressive Matrices was used for assessing intelligence. The

participants were fifth grade elementary students (N= 91, 47 girls, 44 boys, Mage = 10.04 years, age range: 9-11 years). The results of the study indicated that intelligence do not correlate significantly neither with the scores from the self-report questionnaire nor with the scores from think aloud protocols. On the other hand, there is a significant correlation between accuracy ratings and intelligence scores. The results, also, showed that the scores from the self-report questionnaire do not contribute to students' text-learning performance. Accuracy ratings, together with intelligence predict text-learning performance and both predictors have their own unique contribution. This result corroborates the mixed model. The scores from the think aloud protocols, together with intelligence contribute to text-learning performance but think aloud protocols do not have predictive value independent of intelligence. This result confirms the intelligence model. This study confirmed the importance of using multiple metacognitive measures in metacognitive research as previously recommended by Veenman (2005) and Winne and Perry (2000). In conclusion, the findings of the study showed that when we use different metacognitive measures, we get different results in terms of the relationship among metacognition, intelligence and learning performance. This finding leads us to think about what we are really measuring. Are the measures that researchers frequently use in metacognitive research are valid means of assessing metacognition? Are these methods measuring different metacognitive constructs?

PAPER PRESENTATION

Teachers' vs. student language learning beliefs

Martin Herles, WU Vienna, Austria; Ruth Trinder, WU Wien, Austria

The English programme at WU Wien is characterised by a strong focus on content, particularly terminology, which poses a considerable challenge for teachers and students without business background. Additionally, a number of administrative and logistical constraints impact on the learning environment: class size, heterogeneity of groups, testing parameters, reduction in contact hours, etc. This gives rise to the question of how local conditions/contexts interact with more global influences to affect teachers' and students' perceptions of the learning situation, their motivations and their actions.

Students' notions of what constitutes good and useful English for their future careers and their beliefs as to how languages are best learnt and taught were identified in an earlier qualitative survey. Emerging themes included views on formal teaching activities and informal learning, the importance of interaction and pronunciation, accuracy versus fluency, attitudes towards content and language integrated teaching, and preferred learning strategies.

Building on that, the present talk adds the teachers' perspective, identifying differences and similarities to students' cognitions. We investigated how the interplay of local learning context and global developments determines the expectations of all players involved, and whether there is a mismatch between students' and teachers' perceptions, frequently claimed to negatively affect achievement and satisfaction. Results indicate that in many areas, learners' and teachers' beliefs diverge to a lesser degree than expected, and conflicts mainly arise from the pressure exerted by top-down and contextual constraints. We will further discuss students' and teachers' coping strategies, as well as insightful beliefs and approaches of successful students.

Learner attributes and cognitions are increasingly seen as critical factors determining approaches, behaviours and choice of strategies, and thus, by extension, ultimate attainment. In the field of foreign language learning, learners' conceptions about what the process of language learning entails include ideas about the nature and difficulty of the language to be studied, about the role of personal attributes such as aptitude or extroversion, and about the effectiveness of certain teaching approaches and learning strategies. The effects of beliefs on learner actions (or refusal of action) is well documented in the literature (e.g. Mori 1999, William and Burden 1997) and can be disconcertingly direct. Learners may refuse or invest little effort in learning activities if they conflict with their views of how languages should be taught, and what appropriate roles for teachers/learners are. Mismatch between beliefs and the prevailing teaching approach has been found to cause disillusionment and demotivation or even lead to discontinuation of study (Brown 2009, Stracke 2007).

It is the potential conflict between the beliefs of students, teachers, and the institutional teaching environment which was the focus of an empirical study we conducted at WU Vienna. The interest in the field of learner beliefs has been unabated since Horwitz's pioneering study in 1981. Similarly, there have been abundant studies looking at how teacher beliefs on various aspects of language teaching translate into classroom action; yet only few researchers have attempted to present a more global picture of how teachers' and students' conceptions of language learning compare against the background of a given teaching context.

The present study aims to redress this issue, investigating whether there is friction or alignment between students' and teachers' notions of effective language learning and teaching, to what extent these ideals are realized in the

teaching environment in question, and how teachers and students deal with mismatches between their expectations and reality. A qualitative approach (interviews and mini-essays) was used to answer the following research questions: What are students' and teachers' beliefs concerning the nature of language learning, the usefulness of the target language, and the role of individual learner attributes? How do students' and teachers' notions of effective teaching and learning practices compare? To what extent are these practices facilitated by the WU programme? How do they correspond to students' aims and motivations? How do students and teachers deal with mismatches between their beliefs and the actual learning situation?

Entwistle (1991) argues that any investigation of student learning must take account of the complex net of environmental factors shaping the reality of studying at a higher education institution. In line with this exhortation, we identified local and global influences on institutional practices and explored how these external factors affect belief systems. Contextual factors shaping the learning context range from global to national and local. Global developments include a shift from EFL (English as a foreign language) to ELF (English as a lingua franca), the predominance of English in international business, and the ubiquity of the web and social media - all of which may alter students' perceptions of the role and importance of 'correct' English as well as their motivations and opportunities for learning in and out-of-class. Developments that impact on the situation of Austrian universities have taken place on the European level (i.e. Bologna process) and the national level (i.e. open university access, budget cuts). Effectively, the latter two factors have meant reductions in contact hours and, consequently, oversubscribed classes and highly unfavourable student-teacher ratios. The strongest local influence is departmental policy, dictating pronounced emphasis on content and terminology and standardized testing. These conditions interact to produce heavy constraints on what is actually feasible in terms of instructional approaches and testing, and may lead to teaching situations that are at odds with teachers' as well as students' aims, motivations and expectations.

The empirical study presented here builds on an earlier survey of student beliefs conducted by the authors. Emerging themes included views on formal teaching activities and informal learning, the importance of interaction and pronunciation, accuracy versus fluency, attitudes towards content and language integrated teaching, awareness of English as a lingua franca, and preferred learning strategies. Building on that, the present talk adds the teachers' perspective, identifying differences and similarities to students' perceptions. We interviewed the entire departmental teaching staff (n=28) to get an insight into the ramifications of context and beliefs from the faculty's perspective; this was compared and contrasted with advanced students' views (n=80) established in the survey mentioned above. Results indicated that in many relevant areas, students' notions are broadly in agreement with the teacher perspective. There are just a few aspects where teachers' and learners' opinions diverge, such as the role of aptitude and the usefulness of explicit error correction. What clearly transpired was that the main conflict students and teachers experience is due to top-down pressure and contextual constraints, and, sometimes, an overreliance on teacher-transmitted knowledge.

The study uncovered how academic institutions may fall short of fulfilling students' (and teachers') needs, and, furthermore, how students' studying orientations may be dysfunctional in a given context. One step towards alleviating the present situation would be to key into students' meta-cognitive knowledge and explicitly address curricular goals and constraints, as well as to discuss limiting beliefs & underused strategies; in short, to point students in the direction of autonomy and independent learning.

References

- Brown, A. (2009). Students' and Teachers' Perceptions of Effective Foreign Language Teaching: A Comparison of Ideals. *The Modern Language Journal* 93 (i), 46-60.
- Entwistle, N. (1991). Approaches to learning and perceptions of the learning environment. *Special Issue of Higher Education* 22, 201-204.
- Mori, Y. (1999). Epistemological beliefs and language learning beliefs: What do language learners believe about their learning? *Language Learning*, 49(3), 377-415.
- Stracke, E. (2007). A road to understanding: A qualitative study into why learners drop out of a blended language learning (BLL) environment. *ReCall* 19 (1), 57-78.
- Williams, M., and Burden, R. (1997). *Psychology for language teachers. A social constructivist approach*. Cambridge, CUP.

PAPER PRESENTATION

Optimism, self-concept and school achievement: relations and educational consequences

Helena Bilimoria, Instituto Piaget - Gaia, Portugal

The aim of our study is to verify the relations between optimism, self-concept and school achievement.

Optimism is associated with low levels of anxiety (Ruthig et al., 2004; Stoecker, 1999). Regarding academic success, there is some inconsistency in research results.

We applied to 36 7th grade students (17 boys and 19 girls; mean age - 12 years old), the "scale of optimism" (Barros, 1998), a 5 options likert scale, with 4 dimensions (future perspectives, hope, future projects and general optimism) and the Portuguese version of the Piers-Harris Self-Concept Scale for Children (Veiga, 2006), a dichotomous scale with 6 dimensions (behavior, anxiety, popularity, intellectual and school status, physical appearance and satisfaction). The school results were also obtained in the end of the first school period (December).

The results point to significant correlations between anxiety and some optimism dimensions. Significant correlations between future projects and intellectual status, as well as with satisfaction.

General optimism was found to be associated with most of all self-concept dimensions.

Regarding school achievement, no significant correlations were found with optimism.

A multiple regression analysis revealed that intellectual status explains 38,6% of school achievement variance ($R^2 = .386$, $b = .62$, $t = 4,623$, $p = .000$). We suggest in future research, the use of a domain-specific measure of optimism (e.g. academic optimism) and recommend further investigation with causal models to verify the associations and mediation effects of anxiety, intellectual and school status, optimism and school results

Optimism as a general disposition to expect positive events and positive outcomes for personal, present and future experiences (Barros, 2004; Koizumi, 1992; Solberg et al., 2006; Toor, 2009) is associated with physical and psychological well-being (Fontaine & Seal, 1997; Scheier & Carver, 1985, 1992; Scheier, Carver & Bridges, 2002). It's associated with low levels of anxiety, namely in academic settings (text anxiety) (Ruthig et al., 2004; Stoecker, 1999). Regarding academic success, there is some inconsistency in research results. Some enlighten the relation between optimism and school achievement (Brown & Marshall, 2002; koizumi, 1992; Schulman, 1995); others, on the contrary, refer the high levels of optimism as detrimental to school achievement (Haynes et al., 2006; Ruthig et al., 2004; Satterfield et al, 1997). Some studies link indirectly optimism to school achievement through the relation between optimism and anxiety (Ruthig et al., 2004).

The aim of our study is to verify the relations between optimism, self-concept and school achievement.

To do so, we applied to 36 7th grade students of a Portuguese school near Oporto (17 boys and 19 girls; mean age - 12 years old), the Portuguese "scale of optimism" (Barros, 1998), a 5 options likert scale, with 4 dimensions (future perspectives, hope, future projects and general optimism). This scale is based on LOT scale (Life Orientation Test (Scheier & Carver, 1985). We also applied the Portuguese version of the Piers-Harris Self-Concept Scale for Children (Veiga, 2006), a dichotomous scale with 6 dimensions (behavior, anxiety, popularity, intellectual and school status, physical appearance and satisfaction). The school results were also obtained in the end of the first school period (December).

The results point to significant correlations between anxiety and future perspectives ($r(36) = 0,488$, $p = .003$), future projects ($r(36) = .357$, p

Also significant correlations were found between the future projects and intellectual and school status ($r(36) = .384$, p

We also detected that general optimism seems to be associated with satisfaction ($r(36) = .388$, locus of control (Barros et al. 1993) and less anxiety, characteristics that can contribute to feel more satisfied with oneself. Also, optimistic persons are more sociable (Barros, 2004) what can explain the correlation with popularity (being more sociable can explain popularity, but being popular can explain being optimistic in general).

Regarding school achievement, no significant correlations were found between school results (mean score and grades in each discipline) and the dimensions of optimism. This can be explained taking into consideration the high mean levels for the dimensions of optimism (around 4,0 each). These high means point to a situation of "unrealistic optimism": some students may be overly optimistic. These students might withdraw from the academic context to protect themselves from negative effects of failure (Robins & Beer, 2001), or fail to have a backup plan to respond to unpredicted outcomes (Ruthig et al., 2004). These behaviors can explain the absence of a correlation between optimism and school achievement.

In our study, however, we didn't prove the deleterious effects of higher levels of optimism on the school results, presented in other studies (Haynes et al., 2006; Ruthig et al., 2004; Satterfield et al., 1997). In future researches, we consider important to use a domain-specific measure of optimism (e.g. academic optimism), once it has been proved to be more related to academic achievement than the general optimism measures (Toor, 2009).

A multiple regression analysis with stepwise method, revealed that only intellectual status explains school achievement (as a mean score of grades): 38,6% of the variance is explained by intellectual and school status ($R^2 = .386$, $b = .62$, $t = 4,623$, $p = .000$). The effect of the school and intellectual status on school achievement has been largely proved (Marsh, 1990, 2003; Marsh and Yeung, 1997; Shavelson & Bolus, 1982).

This investigation contributed to understand the central role of self-concept, namely, intellectual and school status, regarding the school achievement. It also enlightened the role of anxiety. Indirectly, it also contributed to the reflection and debate about teachers' ideal attitudes and pedagogical practices in order to promote academic access and success for all students.

Given the relations found between the self-concept dimensions (anxiety and intellectual and school status) and optimism dimensions (general optimism and future projects) we suggest further investigations, with causal models to verify the associations and mediation effects of anxiety, intellectual and school status, optimism and school results

PAPER PRESENTATION

Teacher Epistemic Beliefs and their articulation to broader personal beliefs. An Empirical Exploratio

Cecilia Mornata, University of Geneva, Switzerland; Etienne Bourgeois, University of Geneva, Switzerland

The study presented in this paper is part of a broader research project aiming at three objectives: 1) to explore the various dimensions and functions of high school teachers' cognitions and beliefs about learning and knowing; 2) their antecedents as related to both the teachers' biographies and current work environment; and 3) the process through which these cognitions are gradually constructed over the teachers' career. The study concerns the first part of this project. Being able to characterize teacher epistemic beliefs in their content and to see how they are articulated to the person's broader system of personal beliefs and values is therefore a necessary preliminary step to further examination of their antecedent and consequences. Preliminary results are presented and discussed here.

Aims

The study presented in this paper is part of a broader research project aiming at three objectives: 1) to explore the various dimensions and functions of high school teachers' cognitions and beliefs about learning and knowing; 2) their antecedents as related to both the teachers' biographies and current work environment; and 3) the process through which these cognitions are gradually constructed over the teachers' career. The study presented here concerns the first part of this project.

Teachers' epistemic cognition deserves careful attention, in particular to the extent that they appear to play a crucial function in structuring and orienting actual teaching practices (Maggioni & Parkinson 2008; Brickhouse, 1990; Hashweh, 1996) and in influencing student beliefs about knowledge and learning (Maggioni, Riconoscente & Alexander, 2006; King & Kitchener, 2004; Louca, Elby, Hammer & Kagey, 2004; Rading, 2002). It can also be hypothesized that they may have some specific particularities in their content given the specificity of the teaching profession (teaching is an activity about learning and knowing) (Lyons, 1990). This particular profession may be likely to attract people with certain beliefs and cognitions about learning and knowing and engagement in this profession is in turn likely to shape these beliefs over time (Wandsworth, 2007). Being able to characterize teacher epistemic beliefs in their content and to see how they are articulated to the person's broader system of personal beliefs and values is therefore a necessary preliminary step to further examination of their antecedent and consequences.

The literature on this issue is quite rich but also somewhat disparate, borrowing from both sociology and psychology of teaching and education. A review of this literature led us to select 4 major dimensions (Hofer & Pintrich, 1997; Schommer, 1990; Hofer, 2004; Hammer & Elby, 2002; Charlot, 1997, 2003, 2006; Charlot, Bautier & Rochex, 2000; Dweck, 1999):

- Epistemic beliefs *stricto sensu*, i.e., cognitions about what learning and knowing are, how they function and can be characterized as processes, their sources and aims or functions
- Personal beliefs about the world as potential source of Learning and knowledge: society at large
- Personal beliefs about significant others, such as one's family, colleagues, students or any person acknowledged as mentors: one's local environment (family and school)

- Personal beliefs about oneself, as a teacher, parent and student: one's own experience as a teacher or as a parent

In this approach, the focus is primarily on the functions that knowing and learning fulfill in the teachers' personal and professional life: how they are invested and valued in relation to teachers' personal goals? We were primarily interested in examining the articulation of epistemic beliefs to other personal beliefs and values (about oneself, others and the world) and not only the content of the epistemic beliefs in the narrow sense.

Method

Data collection

The study was based on individual semi-structured interviews conducted with the whole teaching staff of a small public high school in Geneva, Switzerland, addressing teenagers aged 12 to 15 years. 19 teachers in total were interviewed, ranging from 30 to 61 year-old, including 7 males and 12 females. Each teacher was interviewed twice on his or her workplace except for one, who was interviewed at home.

In the first interview teachers were presented a set of pictures and asked to choose the one representing the most and the one representing the least – knowledge » in their eyes. They were subsequently asked to justify and comment their choice with a view to elicit what learning and knowing meant to them.

The second interview took place three months later (in order to avoid any priming effect of the first one). Respondents were given a task in four steps that was meant to have teachers think and speak as freely as possible about the most significant learning experience in four life areas (personal, professional, schooling and continuing education).

Data analysis

Interviews were transcribed verbatim and analyzed through a classical content analysis method (using ³N*Vivo software) in reference to analytical categories derived from the four theoretical dimensions initially selected. However, other categories emerged in the course of the analysis, which were incorporated into the initial category framework.

Preliminary results

The content analysis of the teachers' epistemic beliefs and cognition led to identifying three main profiles.

1. Teachers for whom epistemic beliefs appear to be invested as a central component of their personal and professional self-concept
 - a. They define themselves and the world through the subject-matters they teach and knowledge they have invested
 - b. What they teach is associated with strong emotions
 - c. Their beliefs about knowing and Learning cannot be dissociated from their other personal beliefs
2. Teachers for whom knowing and learning are instrumental means of achieving specific personal goals (such as having a job or better understand an particular activity considered as important to the person)
 - a. Knowing and learning appear to be clearly subordinated to personal goals
 - b. Knowing and learning are not valued for their own sake, but only as means to achieve overarching personal goals
3. Teachers for whom knowing and learning are seen primarily as means of personal development
 - a. They are invested as means to become a "better person"
 - b. They are valued for their own sake, as crucial avenues to personal growth

Theoretical and educational significance

This part of the study allowed for a clarification of "epistemic beliefs" as the core construct of our broader research project. In particular, it shows the extent to which are deeply embedded in a broader beliefs and values system and cannot therefore be looked at as isolated from the latter. It also shows that epistemic beliefs are "functional", not only in the area of teaching practices but also in the person's approach to life in general.

PAPER PRESENTATION

Warm Achievement in Science: Interplay of Epistemic Beliefs, Motivational Beliefs, and Knowledge

Lucia Mason, University of Padova, Italy; Pietro Boscolo, Università di Padova, Italy; Caterina Tornatora, University of Padova, Italy

This study examined the role of students' knowledge and "warm" characteristics to explain achievement differences in the domain of science. To extend current research, we were interested in testing a comprehensive model that

includes simultaneous interactions between domain-specific epistemic beliefs, achievement goals, knowledge, self-concept, and self-efficacy. Participants were 193 high school students in grade 11. Structural equation modeling was performed to test the hypothesized relations among the observed variables. Starting from a baseline model, variables and paths were removed on the basis of statistical reasoning and theoretical aspects. A revised model provided a good fit for the results obtained. This model indicated that science epistemic beliefs were directly related positively to mastery-approach. In turn, mastery-approach was positively related to knowledge in science. Epistemic beliefs were also directly related to knowledge, which had a direct effect on achievement in science. Mastery-approach was also positively related to self-concept and self-efficacy. Finally, both self-concept and self-efficacy had a direct effect on achievement.

The study is of educational significance, especially for science teachers, as it indicates the complex and delicate interplay of individual characteristics that underlies academic achievement in science, starting from the role of domain-specific epistemic beliefs.

Theoretical Framework and Aim

Since Pintrich, Marx, and Boyle (1993) classic article, who called for "hot" conceptual change, not only cognitive factors but also affective and motivational variables have been taken into account by scholars interested in science learning, which often implies revision of inaccurate conceptions (Sinatra, 2005). Besides knowledge, in this study we examined several "warm" constructs as possible resources for achievement in science: epistemic beliefs, achievement goals, self-concept, and self-efficacy.

Epistemic beliefs, that is, representations about the nature of knowledge and the process of knowing (Hofer & Pintrich, 1997) have been proved to be associated not only with learning scientific concepts (Strömsö, Bråten, & Samuelstuen, 2008; Mason, Gava, & Boldrin, 2008; Sandoval, 2005; Sinatra, Southerland, McConaughy, & Demastes, 2003; Stathopoulou & Vosniadou, 2007) but also with overall academic achievement (Hofer, 2000; Schommer, 1993; Schommer-Aikins, Duell, & Rutter, 2005). Only more availing beliefs in knowledge as complex, evolving, and personally constructed act as resources for academic performance. Much empirical evidence has also documented that academic achievement is influenced by achievement goals. Mastery (focus on improving one's competence) and performance-approach (focus on demonstrating competence), and performance-avoidance goals (focus on avoiding lack of competence) in particular, have been studied in relation to achievement (Harackiewicz, Barron, & Elliot, 1998; Midgley, 2002; Pintrich, 2000). According to normative models of achievement goals, mastery goals are associated with deep learning, adaptive self-regulatory behavior, and positive affect. Performance goals are related instead to superficial learning, low self-regulation, and negative affect (Maehr & Zusho, 2009; Smiley & Dweck, 1994; Pintrich, 2000; Urdan, 1997). Scholars however, have questioned whether performance goals are truly maladaptive (Barron & Harackiewicz, 2001; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). Studies in the science domain have shown their effects to be insignificant (Linnenbrink & Pintrich, 2002), or even positive in certain cases (Qian & Pan, 2002). In contrast, deleterious consequences are related to performance-avoidance goals (Elliott, McGregor, & Gable, 1999). In addition, the positive role of self-efficacy, that is, future-oriented self-perception of one's abilities to learn or perform at a designated level, has been documented in science (Chen & Pajares, 2010; Pajares, Britner, & Valiante, 2000). Furthermore, self-concept in a domain, that is, past-oriented self-perception of one's capability (Marsh, 1990) is not only positively related to self-efficacy but also to achievement (Schunk & Pajares, 2005). Interestingly, a relationship between epistemic beliefs, achievement goals, and learning strategies has emerged (Bråten & Strömsö, 2004; Buhel & Alexander, 2005, 2009; DeBacker & Crowson, 2006; Muis & Franco, 2009). It has also been indicated that mastery-approach is associated with more availing beliefs in complex, evolving, and personally constructed knowledge (Bråten & Strömsö, 2004; DeBacker & Crowson, 2006). Given that a multiplicity of factors, besides knowledge, play a role in academic achievement, an open question concerns how these factors interact simultaneously and what direct and mediated effects they produce on achievement. The following research question guided the study: for the science domain, what are the associations of domain-specific epistemic beliefs, achievement goals, self-concept, self-efficacy, and knowledge with achievement in high school? Based on Muis' (2007) model, we hypothesized that epistemic beliefs about science would be positively related to mastery-approach and negatively related to performance-avoidance goals. We also expected that both mastery and performance approach goals would be positively related to knowledge in science, while performance-avoidance goals would be negatively related. We also hypothesized that knowledge would have a direct effect on achievement in science as well as indirect effect through self-concept and self-efficacy. Mastery and performance goals would also be positively related to self-concept and self-efficacy, whereas performance-avoidance goals would be negatively related to both. Finally, both self-concept and self-efficacy would have a direct effect on achievement.

Method

Participants were 193 high school students in grade 11 (mean age= 16.4; 94 girls). Through self-report questionnaires the following measures were collected: science epistemic beliefs (Conley, Pintrich, Vekiri, & Harrison's, 2004), science achievement goals (Middleton & Midgley, 1997), science self-concept (Marsh, 1990), and science self-efficacy (Pintrich, Smith, Garcia, & McKeachie, 1991). All instruments had good reliability coefficients. Questions taken from PISA were used to assess domain knowledge at the beginning of grade 11. Achievement in science was measured through the end-of-term grade collected in numerical form as the teachers marked it. Structural equation modeling was performed to test the hypothesized relations among the observed variables using the LISREL 8.7 (Jöreskog & Sörbom, 1998). Assessment of fit was based on several indices. We considered the NNFI (Non-Normed Fit Index) and the CFI (Comparative Fit Index), which perform well with small and large samples. The Root Mean Square Error of Approximation (RMSEA) was also used. This is an absolute fit index assessing approximation of parameter estimates to true parameters in the population.

Results

First, scores for all scales were examined for normality (Kline, 1998). All scales were well within the ranges suggested for skewness and kurtosis. Structural equation modeling was then performed to answer both research questions. Starting from a baseline model, variables and paths were removed on the basis of statistical reasoning and theoretical aspects. A revised model provided a good fit for the results obtained, $\chi^2(6, N=193) = 4.06$, $p=0.67$, NNFI=1.01, CFI=1.00, and RMSEA= 0.0. This model indicated that science epistemic beliefs were directly related positively to mastery-approach. In turn, mastery-approach was positively related to knowledge in science. Epistemic beliefs were also directly related to knowledge, which had a direct effect on achievement in science. Mastery-approach was also positively related to self-concept and self-efficacy. Finally, both self-concept and self-efficacy had a direct effect on achievement (Figure 1).

Scientific and Educational Significance

The study has scientific significance in that it sought to advance theoretical specifications of the relationships between domain-specific epistemic beliefs, achievement goals, knowledge, and self-beliefs by testing their simultaneous interaction influencing achievement in science. The study is also of educational significance, especially for science teachers, as it indicates the complex and delicate interplay of individual characteristics that underlies academic achievement in science, starting from the role of domain-specific epistemic beliefs.

PAPER PRESENTATION

Activating and sharing prior knowledge before reading an expository text

Christian Tarchi, University of Florence, Italy

Although the process of learning from text has been widely studied, students still encounter difficulties, especially when engaged with expository texts. Literature on this issue has often underlined the importance of reader's prior knowledge, inference-making skill, and metacognition. This contribution had a twofold aim: 1) verifying the efficacy of a model of intervention on reading comprehension based on the activation and sharing of prior knowledge; 2) verifying the impact of this model on several reading comprehension components. The participants to this study were 213 7th and 8th graders. The sample was divided into three groups: two experimental groups (one working with the prior knowledge model, the other one with the reciprocal teaching approach) and a control group. In the two experimental samples, students worked collaboratively in small groups for 1 hour on four different texts, each belonging to a specific domain: history, geography, science, and a newspaper article. The prior knowledge activation group outperformed the control group in reading comprehension and semantic inferences, and outperformed the reciprocal teaching group in metacognition and free recall. On the other side, the reciprocal teaching group was more effective in asking questions about the topics tackled in the texts. From an educational perspective, this study helps to explore the interaction among reader's characteristics, text properties, and instructional environment.

Aims

The main aim of the present contribution was to assess the efficacy of a training for fostering reading comprehension based on the activation and sharing of prior knowledge among readers. Theoretical background

Almost every day students from primary to high school are engaged with expository texts. Text comprehension represents one of the most important aspects in learning, given the role it plays in the processes of acquisition, sharing, and construction of knowledge. According to the data of the PISA project, only a minority of students (8.6%) were proficient at the highest reading level (OECD, 2007). Students encounter difficulties especially when reading and learning from expository texts (Dymock, 2005). The factors that influence the process of "learning from text" have been the central interest of many educational psychologists over the past decades, who focused on the cognitive processes and mental structures underpinning this activity, as well as the textual properties that contribute to successful reading (Hailikari, Nevgi & Lindblom-Ylaenne, 2007). Research on reading comprehension has often

underlined the importance of reader's prior knowledge (Dochy, Segers, & Buehl, 1999; Ozuru, Dempsey & McNamara, 2009; Shapiro, 2004). Prior knowledge is considered a multidimensional construct (Alexander & Jetton, 2010). In a previous study (Author, 2010) a model of prior knowledge based on the contributions of Alexander & Jetton (2000), Dochy (1994), Hailikari et al. (2007), and Samuelsten & Braten (2005) has been tested, and results showed the importance of addressing both categories of topic knowledge, meanings and facts, in order to foster students' inference-making skills and the construction of a mental model of the text. On the other hand, many studies have widely demonstrated the importance of inferences (Oakhill & Cain, 2007; Rapp van den Broek, McMaster, Kendeou & Espin, 2007) and metacognition (Veenman & Beishuizen, 2004) for reading comprehension. Prior knowledge generally makes the largest total contributions to comprehension, but this variable has both, a direct effect and an indirect effect mediated by metacognition and inference, on reading comprehension (Cromley & Azevedo, 2007). Research question and Hypothesis

Despite the role played by prior knowledge in accordance with inference-making skills and metacognition has been widely demonstrated, there is a lack of studies assessing the efficacy of training addressing this pattern of components in order to foster reading comprehension. Therefore this contribution had a twofold aim: 1) verifying the efficacy of a model of intervention on reading comprehension based on the activation and sharing of prior knowledge; 2) verifying the impact of this model on several reading comprehension components. Methodology

Participants. The participants to this study were 213 students attending grade 7 and grade 8 of three schools placed in Florence, Italy (Age: 12.85 \pm .79).

Materials and measures

Four texts have been used for the two experimental groups' trainings, each belonging to a specific domain: history, geography, science, and a newspaper article. Two kinds of assessments have been utilized, one as a measure of change, the other one as a measure of process. In the former, a set of reading comprehension components has been assessed before and after the trainings, in order to compare the differences between the pre-assessment and the post-assessment (reading comprehension, inference-making skills, metacognition, topic interest, and free recall). In the latter, at the end of each training session the students were assessed on the level of depth of their comprehension of the text just read (literal and inferential comprehension, conceptual-map, and problem-solving questions).

Procedure

The sample was divided in three groups: one following the approach based on the activation and sharing of prior knowledge, one following the reciprocal teaching approach (Palincsar & Brown, 1984), and one following traditional didactic. In the two experimental samples, students worked collaboratively in small groups for 1 hour.

Findings

In order to assess the differences in the three groups between pre-test and post-test, a series of repeated measures MANOVAs have been conducted through general linear models. The within-subjects factor was time (2 levels), that is pre-test and post-test assessments, and the between-subjects factor was group (3 levels): prior knowledge activation group, reciprocal teaching group, and control group. The prior knowledge activation group outperformed the control group in reading comprehension and semantic inferences, and outperformed the reciprocal teaching group in metacognition and free recall. On the other side, the reciprocal teaching group was more effective in asking questions about the topics tackled in the texts.

In order to explore more the process through which the two trainings implemented exert their effect, data have been analyzed through a series of one-way analyses of the variance (ANOVA). The prior knowledge group outperformed the reciprocal teaching group on the history, geography, and science text, whereas no differences were found regarding the newspaper article.

Theoretical and educational significance

This study has both, a theoretical and educational significance. From a theoretical perspective, it helps to explore the interaction among reader's characteristics (reading comprehension components), text properties (different disciplinary-content texts), and instructional environment (focus on prior knowledge or on strategies), which is considered to be the determinant of the processes readers apply during comprehension (Rapp et al., 2007). From an educational perspective, this study assessed the efficacy of a training that can be easily implemented by teachers in their classroom, without the need of expensive resources. The study explores also the efficacy on single reading comprehension components, so that it can be used also to tackle difficulties in both, reading comprehension as a whole process or single processes, such as inference-making or metacognition. Finally, this study refers to a vast literature on prior knowledge and reading comprehension, therefore the training can be potentially implemented in

accordance with the available assessment tools (i.e. tests for inference-making skills, or assessment of prior knowledge).

PAPER PRESENTATION

The relationship between collaborative learning activities and individual learning

Inge Molenaar, University of Amsterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Peter Sleegers, University of Amsterdam, Netherlands; Ming Ming Chiu, University of Buffalo, United States

This study examines how different learning activities contribute to knowledge acquisition during collaborative learning. We analyzed cognitive, metacognitive, relational, procedural and off task behaviors of students. We analyzed the relationship between individual learning behaviors and other group members' behaviors and their contributions to knowledge acquisition. We found that students own cognitive and metacognitive behaviors during collaboration contribute to domain and metacognitive knowledge. Additionally, other group members' social regulation positively influences the development of domain knowledge and students own off task behavior negatively influences metacognitive knowledge.

Aim

The underlying assumption of constructivist learning theories is that the nature of learning activities influences learning achievement (Duffy & Jonassen, 1992). The assumption has been extended to collaborative learning settings (Janssen, Erkens, Kirschner, & Kanselaar). However studies addressing on the relation between collaborative learning activities and knowledge acquisition focused on the effects of one particular learning activity, such as elaboration (Van Boxtel, 2004; Van Drie & Van Boxtel, 2004), metacognition (Azevedo & Cromley, 2004; Molenaar, Van Boxtel, & Sleegers, In press) or off task behavior (Chiu, 2004). This provides an isolated view of the contributions of these learning activities. Cognitive activities, metacognitive activities and social regulation independently contribute to effective collaboration and consequently influence group performance and students knowledge acquisition. However, we lack a complete overview of the learning activities that contribute to individual knowledge acquisition during collaborative learning (Jansen et al., 2010). Additionally, both the individual student's constructive involvement and the contributions of other group members are emphasized as important factors influencing individual learning in collaborative settings (Chi, 2009; Webb, 2009). Nevertheless, little is known about the relation between one's own learning behaviors and other group members' behaviors and individual knowledge acquisition. The "active, constructive, interactive framework" formulates the hypothesis that students own activities are more constructive than listening to other students activities. Therefore individual activities are expected to be more influential for knowledge acquisition (Chi, 2010). The purpose of our study is to examine all learning activities during collaborative learning and determine the relationship between individual behaviors, other group member behaviors and individual knowledge acquisition.

Methodology

We describe the learning activities of 54 students (aged 10-12) collaborating face-to-face in triads while working in an electronic learning environment. We analyzed the discourse to determine the learning behaviors of the students. The total dataset of discourse turns entails 108 hours and 51.339 utterances. As learning achievements we measured students' domain and metacognitive knowledge. We present a mixed method study, with a statistical component and a qualitative component. We performed a multi-level regression analysis to examine how students engaging in specific behaviors, and experiencing other group members' behaviors acquire knowledge. The findings of these analysis are elaborated on with qualitative examples, which will not be discussed in this abstract.

Findings

Our first goal was to understand which learning activities small groups' engage in during collaborative learning. Students in our study engaged in content related activities such as cognitive activities (27%) discussing the task content and metacognitive activities (20%) regulating the cognitive activities. Additionally, student performed relational oriented activities such as social regulation (21%) of their collaboration, procedural regulation (12%) of the learning environment and off task activities (11%). Our second aim was to determine the effects of individual students behaviors and other group members behaviors on students knowledge acquisition. Relative to their group's total turns, students who perform proportionately more cognitive and metacognitive behaviors scored higher on the domain knowledge test. Moreover, students whose group members performed proportionately more social regulation behaviors scored higher on the domain knowledge test. Students who performed proportionately more cognitive behaviors and metacognitive behaviors scored higher on the metacognitive knowledge test. In contrast, students performing proportionately more off task behavior scored lower on the metacognitive knowledge test.

Theoretical and education significance

On a theoretical level, this shows that different learning activities contribute to the knowledge acquisition of students and therefore it is important to study all learning activities opposed to isolating only one particular activity. Additionally, these findings are in line with the hypothesis of "the active, constructive, interactive framework", indeed students own behaviors on the content space (cognitive and metacognitive activities) are most influential for knowledge acquisition. Additionally, domain knowledge is also influenced by the social regulation of other group members. Thus students' own social regulation does not influence their own knowledge acquisition, but it does support other group members to gain more domain knowledge. This indicates that during collaboration not only contributions on the content space (cognitive and metacognitive behaviors) are important, but also contributions on the relational space (social regulation) play an significant role in contributing to domain knowledge acquisition. On a practical level, the results can help us to create instructional designs which engage students in those activities most beneficial for learning achievements. This study suggest that instructional designs might enhance individual group members domain knowledge by engaging all group members in cognitive and metacognitive activities and helping group members to uphold social regulation of one another. Additionally, instructional designs could enhance individual group members metacognitive knowledge, by engaging all group members in cognitive and metacognitive behavior and reducing their off task behavior.

References

- Azevedo, R., & Cromley, J. G. (2004). Does Training on Self-Regulated Learning Facilitate Students' Learning With Hypermedia? *Journal of Educational Psychology*, 96(3), 523-535.
- Chi, M. (2009). Active-Constructive-Interactive: A Conceptual Framework for Differentiating Learning Activities. *Topics in Cognitive Science*, 1(1), 73-105.
- Chiu, M. (2004). Adapting Teacher Interventions to Student Needs During Cooperative Learning: How to Improve Student Problem Solving and Time On-Task *American Educational Research Journal* 41, 365-399.
- Duffy, T. M., & Jonassen, D. H. (1992). *Constructivism and the technology of instruction: a conversation*. Hillsdale: Lawrence Erlbaum Association.
- Janssen, J., Erkens, G., Kirschner, P., & Kanselaar, G. Task-related and social regulation during online collaborative learning. *Metacognition and Learning*, 1-19.
- Molenaar, I., Van Boxtel, C., & Sleegers, P. (In press). Metacognitive Scaffolding in an Innovative Learning Arrangement. *Instructional Science*.
- Van Boxtel, C. (2004). Studying peer interaction from three perspectives: the example of collaborative concept learning. In J. L. v. d. Linden & P. Renshaw (Eds.), *Dialogic Learning: Shifting Perspectives to Learning, Instruction and Teaching* (pp. 125-144). Dordrecht: Kluwer Academic Publishers.
- Van Drie, J., & Van Boxtel, C. (2004). Historical reasoning: a comparison of how experts and novices contextualise historical sources. *International Journal of Historical Learning, Teaching and Research*, 4(2), 84-91.
- Webb, M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. . *British Journal of Educational Psychology*, 79, 1-28.

PAPER PRESENTATION

Self and social regulation of learning during collaborative activities in the classroom

Valeska Grau, Pontificia Universidad Catolica deChile, Chile

It has been widely recognised that in order to explain processes of self-regulated learning, consideration of the social regulatory aspects should not be left behind especially when we try to explain the quality and effectiveness of collaborative learning processes. This present paper presents the finding of two subsequent observational studies attempting to integrate the self and social aspects of regulation in learning contexts through an integrative model of analysis applied to collaborative learning activities in primary school. The findings of study 1 suggest interesting associations between individual self-regulated learning and social regulation within the collaborative activities, while the findings of study 2 focus on the conditions of the emergence of shared regulation episodes described in study 1, and shed light on the individual behaviours triggering episodes of productive mutual regulation. The two studies represent a contribution to the study of different levels of regulation in relation to learning processes in primary school.

Introduction

Nowadays, the inclusion of the social dimension in the traditional self-regulation of learning models have had two directions: on one side, the socio-cognitive models conceive the social as influencing self-regulatory processes and, on the other side, the sociocultural models define regulatory processes as intrinsically social. It has been argued that in order to give a more complete account of the regulation processes occurring during collaborative learning, there must be an explicit consideration of self and social aspects of regulation, and the avoidance of reductionism to the individual or the collectives to which they belong. (Akkerman et al, 2007; Hadwin, 2007; Iiskala et al, 2004; Volet, Vauras & Salonen, 2009). Following the conceptualization of self, co-regulation, and shared regulation described by

Iiskala et al (2004), and the concept of co-regulation defined by Volet et al (2009) the current paper presents two studies attempting to integrate the self and social aspects of regulation in learning contexts through an integration of analysis models applied to collaborative learning activities in primary school.

Thus, the research questions are basically, How can we integrate individual and social levels in the analysis of collaborative learning activities in primary school? In which ways these two levels are related? How can the episodes of social regulation be described and which dimensions are related to their emergence? The relevance of the studies relates to 3 issues: the attempt to develop a framework of analysis integrating self and social aspects of regulation; the advance on the description of shared regulation episodes and the conditions of emergence; and the contribution to the study of children working together and regulating each other during the first years of schooling, who are relatively under-represented in studies of self-regulated learning as much as collaborative group-work.

Methodology and findings

Study 1 is part of a broader exploratory study which aimed to collect evidence of self-regulated learning skills and conceptual development in authentic classrooms. It consisted of a multiple case study of 8 children followed up during one academic semester, belonging to the third grade of primary school. Thus four cases per classroom were systematically observed in different school situations regarding the teaching and learning of scientific concepts in order to obtain 'thick' data of each case. Data collection and analysis presented in this paper are related to the video data of 5 sessions of collaborative learning spread throughout the semester (March to July). In terms of data analysis, a coding scheme of individual evidence of self, co-, and shared regulation was developed, together with a discourse analysis in order to qualify individual utterances and interactive episodes of shared regulation, respectively. Considering the results obtained through the rates of self-regulated behaviours using the coding scheme, there was a significant increase in the rates of self-regulated behaviour –adding all the individual contributions- between session 1 and 5 in the two groups observed. However, there were significant differences in the percentages of rates of shared regulation between the two groups. Also, the rates of shared regulation were significantly correlated to the students' talk about relevant knowledge needed to solve the task. These differences were even more accentuated when the analysis of interactional episodes was carried out. The students belonging to the class showing more individual utterances directed to shared-regulation also had far more episodes of shared regulation. Study 2 has a similar design, but it aimed to answer some questions posed by study 1. Specifically, it addressed the issues related to the contexts of emergence of episodes of shared regulation during group work and sought to improve the analysis framework. It consisted of the follow up of 4 groups of students working together (16 children), belonging to 2 parallel classes over 7 months (between 3rd and 4th grade of primary school) during sessions of collaborative group-work. 5 sessions were videotaped (around once a month), with a focus on individual and social processes of regulation. The main differences with study 1 were, in terms of data collection, the consideration of a longer period of time, more participants, the inclusion of interviews with the children directly after the collaborative session and a feedback to teachers after each videotaped session -with the objective of planning activities to improve the quality of the collaborative activity. In terms of analysis, the coding system and the discourse analysis were refined, considering the elements suggested by study 1, and the analysis of interviews. The findings of study 2 are still preliminary. Up to now, it shed light on the characterization of emergence of episodes of shared regulation, and the way in which individual participants perceive the group situations. These preliminary findings are pointing to two main features of individual behaviour as playing an important role on triggering episodes of shared regulation: (1) The ability to make an argument and articulate thinking processes and (2) The capacity of emotional openness to discuss, negotiate and evaluate student's own thinking with others. There is still some analysis to be done to confirm these initial results.

Also, this study is enabling us to carry out an improved temporal analysis on the history of interactions within a group, and look at how this temporal dimension plays a role in the group development of regulatory processes. These studies attempted to conceptualise individual and social aspects of regulation within regular primary school children, carrying out collaborative activities in natural contexts. Also, they have involved an innovative methodology of data analysis, allowing the consideration of individual and group cognition, in the search of integration between both levels of analysis. Finally, they represent a contribution to the study of effective collaborative learning interactions during the first years of schooling.

References:

- Akkerman, S., Van de Bossche, P., Admiraal, W., Gijssels, W., Segers, M., Simons, R.-J., et al. (2007). Reconsidering group cognition: From conceptual confusion to a boundary area between cognitive and socio-cultural perspectives? *Educational Research Review*, 2(1), 39-63.
- Hadwin, A., & Oshige, M. (2007). Self-regulation, co-regulation, and socially shared regulation: Examining the many faces of social models of SRL, Paper Presented at the Conference of European Association for Research in Learning and Instruction. August 28-September 1. Budapest, Hungary

Iiskala, T., Vauras, M., & Lehtinen, E. (2004). Socially shared metacognition in peer-learning? *Hellenic Journal of Psychology*, 1, 147-178.

Volet, S., Vauras, M. & Salonen, P.(2009). Self- and social regulation in learning contexts: An integrative perspectiva. *Educational Psychologists*, 44 (4), 215-226.

PAPER PRESENTATION

Knowing how to collaborate: Collaborating to know with Web 2.0 tools

Dorothy Faulkner, Open University, United Kingdom; Denise Whitelock, Open University, United Kingdom; Rebecca Ferguson, Open University, United Kingdom; Kieron Sheehy, The Open University, United Kingdom

This paper reports an exploratory study that draws on sociocultural accounts of learning to frame an investigation of 10 – 11 year-olds' experience of using of Web 2.0 tools to support informal, self-directed learning activities at home and out-of school contexts. Focus group interviews and visual elicitation methods were used to support informed dialogues with 10-11 year-olds about their use the Internet and Web 2.0 applications. Fourteen children from a UK primary school's robotics and with computer clubs participated in the study. Children were interviewed in small groups of three or four and were also invited to produce visual representations of the ICT hardware, software and Internet applications they used at home. Preliminary analyses of the drawings and interview transcripts revealed that these participants routinely engage in both face-to-face and on-line learning activities with friends and that they use a variety of instant messaging and mobile technologies to share and exchange knowledge and expertise about gaming and the Internet, the usefulness of different search engines and information and retail sites. The data also reveal that although these children enjoy an extended, global network of family and friends, the learning potential afforded by Web 2.0 tools is hampered by inefficient information search and knowledge-sharing strategies. The paper will draw on the theoretical and analytical framework of activity theory to explain these findings.

Collaborative Web 2.0 tools, (social networking sites, blogs, wikis, video- and music-sharing sites), offer many potential benefits to learners and can facilitate information sharing, knowledge creation and on-line collaboration in both formal and informal learning contexts. Selwyn, Potter and Cranmer, (2009) report that for 7-11 year-old children, creative and collaborative uses of Web 2.0 applications are not prevalent either at home or at school and there is little evidence for the 'transformatory and empowering influence on children's learning' often claimed for these tools by educational technology commentators, (p. 292). Although this study demonstrated little difference between home and school, a considerable body of evidence has demonstrated that for children, these two sites represent distinct cultural settings or 'activity systems'. As the motivation and purposes of children's ICT-related activity is likely be different in each setting (Kerawalla & Crook, 2002), it is claimed their experiences of learning, and the mental resources and higher order thinking skills they are willing to expend on educational activities will depend in part on how they perceive the activity system and sociocultural context in which this activity is located (Lim, 2002). The study reported in this paper is exploratory in nature and draws on sociocultural accounts of learning. These emphasize the need for detailed investigation of, 'the whole configuration of events, activities, contents and interpersonal processes taking place in the context that ICT is used', (Lim, 2002, p.411). The study investigated 10 – 11 year-olds' experience of using of Web 2.0 tools to support informal, self-directed learning activities at home and out-of school contexts. The research question was, 'How do young learners make use of the collaborative tools available online to support informal learning?' The aims were to identify the tools used by 10-11 year-olds to support their learning outside school; to examine their knowledge and understanding of the ways in which they learn of, about and with these tools; and to investigate how young learners perceived the constraints and affordances of these tools. As outlined above, there is little evidence that the affordances of Web 2.0 tools for collaborative learning and knowledge sharing are employed effectively in formal educational contexts. Nevertheless, Hermans et al. (2008) maintain that the Web offers an enabling learning-environment. The rapid increase in the availability and sophistication of computer-mediated communication applications and social media means that the online, collaborative tools available to learners today are radically different compared with a decade ago. Tools are no longer primarily text-based: they offer multimodal communication opportunities with simultaneous images, sounds and speech (Jewitt & Kress, 2003). In informal educational settings, (e.g. computer clubs), these are taken up enthusiastically by children, who report that they both support and motivate learning (e.g. Maloney, Peppler, Kafai, et al., 2008). By contrast, the slow educational uptake of these media may reflect the fact that adoption of Web 2.0 creates a number of practitioner tensions, which exist as significant challenges to innovation (Crook, et al., 2008). The high levels of informal learning identified by some previous studies of collaborative Web 2.0 tool use, suggests that finding out how Web 2.0 applications are used successfully can offer guidance on ways to resolve these tensions so that these tools can be deployed successfully in formal learning contexts (Clough, 2009). To date, however, the majority of studies have focused on adult learners and secondary school students. The experience of younger learners has been somewhat neglected. Also, (with notable exceptions, e.g. Kerawalla & Crook, 2002), recent studies have used written questionnaires to interrogate younger learners' understanding of learning in relation to their use of these applications in school and at home, (e.g. Selwyn et

al., 2009, Murphy & Beggs, 2003). Even with open-ended questions, however, this may not be a sensitive-enough method. Written answers to questions are unlikely to be sufficiently comprehensive to reveal all of the ways that younger learners use Web 2.0 tools and is unlikely to reveal their meta-knowledge and understanding of the affordances of these tools. Consequently, our study used focus group interviews and visual elicitation methods to support informed dialogues with 10-11 year-olds about their use the Internet and Web 2.0 applications. A semi-structured interview format allowed the researcher to offer flexible responses to emerging themes in the conversation. Offering drawing materials provided a means for children to use various forms of visual representation to support their verbal descriptions. Interviews were carried out at a local primary school with members of a Year Six robotics club, and with organizers and members of a computer club. Fourteen children, (ten boys and four girls) were interviewed in small groups of three or four and all children were invited to produce visual representations of the ICT hardware, software and Internet applications they used at home. Preliminary analyses of the drawings and interview transcripts has revealed that the 10-11 year-olds in our study routinely engage in both face-to-face and on-line collaborative, learning activities around computers with friends and that they use a variety of instant messaging and mobile technologies to share and exchange knowledge and expertise about gaming and Internet searching techniques and to discuss the usefulness of different search engines and information sites. These children discuss and evaluate the usefulness of Internet book and music stores and appear to be discerning and discriminating consumers. They offered interesting evaluations of the reliability of information sources, (e.g. Wikipedia, the BBC, You Tube) and revealed good awareness of the potential risks of participating in social networking sites such as Facebook. The data also reveal that although these children report on-line engagement with an extended, global network of family and friends, the learning potential afforded by Web 2.0 tools is hampered by inefficient information search and knowledge-sharing strategies. More detailed analysis will draw on the theoretical and analytical framework of activity theory to organize themes that are beginning to emerge from the data concerning children's use of Web 2.0 tools to mediate simultaneous activity in overlapping activity systems; their collaborative division of labour during in knowledge building activities and their understanding of rules and strategies that enable or restrict these activities. The findings suggest that if an (adult) objective of these informal learning activities is the development of higher order thinking and communication skills, (Cole & Engeström, 1993), then there is a need for sensitive scaffolding by more knowledgeable adults and peers that can enable children to realize the full social-learning potential of Web 2.0 tools.

PAPER PRESENTATION

Training English Skills among Finnish Dysfluent Readers

Piia Bjorn, University of Jyväskylä, Finland; Paavo Leppanen, University of Jyväskylä, Finland

Responding to intervention (FastForWord) of English language was examined among Finnish speaking students. The fifth-grade students identified as having reading problems were randomly assigned to a training group and a training control group. The training group (n = 14) received a 50-minute computer program-based instruction daily for a 10-week period. Students in the comparison condition (training control group, n = 11) received the school's regular instructional program. The third group (typically reading control group) consisted of fourteen normally advanced students. The students' skills in English and Finnish languages were examined in pre-test, post-test and follow-up measures containing a battery of psychometric, phonological and language comprehension tests. This presentation will discuss the findings concerning the English language skills. The findings showed modest improvement in rapid naming skills among the training group students suggesting that the program is useful in training basic language elements. Educational implications of the results are discussed.

Introduction

Children who learn English as a second language struggle with acquisition of grammar, phonology, and semantics. Auditory perception and phonological awareness are essential skills in processing language (Gaab et al., 2007). It remains unclear, whether problems in these skills are a result of poor speech-sound perception or problems in sound representations in the brain. Further, the problems in the speech-sound perception might also be interrelated with more comprehensive deficits in the auditory system itself (Hämäläinen et al., 2008). The FastForWord program we used in the intervention, is based on a theory assuming that developmental language deficits are driven or caused by difficulties in perceiving rapid changes in sensory stimulus stream within speech (Tallal, 1996). However, not all the dysfluent readers have problems in auditory processing (See, Hämäläinen et al., 2008; Pennala et al., 2010). A common trend has been that intervention research targeted to language problems uses Internet and very "high-tech" computer programs (For example, see Goswami, 2005; Lyytinen et al., 2007). One of these kinds of Internet-based programs is the FastForWord-program family (www.scilearn.com). There is some previous literature available reporting research conducted within similar conditions compared to the present study (see, Friel-Patti et al., 2001). Aims In this presentation, our aim is to discuss the results of FastForWord computer intervention among Finnish fifth-grade dysfluent readers reported as having problems in English (secondary language, learned at school) in comparison to typically reading class mates and a training control group. Methods Participants The name of our project "EngLexia"

comprises of the first part 'Eng' referring to English language and the latter part 'Lexia' referring to reading. Using reading fluency tests and teacher assessments we formed three groups: training group (n = 13), training control group (dysfluent readers, n = 11) with the school's regular instructional program only and typically reading control group, also only attending to regular school program (normal readers, n = 14).

Procedure

The pre-measurements took place in February 2007. End-measurements after training phase were administered in May 2007. Finally, the follow-up measurements took place in December 2007. The participants' auditory skills (CTOPP and TAPS), English language comprehension (WLPB-P), rapid naming (CTOPP) and items measuring phonemic awareness (CTOPP) of English language were tested. InterventionFastForWord Language -program was developed on the basis of research conducted by Professor Paula Tallal (Tallal et al., 1996). The program includes items which, for example, train discrimination and order judgment of non-speech auditory items presented at different frequencies, word-level comprehension, grammar and finally sentence-level comprehension. The program was administered via classroom computers with headphones (50 minutes daily for 10 weeks).

Analysis

This presentation discusses the results of pairwise post hoc tests (Tukey's HSD) for group comparisons at each measurement timepoint. Results The results presented here are examples. In the actual presentation we will discuss all the measured areas of English language comparing the three groups. In English language pre-measurements, we found no statistically significant differences in any of the measured skills between the dysfluent reader groups and the typically reading group, suggesting that the English language tests were equally difficult for all the groups at the baseline.

At the end-measurement tests right after the training period, a difference in rapid naming errors was found between the training group and typical readers (mean difference = 0.82, p rapid naming time (mean difference = 2.42, p In follow-up measurements after six months, the training group participants had now gained in rapid naming errors (mean difference = 0.37, p = 0.67) –the difference was no longer statistically significant. In addition, although the difference in rapid naming time was still statistically significant (mean difference = 1.83, p English reading comprehension (mean difference = 0.93, p

Theoretical and Educational significance

Our research project showed that computer-assisted games work as motivating extras from both the teachers' and students' perspectives. Our results concerning second language learning were only modest suggesting that in the future it would be useful to develop ways to combine computer-assisted learning and actual teacher - student interaction.

References

- Friel-Patti, S., Loeb, D.F. & Gillam, R. B. (2001). Looking ahead: An introduction to five exploratory studies of FastForWord. *American Journal of Speech-Language Pathology*, 10, 195–202.
- Gaab, N., Gabrieli, J.D.E., Deutsch, G.K., Tallal, P. & Temple, E. (2007). Neural correlates of rapid auditory processing are disrupted in children with developmental dyslexia and ameliorated with training: An fMRI study. *Restorative Neurology and Neuroscience*, 25, 295–310.
- Hämäläinen, J.A., Leppänen, P.H.T. & Lyytinen, H. (2008). Kuulotiedon käsittelyn pulmat lukihäiriön yhteydessä – katsaus teorioihin. *NMI-Bulletin*, 18 (2), 8–22. [Problems in auditory processing and dyslexia – a theoretical review].
- Lyytinen, H., Ronimus, M., Alanko, A., Poikkeus A.-M. & Taanila, M. (2007). Early identification of dyslexia and the use of computer game-based practice to support reading acquisition. *Nordic Psychology*, 59 (2), 109–126.
- Pennala, R., Eklund, K., Hämäläinen, J., Richardson, U., Martin, M., Leiwo, M., Leppänen, P.H.T., & Lyytinen, H. (2010). Perception of phonemic length and its relation to reading and spelling skills in children with family risk for dyslexia in the first three grades of school. *Journal of Speech, Language, and Hearing Research*, 53, 710–724.
- Tallal, P., Miller, S.L., Bedi, G., Byma, G., Wang, X. & Nagarajan, S.S. (1996). Language comprehension in language-learning impaired children improved with acoustically modified speech. *Science*, 271, 81–84.

PAPER PRESENTATION

Inclusive education: A Portuguese study about attitudes and concerns

Joel Santos, Lisbon University, Portugal; Margarida Cesar, Lisbon University, Education Institute, Portugal

The 21st century mainstream schools are characterised as cultural diverse spaces/times (Céêsar, 2009). In Portugal, we observe a growing diversity among students that attend mainstream schools (Céêsar & Santos, 2006) offering opportunities to develop broader inclusive educational settings (Ainscow, 1999; Céêsar & Ainscow, 2006). The

construction of more inclusive educational settings is intimately related with the educational agents' sentiments, attitudes and concerns towards inclusive education (IE) (Forlin, Loreman, Sharma, & Earle, 2007; Loreman, Earle, Sharma, & Forlin, 2007). It is crucial to study changes promoted by teacher education on the educational agents' sentiments, attitudes and concerns towards IE (Forlin et al., 2007; Loreman et al., 2007). This research is from a broader research project *Educação Inclusiva e Processos de Formação*. Its main goal is to study the sentiments, attitudes and concerns presented by teachers and other educational agents, before and after attending pre- and in-service teacher education curricular units regarding IE. We developed a long panel survey (Cohen & Morrison, 2001). The participants (N=289) included teachers and other educational agents from all over Portugal. To collect data we used: (1) documents; and (2) the SACIE scale – Sentiments, Attitudes & Concerns about Inclusive Education – by Loreman, Earle, Sharma, and Forlin (2006). This scale was answered in two moments: at the beginning and at the end of the selected curricular units. When confronting data from these two moments we observe a slightly increasing number of answers that indicate more inclusive sentiments and attitudes along with a high level of concerns towards IE.

In the last decades the Portuguese society has become increasingly multicultural (Céêsar, 2009). These changes fostered diversity within students who attend the Portuguese mainstream schools (Céêsar & Santos, 2006). Although students have become more diverse, from the 1.2 million mainstream students around 95 thousand still face exclusion by failing school or experiencing early school dropouts (INE, 2009). We conceive IE as a mediation tool for developing a quality education for all, within a specific culture, space and time (Céêsar & Santos, 2006; Daniels, 2001; Vygotsky, 1934/1962), in which all voices are celebrated as valuable resources for all (Armstrong, Armstrong, & Barton, 2000; Bakhtin, 1929/1981; Céêsar, 2009). In Portugal, the graduate and post-graduate teacher education curricula changed. They started including curricular units addressing IE and/or special educational needs (SEN) (Santos, 2008; Santos & Céêsar, in press). Although these changes promoted the construction of more inclusive settings, we still observe non-inclusive practices in Portuguese mainstream schools (Rodrigues, 2003). Authors stress the relations between the construction of (more) inclusive educational settings in mainstream schools and the sentiments, attitudes and concerns of the educational agents towards IE, and how these may be fostered through teacher education (Forlin et al., 2007; Loreman et al., 2007). Furthermore, teacher education must be consistent with the educational agents' zone of proximal development (ZPD) (Vygotsky, 1934/1962) in order to promote more desirable impacts on the educational agents' sentiments, attitudes and concerns towards IE. Thus it is essential to study the changes after pre- and in-service teacher education on the sentiments, attitudes and concerns of the educational agents (Forlin et al., 2007; Loreman et al., 2007). This study is part of a broader research project *Educação Inclusiva e Processos de Formação*. Its main goal was to study the sentiments, attitudes and concerns presented by educational agents in Portugal.

The problem that originated this research was the existence of non-inclusive sentiments, attitudes and concerns from the teachers and educational agents who develop their practices in mainstream schools (Santos, 2008). We considered these research questions: (1) What sentiments, attitudes and concerns about inclusive education do the teachers and other educational agents present before attending some teacher education units related to inclusive education?; (2) What sentiments, attitudes and concerns do the teachers and other educational agents present after attending some teacher education units related to inclusive education?; and (3) What are the changes between these two moments?

We carried out this research using a design based in a long panel survey (Cohen & Morrison, 2001). The participants include teachers and other educational agents (N=289), like educational psychologists, physical rehabilitation professionals and special education teachers. They attended higher education professional courses with curricular units related to IE. Since the participation was in a volunteer basis, some institutions did not accept to participate. To collect data we used: (1) documents; and (2) the SACIE scale – Sentiments, Attitudes & Concerns about Inclusive Education – by Loreman, Earle, Sharma, and Forlin (2006). This scale was answered in two moments: at the beginning and at the end of the selected curricular units. The selection of the curricular units was conducted through a document analysis in which we identified the intention to explore contents related with IE and/or to SEN.

Data analysis showed a high level of concern towards students categorised as presenting SEN along with a substantial number of educational agents that indicated inclusive comfort sentiments and attitudes towards IE. When confronting data from the before and after the curricular units regarding IE and/or SEN, there is a slightly increasing number of individuals that indicated more inclusive comfort sentiments, attitudes and concerns. For instance, more of these educational agents indicated comfort when around a student categorised as presenting SEN, also agreeing with the presence of aggressive students in mainstream classes. We also observe a slightly decreasing number of teachers and educational agents that indicated concerns towards an increase in stress when in the presence of a student categorised as presenting SEN in a mainstream classroom. A possible interpretation is that the curricular units only

lasted three/four months and sentiments, attitudes and concerns change processes need more time to become visible.

References

- Ainscow, M. (1999). *Understanding the development of inclusive schools*. London: Falmer Press.
- Armstrong, F., Armstrong, D., & Barton, L. (2000). *Inclusive education: Policy, contexts and comparative perspectives*. London: David Fulton Publishers.
- Bakhtin, M. (1929/1981). *The dialogical imagination* (M. Holquist, Ed.) (M. Holquist, & C. Emerson, Trans.). Austin: University of Texas Press. [Original work published in Russian in 1929]
- Céêsar, M. (2009). Listening to different voices: Collaborative work in multicultural maths classes. In M. Céêsar, & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 203-233). Rotterdam: Sense Publishers.
- Céêsar, M., & Ainscow, M. (Eds.) (2006). *European Journal of Psychology of Education*, XXI(3).
- Céêsar, M., & Santos, N. (2006). From exclusion into inclusion: Collaborative work contributions to more inclusive learning settings. *European Journal of Psychology of Education*, XXI(3), 333-346.
- Cohen, L., & Morrison, K. (2001). *Research methods in education*. London: Routledge Falmer.
- Daniels, H. (2001). *Vygotsky and pedagogy*. London: Routledge Falmer.
- Forlin, C., Loreman, T., Sharma, U., & Earle, C. (2007). Demographic differences in changing pre-service teachers' attitudes, sentiments and concerns about inclusive education. *International Journal of Inclusive Education*, 22(2), 150-159.
- Instituto Nacional de Estatística (INE) (2009). *Anuário estatístico de Portugal: 2008*. Lisboa: INE.
- Loreman, T., Earle, C., Sharma, U., & Forlin, C. (2007). The development of an instrument for measuring pre-service teachers' sentiments, attitudes, and concerns about inclusive education. *International Journal of Special Education*, 22(2), 150-159.
- Rodrigues, D. (Ed.). (2003). *Perspectivas sobre a inclusão: Da educação à sociedade*. Porto: Porto Editora.
- Santos, J. (2008). *Construir inclusão: Os sentimentos, atitudes e preocupações dos agentes educativos em relação à inclusão*. Lisboa: DEFCUL. [Master thesis]
- Santos, J., & Céêsar, M. (in press). *Atitudes e preocupações de professores e outros agentes educativos face à inclusão*. Interacções.
- Vygotsky, L. S. (1934/1962). *Thought and language* (Myshlenie I rech', Trans.). Cambridge MA: MIT Press. [Original work published in Russian in 1934]

PAPER PRESENTATION

Index of Commitment toward Inclusive Communities

Marina Santi, University of Padua, Italy; Elisabetta Ghedin, Padua University, Italy

The benefits and the advantages of full-inclusion are recognized in the scientific and cultural communities at international level (UN Convention on the right of persons with disabilities, 2006, UNESCO). To this aim some instruments are created to sustain the process of inclusion such as that created by the CSIE (Booth and Ainscow, Index for inclusion in schools). In the Italian context the need and the importance to enlarge the attendance of all children are recognized and regulated by Italian law but the authentic process from insertion through integration to inclusion is very complex, long and difficult.

Starting from the "Index for inclusion" (Booth et al., 2000, 2006) the aim of this study is to create an "Index of Commitment toward inclusive communities", that can be used by the schools in a double way:

- to recognize specific educational political and cultural actions toward inclusive education in which schools are committed to, and which could be observed, implemented and evaluated.
- to provide a tool of self-evaluation, accountability and a repository of good practices for organizations and staff.

The implications of these findings are considerable because the study provides results directly derived from a favorable context as Italy (the unique context of full-inclusion of children with disabilities in mainstream schools) and from the modification and application of indicators accredited and recognized at international level (Index for Inclusion in Italy). The main results of this study is the creation of a "mixed tool" in which top-down principles are related with bottom-up good practices implemented in the schools in order to create an inclusive communities repertoire.

Summary:

In the first step of the research a definition of inclusion is elaborated and provided. based on the concept of belonging relationship. Transposing this definition in the field of social inclusion, this relationship is considered as a complex

sense of (well)-being which implies: feeling respected, valued for who you are; feeling a level of supportive energy and commitment from others so that you can do your best work (Santi & Ghedin). Many authors (Sen, 1999; Nussbaum, 2007, Terzi, 2005, Unterhalter 2009, Saito, 2003) establish strong connections between philosophical aspects of inclusion with the processes of inclusive education, and link inclusion to core-dialectics as equality/inequality, justice/discrimination, inclusion/exclusion and core-concepts as dignity, human development and freedom. In our Italian context several authors (Canevaro, 2007; Caldin, 2004; Ghedin, 2009; Pavone, 2010, lanes, 2005) wrote about the process of inclusion of the persons with disabilities in school, considering historical evolution from "inserimento", to "integrazione", towards inclusion. Also the international organizations recognize the right/need of inclusion of disabled in many documents as Salamanca Statement (UNESCO, 1994), the Convention on the Right of Persons with Disabilities (UN, 2006), the International Classification of Functioning (ICF; WHO, 2001), and the Index(es) for Inclusion (Booth & Ainscow, 2002, 2006).

State of the art

The concept and practices of school integration are a unique part of the Italian social and cultural context and historical development (Armstrong, 2009). In the Italian context the children with special educational needs and disabilities are integrated in mainstream schools because the Italian legislation (L. 181/71, L. 517/77, 104/92) recognized the importance of inclusion for the activity and participation dimensions of the child and the importance of the environmental factors for the determination of a disability. The notion of inclusion does not set boundaries around particular kinds of disability or learning difficulty, but instead focuses on the ability of the school itself to accommodate a diversity of needs (Booth et al., 2000, Kalambouka et al 2005, Demeris et al. 2007).

Our study starts by analyzing the two Index(es) for inclusion in schools and in early years and childcare edited by CSIE (2002, 2006), considered as a way of improving settings (Schools/Communities) by:

- a) Offering supportive process of self-review and development
- b) Building collaborative relationships and improvements
- c) Encouraging a view of learning in which children and young people are actively involved.

Purposes

The purpose of our study is to move from a descriptive aim, that of the Index(es) for inclusion, to a pre-scriptive aim, that of our index of commitment toward inclusion.

To this aim we create an "Index of Commitment toward inclusive communities" that can be used in particular by the schools both to:

- recognize specific educational political and cultural actions toward inclusive education in which schools are committed to, and which could be observed, implemented and evaluated;
- provide a tool of self-evaluation, accountability and a repository of good practices for organizations and staff .

Hypotheses

The accessibility of mainstream school by all children (disabled and not) is a right and an opportunity for learning and citizenship. To this aim instruments are created such as the Indexes of inclusion by the CSIE. In the Italian context the integration of students with disabilities in school are guaranteed by the law, but the authentic process from insertion towards inclusion is very complex, long and difficult.

An "Index of Commitment toward inclusive communities" allows the schools:

to recognise their strengths and weaknesses toward the implementation of inclusive education as a dynamic process realizable through a set of responsible and shared actions, providing explicit declinations into praxis and producing evaluable and "externalised" changes in schools activities and politics.

Methods

In order to create an "Index of Commitment toward inclusive communities" we have started from the two existing "Index for inclusion" considering the three dimensions (creating inclusive cultures, producing inclusive policies, evolving inclusive practices), and the connected indicators and the detailed questions.

Focus-group with schools' staff representatives (Headmasters, Representatives of Territorial Centre for Integration, teachers for disabled students, mainstream teachers, students, disabled students...) was carried out in order to explore the coherence and consistency of the index of commitment and its efficacy of grasping different school practices.

A first part of the study is already concluded: the modification of the Index for inclusion into the Index of Commitment to inclusive communities, with the selection of 35 commitments and 5 questions for each commitment that represent the feedback for the schools' work toward inclusion.

The second part of the study involved a representative group of the schools (primary and secondary schools) of the Veneto Region spread over all the different provinces, in collaboration with the Veneto Regional Instructional Office with the aim of bringing out the commitment of the schools toward inclusion.

Results and Discussion

The data implementation is still in progress and will be presented and discussed in the paper, with the main educational implications of the results. Data collected will be analysed with SPSS with the aim to accredit and certificate the schools committed to the process of inclusion. The main results of this study is the creation of a "mixed tool" in which top-down principles are related with bottom-up good practices implemented in the schools in order to create a useful inclusive communities repertoire.

Findings

The implications for these findings are considerable because:

- 1) the study provides results directly derived from the application of indicators of the Index for Inclusion in Italy, the unique context of full-inclusion of children with disabilities in mainstream schools.
- 2) it is interesting to use a Commitment version of Index in which the corresponding
 - actions/doings for inclusion
 - features/beings for inclusionare expressed/externalized and became recognisable, sharable, and available among different institutions and so evaluable, also by families and students.

Future directions

- . To provide an on-line form of the tool for school accountability
- . To create a good practices repository/self/reciprocal-trainingpedia
- . To realize the participation of children/ parents' commitments considering the inclusive paradigm.

PAPER PRESENTATION

Raising levels of achievement for pupils with Moderate Learning Difficulties

Annamari Ylonen, University of Exeter, United Kingdom; Brahm Norwich, University of Exeter, United Kingdom

While pupils with moderate learning difficulties (MLD) represent the largest proportion of those identified as having special educational needs, they have tended to be neglected as a focus for educational initiatives. The Raising Levels of Achievement project aims to improve the learning experiences and opportunities of pupils with MLD to enhance their educational achievements and broader well-being in schools. This will be done through a programme of professional development using Lesson Study methodology, a high profile international method of in-school professional development. The project has a multitude of different aims and objectives – all of which cannot be considered here. This proposal focuses on one specific element of the evaluation of the project, namely the outcomes for participating pupils (especially MLD pupils), teachers, classes and schools at a half-way point of the two-year long project. More specifically, this evaluation focuses on examining how and why changes took place following the introduction of the Lesson Study methodology and the impact of these changes on individuals and schools concerned.

Aims

At the heart of this project lies the aim of raising the status of MLD as an important area of educational research and a field for development. Pupils identified with MLD come disproportionately from families who experience socio-economic disadvantage compared to other areas of SEN, such as autism and speech and language impairment. There is a notable lack of well established advocacy or voluntary groups dedicated to the interests of these pupils. Another difficulty arises from the fact that the MLD category is a contested one. Moderate learning difficulties was a term introduced in the Warnock Report 1978, but there is prevailing uncertainty as to which pupils are designated as having MLD. The debate about the MLD category highlights the question about whether these pupils are just the lowest of the lower attaining pupils or whether they have an intellectual disability (Norwich and Kelly 2005). This historic uncertainty about the position of pupils with MLD as being between those with severe intellectual disabilities and 'normal' pupils who are lower attaining is also relevant to understanding the educational neglect of these pupils. It is important to note that MLD pupils – regardless of the problems and debates over categorisation – tend to be notable educational underachievers, as Desforges (2006) concluded in his review of achievement of pupils with MLD at Key Stage 3 and 4. DCSF statistics show, for instance, that while 68% of those doing GCSE achieved 5+ A*-C grades in 2007, only 17% with SEN at School Action Plus and 9% with Statements achieved this level (DCSF 2007). Though these figures relate to all identified as having SEN at these levels, given that MLD represents a quarter of these pupils, these

statistics give some indication of levels of secondary school attainments. The Raising Levels of Achievement project, which began in the autumn of 2010, aims to improve the learning experiences and opportunities of pupils with MLD to enhance their educational achievements and broader well-being in schools. This will be done through a programme of professional development using Lesson Study methodology, a high profile international method of in-school professional development originating from Japan. In short, the Lesson Study methodology provides opportunities to examine lessons in a detailed way, which enables planning for wider learning aims (DCSF 2009). The evaluation of the project will be ongoing during the two-year period of the project and it will focus on two domains: outcome evaluation and process evaluation. The paper proposal discussed here focuses on outcome evaluation at a half-way point of the project as outlined below. The aims of the evaluation of the project considered here relate to three separate, but interlinked areas: The impact of the Lesson Study on the learning and learning dispositions of pupils with MLD in the project schools. The enhanced professional development of participating teachers. The enhanced curriculum and pedagogic development in the participating schools. In addition, the evaluation aims to examine the usefulness of the MLD category in secondary schools. The research question is whether there are any differences between participating pupils identified as having MLD, those who are below average and with other kinds of learning difficulties in terms of attainments, cognitive abilities, attitudes to learning and self concept.

Methodology

At phase 1 of the evaluation there are a mixture of 20 secondary and special schools from two urban authorities (Plymouth and Bristol) and two rural areas (Somerset and Devon). The secondary schools have been selected to reflect a range of provision for MLD. The special schools have a high proportion of pupils with MLD, but may not be designated as MLD special schools. 20 teachers from the participating schools are trained in Lesson Study design and will continually review their own classroom practice in order to help them to develop learning experiences. They will be also trained in research methods to support this work – data gathered by teachers constitutes an important element of the project evaluation. In each secondary school there are two classes where the Lesson Study method is used. Within these classes the sample of pupils include two pupils identified with MLD, one with specific learning difficulties (e.g. dyslexia), one low attaining pupil and one average attaining pupil. Within the special schools the sample consists only of pupils designated as having MLD with some having other kinds of associated difficulties. . Testing and assessment of these case pupils (pre and post intervention) focus on examining academic, cognitive and self-concept issues and will utilise the British Ability Scales (BAS), Myself-as-a-learner Scale (MALS), Resiliency Scales, and pupil attitude to school measures. In addition, teacher attainment assessment will be utilised. These measures are relevant to the question of the usefulness, or otherwise, of the MLD category as well as elucidate outcomes of the Lesson Study method. Data used in the evaluation come from a variety of different sources and consist of data collected directly by evaluation staff by using both quantitative and qualitative methods (e.g. test, surveys, interviews and observations), and data collected by teachers in the development work (e.g. interview and observation data, video recordings and field notes).

Findings

The paper reports learning characteristics and achievements of participating pupils with MLD and other pupils in the participating Lesson Study classes and the wider impact of Lesson Study on teachers and schools. The pupil level assessment highlights findings about the usefulness of the MLD category while teacher/class/school level analysis highlights the impact of the Lesson Study method on teacher professionalism, class cohesion and the school as an effective learning environment. Issues of inclusion (and exclusion), school-wide ethos and pupil-pupil/ teacher-pupil relationships are also brought to attention. The paper contributes to developing theoretical knowledge and awareness of MLD as a SEN category, how to develop specific pedagogies addressing the needs of this thus far largely neglected group of children in educational research, and how to increase teacher professionalism and efficacy in this area.

References

- DCSF (2007) National Curriculum Assessment, GCSE and Equivalent Attainment and Post-16 Attainment by Pupil Characteristics, in England 2006/07. London: DCSF
- DCSF (2009) Improving subject pedagogy through Lesson Study. London: DCSF
- Desforges, C. (2006) Review of literature about pupils with moderate learning difficulties. London: Esmee Fairbairn Foundation
- Norwich, B. and Kelly, N. (2005) Moderate Learning Difficulties and the Future of Inclusion. London: Routledge Falmer

PAPER PRESENTATION

Comparison of a direct and combined training in cognitive learning strategies

Silja-Susann Taxis, Ulm University, Germany; Tina Seufert, Ulm University, Germany

Cognitive learning strategies are effective support for learners dealing with complex learning material. In our study we analyzed the effects of direct and combined training in learning strategies (containing text reading, task solving and reciprocal teaching) on strategy use and learning performance. Furthermore, interaction effects between partners' cognitive abilities in reciprocal teaching were investigated. Students in grade 5 received either a direct or combined training or remained untrained. Results indicate an advantage of direct over combined training in text reading and problem solving on strategy use and learning performance. Both training groups outperformed the control group in reciprocal teaching and students with higher cognitive abilities showed better learning results when learning with low ability than with high ability students.

Introduction and Theoretical Background

When learning, learners need specific strategies for understanding texts or solving complex tasks or problems. Besides these specific strategies, there are general strategies like reciprocal teaching, where students share their ideas to understand a text or solve a problem together. When these interactions are unscripted, high ability learners take on the teacher's role, while low ability learners take on the role of a learner (Wiegmann, Dansereau & Patterson, 1992). Specific as well as general strategies can have a positive impact on learning outcomes and can be fostered directly or indirectly (e.g. Artelt, 2006). In a direct training strategies are delivered explicitly, whereas in an indirect training strategies are an implicit part of the learning environment. Both types of training can be combined with indirect learning opportunities after an explicit instruction. In our study we analyzed the effects of direct and combined training on learning performance and strategy use. We predicted advantages of the combined over the direct training because of the increased number of learning opportunities. Moreover, concerning reciprocal teaching, we investigated interaction effects between the cognitive abilities of both partners on learning performance. One could assume role conflicts when learners with comparable cognitive abilities are learning together, which may lead to lower performances than in groups of learners with different cognitive abilities.

Method

We compared three groups of 5th grade Gymnasium students: one training group received only a direct training in learning strategies (N=54), the second one received a combined training over three months (N=58) and the third group served as an untrained control group (N=51). The learning strategy training consisted of three cognitive strategies: a text reading strategy, a problem solving strategy and a strategy for reciprocal teaching (Palinscar & Brown, 1984). The learning strategy training was implemented in class by teachers. After the direct instruction of the strategies the students received cards for lessons and homework where the three strategies were described stepwise. Cognitive ability was assessed by a cognitive ability test (Heller & Perleth, 2000). Students were classified by median split into four groups: students with low or high cognitive abilities learned with partners with either low or high cognitive abilities. After the end of the combined training, we assessed strategy use on a behavioural level and analyzed if students conducted the steps of the strategy cards while working with texts and complex tasks. To assess the effect of the text reading strategy and reciprocal teaching on performance, students had to answer questions pertaining to the texts; the effect of the problem solving strategy was measured by complex mathematical problems.

Results

With respect to strategy use, an ANOVA for effects of the text reading strategy found a main effect for training ($F(2, 162) = 28,88, p < .001, \eta^2 = .27$). Both training groups used more text reading strategies than the control group (control group vs. direct training: $MD = -.49, SE = .07, p = .001, MD = -.20, SE = .06, p = .001, MD = .29, SE = .06, p = .001, MD = 6,48, SE = 3,41, p = .03$). An ANOVA for strategy use while solving a task found a main effect for training ($F(2, 160) = 6,09, p < .001, \eta^2 = .07$). The directly trained students used more strategies than the control group ($MD = -.16, SE = .07, p = .02$) and the combined training group ($MD = 0.23, SE = .07, p = .001, MD = .17, SE = .10, p = .04$) and the control group ($MD = -.24, SE = .10, p = .02$). Concerning reciprocal teaching, an ANOVA with the factor treatment and the factor for the interaction effect between the cognitive abilities of both partners on learning performance found a main effect for training ($F(2, 163) = 13,59, p < .001, \eta^2 = .15$): both training groups outperformed the control group (control group vs. direct training: $MD = -19,55, SE = 4,04, p = .001, MD = -16,48, SE = 3,90, p = .001, F(3, 163) = 5,47, p < .001, \eta^2 = .10$). Students with higher cognitive abilities learning with students with lower cognitive abilities showed better learning results than those learning with students with higher cognitive abilities ($MD = 8,38, SE = 4,65, p = .04$).

Summary and Discussion

We analyzed the difference between direct and combined learning strategy training on strategy use and learning performance. For all three strategies we didn't find the assumed advantage of a combined training over a direct training on the level of strategy use and learning performance. One explanation might be that we measured the effects after different time periods: while students of the direct training have been tested on short-term effects directly after the training, the combined group was only tested after a longer period. Hence, positive short-term effects might have declined during this time, which might be due to interference effects with existing strategies, or due

to the reduced intensity of the training. Reciprocal teaching led to better learning performance. Partly, we also found an interaction effect of learners' cognitive abilities. Students with higher cognitive abilities showed better learning results when learning with low ability students than with high ability students. With an inferior partner they can follow the classical role arrangement and profit from taking over the active role.

References

- LiteratureArtelt, C. (2000). *Strategisches Lernen*. Mýnster: Waxmann.
- Palinscar, A. S., & Brown, A. L. (1984). Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities. *Cognition and Instruction*, 1, 117-175.
- Wiegmann, D.A., Dansereau, D.F. & Patterson, M. E. (1992). Cooperative-Learning: Effects of Role Playing and Ability on Performance. *Journal of Experimental Education*, Vol. 60.

PAPER PRESENTATION

The development of high school students' interest in philosophy: A longitudinal study

Pietro Boscolo, Universita di Padova, Italy; Paolo Piccinin, university of Padova, Italy

The study was aimed at analysing the development of 11th graders' interest in philosophy, a discipline novel to them, which was taught according to two different methods: dialogue-based and text-based. The first method is based on the teacher's exposition of a topic and students' participation through questions and discussion. In the second method, the teacher starts with the reading of a philosophical passage, from which students are guided to get information about a problem and related concepts. The study, lasting for a school year, was conducted with 101 11th-graders from 4 classes of a Scientific Lycaenum (M = 58, F = 43). Two classes (N = 51, M = 29, F = 22) were casually assigned to the dialogue-based teaching procedure, and two (N = 50, M = 29, F = 21) to the text-based teaching procedure. The philosophy syllabus was divided into 5 main topics (from pre-Sophists to Aristoteles) and students' interest and learning were assessed after each topic.

Results showed that interest was higher in the dialogue-based group, whereas the text-based group students were more cognitively involved. Regarding the relationships between interest in a topic and learning, in the most interesting topic students scored better in all questions, and significantly higher in questions requiring deeper elaboration of knowledge.

In recent years, several studies have analysed the nature of interest, mainly in the light of the distinction between situational and individual interest (e.g., Hidi, 1990; Hoffman et. al., 1998; 2006; Renninger et al., 1992; Schiefele, 1991). Situational interest is elicited by the attractive or novel features of an object/event, whereas individual interest is a long-standing orientation towards an object. The relationships between the two types of interest have been conceptualized in Hidi and Renninger's (2006) four-phase model of interest development. According to the model, situational interest includes two phases: triggered and maintained, whereas individual interest includes emerging and well developed interest.

The study was aimed at analysing the effects of the teaching method on the development of 11th graders' interest in philosophy, a new discipline to them. The study was based on two main assumptions. The first assumption was that, although interest is often considered a unique variable, it includes several components, which may emerge in different ways in its development. For instance, being interested in a philosophical topic implies to perceive the relevance of a theory, and/or to feel cognitively stimulated by philosophical argumentation (e.g., Boscolo et al., in press; Schraw, Bruning, & Svoboda, 1995; Schraw & Lehman, 2001). The second assumption was that the teaching method influences the development of interest in a complex subject. In the study, two methods were compared, differing in the role of analysis of philosophical texts (Bowery & Beaty, 1999; Sadler, 2004). The dialogue-based method starts from the teacher's exposition of a topic and the related basic concepts. Analysis and interpretation of a philosophical text follows, does not precede, the exposition of topics. During the exposition, the teacher re-constructs an author's ideas and stimulates and facilitates students' participation in the lesson through questions and discussion. In the text-based method, the teacher starts with the reading of a philosophical passage, from which students are guided to get information about a problem and related concepts. During the lesson, the teacher helps students clarify concepts, integrate information, and focus on the context, ideas and new words emerging from reading.

The study, lasting for 1 school year, addressed the following questions:

1. does teaching philosophy through students' questions and classroom discussion contribute to students' interest in the subject more than a method based on philosophical text analysis?
2. do the two methods have different effects on the development of students' ideas of philosophy and its utility?
3. does an interesting topic influence learning more positively than an uninteresting one?

Method

Participants

The study was conducted with 101 11th-graders from 4 classes of a Scientific Lycaem. (M = 58, F = 43). Two classes (N = 51, M = 29, F = 22) were casually assigned to the text-based teaching condition, and two (N = 50, M = 29, F = 21) to the dialogue-based condition. The students had not previously studied philosophy. The teacher of philosophy was the same in the four classes.

Measures and procedure.

1. Initially, all students were administered questionnaire 1 regarding their ideas and expectations about the contents of philosophy, usefulness for young people's education, interestingness, and main sources of study difficulties. The philosophy syllabus was divided into 5 topics: 1. Pre-sophist philosophy, 2. Sophists and Socrates, 3. physis and nomos (nature and law), Plato, Aristoteles.

After presentation and study of each topic, that is 5 times, questionnaire 2 was administered, including questions on global interest in a specific topic and sources of difficulty; open-ended questions on the most and least interesting parts of the topic. Moreover, 24 questions (4-point rating from "False for me" to "True for me") regarded the following aspects of interest in philosophy:

Liking (e.g. "I like philosophy because it poses basic questions")

Relevance of themes/topics ("While studying philosophy, I realize that the basic questions of our life are always the same")

Situational interest ("The teacher's lively presentation of philosophers and their theories makes the philosophy class enjoyable")

Cognitive involvement ("I feel stimulated by the study of philosophy to think by myself, not only through the teacher's or book's words").

Questionnaire 2 also included questions aimed at assessing the comprehension of the specific topic.

Lastly, at the end of the year, all students were administered questionnaire 3, including some questions of questionnaire 1 (definition of philosophy, perceived usefulness for young people's education). Moreover, students were asked to indicate the most and least interesting topic, and reply to open-ended questions regarding these topics. These questions regarded different levels of knowledge elaboration.

Results

All students' interest scores increased from topic 1 to 3 (from pre-sophists philosophy to physis and nomos), and decreased with topic 4 and 5. Regarding the development of interest, a multivariate analysis of variance, with group as a between-subject factor and time (5 administrations) and components (4) as within-subject variables, showed that the dialogue-based group students scored higher than the text-based group in the Liking, Situational interest and Relevance components, but lower in Cognitive involvement ($F(2, 367) = 12,57$, $p2=.11$). Regarding the relationship between interest and learning, the most interesting topic was always related to better scores in the learning questions requiring deeper elaboration of knowledge ($F(2, 92) = 23,24$, $p2=.17$). Lastly, regarding students' ideas on philosophy, a log-linear analysis showed a higher frequency of more advanced definitions at the end of the year, regardless of the teaching method ($z = 2.745$, p

Discussion

The development of participants' interest in philosophy partially confirmed the developmental trend from triggered to maintained interest. The text-based teaching method fostered students' cognitive involvement, but they preferred a less cognitively demanding method, based on dialogue. The role of interest in fostering learning, underlined in recent literature, was confirmed. The study is relevant from the instructional and theoretical points of view, because it gave the opportunity to analyze the development of interest in a discipline in the classroom context, and to test the Hidi and Renninger's (2006) model.

PAPER PRESENTATION

Better thin harmony than thick dispute? On different ways to communicate scientific controversies

Dorothe Kienhues, Institute of Psychology, Germany; Rainer Bromme, Universitat Muenster, Germany

To be active members of our knowledge society, people not only need to possess basic scientific knowledge but also, and in particular, an understanding of the sciences, their potentials and limitations. Although scientific uncertainties and controversies routinely come along with the process of establishing knowledge, laypeople usually expect sound orientational knowledge. This paper focuses on laypeople's cognitive processing of scientific controversies. We assume that laypeople may struggle with finding a good explanation for scientific controversies, especially when the conflict displayed is emotionally charged, because then the conflict might appear to be interpersonal but not inherent to the topic. We presented a newspaper article on two experts discussing the benefits and harms of a fictional anesthetic. In a first study, psychology students ($N = 40$) were randomly assigned to two different versions of this newspaper article: a neutral version or an emotionally charged version. Dependent variables were change in epistemic beliefs, confidence in the two experts, whether participants would recommend the anesthetic, their own decision certainty and the assumed certainty of experts. Results reveal an equal change in epistemic beliefs for both groups, and only minor differences in the other variables. We assumed that effects might be stronger in a sample less experienced in dealing with controversies than psychology students. We conducted a second (ongoing) study where less experienced participants ($N = 60$) dealt with the same materials, and we added measures on several potential covariates. We will derive implications for laypeople's understanding of scientific controversies

In western culture, we live in a knowledge society. On the one hand, we have easy access to all kinds of information (e.g. via the Internet, independent newspapers or magazines). On the other hand, knowledge and facts play a dominant role in many everyday decisions, e.g. whether to stick with nuclear energy, what kind of medical treatment to select. In consequence, to be active members of the knowledge society, people not only need to possess basic scientific knowledge but also an understanding of the sciences, their potentials and limitations. A normal feature of scientific knowledge is its uncertainty and preliminaryity. Although scientific controversies are everyday routine in empirical sciences and come along with the process of establishing knowledge, laypeople usually expect sound orientational knowledge. This paper focuses on laypeople's cognitive processing of scientific controversies. Scientific controversies are – in an epistemological sense – argumentative approaches towards the best conclusion. They are based on the cognitive content of the conflict, and the conflict is inherent to the topic. That means the conflict is not predominately made up by the opponents, e.g. because they are at strife with one another or dislike each other. Such emotional "side effects" of conflict can occur, but are not the dominant explanation for scientific controversies. We assume that laypeople, who do not expect scientific controversies, may struggle with finding a good explanation for scientific controversies, especially when the conflict displayed is emotionally charged: Then the conflict might appear to be interpersonal but not inherent to the topic. For our studies, we made up a newspaper article on a scientific controversy. The article was about two experts discussing the benefits and harms of the fictional anesthetic "madofol". The newspaper article differed with regard to the affectivity and asperity included. In one version of the article, the discussion of the experts was displayed as neutral and fair (neutral condition). In the other condition, the discussion of the two experts was emotionally charged (emotional condition). In this version, the experts were much more excited and verbally attacked each other. The two versions of the article were identical with regard to the factual information they contained. In a first study, participants ($N = 40$, predominately psychology students) were equally assigned to the research conditions. We administered an instrument (CAEB) measuring two dimensions of epistemic beliefs about medicine (texture and variability of knowledge) a few days before participants read the newspaper article. After participants read the newspaper article, we again administered the CAEB. Participants also filled in several questions regarding their confidence in each of the two experts, whether they would recommend the application of madofol, the estimated certainty in this decision, and the estimated certainty of experts making the same decision. An ANOVA revealed a significant difference between pre- and post-instructional measurements for both factors of the CAEB (texture: $F(1,38) = 17.07$, $p = .00$, $\eta^2 p^3 = .31$; variability: $F(1,38) = 26.56$, $p = .00$, $\eta^2 p^3 = .41$). The interaction between the pre-post comparison and the between-subject variable condition failed to attain significance for both factors (texture: $F(1,38) = 1.90$, ns; variability: $F(1,38) = .29$, ns). In line with other studies on confronting participants with the complex and conflicting nature of science, dealing with conflicting information lead to more advanced beliefs. The emotionality of the information dealt with did not have specific influence on the change. With regard to the confidence in the two experts, we checked whether the two groups differ in the estimation of each of the two experts and also in how far they differentiate between the experts. Results reveal that the two groups did not differ in their confidence in expert A, $t(38) = -.89$, ns, and in expert B, $t(38) = .00$, ns. Furthermore, we tested in how far participants differentiated between the two experts, indicating a significant difference for the estimation of the experts, $F(1,38) = 9.38$, $p = .00$, $\eta^2 p^3 = .20$, but no significant interaction between estimations and the between-subject variable condition, $F(1,38) = .35$, ns. An inspection of the means suggested that the groups indicated a greater confidence in the expert who argued against the anesthetic. We tested for differences in the decision on whether they would recommend the application of madofol. In the neutral condition, five participants said yes, six said no and nine didn't know. In the emotional condition, eleven participants said yes, five said no and four didn't know. However, the two groups did not differ significantly, $\chi^2(2, N = 40) = 4.24$, ns. In addition, participants

did not differ significantly in their own decision certainty, $t(38) = -.49$, ns, and in the assumed certainty of experts making the decision, $t(38) = .63$, ns. Participants differentiated between their own certainty and the certainty of experts, $F(1,38) = 3.89$, $p = .06$, $\eta^2 p^3 = .09$. The interaction between the pre-post comparison and the between-subject variable condition failed to attain significance, $F(1,38) = .66$, ns. However, the results for the two conditions suggested different amounts of differentiation depending on the kind of article dealt with. In order to clarify the results further, paired t tests were conducted, revealing that only the participants of the neutral condition considered experts to be more certain in their decision than themselves, $t(19) = -2.35$; $p = .03$; $d = -2.82$, while participants in the emotional condition did not differentiate between experts and themselves. $t(19) = -.72$; $p = ns$. We assume that some of the effects might be stronger in a sample less experienced in dealing with controversies than psychology students. Therefore, we conducted a second study ($N = 60$) with less experienced participants. We added instruments on participants' prior attitude and their perceived relevance of the topic, as these might be determining factors of how people deal with scientific controversies. We will also report on these data and compare the results found in the two studies. We will discuss implications of our studies for laypeople's understanding of scientific controversies in modern societies. Suggestions for communicating scientific controversies will be highlighted in the full paper.

PAPER PRESENTATION

The impact of standard-based teaching on students' performances in English as a foreign language

Jenny Frenzel, Humboldt University Berlin, Germany; Jessica Andrade, Humboldt University Berlin, Germany

Based on data of the first German national assessment in English as a foreign language, this contribution investigates the impact of standard-based teaching practices on students' performances in listening and reading comprehension. We analysed 684 teachers' responses concerning the frequency of initiated activities in class in a multi-level-model in regards to 23,934 students' performances in listening and reading comprehension on a standard-based English test. Although students' performances for listening and reading highly correlate ($r = .87$), we analyse data separately due to didactical reasons.

First, descriptive results for listening comprehension show a rare use of standard-based listening activities during class for all German school tracks. Nevertheless, further results from multi-level analysis show a significant impact of listening activities on students' performance controlling for students' sex and self-concept. The impact still holds when controlling for teachers' age, sex and regional differentiation. We hypothesize that the results for reading comprehension also support these findings. Furthermore, we expect an impact of about more than a standard deviation. The results will be discussed with respect to further implementation of competence-orientation in teaching and curricular development.

Changes in the German education system have shifted toward teaching which focuses on the development on students' individual competencies. The reform asks teachers to initiate processes of competence development in classroom activities to reach the defined Educational Standards (NES) in English as a foreign language.

The NES are based on the Common European Framework of Reference for Languages (CEF, 2001) and include reading and listening comprehension in the area of communication skills. Because reading and listening are receptive activities, the CEF focuses on active language use in authentic situations, such as activities listening to public announcements, to media and listening as a member of a live audience (CEF, 2001, p. 65). The tasks for national assessments is grounded in the CEF and NES objectives, which is why care is taken to utilize authentic audio materials. The classroom offers the possibility of language acquisition through language development activities in listening and reading as well as writing. Bernaus and Gardner (2008) analysed the relationship between several classroom activities and achievements in English. With regard to perceived use of traditional and innovative strategies, they found no significant correlation between the perceived strategy use of either type and level of English achievement (Bernaus and Gardner, 2008, 393). They conclude that teachers use rather traditional than innovative strategies and that students are more aware of the traditional strategies.

Since standards-based testing focuses on reading and listening comprehension in Germany, we developed the following research:

- 1) Do reading and listening activities in the classroom as reported by students differ from teachers' suggestions towards competence orientation?
- 2) How do reading and listening activities affect students' outcome when controlling for age, sex, self-concept and regional differences?
- 3) Do competence-oriented classroom activities have an impact on student outcomes?

We hypothesize that teachers and students have different perceptions about classroom practices. Teachers will respond with more socially desired answers than students.

We also hypothesize that initiated standard-based listening activities during class have a positive association with students' listening outcome.

Sample:

The first national assessment took part in 2009 in the domain of English as a foreign language. Nationwide, 23,934 ninth-graders were tested in the domains of listening and reading comprehension. Students answered a questionnaire about classroom practices and background information. 684 English-teachers answered a questionnaire about their teaching, qualifications, and perceptions of the Educational Standards.

Method:

We scaled the standard-based reading test consists of 237 items and the listening test of 213 items using IRT-modeling, controlling for several background-characteristics. We compared teachers' and students' questionnaire data, which in part consists of six items on reading activities in class as well as six items on listening activities, inquiring about the frequencies of standard-based activities within the last six months using a scale from 1 (never) to five (each lesson). We calculated students' standardized differential value and compared with teachers' suggestion for that class using Kendall's tau.

For the second research question, because of the nested data, we constructed a series of multi-level-models using HLM (Raudenbush & Bryk, 2002). We scaled the six listening activity-items by means to a common variable called "listening activities". Analysed with random-intercept models, polynomial variables on level 1 are were group-centered and grand-centered on level 2.

Results:

Listening and reading performance data is highly and significantly correlated ($r = .87$).

The descriptive analyses divided into two school-tracks and reported by students show a small mean for the listening activities within the last six months (see Table 1).

For the reading activities, the frequencies are increased. The mean for the 15 items ranges from 2.24 to 3.16 for Gymnasium and from 2.41 to 3.12 for the other schools, which means a frequency of two to five times in the last six months.

When comparing the two perceptions within the same class (teacher perception versus students' statements), Kendall's tau ranges from $\tau = .10$ to $\tau = .74$ (mean = .48).

Regarding the second question, we constructed a series of multi-level-models to investigate the impact of standard-based teaching practices on students' outcome controlling for sex and the self-concept of students. The Intra-class-correlation (ICC) ($\rho = .55$) on level 1 shows an explained variance of students' outcome in listening comprehension of 55 percent. Model 3 shows an impact of standard-based listening activities on students' listening outcome. This effect remains when taking in account the eastern/western differences.

By calculating the same model for reading comprehension, we predict a strong, positive magnitude, based on the fact that teachers reported a higher frequency of reading activities than listening activities.

Discussion

Even preliminary results show that competence-oriented activities have a positive impact in students' outcomes. Despite this, teachers and students both report a small frequency of usage during class. This analysis has major implications for classroom practices. Teachers, who plan their lessons with authentic activities focusing on competence orientation, can help their students towards higher learning outcomes. One limitation of this analysis is that the questionnaire only addressed certain activities in receptive domains. Further research should focus on all domains of English as well as a wider breadth of activities.

PAPER PRESENTATION

Integrating Self-regulation Procedures in the Reciprocal Teaching of Reading Strategies.

Nina Schuenemann, Justus Liebig University Giessen, Germany; Vanessa Seuring, Justus-Liebig-Universität Giessen, Germany; Nadine Spoerer, University of Potsdam, Germany; Joachim Brunstein, Justus-Liebig-University, Germany

In this classroom intervention study, we examined incremental effects of integrating methods of self-regulated learning in the reciprocal teaching of reading strategies on 5th graders' text comprehension skills. For this purpose, we contrasted students who were taught reciprocal teaching strategies in tandem with self-regulation procedures (RT+SRL) with (a) students in a traditional reciprocal teaching condition (RT) and (b) students in a no-treatment control condition. In a clustered randomized trial, fifteen intact classes (N = 323 students) were randomly assigned to conditions. The treatment phase comprised 7 weeks and was delivered by trained teaching assistants in natural classroom settings.

Measures of reading comprehension, reading fluency, and self-efficacy were administered at three occasions: pretest, posttest, and maintenance.

At posttest, students in both treatment conditions outperformed students in the control condition on a standardized test of reading comprehension. Students in the two treatment conditions did not differ at posttest but at maintenance, favouring the combined RT+SRL program over the traditional reciprocal teaching program. In addition, at maintenance, RT+SRL students read more fluently and reached higher reading self-efficacy scores than students in the two comparison conditions.

These findings suggest that the integration of self-regulation procedures in the reciprocal teaching of reading strategies produces beneficial and lasting effects on students' literacy skills and personal sense of reading competence.

Reciprocal teaching (RT) is an instructional procedure in which small groups of students learn to improve their reading comprehension through the use of the four reading strategies clarifying, summarizing, questioning and predicting (Palincsar & Brown, 1984). In the last 20 years, many studies have been conducted to test the effectiveness of RT (Rosenshine & Meister, 1994). Although there is clear evidence that RT promotes reading comprehension, a number of difficulties with implementing and practicing RT in a whole-class setting have been reported. As Hacker and Tenen (2002) pointed out, teachers modify the practice of the four strategies in several ways to adopt RT to the classroom situation. These modifications often led to deficits in or loss of the three key elements of RT, strategy use, meaningful dialogues within the groups and scaffolded instruction. According to current models of self-regulation, metacognitive monitoring will produce effective regulation, and this in turn will improve students' learning processes (Thiede, Anderson, & Theriault, 2003). The awareness and use of self-regulation strategies can enhance students' reading comprehension. However, until today only a few studies investigated the effect of self-regulation procedures on reading comprehension (Paris, Cross, & Lipson, 1984).

Aims

In order to close this knowledge gap, we trained students to become self-regulated readers who acquire and use self-regulatory knowledge and skills that enhance their reading performance. The aim of this study was to examine the effects of a potentially more classroom-appropriate intervention in which the students' use of RT is facilitated by incorporating specific self-regulation procedures into the training.

For this purpose, we contrasted students who were taught reciprocal teaching strategies in tandem with self-regulation procedures (RT + SRL) with (a) students in a traditional reciprocal teaching condition (RT) and (b) students in a no-treatment control condition. In the RT condition we integrated methods of direct instruction with cognitive modeling and phases of independent group work to help students acquire the reading strategies. In the RT+SRL condition students were trained equally but we taught RT in tandem with self-regulation procedures (setting process and outcome goals, self-monitoring, self-recording, self-evaluation).

We predicted that, compared to traditional RT and a no-treatment control condition, RT+SRL would be more effective in fostering the reading comprehension, reading fluency and self-efficacy in the short and medium term.

Methods

The sample consisted of 323 students of 15 fifth-grade classes from four different German comprehensive schools. In a clustered randomized trial, fifteen intact classes were randomly assigned to conditions. Six classes were assigned to each RT and RT+SRL and three classes acted as no-treatment control condition.

Strategy instruction in both training conditions was delivered in 14 lessons (7 weeks) by trained teaching assistants. Measures of reading comprehension and reading fluency were assessed at pretest, posttest (directly after training) and maintenance (8 weeks after the end of the treatment) with standardized German reading comprehension and fluency tests (Auer, Gruber, Mayringer & Wimmer, 2005; Souvignier, Trenk-Hinterberger, Adam-Schwebe & Gold,

2008). Self-efficacy was assessed with six items following the model of Wigfield's and Guthrie's (1997) MRQ. The items used a four-point Likert scale and showed a satisfying reliability ($\alpha > .80$).

The data collected in this study was analyzed with a nested analysis of covariance approach. Using classroom as the unit of analysis, we conducted a fully specified mixed-model ANCOVA with student nested within classroom and with classroom nested within treatment condition. When no classroom-within-treatment effects were found, classrooms within a treatment were combined and the individual student became the unit of analysis, thereby providing greater statistical power for the detection of treatment effects.

Results

Regarding all measures no classroom-within-treatment effects were found at posttest and maintenance ($p > .25$). Therefore we analyzed our data on the student level.

An analyses of covariance with condition as between-subject factor and pretest scores as covariate showed a significant main effect for condition at posttest, $F(2, 300) = 4.090$, $p = .03$, and maintenance, $F(2, 299) = 4.198$, p

Students reading fluency scores did not differ at posttest, $F(2, 288) = 1.828$. At maintenance there was a significant main effect for the between-subject factor condition, $F(2, 288) = 15.673$, p

Self-efficacy measures at posttest failed showing a significant main effect for training condition, $F(2, 268) = 2.704$, $p = .06$, but post-hoc tests revealed a significant difference between RT+SRL and the no-treatment control condition.

At maintenance a significant main effect for condition was found, $F(2, 285) = 4.833$, p

Educational significance of this research

The results of our study indicate that traditional RT and RT+SRL can be effectively implemented in regular classrooms. Furthermore we were able to show a significant gain of reading comprehension for students in the RT+SRL condition. These students benefited most from the intervention, while RT students showed no or only small improvements in contrast to a no-treatment control condition. These results lead to the conclusion that including self-regulation procedures in the training leads to higher self efficacy and more fluent reading in the medium term and better reading comprehension in the short and medium term.

Future research is needed to preserve the best possible results directly after the training. To gather more information on possible improvements in the training itself we could reanalyze the data and investigate possible mediators like self-efficacy that could determine the success of the RT+SRL condition.

PAPER PRESENTATION

Parental engagement and home support on betterment of adolescents' reading literacy in Macao

Kwok Cheung CHEUNG, University of Macau, Macau; Pou Seong SIT, University of Macau, Macau; Soi Kei MAK, University of Macau, Macau

Macao, special administrative of China, participated in PISA 2009 reading literacy study. Through the use of the parents' responses in the parent questionnaire and the 15-year-old students' responses to the test booklets, the present study sought to examine the effects of parental engagement and home support variables on reading literacy performance. Through the use of structural equation modeling (SEM) and hierarchical linear modeling (HLM) to analyze the interrelationships amongst parents' engagement and support of child's reading literacy variables, provision of home reading resources for child's use, and reading literacy performance, it was found that the direct/independent effects of the parents' engagement and support of child's reading literacy variables on reading literacy performance was negligible, and their joint indirect effect was weak but practically substantial, essentially mediated by provision of home reading resources for child's use. This finding has taken into account the effects of economic, social and cultural status of the home and gender of student. In the light of these findings, recommendations are put forward for Macao parents and schools to develop better home literacy environments for the betterment of adolescents' reading literacy in Macao.

Reading literacy is a fundamental competence cherished worldwide and nourished early in childhood (Anderson, Hiebert, Scott, & Wilkinson, 1985). Unless resources and environments are available from the earliest stage, a child is unlikely to read well or love to read (Gates, 2002). Because reading acquisition is not a natural process, without appropriate parental guidance and support, our literate society will have youngsters and adults who are illiterate (Lyon, 1998). Research shows that certain kinds of parental engagement and home activities do make a difference to

young children's reading literacy development (Finn, 1998). However, some parents' engagement and home reading activities are more effective than others, suggesting that family literacy is needed for family members working together to promote mutual literacy development (Smith, 1991). Teachers and parents can partner to create conducive environments to support children's reading acquisition at home and in the classroom (Finn, 1998; Marion, 2000; Darling, 2005).

Throughout childhood, there are changing roles for parents in motivating their children to learn to read, and after that to read to learn (Klauda, 2009). For the unmotivated or uneducated parents, promoting their adolescent children's reading motivation and activities is a daunting formidable task and this is especially the case when dealing with struggling readers (Baker, 2003). In addition, unmotivated/ uneducated parents are less likely to create developmentally appropriate environments for their adolescent children to read to learn. The present study examines the effects of parental engagement and home support, as well as provision of home reading resources, on the enhancement of reading literacy for 15-year-old students in Macao.

In 2009, around six thousand 15-year-old students (3036 males and 2960 females) from a total of 45 secondary schools were sampled for the PISA 2009 reading literacy study. The two-stage sampling, involving all Macao schools in the first stage, followed by all eligible students in the second stage necessitates data analyses to take into consideration the nested structure of the sample design. In the parent questionnaire there were questions pertaining to parental engagement and support in home and reading activities, namely: (1) parents' reading activities when their child attended the first year of primary school (e.g. read books, write letters or words); (2) motivational attributes of parents' own reading engagement (e.g. reading is one of their favorite hobbies); (3) parents' current home and reading activities with children (e.g. discuss how well the child is doing at school); (4) provision of reading resources for child's use at home (e.g. Internet connection, chat online, books of the child's own).

Scaling of these responses using factor analyses and item response theory (IRT) resulted in the composition of the four conceptually and empirically clear constructs to interrelate with reading literacy performance: (1) parents' support of child's reading literacy at beginning of primary education (PRESUPP: 9 items); (2) motivational attributes of parents' own reading engagement (MOTREAD: 4 items); (3) parents' current support of child's reading literacy (CURSUPP: 6 items); (4) provision of reading resources at home for child's use (READRES: 6 items). In the present study parents' engagement and support of child's reading literacy was manifested in terms of: PRESUPP, MOTREAD and CURSUPP. Utilizing these constructs, the following three research questions may be answered:

1. What is the frequency distribution of variables pertaining to parental engagement and support in home and reading activities?
2. What is the interrelationship amongst parents' engagement and support of child's reading literacy, provision of home reading resources for child's use, and reading literacy performance?
3. To what extent the effect of parents' engagement and support of child's reading literacy on reading literacy performance is mediated by provision of home reading resources for child's use, after accounting for the effects of economic, social and cultural status of the home and gender of student?

For research question 1, frequency distribution of parents' responses to questions pertaining to their engagement and support of home and reading activities were carried out. For research question 2, Pearson correlations of the constructs delineated were calculated. Structural Equation Modeling (SEM) was applied to test the hypothesis that provision of home reading resources was a mediating variable channeling the joint effects of parents' engagement and support of child's reading literacy on the enhancement of reading literacy performance. For research question 3, Hierarchical Linear Modeling (HLM) was applied to examine the independent mediating effect of provision of home reading resources for child's use on reading literacy performance, after accounting for the effect of parents' engagement and support of child's reading literacy, economic, social and cultural status of the home and gender of student.

In Macao, upon entering primary schools, parents should have engaged with their children on emergent reading activities, and the common ones understandably are reading storybooks, and writing letters or words with the children together. The first finding of the present study is that this kind of early parental engagement has not been associated to any appreciable degree with enhanced reading literacy performance some ten years later when children reached aged 15.

The second finding is that although research in other parts of the world often shows that when children grow older parents' motivated, and continued support is of utmost importance for children's reading literacy development. Regrettably, in Macao, for those parents with positive motivational attributes, the direct independent effect of their

support on their children's reading literacy development is not statistically significant, and in fact is practically negligible.

The third finding is that although the effect of parents' current support for students' reading literacy development may not be as productive as it should be, the role of home reading resource provision which mediates the effects of parental engagement and home support in the enhancement of students' reading literacy performance is not only statistically significant but also practically substantial in magnitude of influence.

With these findings, the authors propose a number of recommendations to revitalize parental engagement and home support for the betterment of adolescents' reading literacy in Macao. Successful experiences of other educational systems, such as Korea, Hong Kong and New Zealand are consulted (Pressley, Billman & Perry, 2007).

PAPER PRESENTATION

Teachers' knowledge of reading

Henk Van den Hurk, Utrecht University of Applied Sciences, Netherlands; Wim Van de Grift, Groningen University, Netherlands; Thonia Houtveen, University of Applied Sciences, Netherlands

Teachers' professional knowledge of reading is of major importance in designing the effective reading instruction needed to improve student learning. In contrast to other content areas such as mathematics and science, surprisingly little is known about what teachers need to know about reading in order to teach it. At present, research has yielded only a few tests of teachers' knowledge of reading with adequate psychometric characteristics. In the Netherlands there are no such tests at all. In this paper we present a questionnaire for measuring teacher knowledge of reading building on Lee Shulmans concept of pedagogical content knowledge.

Background:

In our ideas on test development for measuring teachers' professional knowledge we highly build upon Lee Shulman's concept of Pedagogical Content Knowledge (1986, 1987). In the last decades this PCK-concept was extended and further developed by several other scholars (e.g. Grossman, 1990; Thames & Phelps, 2008; Sherin, 1996; Van Driel, 2008). In contrast to the quantity of research on teachers' Pedagogical Content Knowledge in for instance science (for a review see: Abell, 2007) and mathematics (see further: Baumert et. al. 2010), strikingly less research has been done in the field of reading (Lyon & Weiser, 2009). At present, research has yielded only a few tests of teacher knowledge on reading with adequate psychometric characteristics. In the Netherlands there are no such tests at all. Therefore we had to start out with the construction of a test for measuring teachers' professional knowledge on teaching reading.

Aims:

Our study focuses on the relationships between 'teachers' professional knowledge on teaching reading', 'the quality of reading instruction these teachers are supplying' and 'student outcomes on reading'. In our presentation we would like to elaborate on the first part of our study in which we developed a test for measuring teachers' professional knowledge on teaching reading.

Method:

We started the process of test development with writing an item pool on three major domains: 'phonemic awareness', 'phonics' and 'reading fluency'. These domains were selected because they represent a range of important content in the elementary reading curriculum.

Content Validity

In order to check the content validity of the test, we presented these items to a panel of 30 reading experts. We wanted to find out whether these experts agreed on the importance to include these items in a test about teacher's knowledge of reading. The expert consultation resulted in a test of 45 items, 15 items on each topic area.

In spring 2010 the test was presented to a group of 217 teachers. In the psychometric analyses we sought to answer the question whether it is possible to develop a reliable measure of teacher knowledge on the afore mentioned domains.

Reliability: Classical test theory

First of all we studied the reliability of the test in terms of classical test theory. After removal of four test items the coefficient KR-20 on the whole test was .71. The four items removed were equally divided over the three domains. One removed item originated from the domain of 'phonemic awareness', another item originated from the domain of 'phonics' and two items were removed from the domain of 'reading fluency'.

Reliability: Item-response theory

Item-response theory puts more stringent demands on reliability. For fulfilling the demands of the dichotomous Rasch model all items should have parallel item characteristic curves and the whole set of test items should be unidimensional.

We tested the parallelity of the item characteristic curves of the original 45 items with the Anderson test in which the item parameters of a high-scoring and a low-scoring group were compared. After removal of 7 items the chi square satisfied the demands ($\chi^2 = 36.77$; $df = 37$; $p = .480$). Three of the removed items were the same as the items that had to be removed to fulfill the demands of classical test theory and four other items did not have parallel item characteristic curves. One removed item originated from the domain of 'phonemic awareness', four removed items originated from the domain of 'phonics' and two items were removed from the domain of 'reading fluency'.

By using the Anderson test on the 38 remaining items we tested whether the unidimensionality of the scale was violated by gender, age, years of experience in teaching, grade, and level of education. The results were fully satisfying on gender, age and years of experience (male and female teachers ($\chi^2 = 38.71$; $df = 37$; $p = .392$); younger (age 40) teachers ($\chi^2 = 29.29$; $df = 37$; $p = .813$); less (10 years) experienced teachers ($\chi^2 = 30.57$; $df = 37$; $p = .763$)). From these results we concluded that the unidimensionality of the scale was not violated by gender, age and years of experience of teachers.

The results on grade, and on level of education were satisfying in a more moderate degree (teachers working in kindergarten and grade 1 and teachers working in grade 2 to 5 ($\chi^2 = 70.70$; $df = 37$; $p = .001$); teachers and teacher-assistants ($\chi^2 = 69.86$; $df = 37$; $p = .001$). More research is needed to explore why the unidimensionality test had such humble results on grade. The knowledge base for teaching lower grades might be different from the knowledge base needed for teaching higher grades. If so, it probably is more suitable to work with another knowledge test about reading for teachers working in grades 2 to 5. The same line of reasoning (differences in knowledge about reading) might be valid for the small unidimensionality problems found comparing teachers with teacher-assistants.

Results:

The mean score on the questionnaire was 1.47 ($sd = .80$) on a scale ranging from -5 to +5, indicating an acceptable knowledge level of the participating teachers. On the basis of these findings we are able to differentiate less-knowledgeable from more-knowledgeable teachers.

Educational and theoretical significance:

Theorists assume that teachers' professional knowledge of reading is of major importance in designing the effective reading instruction needed to improve student learning. In this study we hypothesize that students of more knowledgeable teachers will make greater reading progress. In order to study this relationship we first constructed a test about teachers' professional knowledge of reading. Next in our research we will combine these outcomes with the results of teacher observations and teacher questionnaires on the quality of delivered instructions. In the last stage of our research we will compare outcomes of these analyses with students reading achievement.

PAPER PRESENTATION

Does reading development over summer vacation depend on family background and reading motivation?

Ellen Schaffner, University of Potsdam, Germany; Ulrich Schiefele, University of Potsdam, Germany; Anne Kruger, University of Potsdam, Germany

Past research has demonstrated effects of family background and reading motivation on reading achievement. We expect these effects to be especially pronounced during summer vacation, when school cannot compensate for less stimulating out-of-school environments (cf. Alexander, Entwistle, & Olson, 2001). Thus, the major objective of the present study was to investigate the effects of family background and reading motivation on reading development over six weeks of summer vacation. Participants were 235 third-grade students whose reading achievement (word, sentence, and text comprehension) was assessed shortly before and after summer vacation. Before summer vacation, reading motivation, reading frequency, and family background (cultural communication, cultural activities) were also assessed. Partial correlations (controlling for gender) revealed that intrinsic reading motivation, reading frequency, and family background were significantly associated with reading achievement, and that these correlations were higher after summer vacation than before. Structural equation analyses with latent variables will be applied to investigate, if the development of reading achievement over summer vacation depends on students' and family background reading engagement. These analyses are still in progress.

There is ample evidence that family background and reading motivation both play influential roles in the development of reading achievement. For example, it has been shown that socioeconomic status and cultural resources of a family

are significantly related to children's reading skills (van Steensel, 2006). Research on reading motivation suggests that intrinsic and extrinsic components have to be distinguished. Intrinsic reading motivation aims at the fulfillment of interests or feelings of enjoyment while reading. Extrinsic reading motivation, in contrast, has been characterized by the purpose to obtain positive consequences of the reading activity (e.g., better grades or social recognition). In prior studies, intrinsic reading motivation proved to be positively related with children's reading frequency and reading achievement, whereas extrinsic reading motivation seemed to be less conducive to foster reading development (cf. Wang & Guthrie, 2004).

Both family background and intrinsic reading motivation presumably affect reading skills mainly during out-of-school time (e.g., in summer vacation; cf. Alexander, Entwistle, & Olson, 2001). As a consequence, students with highly supportive families and high intrinsic reading motivation should exhibit a more favourable reading development over summer vacation than students of less supportive families or with lower intrinsic reading motivation. The present study intends to investigate these assumptions. Participants were 235 third-grade students who were tested twice, before and after summer vacation. On the average, they were nine years old ($SD = .58$). Approximately the same number of boys and girls participated in the study.

Shortly before summer vacation, the students were given a questionnaire regarding their intrinsic reading motivation (e.g., "I read, because reading helps me to learn more about my interests"; $\alpha = .77$, $n = 217$), extrinsic reading motivation (e.g., "I read, because I want to be a better reader than my classmates"; $\alpha = .75$, $n = 211$), reading frequency (e.g., "How many books did you read during the last twelve months?"; $\alpha = .71$, $n = 224$), cultural communication in the family (e.g., "Did your parents ever talk to you about books and authors?"; $\alpha = .66$, $n = 223$), and cultural activities in the family (e.g., "Did you ever go to a museum or exhibition with your parents?"; $\alpha = .61$, $n = 222$). In addition, students were administered a standardized reading test (ELFE 1-6; cf. Lenhard & Schneider, 2006) on word comprehension ($\alpha = .92$, $n = 227$), sentence comprehension ($\alpha = .84$, $n = 229$), and text comprehension ($\alpha = .75$, $n = 229$). After six weeks of summer vacation, we assessed students' word comprehension, sentence comprehension, and text comprehension again by means of parallel test forms. EM-estimates of missing values were computed by NORM 2.03 (Schafer, 1999). The percentage of missing data per variable did not exceed 10%. Six students with missing data on gender had to be excluded, because EM-estimates should not be computed for binary variables.

Mean comparisons for paired samples were conducted to test the difference between reading achievement measured before and after summer vacation. Because three separate analyses were performed (for word, sentence, and text comprehension), we reduced the level of significance to $\alpha = .017$ (Bonferroni adjustment). Results revealed that students' word and text comprehension on the average did not change across summer vacation. However, text comprehension improved significantly (before vacation: $M = 4.9$, $SD = 2.2$; after vacation: $M = 5.9$, $SD = 2.5$; $t [227 \text{ df}] = -8.7$, p

To investigate the relations between our predictor variables (family background, reading motivation/reading frequency) and reading achievement, partial correlations were computed (controlling for gender). Results revealed that, with the exception of extrinsic reading motivation, all predictor variables were significantly associated with at least one measure of reading achievement (see Table 1). The highest partial correlations were observed between sentence comprehension (after vacation) and intrinsic reading motivation ($r = .40$, $df = 225$, p after vacation) than with reading achievement before vacation. This seems to support the assumption that family background and intrinsic reading motivation exert a stronger impact during vacation than school time.

To investigate the effects of family background on reading development over summer vacation, structural equation modelling will be applied (these analyses are still in progress). Two latent variable models will be tested (see Figure 1) to investigate, if the cultural capital of a family (indicated by cultural communication and cultural activities) and a student's reading engagement (indicated by intrinsic reading motivation and reading frequency) contributes to the prediction of reading development over summer vacation.

Literature:

- Alexander, K. L., Entwistle, D. R. & Olson, L. S. (2001). Schools, achievement, and inequality: A seasonal perspective. *Educational Evaluation and Policy Analysis*, 23, 171-191.
- van Steensel, R. (2006). Relations between socio-cultural factors, the home literacy environment and children's literacy development in the first years of primary education. *Journal of Research in Reading*, 29, 367-382.
- Wang, J. H.-Y. & Guthrie, J. T. (2004). Modeling the effects of intrinsic motivation, extrinsic motivation, amount of reading, and past reading achievement on text comprehension between U.S. and Chinese students. *Reading Research Quarterly*, 39, 162-186.

PAPER PRESENTATION

Computer-supported writing activities for bridging the gap between learning locations in VET system

Elena Boldrini, Swiss Federal Institute for Vocational Education and Training, Switzerland; Alberto Cattaneo, Swiss Federal Institute for Vocational Education and Training, Switzerland; Elisa Motta, Swiss Federal Institute for Vocational Education and Training, Switzerland; Christoph Arn, Swiss Federal Institute for Vocational Education and Training, Switzerland; Carmela Aprea, Swiss Federal Institute for Vocational Education and Training, Germany

Do computer supported collaborative writing activities help to better connect the different learning locations in the context of the dual-track school/work based Vocational Education and Training Swiss programmes? This is the underlying question of a study conducted with commercial employee apprentices in the framework of a wider Swiss national project founded by the Federal Office for Professional Education and Technologies (OPET) and named Dual-T. More specifically the research question investigates whether giving apprentices the opportunity to collaboratively write about the professional experiences they encounter at the workplace is beneficial in fostering reflective thinking, professional identity and the linking between general procedures and real professional situations.

The Swiss VET system as an instance of the so called 'dual systems' foresees different learning locations, being established mostly on an alternation between the work-based and the school-based segments. However, apprentices do not only experience workplace situations that differ among companies, but often even perceive a gap among the different learning contexts (e.g. Eteläpelto, 2008). We assume that technologies can help to bridge this gap mainly by serving as tools to capture authentic professional situations experienced at the workplace, and consequently to exploit them at school[1]. The hypothesis is that collaborative writing on these experiences can be a useful means in this respect, as well as for encouraging confrontation, and comparison dynamics among the apprentices. More specifically, our research is focused on the design and evaluation of Computer Supported Collaborative Learning activities. Adopting a writing-to-learn perspective (e.g. Flower & Hayes, 1980) we hypothesize that describing professional experiences lived on the job and commenting the peers' ones can 1. have a direct influence on apprentices' capacity to describe and understand professional procedures, 2. foster – by inserting scaffolding questions – their reflective attitude and consequently 3. effect – through confrontation with peers' practices – their self-efficacy and particularly reinforce their professional identity. To explore these hypotheses, we conducted a study with 186 first and second year commercial employee apprentices in Ticino, Switzerland. More specifically, the study involved three intact classes as the treatment group (n=46) and other 140 apprentices as control group.

With the treatment group, we implemented three peer-tutoring and peer-commenting activities using blogs and wikis. In these activities the learning tasks were focussed on the detailed description of a procedure experienced at the workplace. Each activity was structured in three parts: 1. each apprentice developed the starting text; 2. had to comment and revise the text written by a peer; 3. refined his/her starting text, taking into account the peer's contributions. To assess the learning outcomes we considered the Process Unit (PU)[2], using a. the official overall rates of its descriptive part, and b. the quality of the texts produced by apprentices. This latter was evaluated on the reflective capacity on professional practice, using the 5Rs model (Bain et al., 2002). Additionally, we submitted a pre-post questionnaire which – among others – intended to detect apprentices' perceived self-efficacy (Bandura, 2006), reflective attitude (Kember et al., 2000) and professional identity (Heinemann & Rauner, 2008). Concerning the PU overall rates, no significant differences emerged between the two conditions. However, the experimental group has significantly higher rates in the test items concerning their capacity to link the experience described and the "general" underlined procedure they know in an abstract form (i.e. as a flowchart), both for 2nd year classes ($t(96)=2.146$; $p=.034$) and the 1st year one (Mann-Whitney U test: $z=-2.29$; $p=.022$). Concerning reflective attitude, we have an overall significant difference ($t(97)=2.17$; $p=.032$) between the control and the experimental conditions, favouring the latter ($M_{exp}=3.54$; $SD=.74$ versus $M_{contr}=3.2$; $SD=.83$). Besides, the experimental group agrees on the fact that "describing professional experiences makes one reflect" significantly more than the control group ($t(97)=2.23$; $p=.028$). Concerning self-efficacy, we found a significant pre-post decrease for the control group ($t(39)=2.17$; $p=.036$) and a stable perception for the experimental group. Focusing on self-efficacy at school, interesting differences appear comparing the pre-post difference of the 1st year experimental class and the control group ($MD(I-J)=7.16$; $SDE=3.27$; $p=.032$ for the overall subscale; $MD(I-J)=13.35$; $SDE=5.02$; $p=.010$ for specific commercial employees subjects). Concerning professional identity, the post test measure is significantly higher ($t(52)=-2.17$; $p=.035$) in the experimental condition ($M=21.96$; $SD=2.92$) than in the control group ($M=20.05$; $SD=2.73$). Furthermore, the data indicate a significant pre-post decrease for the control group ($t(39)=-2.99$; $p=.005$). Although not being completely consistent with respect to the overall PU rates, the results of the study all in all give promising hints concerning the efficacy of the presented approach. However, in order to further substantiate our conclusions, the data from the questionnaires have to be combined with the qualitative analyses of the textual productions, which are currently in progress and will be available for the Congress. Moreover, additional formative evaluations indicate that teachers and apprentices were satisfied with the proposed learning activities. Thus, we decided to re-implement them in the current school-year. This will give us not only the chance to approve the procedural measures but also to further clarify the theoretical model.

References

- Bain, J. D., Ballantyne, R., Mills, C., & Lester, N. C. (2002). *Reflecting on practice: Student teachers' perspectives*. Flaxton, Queensland: Post Pressed.
- Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents*, (Vol. 5., pp. 307-337). Greenwich, CT: Information Age Publishing.
- Eteläpelto, A. (2008). Perspectives, prospects and progress in work-related learning. In S. Billett, C. Harteis & A. Eteläpelto (Eds.), *Emerging perspectives of workplace learning* (pp. 233-247). Rotterdam: Sense Publishers.
- Flower, L. S., & Hayes, J. R. (1980). The dynamics of composing: making plans and juggling constraints. In L. W. Gregg & e. R. Steinberg (Eds.), *Cognitive Processes in Writing* (pp. 31-50). Hillsdale (NJ): Erlbaum.
- Heinemann, L. & Rauner, F. (2008). *Identität und Engagement: Konstruktion eines Instruments zur Beschreibung der Entwicklung beruflichen Engagements und beruflicher Identität*. IBB:
- Bremen.Kember, D., Leung, D.Y.P., Jones, A., Yuen Loke, A., McKay, J., Sinclair, K., Tse, H., Webb, C., Wong, F.K.Y., Wong, M. & Yeung, E. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education*. 25, 381-395. [1] These considerations are the basis of Dual-T, a Swiss research project funded by OPET and managed by the "Technologies for Vocational Training" leading house, which gathers up four partners: EPFL-CRAFT, UniGeneva-TECFA; UniFribourg-Psychology Dept., and SFIVET. This paper deals with a project jointly conducted by the SFIVET and Geneva teams.[2] The PU is a report that each apprentice must produce every year of the apprenticeship and which includes – among other things – the detailed description of a professional procedure applied at the workplace. The PU is part of the final exam which provides the Federal VET Certificate.

PAPER PRESENTATION

Capturing Workplace Situations to be Exploited at School

Alberto Cattaneo, Swiss Federal Institute for Vocational Education and Training, Switzerland; Elisa Motta, Swiss Federal Institute for Vocational Education and Training, Switzerland; Carmela Aprea, Swiss Federal Institute for Vocational Education and Training, Germany

Learning is a contextually and socio-culturally shaped process and is conditioned by the learner's engagement and the affordances he/she finds on site (Billett, 2001). This is particularly true for Vocational Education and Training (VET), where apprentices experience multiple learning contexts and have to connect them into a whole. Using technology as means to capture professional situations lived at the workplace in order to exploit them at school as learning material - maybe hypermedially enriched by the teacher - could help in designing effective learning activities at school. On this subject, a preliminary study conducted with three classes of car mechanics apprentices in Switzerland is presented here to exemplify this assumption. Measures include apprentices' learning outcomes (in terms of declarative knowledge) and both apprentices' and (school) teachers' perceived ease of use and usefulness of the captured materials. Preliminary results indicate very positive tendencies, even if more sophisticated designs have to be tested.

In Switzerland, roughly two-thirds (65%) of the young people coming out of lower-secondary school enrol in an upper secondary level vocational education and training (VET) programme. These VET programmes are mostly based on a "dual" system which alternates the work-based and the school-based segments. A third training segment – known as "intercompany courses" or "industry courses" – is also added to complete the model. Concretely, this means that apprentices spend between 3 to 4 days – depending on the profession – in a company and the rest of the week at school. This structural characteristic can be a very interesting opportunity, but at the same time a source of problems: by splitting opportunities for learning over at least two main locations (i.e. workplace and school) the dual-track VET system imposes an important condition to promote learning, namely that of being able to aggregate information and experiences gathered in two different contexts into a coherent body of knowledge.

Since this aggregation task is neither obvious nor self-making, we need to foster it through a specific learning environment design, able to exploit the effects that the context has on the learners' motivation (Volet & Järvelä, 2001). The study presented here starts from the assumption that mobile technologies can constitute an effective means on which to design learning activities able to properly connect the two mentioned contexts. Considering that 1. apprentices are generally more motivated to learn in the context of the company than at school, and 2. that the workplace-segment influences learning but is in turn conditioned by the apprentices' personal engagement and the affordances that it offers him/her (Billett, 2001), we suppose that the design of the learning activities should be based on the exploitation of what apprentices experience at the workplace. In this respect, technologies can be used to capture real professional situation to be used at school. Given these premises, the underlying research questions can be summarized as follows: a) Are mobile technologies a feasible means to capture professional situation at the workplace? b) Do apprentices and teachers accept these technologies? c) Which effects can the "captured materials"

have on learning? The present study[1] involves three intact vocational school classes (n=60) of car mechanics apprentices from Ticino, Switzerland. The apprentices from one of these classes were allowed by their supervisors to wear a headband camera while working, so that they could video-record significant situations experienced at the workplace. The material collected was then handed over to the teachers, who selected interesting pieces of the videos and edited them in three- to five-minutes-long clips. Five videos have been developed and subsequently used in four different sessions, in three different ways, corresponding to three different treatment groups: in one class (EXP-RAW), the teacher just showed the raw videos at the end of the lesson. In a second class (EXP-PLUS) videos were hypermedially enriched with additional learning materials, considering principles coming from the Cognitive Theory of Multimedia Learning (Mayer, 2005), and have been used during the lesson. Apprentices of this class also had at their disposal the enriched videos on a moodle platform to prepare themselves to the learning tests. A third class (CON) was involved as a control group. After each of the four mentioned sessions, a learning test was submitted. Additionally, at the end of the school year, a final learning test on all the contents was submitted to assess the mid-term effects on retention.

In parallel, we submitted two questionnaires, based on technology acceptance models (e.g. Venkatesh et al., 2003), to measure apprentices' and teachers' perceived usefulness of the materials produced, as well as their quality and richness. Preliminary results show that the EXP-PLUS group got significantly higher learning outcomes than the CON group and the EXP-RAW group in four of the five post tests: Session-1, $F(2;53)=26.00$ $p < .05$, Session-4, $F(2;47)=7.20$, $p < .05$. The EXP-PLUS class perceived a higher – even if not significant – degree of usefulness of this kind of learning material for the school ($M=5.74$ - on a 7-points Likert scale - $SD=1.33$; $p > .05$) than the control group ($M=5.37$; $SD=1.36$). The EXP-RAW class, when showed the enriched one, perceived – as imagined, not as really experienced – a higher potential usefulness of the tool both for the school and the "garage life" ($M(\text{EXP-RAW})=6.39$ $SD=0.69$) than the other classes ($F(2;50)=5.36$; $p < .05$).

Concerning the quality and richness of the materials produced, mechanics' teachers (n=15) were positive, both for the technical quality ($M=4.33$, $DS=1.59$) and above all for the potential to be used at school ($M=5.7$, $DS=0.68$). The teachers gave significantly higher ratings for the didactical potential (Mann-Whitney Test $p=.01$) of enriched videos compared to the raw ones. Teachers recognize the potential of the "captured materials", especially if they are enriched with additional information. Even more interestingly, it seems that the use of this approach has positive effects on declarative knowledge acquisition. The present study was an attempt to go beyond the consideration of the motivational effects on learning and to integrate the cognitive and practical sides of learning. The solution presented here seems to be promising, but surely needs additional deepening and refinements: for example, 1. the "teacher" effect should be better controlled in a new study. 2. Cognitive Load measures should be included; 3. a special focus on the integration of the learning activities in larger learning units and in the curriculum is needed.

References

- Billett, S. (2001). Learning through work: Workplace affordances and individual engagement. *Journal of Workplace Learning*, 13, 209-214.
- Mayer, R. E. (Ed.). (2005). *The Cambridge handbook of multimedia learning*. New York: Cambridge University Press.
- Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3), 425-478.
- Volet, S., & Järvelä, S. (Eds.). (2001). *Motivation in Learning Contexts*. Amsterdam: Pergamon. [1] The study is part of "Dual-T" project, managed by the "Technologies for vocational training" leading house funded by OPET and gathering up 4 partners: EPFL-CRAFT; UniGeneva-TECFA; UniFribourg-Psychology Dept., SFIVET. This paper deals with a sub-project jointly conducted by the SFIVET and Fribourg teams.

PAPER PRESENTATION

Technology and Gender Equity Among Secondary School Students in Ghana

Kwaku Frederick Sarfo, University of Education, Winneba, Ghana

This study explored the attitudes of male and female students in Ghana towards ICT. The results show that students' attitudes towards technology do not differ in terms of gender. Furthermore, the results indicate that the locality (rural or urban areas) of the male and female students does not influence their attitudes towards technology. However, according to the results female students from urban areas have more positive attitudes towards technology than female students from rural areas.

Technological literacy and integration of information and communication technology (ICT) in education have received a great attention worldwide. This is because ability to use ICT to achieve one's means, is critical to economic, social, cultural, and educational life. Harvey (1983) envisages that the effectiveness of the use of computers in education may

be an important factor in determining which countries will succeed in the future. Following this idea, many governments have carried out policies involving investment in education, investment in infrastructure, creation of favourable institutions, and fostering new institutional innovations to promote ICT literacy programmes and integration of ICT in education (Quibria et al, 2003).

In Ghana many educational practitioners, policy-makers including the government, and other agencies accept that computer technology is the bedrock of quality socio-economic activities and quality education, particularly quality teaching and learning (President's Committee on Review of Education in Ghana, 2002; ICT4AD, 2003; World Bank, 2007). In this regard, a significant portion of the country's budget is invested in the planning and implementation of ICT policies for quality education and socio-economic development of the nation. In 2004, the Parliament passed into law Ghana's ICT for Accelerated Development (ICT4AD) policy. The policy indicates the vision of Ghana in relation to ICT in the knowledge and technological age. It addresses the exploitation and deployment of ICT to promote the economy – financial system, agriculture, civic, culture, import, export, democracy, legal, education, and others – of Ghana. This policy is at various stages of implementation. For instance, in 2009, ICT courses were introduced in all basic and second cycle schools in rural and urban areas of Ghana. This initiative by the government, as stipulated in ICT4AD policy, is to ensure that students have ICT skills before coming out of each level of education.

Even though ICT awareness and competencies are increasingly important, there are some barriers that can handicap the success of ICT literacy programmes and the integration of ICT in education for the nations' development (Cunningham 2007). Among other factors, researchers (e.g., Shade, 2002) often describe women's attitudes towards technology as problematic. Research findings from science, technology, engineering and math (STEM) provide theoretical grounding for the study of gender and ICT. In other words, research findings from STEM perspective identified emotional, cultural, and structural barriers which girls and women face in achieving technological equity. Studies on women's attitudes towards technologies in developed countries indicate that women's negative experiences with technologies have several consequences including limited participation in the information economy as well as limited participation in courses related to technology (Cunningham, 2007). In Ghana, generally, both national and education policies pay attention to gender balance. However, specifically, from the perspective of planning and implementation of ICT policies (ICT literacy programmes as well as integration of ICT in education) in Ghana, little or no attention has been paid to research on gender differences with technologies. This state of affair is in line with the assertion of Benzie (1995), confirmed by Albrini (2006) that in developing countries, national programmes have not been so successful to implement ICT into educational systems because they were not supported with educational research.

The present study is aimed at investigating the attitudes of male and female students (from rural and urban areas in Ghana) towards 1) ICT policy (ICT4AD) in Ghana, 2) learning to acquire ICT skills, and 3) using ICT to facilitate teaching and learning. Furthermore, the study is intended to explore the effect of the locality (rural and urban areas) of the male and female students on their attitudes towards technologies. An evidence-based understanding of girls and boys (in the rural and urban areas in Ghana) attitudes towards technology will help contribute to decisions of successful planning and implementation of gender equity ICT literacy programmes and gender equity policies for integrating ICT into education. In addition, effective and efficient management and administration of ICT; investment in infrastructural support; and in-service training of teachers will also benefit from evidence of girls and boys (from rural and urban areas in Ghana) attitudes towards technology

To answer the research questions, 307 participants comprising 157 males (60 from rural areas and 97 from urban areas) and 150 females (70 from rural areas and 80 from urban areas) were randomly selected from 3 rural and 3 urban senior high schools in Ghana. Their average age is 18.3 with SD of 1.4. Three kinds of five points Likert-type scale questionnaire, ranging from strongly agree to strongly disagree, were constructed to measure the participants' attitudes towards: ICT4AD policy in Ghana, 2) learning to acquire ICT skills and) using ICT to promote teaching and learning; Cronbach alphas were .77, .72, and .70 respectively. The questionnaire was administered to the students in their normal classrooms. The participants were instructed to do independent work and they were supervised by the researchers. They were allowed to use 25 minutes to answer the questions.

Univariate analysis and t test were employed to analyse the data. The results of the analyses indicate that secondary school students' attitudes towards: 1) ICT4AD policy in Ghana, 2) learning to acquire ICT skills, and 3) using ICT to facilitate teaching and learning do not differ in terms of gender. Furthermore, the results indicate that the locality (rural or urban areas) of the male and female students does not influence their attitudes towards technology. However, according to the results the female students from urban areas have more positive attitudes towards technology than female students from rural areas. Interestingly, there is no significant difference between the attitudes of males from rural areas and the attitudes of males from urban areas towards technology. The outcome of

the study can be used in the designing and implementation of gender sensitive ICT policies and gender sensitive innovative educational programmes in the rural and urban areas in Ghana.

PAPER PRESENTATION

Equity and access issues in the educational use of learning management systems (LMS) in a globally networked society

Ramon Garrote Jurado, University of Borås, Sweden; Michael Christie, Stockholm University, Sweden

In this paper the authors present research findings from a comparative case study involving the pedagogical use of learning management systems (LMS) at the university level. Two engineering programs are compared, one based at the University College, Borås, Sweden (hereafter UB) and the other at the Instituto Superior Politécnico Joséé Antonio Echeverría, Havana, Cuba (hereafter ISPJAE). At UB twenty two engineering lecturers were surveyed concerning their use of LMS. At ISPJAE fifteen lecturers were given a course on LMS, provided with tools to use it, and subsequently interviewed about the extent to which they had employed it in their courses. The aim of the case study was threefold. Firstly to compare the lecturers' knowledge and understanding of the pedagogical advantages of using LMS in face-to-face, blended and online learning. Secondly to determine the extent to which an LMS was used and evaluate the pedagogical value of such use. Thirdly to investigate the administrative, technological and pedagogical barriers involved in using an LMS.

As the title of the paper suggests the purpose in comparing such disparate groups was to investigate if there were differences in terms of equity and access issues in the use of LMS in higher education. Another aim was to use the case study to better understand some of the assumptions underlying the concept 'education for a globally networked society'.

The paper used case study as its research method and data was gathered by means of surveys, interviews and the analysis of course evaluations. The method was embedded in an action research process. Results from an earlier cycle of the research process have been used to inform and help the participants in their use of LMS. The extent to which this has resulted in a more efficacious use of LMS is still being monitored and the project is now engaged in a third cycle of research. The theoretical basis for the research is Habermas' communicative action theory (Habermas, 1989). This paper makes a theoretical and educational contribution by using the empirical case to illustrate differences in access to an uncensored Internet and the barriers that lecturers from different political, social and economic systems encounter when seeking to use LMS as a pedagogical tool in Higher Education.

The results from the case study indicate that because lecturers at UB were regular users of the Internet they had a more sophisticated knowledge and understanding of the pedagogical potential of LMS. In Cuba lecturers have to ask permission and book time to use the Internet. For economical reasons only 50% of the Cuban participants had a computer at home and none of them had internet access. During brainstorming sessions however it was clear that many of these lecturers had innovative ideas about the use of LMS. Our second aim concerned the use of LMS at both sites. LMS was available to both sets of teachers. The teachers at UB used the 'content' tools available in the LMS in 60% of their courses. They employed the system to create a course structure, publish document files, link to pages on the internet and allow students to download information. Only 21% of their courses made regular use of tools that allowed students to submit assignments online and receive feedback about their results. The use of communicative tools such as chat, asynchronous discussions, email within the system, announcements and calendar varied from 13% to 20% in the courses. At ISPJAE the LMS freeware Moodle was available on the faculty's server for intranet use but none of the teachers had used it prior to March 2010. In that month the first author gave a course on the pedagogical use of LMS and in June 2010 conducted a follow up meeting with the participants. Eight presented their progress and detailed ways in which they used both content and communicative tools Seven could not be present at the presentations but were surveyed later and indicated that they mainly used the content tools available in the LMS. Participants from both UB and ISPJAE perceived that the LMS provided the means to better organise their courses and enable students to obtain course material. Downloading material was much easier for Swedish than Cuban students because the latter have to queue to gain computer access. The teachers were uncertain about the overall pedagogical value of LMS use and this needs further research. In terms of the administrative, technological and pedagogical barriers to LMS use the case study clearly reveals differences between UB and ISPJAE participants. Lack of time was the most common barrier at UB whereas lack of computer hardware, software and bandwidth were restraining factors in Cuba. At UB the lack of time also meant that lecturers were not so willing to change their pedagogical practice unless they could be convinced that using an LMS was both pedagogical and time efficient.

The theoretical and educational significance of this paper is that it provides an actual case that illustrates access and equity issues in education for a globally networked society. Just under 500 million users come from countries that

control Internet content for ideological reasons. In the case of Cuba access itself is controlled. Can we talk about a global network when 1.5 billion people have no electricity (Gronewold, 2009), no digital infrastructure and no public or personal resources to buy computers, mobile devices and bandwidth? Can we talk about a networked society when its 2 billion users come from different countries with very different social, cultural, political and economic systems?

References

Gronewold, N., *Scientific American*, 24 November 2009 Habermas, J. (1989). *The structural transformation of the public sphere: an inquiry into a category of bourgeois society*. Cambridge Mass.: MIT Press.

PAPER PRESENTATION

The Relationships Among Personality Traits and Video Game Preferences in Undergraduate Learners

John Quick, Arizona State University, United States; Robert Atkinson, Arizona State University, United States; Wilhelmina Savenye, Arizona State University, United States; Lijia Lin, Arizona State University, United States

Very little research has been conducted on how personality impacts learner perception and use of video games. This study aims to identify the relationships among undergraduate learners' personality traits and their video game preferences. As of this writing, 164 undergraduate students have completed an online survey representing these aspects. A preliminary factor analysis has identified six categories that explain how and why players engage in gaming activities. A preliminary cluster analysis has identified three major categories of learners based on their game preferences and personality traits: avid gamers, casual gamers, and non-gamers. EARLI attendees will be introduced to the relationships between personality traits and gaming, which are believed to have meaningful implications for the design, use, and research of game-based educational technologies.

Introduction

Personality is instrumental in the way that a person perceives of and interacts with the world. Therefore, it follows that personality should affect how learners understand and interface with educational technologies. In spite of this, very little research has been conducted on how personality impacts learner perception of video games.

Related work has been done, but the primary foci have often been on classifying gamers according to their motivations (King, Delfabbro, & Griffiths, 2010, Westwood & Griffiths, in press), examining specific non-student gamer populations (Griffiths, Davies, & Chappell, 2004, Choi & Kim, 2004), and the perceived negative aspects of gaming (Wood, 2008, Anderson & Bushman, 2001, Griffiths & Hunt, 1998).

This study aims to identify the relationships among undergraduate learners' personality traits and their video game preferences. Learners' responses to an online questionnaire are addressing the following research questions.

1. How do undergraduate learners' personality traits relate to their video game preferences?
2. What categories of learners emerge based on the combination of personality traits and video game preferences?

Methods

Participants

As of this writing, 164 undergraduate students from a large southwestern U.S. university have participated. All are enrolled in an undergraduate computer literacy course. The majority are juniors (40%), followed by sophomores (25%), seniors (23%), and freshman (12%). By gender, 64% are female and 36% are male. In age, they range from 18 to 57 years (mean = 26.6, sd = 8.2), with 84% of the sample being between 18 and 30.

Procedures

Participants voluntarily chose to complete an online questionnaire in partial fulfillment of their course's research participation requirement. The questionnaire was made available to students between September and December 2010.

Instrument

The Video Game Preferences section of the survey instrument asked participants to rate how important 37 characteristics were to their enjoyment of a video game on a scale from one (Not at all important) to five (A must-

have feature). The 37 game features were primarily derived from a previous study on the structural characteristics of video games (Wood, Griffiths, Chappell, & Davies, 2004) and each represents a manipulable design attribute.

The Personality section of the survey instrument asked respondents to indicate how accurately a series of 60 statements described them on a scale from one (Very inaccurate) to five (Very accurate). Goldberg's (1999) and Johnson's (2001) public domain representations of the NEO PI-R (Costa & McCrae, 1992) were used as starting points. These have shown comparable reliability and validity to the NEO PI-R, which is widely regarded as the best commercial instrument for measuring the constructs of the Five Factor Model of personality (Johnson, 2005, Johnson, 2001, Johnson, 2000, McCrae & John, 1992). For practical considerations, the 60 items that were anticipated to be most relevant to learners' video game preferences were included.

Data Analysis

Preliminary factor and cluster analyses have been conducted on the initial 164 responses. Approximately 200-300 total responses are anticipated. All final analyses will be completed well in advance of the EARLI 2011 conference.

Preliminary Findings

An exploratory factor analysis was conducted to examine the video game preferences of the initial 164 learners. A principle axis analysis using Direct Oblimin rotation produced a six-factor structure that accounted for 40% of the total variance, with communalities ranging from .29 to .66. Descriptions of the resulting factors follow.

1. Role-player: player enjoys characteristics of MMORPG games, such as taking on alternative identities, never-ending gameplay, and a fantasy setting.
2. Mobile gamer: player does not enjoy games with audio, realistic/3D graphics, and real-world settings.
3. Challenge-seeker: Player pursues challenges, such as problem-solving, overcoming obstacles, and finding hidden things.
4. Social gamer: player engages in gaming to meet new people, play with others online, and publicly display his/her skills.
5. Solo gamer: player prefers single-player games and does not wish to play with friends.
6. Casual kinesthetic gamer: player enjoys characteristics of casual Wii games, such as using physical actions to control gameplay, acting within limited amounts of time, and completing a game in a single session.

Next, a hierarchical cluster analysis using euclidean distance and Ward's linkage method was conducted. Three major categories of learners emerged, each having its own specific gaming preferences and personality traits. Descriptions of these groups follow.

1. Avid gamers show relatively high interest across the six gaming preference factors and are especially characterized as social, challenge-seeking, role-players. In terms of personality, they tend towards anger and excitement-seeking, while scoring relatively lower on the dimensions of morality and cooperation.
2. Casual gamers have a relatively intense preference towards solo and mobile play, but also share in the challenge-seeking of avid gamers. Their personality profile depicts relatively low levels of gregariousness, excitement-seeking, and assertiveness, while showing relatively high levels of self-consciousness, imagination, and cooperation.
3. Non-gamers are inclined to prefer mobile and solo play, however they do not share in the challenge-seeking of avid and casual gamers, nor do they show interest in other gaming factors. These individuals tend to have relatively lower levels of imagination and higher levels of self-discipline, achievement-striving, and gregariousness.

From these analyses, compelling preliminary evidence for the categorization of learners according to their gaming preferences and personality traits has been found. Further, underrepresented gamer types have been identified, as have items with greater and lesser ability to distinguish between learners. Therefore, the analyses have also informed the revision and refinement of the survey instrument.

Significance

As potentially influential variables in learning technology research and practice, EARLI members will become aware of the importance of considering learners' personality traits and preferences in their future designs. These factors are believed to significantly impact how learners perceive of and interact with educational technologies. Ultimately, this line of research is expected to result in an instrument that identifies learners based on their personality traits and perceptions of video games.

PAPER PRESENTATION

Digital Games in Pedagogical Contexts; Critics, Criteria and Quality

Vigdis Vangsnes, Stord/Haugesund University College, Norway

The aim of the research project "Digital Games in Pedagogical Contexts; Critics, Criteria and Quality" is to investigate digital games, an artifact primarily used in children's out of school life, as a didactic tool used in educational contexts, to gain knowledge about digital games for didactic purposes and to develop an analytical framework for discussing criteria and quality in digital games. A new media requires didactic reflections upon function, purpose and intention when it is used educationally. This will include a discussion about possible dichotomies between the didactics found in the object itself (the game) and the ideal general didactics as found in Norwegian hegemonic educational literature. What didactical implications will be problematized when the teacher want to orchestrate the game content as part of either learning or play activities in schools and kindergartens? The main research question is: How can we, by the help from dramaturgic theories, analyse, interpret and understand the games, and the gaming situation, as a media featured by its historical, sociological and cultural context; what will be the requirements for the analytical tools discussing criteria and quality? Didactics, supported by this artifact, is both methodologically and theoretically a research topic of both scholarly and public interest.

Relevance to EARLI domain and conceptual rationale: My field of research interest is about how the technology of mass communication is changing educational practices and creating new possibilities and new challenges when they are implemented in didactic settings. The media I have chosen to do my research on is computer games and the pedagogical use of these games. This topic has become more pressing recently as a result of the new Norwegian policy documents, General Plan for Kindergarten (MOK, 2006), The White Paper 17, An Information Society for all (MOC, 2006-2007), The White paper 41, Quality in Kindergarten (MOK, 2008-2009), and the White Paper 14, Computer games (MOC, 2007-2008). These policy documents indicates a stronger focus towards children's use of technology from early ages and demands both schools and kindergartens to consider digital tools and computer games as a natural part of the daily routines and the local curriculum.

The aim of the research project "Digital Games in Pedagogical Contexts; Critics, Criteria and Quality" is to investigate digital games, an artifact primarily used in children's out of school life, as a didactic tool used in educational contexts, in order to gain knowledge about digital games for didactic purposes and to develop an analytical framework for discussing criteria and quality in digital games. A new media requires didactic reflections upon who, what, why, how, when and where this new media is taken into pedagogical settings. This will include a discussion about possible dichotomies between the didactics found in the object itself (the game) and the ideal general didactics as found in Norwegian hegemonic educational literature. What didactical implications will be problematized when the teacher want to orchestrate the game content as part of either learning or play activities in schools and kindergartens? The main research question is: How can we, by the help from dramaturgic theories, analyse, interpret and understand pedagogical digital games, and the gaming situation, as a media featured by its historical, sociological and cultural context; what will be the requirements for the analytical tools discussing criteria and quality? Didactics, supported by this artifact, is both methodologically and theoretically a research topic of both scholarly and public interest.

Theory: It is a challenge to create a conceptual formulation and analytical approach/method that will function when it comes to analysing phenomena of multimedia or digital expressions that combine text, picture in motion, sound, music, animation and interaction. In the field of digital play research, a dichotomy has arisen between researchers who are interested predominantly in plays as plays (the ludologists) (Frasca, 2003) and those who claim that the plays first of all have a narrative structure (the narratologists) (Murray, 1997). Another way of understanding the phenomenon can be found in dramaturgic theories that see and analyse these games as a means of theatrical practice. I will use dramaturgic theory and models to analyse the way games are built in addition to an analysis of what kind of interaction they invite the players into. I analyze these games as means of a theatrical performance by using dramaturgic theories and concepts, inspired by Danish media- and dramaturgy researchers like Kjetil Sandvik, Janek Scatkowski, Birgitte Holm Sørensen (Sandvik 2004, 2006, 2006; Scatkowski 1989, 2006; Sørensen 2006). In my next part of my research I want to outline an analytical framework for discussing critics, criteria and quality when these games are put in pedagogical contexts. My research question in this follow up study will be: What requirements must be put forward for an analytical tool that aims to make visible and discuss aesthetical and pedagogical quality in pedagogical digital games?

Methodology

The study is based on a qualitative research design. The specified main research approach is phenomenological hermeneutical where dramaturgy and didactics constitutes my theoretical and analytical position. I will combine

several research methods in my research design. I suggested, inspired by the Danish media- and dramaturgy researchers to use dramaturgy as a complementary theoretic position for understanding digital games as means of a theatric phenomenon. This is a pure theoretical study examining digital games and research on the topic from different coherent perspectives. This first section contains a literature review/study of research on digital games. The next part of my study is a case study research (Yin 2008) which implies that we have used purposeful selection (Maxwell 2005), semi-structured interviews (Kvale & Brinkmann 2008) with 8 pre-school teachers, observations (Merriam 1998) of 5 year olds playing digital games in kindergartens (approximately 15 hours) and document analysis (Merriam 1998) of Norwegian policy documents. As a backdrop for our qualitative study we will make references to a national survey carried out by my research group in 2010 (DIGOB). In order to answer the research question and enhance the internal validity we have combined several qualitative research methods (triangulation) in our research design as well as respondent validation and quasi statistics.

The latest section of this research project is based on a phenomenological hermeneutic interpretation of theories on critics, criteria and quality in order to discuss how these theories are transferable to digital games and gaming situations. This part will be based on my two first ones. The theoretical discussion will be related to the thoughts and intentions of game producers and teachers expressed in interviews in addition to dramaturgic reception and interaction analysis based on critics of digital games. In my PAPER PRESENTATION I would like to present my plans for the final part of my research in order to discuss theoretical and methodological challenges according to discussing quality in pedagogical digital games.

PAPER PRESENTATION

Experts and Novices in Virtual Space: Spatial Behaviors, Learning, and Issues in Education

Michael McCreery, University of Nevada, Las Vegas, United States; P.G. Schrader, University of Nevada, Las Vegas, United States; Kathleen Krach, Troy State, United States

Because learning in virtual worlds is mediated by a three-dimensional representation of space, this research examines spatial ability in terms of novice and target (i.e., expert) behaviors within a popular virtual world, the World of Warcraft or WoW. Specifically, hundreds of in-game actions from five expert and 11 novice players' were directly observed over the course of 60 minutes of play and classified into one of five spatial categories (i.e., positioning, appropriation, interactivity, reasoning, and socio-spatial interactivity). Trend analyses across three segments of time (i.e., early, middle, and late) indicated that there were clear differences in terms of how experts and novices interact with and within WoW as well as when they engage in spatial behaviors. The findings have significant implications for education, research, and future design of virtual worlds.

INTRODUCTION

Three-dimensionality is a widely recognized, salient property of contemporary virtual environments. Because of the ability to represent the real world, many have argued that immersive environments allow users to interact with tremendous virtual landscapes, dynamically changing content, and players from various backgrounds and locations (Gee, 2003; Squire, 2006; Young, Schrader, & Zheng, 2006). In this way, virtual worlds support valuable learning goals like collaboration, situated problem solving, and authentic activity (Squire, 2006, Young et al., 2006). Unfortunately, research also indicates that individuals vary in terms of their spatial abilities, navigation, and cognitive abilities (Alexander, 2003; Glaser, Chi, & Farr, 1988; Jones, Gardner, Taylor, Wiebe, & Forrester, 2010; Lawless & Schrader, 2007). As a result, this research examines the differences between novice and target (i.e., expert) behavior within a popular virtual world (the World of Warcraft) as players negotiate the three-dimensional environment.

METHOD

Research Context

The World of Warcraft (WoW) was selected because it allows players to experience a wide range of quests, experiences, and activities while providing researchers with the ability to record their behaviors (i.e., video/screen capture). In these ways, WoW provided an authentic context to examine how initial, novice behaviors unfold.

Participants

Experts were defined to be players with two or more years of experience playing WoW, at least one year of high level play (i.e., end-game raiding experience), and at least one character at maximum level (i.e., level 80 at the time of this writing). By contrast, players who had no personal or direct experience with WoW, although experience in other games was permissible, were considered novices for the purposes of this research.

Participant's average age was approximately 25 (SD=6.1) for novices and 29 (SD=8.5) for experts. Participants' had a high school diploma or higher educational level. Four males and one female were identified as experts. One

male and 10 females were identified as novices. These gender approximations align with previous demographics associated with gamers (Yee, 2006) and the overrepresentation of females in colleges of education.

Procedures

Participants were directed to sit at alternating computer systems and wear an audio headset. The computer systems were identical iMacs equipped with a full version of WoW and a two-button PC mouse. A time sampling procedure, partial-interval recording (PIR), was used to collect data (see Goodenough, 1928). Specifically, every other 20-second interval within the observation period was evaluated and a psychologist experienced with MMOGs logged the type of behavior into the Behavioral Assessment Matrix (BAM; Figure 1). The BAM is a bi-dimensional direct observation instrument employed to assess behavioral data. The 60 minutes were divided into ten-minute intervals that corresponded to the first, middle and last ten-minute time period of play.

The categories associated with the BAM were informed by a combination of previous research and experiences with MMOGs (i.e., de Certeau's, 1988; Cole & Griffiths, 2007; Martey & Stromer-Galley, 2007; Webb, 2001; Williams, Ducheneaut, Xiong, Zhang, Yee, & Nickell, 2006). With respect to WoW, behaviors were identified in terms of movement and avatar positioning (i.e., spatial positioning), use of tool tips and asking for help (i.e., spatial realization), use of the quest log and mini map (i.e., spatial appropriation), dynamic interactions like quest gathering, non-player character interaction (i.e., spatial interactivity), and direct communication or initiating group contact (i.e., socio-spatial interactivity).

Data Analysis

Given the small sample size and the exploratory nature of the study, a combination of statistical significance testing, parametric trend analyses, and follow-up nonparametric time-trend analysis employing Spearman rho was applied to the data. Statistical significance was measured using General Linear Modeling (GLM) as an omnibus test followed by separate post-hoc tests.

RESULTS

Across each variable, experts showed higher scores than did novices. In all of the variables except social behavior, scores showed less variability amongst experts than amongst novices. Omnibus testing was used to investigate statistically significant differences for the dependent variables of ratings on spatial positioning, spatial appropriation, spatial interactivity, spatial realization, and socio-spatial interactivity for the independent variables of expertise (experts versus novices) and the three time points ($F(10, 76) = 1.464, p = .170$; Wilks' Lambda = .703; partial eta squared = .161). Statistically significance was found for the stand-alone independent variable of expertise ($F(5, 38) = 3.583, p$

Follow-up findings indicate statistically significant differences between experts and novices in the areas of spatial positioning ($F = 46.692(1, 42), p = .017$, partial eta squared = .129) and socio-spatial interactivity ($F = 166.484(1, 42), p(2, 42), p$

Linear and quadratic significance tests were run for behavioral trends. For novices, linear statistical significance was found for the variables of spatial positioning ($F(2,30) = 4.405, sig = .021$; $\rho = .426, sig = .013$), spatial appropriation ($F(1,30) = 2.861, sig = .101$; $\rho = .322, sig = .068$), and spatial interactivity ($F(1, 30) = 2.824, p = .103$; $\rho = .304, sig = .086$). Results indicate that these linear equations account for 90.50%, 77.67%, and 99.95% of the variance across each variable respectively. Amongst experts, linear statistical significance was found only for the variable of spatial appropriation ($F(2, 12) = 11.655, sig = .005$; $\rho = -.714, sig = .003$) indicating that a linear relationship accounts for 98.26% of the variance.

DISCUSSION

These findings have several implications for the field of education. As noted in previous findings (Anatonacci & Modaress, 2008; Delwich, 2006), novices require time to adjust to the environment and deal with the steep learning curve that comes with interacting with a new system (i.e., Spatial Appropriation). However, these findings indicate that participants resolve issues fairly quickly, approximately 30 minutes with this environment. Another important concern of previous authors (Delwich, 2006; Martin, 2008) is the need for social interaction and communication in order to achieve collaborative learning benefits. From the findings in the current study, it appears that when left unchaperoned, novices will require more time within the environment than the hour that was recorded, to begin to interact with other participants. Training students or providing more sophisticated, authentic tutorials within virtual worlds could address this acclimation period.

PAPER PRESENTATION

Game-based learning: A review on the effectiveness of educational games

Sylke Vandercruysse, Katholieke Universiteit Leuven, Belgium; Mieke Vandewaetere, University of Leuven - Campus Kortrijk, Belgium; Geraldine Clarebout, KU Leuven, Belgium

A new interest in the use of video games for learning has emerged and a number of claims are made with respect to the effectiveness of games in education. These educational games are as a new instructional technology with great potential. The suggested positive outcomes and effects have been mentioned repeatedly (e.g., Alessi & Trollip, 2001). In this review the learning effects of educational games are studied in order to gain more insights into the conditions under which a game may be effective for learning. A systematic literature search in three databases was conducted. Results reveal that effectiveness research on game-based learning is highly susceptible to a muddle of approaches, methodologies and descriptions of gaming for educational purposes. Some researchers did find a positive effect on learning and motivation, but this is moderated by different learner variables and depends on different context variables.

Background

Games as learning environments are considered as a new instructional technology with great potential (Becker, 2007). Positive outcomes and effects have been claimed and educational effectiveness is expected from the use of games. According to different authors, video games should directly contribute to knowledge construction and skills and attitudes acquisition (Hayes & Games, 2008; Ke, 2008; Papastergiou, 2009). Additionally, educational games should effectively motivate learners and this increase in motivation is assumed to lead to higher invested mental effort, to more intentionally processing of information, and to more enjoyable learning. So an optimistic stance is taken towards the potentials of games in education. In this contribution, we attempted to get some evidence on this assumed benefits of games. By looking at the results and findings from various experimental research, some key issues about the effectiveness of educational games will be illustrated.

Method

A literature search was performed in 3 databases, namely ERIC, PsycInfo, and Web of Science. The following descriptors were used: "game based learning", "serious game*", "educational game*", game* AND learning* and gaming AND learning*. The terms "study" or "research" were respectively used to focus the search since the aim of the study is to find empirical research studies. Only peer-reviewed articles were included and no date limits were set. With this search, 1,013 unique articles were found. All abstracts were read through. Those articles that complied to the following criteria were kept: the article describes (quasi-) experimental research that made use of a computer-based-game in an educational setting. Only 24 journal articles have been selected.

Notwithstanding research on educational games is flourishing, no univocal and generic definition has arisen and there is no agreement on what elements are crucial to constitute a game. Unfortunately, if no studies are referring to similar descriptions and categorizations, comparing the effectiveness of educational games is made impossible. Nevertheless, with this contribution we want to gain insight into the effectiveness of educational games for learning. Therefore, defining the educationally effective parts or elements of a game might be a first step towards a conceptual research framework. As Aldrich (2005, p. 80) stated, "Rather than thinking about games and simulations, it is more productive to think about the distinct elements.". Consequently, this review sketches the empirical research on the effectiveness of educational games by using a framework consisting of game-elements based on the work of among others (Alessi & Trollip, 2007; Becker, 2007; Bergeron, 2006; Prensky, 2001). These elements are: fun, play, rules, goals and objectives, interactivity, adaptivity, outcomes and feedback, win status, problem solving, competition/challenge, interaction and representation or story. So this framework of game-elements will be used to investigate the effectiveness of educational games.

Results and conclusion

Three key factors are indispensable in research focusing on the implementation of educational games: the environment, the mediating variables and the learning results. First, the reviewed articles show that games are used in a variety of domains (e.g., Science, History, Geography) and a variety of game formats (e.g., multiplayer games, virtual reality games) are taken into consideration. Additionally, it seemed that the chosen framework (see method) was not ideal to analyze the studies because they often lack a thorough description of the implemented game. This forms a problem to draw conclusions about which game-elements make the implementation of an educational game effective. In sum, this review showed that there is a clear gap between what is theoretically stated and empirically proved. Secondly, nine studies consider several moderating variables, e.g. learner characteristics such as gender, prior knowledge, etc. Not much evidence for the moderating influence of these variables on the learning outcomes has been found. Another moderating variable, motivation, has been examined in nine studies as well. Unfortunately, the results of the studies do not always show positive effects, meaning that the use of video games not always had

positive motivational effects and if they are, the results could also be attributed to other factors such as the Hawthorne effect, the cooperative goal structure, etc.

Thirdly, although some significant learning effects have been demonstrated in ten studies, prudence is called in stating learning effects of educational games since not all the studies (e.g. Ebner & Holzinger, 2005; Ke, 2008) found that game-playing resulted in significant better performances compared to non-playing conditions.

In sum, no generic effects are found concerning the implementation of games in educational settings on learning results and motivation, as described above. Possible causes are the muddle of approaches, methodologies and descriptions of gaming for educational purposes. The most ideal way to examine which factor(s) is(are) effective, is by manipulating various separate game-elements. By focusing on game-elements, one can more easily find which elements are crucial for defining the successful implementation of a game in educational settings.

Literature

Aldrich, C. (2005). *Learning by doing: The comprehensive guide to simulations, computer games, and pedagogy in e-learning and other educational experiences*. San Francisco: Pfeiffer.

Alessi, S.M., & Trollip, S.R. (2001). *Multimedia for learning. Methods and development* (3rd ed.). Needham Heights, MA: Allyn and Bacon.

Becker, K. (2007). Pedagogy in commercial video games. In D.G Gibson, C.A. Aldrich, & M. Prensky (Eds.), *Games and simulations in online learning: Research and development frameworks*. Hershey, PA: Information Science Publishing.

Bergeron, B. (2006). *Developing serious games*. Hingham, MA: Charles River Media.

Ebner, M., & Holzinger, A. (2005). Successful implementation of user-centered game based learning in higher education: an example from civil engineering. *Computers & Education*, 49(3), 873-890.

Gee, J.P. (2003). *What video games have to teach us about learning and literacy*. New York, NY: Palgrave Macmillan.

Hayes, E.R., & Games, I.A. (2008). Making computer games and design thinking. A review of current software and strategies. *Games and Culture*, 3(3-4), 309-332.

Ke, F. (2008). Computer games application within alternative classroom goal structures: cognitive, metacognitive, and affective evaluation. *Educational Technology Research and Development*, 56, 539-556.

Papastergiou, M. (2009a). Online computer games as collaborative learning environments prospects and challenges for tertiary education. *Journal of Educational Systems*, 37(1), 19-38.

Prensky, M. (2001). *Digital game-based learning*. New York, NY: McGraw-Hill.

PAPER PRESENTATION

Strategy Performance Mediates Effects of Continuous and Faded Scripts on Online Search Competence

Christof Wecker, University of Munich, Germany; Ingo Kollar, University of Munich, Germany; Frank Fischer, Universität München, Germany

Laboratory research has shown that scripts can stimulate productive interaction and thereby positively affect learning outcomes. In a prior field experiment we found positive effects of continuous and faded scripts on online search competence compared to unstructured collaboration, but no effect of the faded script beyond that of the continuous script. This paper presents further analyses from this study about the effects of these two types of scripts with respect to the performance of the strategy during the learning phase and the relation between the performance of the strategy and the development of online search competence. In a curriculum unit about Genetic Engineering with three inquiry cycles involving one online search phase each, three experimental conditions were implemented: No script, continuous script, and faded script. The performance of the strategy was measured based on recordings of learners' utterances and activities on the computer by means of screen-audio-capturing software. A time sample from the online-search phases was coded for the occurrence of activities suggested by the script. Both the continuous and the faded script had positive effects on the performance of the strategy, but these two conditions did not differ from each other in this respect. Learners' own performance of the strategy predicts online search competence, while their learning partners' performance of the strategy does not contribute further to the accuracy of predictions. The findings indicate that the main mechanism of developing online search competence during collaborative learning supported by scripts is by means of performing the strategy.

In prior research, computer-supported collaboration scripts have been developed to provide structure for successful collaborative inquiry learning (de Jong, 2006). Laboratory studies have shown that scripts can stimulate productive interaction and thereby positively affect learning outcomes (Kollar, Fischer & Slotta, 2007). These findings stimulated the question whether similar effects can be obtained in real-world settings with an extended timeframe. Furthermore, they led to the question whether fading a script allows learners to take over control of their activities and thereby fosters learning outcomes even further. We conducted a field experiment about the effects of a continuous and a faded script on the development of online search competence with respect to socio-scientific issues as a part of

scientific literacy. We found positive effects of both types of scripts compared to unstructured collaboration, but no effect of the faded script beyond that of the continuous script (Wecker, Kollar, Fischer & Precht, 2010). In the following, we present further analyses from this study concerning the questions (1) what the effects of these two types of scripts are with respect to the performance of the strategy suggested by the script during the learning phase and (2) how the performance of the strategy is related to the development of online search competence.

Method Participants and design. The sample comprised 129 students (60 girls, 69 boys; age: $M = 14.7$, $SD = 0.67$) from six ninth-grade classes from three urban high schools in three experimental conditions: No script, continuous script, and faded script. **Learning environment, task, and procedure.** A seven-lesson curriculum unit about Genetic Engineering was implemented by the classes' Biology teachers. The unit comprised three cycles about economic, ecological and health-related issues of Genetic Engineering. Each cycle consisted of three steps: background information on Genetics, online searches on the Web for arguments about the issue, and a whole-class discussion. The first two steps were performed in face-to-face dyads. Each student was equipped with a laptop. During online searches, both students saw the same web pages no matter who of them navigated. Students completed pre- and posttests before and after the unit. **Independent variable.** In the condition without script, students did not receive any support during collaborative online search beyond an introduction by the teacher that was identical in all three conditions. In the condition with a continuous script, students received complementary prompts in their web browser for five (partly iterative) stages of collaborative online search. One of the learners had the "operative" role of suggesting initial arguments, search terms, hits etc., whereas the partner had the "metacognitive" task of commenting on these suggestions. In the condition with a faded script, initially the same prompts were presented as in the condition with the continuous script, but their degree of specificity was reduced over time. **Data sources and instruments.** Screen-audio-capturing software recorded learners' utterances and activities on the computer. A time sample of 10 minutes from the beginning of the online-search phase of each cycle was selected for analysis. Occurrence of the activities suggested by the script for this phase was coded separately for both members of each dyad for segments of 10 seconds (Cohen's $k = .64$ to $.89$). The proportion of segments in which one of the activities belonging to the first step of the script was performed was used as an indicator of the performance of the strategy (Cronbach's $\alpha = .82$). Online search competence was measured in the pre- and posttests where students described how they would use the Internet to arrive at a position about a specific issue. The occurrence of the elements of the strategy suggested by the script in the solutions was coded and counted (pretest: ICC = $.51$; posttest: ICC = $.83$). **Results RQ1: Effects of continuous and faded scripts on performance of the strategy.** An ANOVA with the students' performance of the strategy as the dependent variable and script support and classes nested within the levels of script support as independent variables and the pretest as a covariate revealed a significant effect of script support, $F(2; 122) = 5.35$; $p = .01$; partial $\eta^2 = .08$. Both continuous and faded script had positive effects on the performance of the strategy, continuous: $F(1; 77) = 15.53$; $p = .00$; partial $\eta^2 = .17$, faded: $F(1; 78) = 7.56$; $p = .01$; partial $\eta^2 = .09$, but did not differ from each other, $F(1; 122) = 0.00$; $p = .98$. **RQ2: Role of performance of the strategy for online search competence.** A regression analysis with online search competence in the posttest as the criterion variable and learners' as well as their learning partners' performance of the strategy as predictors, while also controlling for prior online search competence was conducted. It showed that the learners' own performance of the strategy can significantly predict online search competence, $b = .25$; $p = .02$, while their learning partners' performance of the strategy does not contribute further to the accuracy of predictions, $b = .00$; $p = .98$. **Discussion** The findings indicate that the main mechanism of developing online search competence during collaborative learning supported by scripts is performance of the strategy suggested by the script. The association of the performance of the strategy with online search competence in the posttest makes it unlikely that scripts affect learning outcomes merely via exposure to and recall of prompts encountered before. Although faded scripts do not seem to raise online search competence more than continuous scripts do, sustained performance during fading, i.e. increasing self-regulation, may yield more robust outcomes, which should be investigated in future studies.

References

- de Jong, T. (2006). Technological advances in inquiry learning. *Science*, 312, 532-533.
- Kollar, I., Fischer, F. & Slotta, J. D. (2007). Internal and external scripts in computer-supported collaborative inquiry learning. *Learning and Instruction*, 17, 708-721.
- Wecker, C., Kollar, I., Fischer, F. & Precht, H. (2010). Fostering online search competence and domain-specific knowledge in inquiry classrooms: effects of continuous and fading collaboration scripts. In K. Gomez, L. Lyons, & J. Radinsky (Eds.) *Proceedings of the ICLS 2010: Volume 1* (pp. 810-817). Chicago: ISLS.

PAPER PRESENTATION

With a little help...: On the role of guidance in knowledge acquisition in complex, dynamic systems

Jens F. Beckmann, University of New South Wales, Australia; Natassia Goode, University of New South Wales, Australia

This study investigates the role of structural information, practice and fluid intelligence in the control of a computer-simulation of a complex, dynamic system. Eighty-nine subjects attempted to discover the underlying structure of an autoregressive system. After initially controlling the system with their limited knowledge, half of the subjects received direct instruction as to the actual underlying structure of the system. All subjects then controlled the system again. In contrast to the results of previous studies, structural information did confer an advantage in controlling the task, and subjects were able to translate the information into effective control actions without practice. Fluid intelligence moderated the extent to which subjects benefited from structural information. These results indicate that the efficacy and timing of instruction, along with learner characteristics, play a more important role in learning to control the outcomes of a system than the mode of instruction.

Knowledge acquisition through an unguided exploration often is referred to as scientific discovery learning. In this approach, the learner is seen as an independent and active agent in the process of knowledge acquisition, as they must develop hypotheses, design experiments to test them, and appropriately interpret the data. The problems that learners experience with discovery learning in hyper-media and computer simulations are well documented, and so far there is no clear evidence that favours discovery learning over more traditional forms of learning such as expository instruction. Reviews of the findings of numerous studies show that learners need extensive guidance in order to facilitate the acquisition of deep conceptual knowledge.

Complex dynamic systems are used to investigate how people manage complex and dynamic systems in the real world. They consist of a number of inputs (variables that the decision maker intervenes on) and outputs (outcomes that are generated by the system). The system is dynamic because the values of the outputs change in response to the problem solvers' actions, and independently over time. The values of inputs can be changed, which affects the values of the outputs via more or less complex causal structures that relate the inputs to the outputs. This is referred to as the underlying structure of the system.

Within the context of complex problem solving learners also experiencing challenges in acquiring knowledge of the underlying structure of the system through unguided exploration. However, instructions providing structural information have not shown effects on control performance. Studies so far suggest that structural information does not directly benefit control performance, as it seems knowledge needs to be independently acquired or practiced in the context of application.

Goal: The main goal of this paper is to determine whether the provision of structural information confers any additional advantage in controlling a complex system over actively acquired knowledge.

Hypotheses:

Subjects who acquire more knowledge about the underlying structure of the system should show better control performance (Knowledge Hypothesis).

Subjects who receive structural information should improve their control performance more than those who receive no additional information (Information Hypothesis).

Under conditions where problem solvers receive information, the magnitude of improvement is a function of their fluid intelligence (Intelligence Hypothesis).

Participants: Eighty-nine first year psychology students participated for course credit.

Design: Subjects were randomly assigned to one of two conditions (45 subjects in the Information condition, 44 subjects in No Information condition). Subjects were required to control a complex, dynamic system on two separate occasions (within-subjects factor). The between-subjects factor was whether or not they received structural information. Subjects were assessed on their structural knowledge, control performance for phase 1, control performance for phase 2 and performance in a test of fluid intelligence.

Procedure:

In the exploration phase participants were prompted to explore the system for two cycles of 7 trials each by changing any of the input variables and observing the effect upon the output variables. At the end of each trial, participants had to record what they had learned using the causal diagram that was displayed on the screen.

In the control phase participants had to manipulate the inputs to reach set values of the outputs for seven trials, which were indicated as lines on the output graphs (Control Phase 1). The causal diagrams remained on screen, providing access to the structural information extracted during the exploration phase. In the information condition participants then watched an instructional video that explained the actual underlying structure of the system. After each trial, the narrator explained how each of the outputs had changed, and how this reflected the underlying

structure of the system. A causal diagram was constructed on screen, to record this information. Participants in the no information condition did not receive any additional information. All participants then had to control the system again for seven trials, with different goals indicated on the output variables (Control Phase 2). In the complete information condition the causal diagram displayed onscreen was the correct and complete one. In the no information condition, the causal diagram that participants had initially created themselves was displayed onscreen.

Results:

Knowledge hypothesis: There was a significant positive relationship between structural knowledge scores and control performance in Phase 1, indicating that subjects who acquired more knowledge controlled the system better.

Information hypothesis: Subjects who received additional information performed better and improved at a greater rate from control phase 1 to control phase 2.

Intelligence Hypothesis: Problem solvers with a higher fluid intelligence tended to perform better overall, and improved more from control phase 1 to 2.

Discussion:

The present study examined the effect of structural information and fluid intelligence on the control of a complex problem-solving task.

Results suggest that the provision of structural information does confer an additional advantage in controlling a complex system over independently acquired knowledge, and that subjects can translate such information into effective control actions. However, the extent to which subjects can benefit from structural information appears to be moderated by their fluid intelligence.

While previous studies have found that a period of active practice is necessary before structural information can be translated into effective control actions, the current study found that the provision of structural information provided an immediate advantage over independently acquired knowledge.

In summary, it is not the mode of knowledge acquisition that seems important for system control, but rather the efficacy and timing of the instruction.

More intellectually capable individuals are able to make use of structural information more effectively than individuals who are less so. Our study extended on previous findings, as it was also found that subjects who are more intelligent are at a double advantage in comparison to those who are less intelligent with regard to acquiring and utilising structural knowledge: they are able to acquire more knowledge without assistance, and they also benefit more from direct instruction.

Overall, our results imply that the direct instruction has the potential to provide benefits over and above the effects of discovery learning. The crucial aspect of instruction, however, is that it is well designed.

PAPER PRESENTATION

Learning can be fun: The story of learning from computer games.

Skevi Demetriou, University of Bristol, United Kingdom

Computer games are a rapidly growing part of our culture and their impact on people of all ages and especially on youth is impressive. The potentially beneficial contribution of technological means and especially of computer games, on education and learning has been highly emphasised by educators and scholars worldwide. This is a study exploring the motivational properties of reward uncertainty and its impact on learning in the environment of an educational computer game. The investigations focused on positive reward prediction error and its relationship to successful or unsuccessful learning in the specific computer game context. An educational computer game especially designed for the purposes of this study was employed. The study, when conducted with 16 adults, found that for recall, prediction error prior to successful learning was again significantly higher [$M=17.55$, $SE=1.35$, $t(15)=3.51$, p

Computer games are a rapidly growing part of our culture [1]. The impact of games on people of all ages and especially on youth has lead to the development of a vast global community of users, affinity groups and entrepreneurs investing millions of dollars on game related projects [1]. Within this progression, the potentially beneficial contribution of technological means and especially of computer games, on education and learning has been highly emphasised [2].

Even though some scholars are rather sceptical regarding the link between computer games and learning, others don't hesitate to overtly acknowledge their potentially beneficial influence on children's education and learning, usually grounding it on the argument that fun learning is effective learning [3]. Some scholars in the area suggest that computer games are not the enemy, but may provide the best opportunity to engage children in real learning situations [e.g. 4]. From a broader view, the game element appears to carry added value in pedagogy, enhancing students' motivation and making learning derived from such instruction often more efficient compared to that achieved in more conventional settings excluding game features [5-7].

It appears to be that the prevalent source of interest in this research area is that computer games may possess the dynamic to motivate and engage people within learning contexts and especially children in a way that formal education often does not [8]. A review based on ninety four studies concluded that computer gaming may serve a range of functions and thus promote learning in many ways [9]. It is also pointed out that frequent computer gaming helps users adjust to the contemporary computer oriented society within which they live and act [10].

A better understanding of why both children and adults are motivated by computer games in order to identify the elements that promote their learning within such contexts, may help devise more effective learning experiences in and out of formal school settings. Previous research has emphasised the key role of uncertainty, competition, optimal challenge and interactivity among others in providing deeply engaging gaming experiences [e.g. 11-15]. The currently presented study focuses on the impact of uncertainty, and particularly reward uncertainty, on children's learning within computer gaming environments. Additionally, literature points out that satisfaction, and hence motivation, arises within a gaming environment due, partially, to encountering competitive challenges with unknown and uncertain results [16]. Therefore, competition and uncertainty seem to be some of the main engaging and motivating elements of computer games that contribute to the learning derived within such environments.

Attitudes towards school and school-type tasks seem to change as children go through primary and secondary school. Within this progression, motivation towards academic achievement can decrease, contrasting with children's increased commitment to their social relationships and also, the use of computers for socialising and gaming. Both within social domains and within gaming practices, the levels of uncertainty that are encountered are greater than in many learning tasks (i.e. school based learning is more predictable in its trajectories) and this may influence the motivation for children to engage and develop their knowledge in these areas. There is neuroscientific evidence for uncertainty enhancing the approach motivation provided by reward, and such evidence also suggests approach motivation can be considered as a function of prediction error – the difference between the reward value and its expected value.

Literature praises the motivational properties of competition and challenge especially in learning and gaming contexts [16-17]. Additionally, educational literature acknowledges a wider beneficial contribution of uncertainty in academic achievement [18] and in students' motivation to engage in learning activities [19]. Also, psychological evidence indicate that we are particularly excited by different levels of uncertainty when seeking rewards, with motivation peaking near 50% probability [20,21], exactly where moderate risk taking is required. However, purely educational research has rarely focused itself specifically on the motivational role of uncertainty especially in computer gaming environments.

Additionally, studies on animal learning on the primate brain, like that of Fiorillo et al. (2003) have provided clues on how reward uncertainty may increase motivation through its impact on dopamine [22]. This suggested a brain-basis for the pleasures of chance-involving tasks, such as gambling, and also the addictive aspects of computer-games [23]. Particularly, it was found that sustained activation of the dopamine neurons of the brain occurs in response to reward uncertainty [23,24], making implications of how reward uncertainty and particularly, prediction error (PE), could impact on learning through dopamine release. One camp of scholars supported an indirect impact of dopamine on memory encoding and/or recall due to its enhancing influence on attention (i.e. 25,26) whereas another favoured a direct impact of dopamine on declarative memory formation involving the hippocampus [i.e. 27,28]. It is important to mention here that, through neuroscientific explorations, PE was found to be proportional to the amount of dopamine generated in the ventral striatum of the brain, and particularly in the NAcc, hence relating to approach motivation [29]. Therefore, these mechanisms may shed light on how games, including learning games, may motivate and engage their players and also promote their learning. Based on the arguments mentioned above about what literature suggests, reward-uncertainty-promoting games may induce dopamine release in the brain in a way proportional to the PE. This is particularly important for learning since dopamine is found to be a "motivation enhancer" and a "learning promoter".

This study explored the motivational properties of reward uncertainty and its impact on learning in the environment of an educational computer game. The investigations focused on positive reward prediction error and its relationship

to successful or unsuccessful learning in the specific computer game context. An educational computer game especially designed for the purposes of this study was employed. The study, when conducted with 16 adults, found that for recall, prediction error prior to successful learning was again significantly higher [$M=17.55$, $SE=1.35$, $t(15)=3.51$, p

PAPER PRESENTATION

Evaluation VR Vs. CAI as Teaching Strategies among Students with ASD: A Meta-Analysis

Orit Hetzroni, University of Haifa, Israel; Juman Tannous, University of Haifa, Israel

Aim: Students with ASD demonstrate severe behavioral, communicative, social, and cognitive deficits. Such deficits interfere with the process of learning new skills and generalizing these skills beyond the learning setting (Mesibov, Shea, & Schopler 2005). Assistive technology (AT) has been found to be effective for teaching individuals with ASD. Computer assisted intervention (CAI) is a successful teaching instrument for children with ASD. The purpose of this study was to investigate differences and similarities between virtual reality (VR) and CAI as teaching instruments for children with ASD. **Method:** A meta-analysis was conducted to evaluate the differences and similarities between VR and CAI as teaching strategies for individuals with ASD. Studies were located between years 1980-2009. The search was restricted to elementary school age children. **Results:** Results indicate that practice was found to be a useful consideration in every process used for teaching children with ASD across different methods of intervention. All components of practice were found in CAI and VR intervention strategies used for teaching individuals with autism. **Conclusion:** Based on the results of this study a proposed model is suggested to represent basic components of practice as a key element in intervention strategies used for teaching elementary children with ASD using VR and CAI. This basic model can be represented using three basic learning processes derived from various learning theories: neurobiological, cognitive and behavioral.

Introduction

Students with Autism Spectrum Disorders (ASD) demonstrate severe behavioral, communicative, social, and cognitive deficits. Such deficits interfere with the process of learning new skills and generalizing these skills beyond the learning setting (Mesibov, Shea, & Schopler 2005). Over the years, many adapted intervention strategies and treatment methods were developed. As a result, an overwhelming number of strategies are available; each of them have different aspects associated with unique theoretical backgrounds, learning processes, environments appropriate for intervention as well as structure, and type of instruction. Such strategies are meant to increase the students' abilities in different domains, including behavioral, communicative, social and cognitive, taking into account the specific and unique learning profile of children who have ASD (Corsello, 2005). An overview of the theoretical background of different intervention strategies demonstrates that there is a steady use of structure, repetition, intensity and consistency across all strategies (e.g., Greenspan, & Weiber, 1998; Kerr, Smyth, & McDowell, 2003; Mesibov, Shea, & Schopler, 2005). This was evident beyond the domains learned and the theoretical background of any intervention method. Assistive technologies offer such unique intervention strategies used for individuals with ASD. The increased use of technology, which characterizes this era, did not skip individuals with ASD. Assistive technology (AT) has been found to be effective for teaching individuals with ASD. Computer assisted intervention (CAI) is a successful teaching instrument for children with ASD. CAI offers opportunities for multi-sensory interactions, controlled and structured environments, use of multilevel interaction functions, and individualized use and independence are some of the factors that can assist children with ASD in working with computers (Hetzroni & Tannous, 2004). Virtual reality (VR) is a combination of technologies, allowing creation and exploration of virtual environments, which are 3D computer-generated representations of environments that may have a realistic appearance, allowing an authentic simulation of situations, potentially helping participants to perceive the relevance of the real world, which maximizes the likelihood of generalized learning (Mitchell, Parsons, & Leonard, 2007). The use of training and practice in controlled environments has been found to be effective for children with ASD when later performing in natural environments (Hetzroni & Tannous, 2004). Offering such environments, CAI and VR interventions have been investigated for effectiveness as teaching strategies. The purpose of this study was to investigate differences and similarities between VR and CAI as teaching instruments for children with ASD.

Materials and Methods

A meta-analysis was conducted to evaluate the differences and similarities between VR and CAI as teaching strategies for individuals with ASD. For this purpose, a wide range search was conducted using several search engines including electronic data-bases, manual search through leading journals, leading researchers and reverse citation lists. Studies were located between years 1980-2009. The search was restricted to elementary school age children receiving intervention in the area of VR and CAI. Coding included documenting different dependent variables: Theoretical background, domain, target of intervention, research method, learning process, number of sessions, number of repetitions in session and across sessions, environment, structure, use of reinforcement, type of instructions,

generalization, age, and function level. Of the studies found using the above search methods, 20% were coded by independent coders for reliability purposes. Effect size was calculated for all intervention outcome studies for group design and single subject design studies based on their appropriate standards for calculating effect size measures.

Results and Discussion

Results indicate that practice was found to be a useful consideration in every process used for teaching children with ASD across different methods of intervention (i.e., CAI and VR). All components of practice were found in CAI and VR intervention strategies used for teaching individuals with ASD. Results demonstrate that elements of intervention structure, repetition, intensity and consistency were most commonly found in the studies. Thus, results of this study demonstrate that learning is highly efficient when practice is used along the intervention process; this evidence was found to be true beyond the domain of each study. Based on the results of this study a proposed model is suggested to represent basic components of practice as a key element in intervention strategies used for teaching elementary children with ASD using VR and CAI. This basic model can be represented using three basic learning processes derived from various learning theories: neurobiological, cognitive and behavioral. A careful view of the model may indicate that each component, presented in the model, addresses one of the difficulty areas associated with ASD. This model suggests that use of practice during intervention may play a critical role in the process of learning. By using practice, the learning process is much more efficient enabling the occurrence of generalization. Further research should investigate use of practice as an intervention method across other teaching and treatment strategies. Results also demonstrate that developing or selecting an intervention program can indicate whether modifications or adaptations to existing programs would be critical, by adding, changing, or omitting components associated with larger or smaller effects. Thus, effective programs are likely to become more potent. Costs associated with adopting and implementing new approaches are also minimized. Such approaches increase uptake of more effective interventions and teaching strategies in the field. Empirical data will be presented as well as the model.

References

- Corsello, C. (2005). Early intervention in autism. *Infants and young children*, 18, 74-85.
- Greenspan, S., & Weider, S. (1997). Developmental patterns and outcomes in infants and children with disorders in relating and communicating: A chart review of 200 cases of children with autism spectrum diagnoses. *Journal of Developmental and Learning Disorders*, 1, 87-141.
- Hetzroni, O. E., & Tannous, J. (2004). The Effect of Computer-based Intervention Program on the Communicative Functions of Children with Autism. *Journal of Autism and Developmental Disorders*. 34, 95-113.
- Kerr, K., Smyth, Ph., & McDowell, C. (2003). Precision teaching children with autism: helping design effective programs. *Early Child Development and Care*, 173, 399-410.
- Mesibov, G., & Shea, V. (2005). The TEACCH Method: Structured Teaching. In: L.S. Wankoff (ed), *Innovative methods in Language Intervention*. (pp. 83- 109). Texas: Pro-ed.
- Mitchel, P., Parsons, S., & Leonard, A. (2007). Using virtual environments for teaching social understanding to 6 adolescents with autistic spectrum disorders. *Journal of Autism and developmental disorders*, 37, 589-600.

PAPER PRESENTATION

Constructing professional circle of knowledge among special-education teachers

Roni Reingold, Achva-College of Education, Israel; Nira May, Achva-College of Education, Israel; Gali Grisaru, Achva-College of Education, Israel; Tzlil Levi, Achva-College of Education, Israel

Paulo Freire's pedagogical philosophy focuses on the potential of education for social transformation. According to Freire, structural reading of reality leads the pedagogical-educational praxis. He claims that a dialogical and reflective process that he names: "the professional circle of knowledge", can lead educators (teachers) to rewrite their personal and collective narratives, and to expand subjective liberating and empowering views (Freire & Shor 1987). In the current paper we report the findings of a unique attempt in Israel to develop a professional circle of knowledge during a six one-hour workshop meetings of experienced in-service special-education teachers. A qualitative evaluation research of this educational intervention was preformed, using combined qualitative methods, such as action research (since one of the researchers was the instructor of the workshop) and ethnographic research (since the other researchers analyzed D.V.D recordings of the meetings). The findings reveal that even though there were a lot of subjective and objective obstacles, the educational intervention succeeded and most of the teachers developed the skills of conducting a professional circle of knowledge. Never the less our findings led us to recommend that such educational interventions take place in earlier stages of teachers' professional education, either in initial teacher education, or in novice teachers' professional developments programs.

Paulo Freire (1921-1997) was one of the most influential thinkers in education in the last 40 years. He became a source of inspiration and hope for justice seekers, equality and freedom in the pedagogical-educational and socio-

cultural fields (May & Flavian, 2010). Freire's pedagogical philosophy focuses in the potential of education for social transformation. According to Freire, structural reading of reality leads the pedagogical-educational praxis. He claims, that a dialogical and reflective process that he names: "the professional circle of knowledge", can lead educators (teachers) to rewrite their personal and collective narratives, and to expand subjective liberating and empowering views (Shor & Freire 1987). Freire claims that the circle of knowledge does not end at the stage of attaining knowledge, it is composed of two additional stages: the stage of creating new knowledge, and the stage of awareness and exposure to reality. This circle enables participants in the educational process to understand the sources of their knowledge and be aware of why and how hegemonic culture and ideology controls them. It also enables them to develop a mental gap from that hegemonic culture and ideology and facilitate the ability to influence. Hence, the expansion of consciousness is authentic when the removal of the veil from reality is united with dialectic practical dynamics of transformation of reality. In Freire's terminology: the pedagogical and political praxis (Freire, 1970). The main tool to create the circle of knowledge is the dialogue, which in Freire's conception contained communicative and epistemological aspects and has a political dimension (May, 2006). The dialogue reveals Freire's educational-social viewpoint, which opposed any kind of official authorized educational oppression. The nature and contents of the dialogue reflect his social-political opinion, the goals and objectives of the educational-political praxis, the nature of educational leadership and the guiding ethical-moral principles of Freire. Analysis of the contents of the dialogue enables us to become acquainted with the epistemological perception of Freire, the way to create knowledge and the role of knowledge in an emancipated, just and equal society structure (Freire, 1984). In the current paper we report the findings of a unique attempt in Israel to develop a professional circle of knowledge during six one hour workshop meetings of experienced in service special education teachers. We have chosen to try to help special education teachers to develop a professional circle of knowledge, since we believe that not only their students but they themselves are suffering from being excluded in the Israeli society.

Methodology

12 special education teachers in one small school in Israel participated in an evaluation research about the possible influence of educational intervention, based on Freire's pedagogical philosophy. Three questions in an open questionnaire were handed prior to the beginning of the educational intervention. The teachers were asked about their main difficulties in schools, their sources of knowledge, and their main helpers in searching to solve school problems. Then a six one hours workshop meetings were performed and were examined using combined qualitative methods, such as action research (since one of the researchers was the instructor of the workshop) and ethnographic research (since the other researchers analyzed D.V.D recordings of the meetings). Beside some quantitative data, such as the percentage of every participant in each of the meetings, the researchers examined, who suggested topics for discussions and who suggested the ways of solutions. Moreover they examined if the topics and the offered solutions were traditional (conservative) or more radical, wide and essential. The content of all the six meetings was content analyzed on the basis of the principles of critical discourse analysis (Van Dijk, 2001).

Findings

At the beginning, the participants reflected a high professional self and collective efficacy. They declared in the questionnaire and in the first meeting that they get all the help they need from their colleagues whenever they have to solve problems or to design lessons: "We are one strong and unified family; we can solve every problem together and do not need someone from the outside". Hence, they resisted participation in an open workshop and when the headmaster insisted and pressured some were very passive. Even the more active participants did not want to present real problems or suggested conservative and partial solutions. As time passed (even though there were only six meetings), some or even most of the participants acknowledged that the sense of togetherness is partially faked, they expressed satisfaction from the opportunity to express their one and unique voice. They began to deeply understand the reality in which the Israeli ministry of Education controls the educational system, and as a result the special education teachers and students suffer from inequality and even oppression. The teachers became more and more active from one meeting to the next one. They talked more (in correlation with the instructor talking less), they suggested the topics for the discussions (meaning the problems they have to deal with) and more real, complex and deep solutions for the difficulties. The real, open and structured dialogues influence them to define the problems wider and to find more essential solutions.

Recommendations

Even though the educational intervention can be regarded as success, we recommend that such educational interventions will take a place in earlier stages of teachers' professional education, either in initial teacher education, or in novice teachers' professional development programs.

References

Freire, P. (1970). *Pedagogia del oprimido*. tr. Mellado, J., Siglo xxi, España, Mexico.

- Freire, P. (1984). *Extencion o Comunicaciôn? La Concientizaciôn en el Medio Rural*, tr. Ronzoni, L., Siglo XXI Editores, Mexico, España, Argentina, Colombia.
- Freire, P. & Shor, I. (1987). *A pedagogy for liberation: Dialogues on transforming education*. South Hadley: Bergin & Garvey Publishers.
- May, N. (2006). "To Become More", "Pedagogical Praxis" and "Dialog Development and Continuity in Paulo Freire's Philosophy. Thesis submitted for the degree of "Doctor of Philosophy". Hebrew University: Jerusalem.
- May, N. & Flavian, H. (2010). *Examination of the Development and Continuity in the Philosophy of Paulo Freire. Proceedings Book.SIG 13: Moral and Democratic Education- 2nd Symposium on Moral and Democratic Education*.
- Van Dijk, T.A. (2001) *Multidisciplinary CDA: A Plea for Diversity*, in R. Wodak & M. Meyer (Eds.) *Methods of Critical Discourse Analysis*, (pp. 95–120). London: Sage.

PAPER PRESENTATION

Nurses in the Netherlands. Do they calculate correctly?

Tecla Lampe, Cito, Netherlands; Theo Eggen, Cito, Netherlands; Gerard Straetmans, Cito, Netherlands

In 2007, several reports in the Netherlands stated that the nurses' medication calculation skills cannot measure up to the demands of their work. In 2010, these calculation skills were assessed by an empirical study. 2,661 nurses answered 30 multiple-choice items on paper. The nurses worked in academic and general hospitals, including revalidation centres. On average, this sample of nurses passed 21.6 items (sd 4.55) out of 30. The items were calibrated by the One Parameter Logistic Model. The mean ability of the nurses was estimated .484 (sd .399). Afterwards, six experts set a national standard, based on the test results. They rated a set of 40 representative items, according to a modified Angoff's standard setting procedure. The experts agreed upon an average cut-off score of 31.17 items (sd 2.37) of this set of 40 items. Despite the small number of raters, rater agreement was .6743. The agreed upon average cut-off score corresponded to a so called 'national standard' of .784 on the estimated ability scale of nurses' calculation skills. Considering this national standard, over 80 percent of the 2,661 nurses in our representative sample appeared to lack sufficient calculation skills. This conclusion confirmed the findings reported in 2007.

Nurses can make medication errors due to a lack of medication calculation skills. For instance, because they do not know the relation between micrograms and milligrams. Several reports state that nurses' calculation skills cannot measure up to the demands of their work (McMillan, 2010; De Jong & Koster, 2007). Therefore testing the medication calculation skills recurrently seems an imperative measure to guarantee the nurses' capability. Aim In 2010, Cito, the Dutch national Institute for Test Development, did a national study to assess the level of medication calculation skills of nurses in Dutch academic and general hospitals and revalidation organizations. The ultimate purpose of this research is to develop a computerized adaptive test package (Straetmans & Eggen, 1998). By this adaptive test the calculation skills of nurses can be determined in an efficient way. Despite the fact that nurses then complete a rather short computer based test, they can still get a very reliable estimation of their arithmetic skill level.

Methodology

Beforehand, Dutch educational and branch organisations for nursing had to agree upon the contents of the test. The target group for this test were to be nurses who completed senior secondary vocational education and higher professional education. Subject matter experts (experienced nurses) constructed a large set of multiple choice items intended to measure the relevant medication calculation skills. The items covered various topics, e.g. solid and liquid medication application, infusion, transfusion, and gasses. For instance, the item in figure 1 is related to the topic of infusion. 36 different test forms were assembled, each consisting of 30 items. Figure 1 Example of item A patient must have two litres of NaCl 0,9% per 24 hours. The drip satchel (500 ml) was started at 8:00 am. At 2:00 pm the physician orders to give this patient one litre per 24 hours, instead of two litres. At what dripping rate (ml/hr) must the dripping pump be set ever since 2:00 pm? A at 27.8 ml/hr B at 41.6 ml/hr C* at 41.7 ml/hr Then, nursing organizations requested academic and general hospitals (including revalidation organizations) to participate in this study. In the period January till March 2010, 2,661 nurses took the test voluntarily to examine their calculation skills. They were asked to answer 30 multiple-choice items on paper. They were also asked to fill in some additional general data, like, gender, age, years of experience, and previous education. The testing time was one hour at most. The nurses took the test in the organizations where they worked, supervised by impartial surveillance. The organizations were evenly spread over the country. The test results were analyzed and the items were calibrated using the One Parameter Logistic Model (Verhelst & Glas, 1995). Afterwards, six Dutch experts of nursing practices and education participated in a standard setting procedure (modified Angoff procedure). The goal of this procedure was to agree upon a national performance standard of nurses' medication calculation skills. Forty representative items were selected, based on both the content specifications and the estimated item parameters. The experts judged these items independently. Then, differences between their judgements were discussed, also considering empirical item

difficulties. Finally, the experts judged the same set of items for a second time, and reached a common standard in the discussion afterwards.

Findings

The sample consisted of 2,661 nurses: $N_{\text{female}} = 2,295$, and $N_{\text{male}} = 282$. 78% of the participating nurses was evenly divided over three categories 25-34, 35-44, and 45-54 years of age. 67% of the nurses completed senior secondary vocational education, of which 51% worked over 15 years. The 27% of the nurses who finished higher professional education were less experienced. Only 28% worked over 15 years. On average, the 2,661 nurses passed 21.6 (sd 4.55) out of 30 items in the test. Test analysis showed an average reliability (Cronbach's Alpha) of .78 in 36 test forms and an average standard error of measurement of 2.08. Each item was taken by 148 nurses on average (sd 45.1). Although the sample size was quite small, a preliminary calibration of 495 items was possible. Model fit was moderate: $R^2 = 1561.816$; $df = 1357$; $p = 0.0001$. The mean ability of the nurses in the sample was estimated .484 (sd .399). The experts agreed upon an average cut-off score of 31.17 (sd 2.37) of the 40 items in the standard setting procedure. Despite the small number of six raters, rater agreement in the last round was .6743. Thus, the raters agreed fairly upon the standard of the test presented. 26% of the variance could be explained by the items. After the last round no average difference was found between the standards of the separate raters. Unfortunately, the residual percentage of 74% was rather high, indicating that the raters did not judge the items consistently. Regularly, the judgements of a particular item changed between raters mutually.

Conclusions

The agreed upon average cut-off score corresponded to a so called 'national standard' of .784 on the estimated ability scale of nurses' calculation skills. Considering this national standard, over 80 percent of the 2,661 nurses in our representative sample appeared to lack sufficient calculation skills. This conclusion confirmed the findings reported in 2007. Hospitals are recommended to improve their nurses' calculation skills. A computerized adaptive test package can provide a reliable and efficient method to assess these skills. Finally, a standard setting procedure involving more raters is recommended.

References

- De Jong, C.W. & Koster, A.P. (2007). *Rekenvaardigheid van verpleegkundigen*. Groningen: Rijksuniversiteit Groningen. (in Dutch).
- McMullan, M. (2010) Exploring the numeracy skills of nurses and students when performing drug calculations. *Nursing Times*; 106: 34, 10-12.
- Straetmans, G.J.J.M., & Eggen, T.J.H.M. (1998). Computerized Adaptive Testing: What it is and how it works. *Educational Technology*, 38, 45-52.
- Verhelst, N.D., & Glas, C.A.W. (1995). The generalized one parameter model: OPLM. In H. Fischer & I.W. Molenaar (Eds.). *Rasch models: Their foundations, recent developments and applications* (pp. 215-237). New York: Springer Verlag.

PAPER PRESENTATION

What makes the difference? Measuring Teachers' Counselling Competency

Simone Bruder, DIPF, Germany; Mara Gerich, Institute of Psychology, Technische Universität Darmstadt, Germany; Julia Klug, TU Darmstadt, Germany; Bernhard Schmitz, Technical University of Darmstadt, Germany

Counselling parents and pupils is an everyday task of teachers at school and can therefore be considered a key aspect of teachers' professional competencies. Especially counselling toward learning strategies is an important counselling aspect. The aim of the present study is to examine which aspects make teachers become better counselors. Counselling competency is measured with a case scenario with an open-answer format. The instrument measures counselling competency closely related to behavior and is based on the model of counselling competency of Bruder, Klug, Hertel, Kelava & Schmitz (submitted). The model includes the dimensions counselling-skills, diagnostic/pedagogical knowledge, cooperation/perspective taking and coping. Furthermore, variables from teacher development research and expertise research like reflected experience, support by others, motivation for counselling and understanding of teacher role have been included in the study. Data of 96 middle-school teachers was collected. For distinguishing between teachers with better results in the tests and lower results cluster analysis was conducted. Results show that teacher scores can be clustered into two groups. Further analysis shows that the group with higher test scores also shows more reflected experience in counselling than participants with lower scores concerning the overall test score. Regarding to the dimension counselling-skills teachers with higher test scores also show more support by others and diagnostic/pedagogical knowledge is significantly associated with a better understanding of teacher role. It can be presumed that counselling competency is influenced by different teacher attitudes.

Theoretical framework

In addition to teaching, education, and grading, counselling parents and pupils is an everyday task of teachers at school (KMK, 2004). The goals of teacher counselling are, for example, to support parents and pupils in their learning strategies, their education, and their school careers. Counselling competence of teachers has been implemented into newer concepts of teachers' professional competencies (Baumert & Kunter, 2006). In particular, counselling with respect to learning difficulties and learning strategies has achieved more importance in recent years in Germany. According to these findings, parental involvement in learning and homework has been shown to increase students' positive outcomes throughout children's schooling, including their high school years (Eccles & Harold, 1996; Epstein, 1991; Epstein & van Voorhis, 2001; Fan & Chen, 2001; Grolnick & Ryan, 1989). Despite this need for teachers' counselling competence, theory and research on counselling in schools has still been rare. To support teachers in improving their counselling competence it is important to specify aspects of counselling-competencies that are particularly important for teachers. For that reason Bruder, Klug, Hertel and Schmitz (2010) developed a model of counselling competence. The model was created by searching through the literature about counselling in general, counselling in schools, and short-term therapy, and trying to find the key aspects of counselling (Hertel, Bruder, & Schmitz, 2009; McLaughlin, 1999; McLeod, 2003; Reid, 1990; West & Cannon, 1988). The model includes the four dimensions counselling skills, diagnostic/pedagogical knowledge, cooperation/perspective taking and coping (Bruder, Klug, Hertel, Kelava & Schmitz, submitted). The dimension counselling skills contains the scales active listening, paraphrasing and structuring the talks. The second dimension diagnostic/pedagogical knowledge includes the scales searching for reasons, defining the problem, strategy knowledge (concerning learning), and goal orientation. The third dimension cooperation/perspective taking focuses on the scales cooperative actions, perspective taking, and resources/solution orientation. The last dimension coping includes the scales coping with criticism and dealing with difficult situations. These dimensions can be seen as main components for counselling interviews with parents. Based on this four dimensional model a case scenario with an open answer format has been developed to measure counselling competency. Validation studies show that it correlates significantly with a self-report about counselling and a situational judgment test (SJT).

The aim of the present study was to examine which aspects are important to differentiate between teachers who are good counsellors and teachers who are less good to find references for supporting teachers in their counselling competency.

Methods

96 middle school teachers participated in the study. 61.5% of the teachers were female. Concerning the age, 63.5 of the teachers were between 30 and 49 years old, 7.2 % were younger and 29.1 % were older.

The study has taken place in a bigger study measuring counselling competency and diagnostic competency of student teachers in the first phase, student teachers in the second phase and practicing teachers. Participants filled out different tests (case scenarios for both competencies, a short form of the SJT, knowledge tests for both competencies and self-reports for expertise in both fields). Results here are only presented for the case scenario and the teacher sample.

The case scenario included 12 open questions to a case of a pupil with learning difficulties and the mother asking for help. The answers have been rated with a detailed rating-system. The instrument was pre-tested on a sample of 125 teachers and the interrater-reliabilities (intra-class-correlations) for the ratings of the case scenario are higher than .79.

To measure expertise in counselling, a questionnaire with self-constructed scales was developed because no existing questionnaires were found. It contained the scales reflected experience (10 items; Cronbach's alpha = .76), support by others (6 items; Cronbach's alpha = .78), motivation for counselling (6 items, Cronbach's alpha = .73) and understanding of teacher role (2 items, Cronbach's alpha = .63)

Results

Results of cluster analysis show two significant clusters for the overall score as well as for the scores of the four dimensions of the case scenario. Taking in account that the self-reported expertise scales influence these clusters it can be seen, that teachers who gain higher scores in the overall score report more reflected experience ($F(1, 4.14)$, $p = .05$), teachers who show better results in the dimension counselling skills have more support by others ($F(1, 4.37)$, $p = .05$) and teachers in the better cluster of the dimension diagnostic/pedagogical knowledge report a better understanding of teacher role ($F(1, 6.13)$, $p = .05$).

Theoretical and educational significance

The results of our study show that two significantly differing groups of teachers, one with a higher and one with a lower counselling competency can be found. The variables reflected experience, support by others and understanding of the teacher role are influencing if teachers show better results in counselling competency or lower results. These results can be useful in fostering teachers in counselling competency. Reflected experience and support by others e.g. colleagues or experts should be established in trainings or in supervision groups and fostered. Furthermore, as role understanding seems to be important to develop diagnostic/pedagogical competency in counselling talks, this aspect should be taken into account in teacher education in general. As counselling competency still is not that much implemented in teacher education but as it is an important part of their everyday work, it seems useful to support teachers or becoming teachers in knowing that counselling is part of their teacher role.

PAPER PRESENTATION

Individual and contextual influences on vocational teachers' innovative work behaviour

Gerhard Messmann, Institute for Educational Science, University of Regensburg, Germany; Regina Mulder, Universitaet Regensburg, Germany; Markus Hirschmann, University of Regensburg, Germany

In contemporary workplaces, innovations are required to deal with problems and challenges arising from societal transformations. For instance, vocational colleges are required to be responsive towards increasing diversity of students and demands of the world of work by developing innovative solutions within complex learning environments.

Innovative work behaviour of employees that comprises all work activities carried out to generate, promote, and realise innovative ideas is central for the development of innovations. In addition, reflective activities are a component of this behaviour.

To foster innovation development, information is required about factors that are facilitative of this behaviour. According to psychological theories and prior research, attention must be paid to individual factors such as employees' attitude, norms and perceptions and to contextual factors such as characteristics of work. Therefore, the central research question is: What individual and contextual factors influence vocational teachers' innovative work behaviour?

In order to address this question empirically, a questionnaire study with vocational teachers comprising three points of measurement was conducted. N=343 teachers (response rate: 32,4%) completed the online-questionnaire at T1. N=80 teachers (response rate: 8,6%) responded three times. Innovative work behaviour as well as individual and contextual factors and teachers' background characteristics were measured. Data are analysed in a cross-sectional and a longitudinal approach by applying structural equation modelling. First results indicate that individual characteristics and variables related to the social context are more strongly related to innovative work behaviour than objective characteristics of work.

Theoretical background and aims

In contemporary workplaces, innovative products and processes that are new, applicable and useful are required to deal with problems and challenges arising from ongoing economic and technological transformations (Messmann, Mulder & Gruber, 2010). For instance in vocational colleges, the increasing cognitive and cultural diversity of students as well as the changing demands of the world of work, that these students are prepared for lead to challenges and problems. Vocational colleges must be responsive towards these transformations (Nijhof & Streumer, 1994) and realise innovative solutions related to the development of complex learning environments (Messmann & Mulder, 2009).

Innovative work behaviour of employees such as vocational teachers that comprises all work activities carried out to generate, promote, and realise innovative ideas is central for the development of innovations (Janssen, 2000; Kanter, 1988). In addition, reflection is an important component of this behaviour (Messmann & Mulder, 2010). Reflective activities are necessary to regulate the process of innovation development as well as to refine and improve one's own actions based on one's experiences (Kolb, 1984; Kolodner, 1997; Van Woerkom, Nijhof & Nieuwenhuis, 2002).

To foster innovation development, information is required about individual and contextual factors that are facilitative of this behaviour. According to the theory of planned behaviour (Ajzen, 1991), attention must be paid to employees' attitude, perceived subjective norm and perceived behavioural control towards innovative work behaviour. According to self-determination theory (Deci & Ryan, 2000), attention must be paid to employees' perception of autonomy, competence and social relatedness. In addition, prior studies on innovative work behaviour (De Jong, 2007) suggest that characteristics of the work group, the supervisor and work tasks are important. In relation to the context of

vocational teachers' work, the central research question therefore is: What individual and contextual factors influence vocational teachers' innovative work behaviour?

Methodology

In order to address this question empirically, a questionnaire study with teachers in vocational colleges in Germany was conducted. Within the design of the study, both a cross-sectional and a longitudinal approach were pursued. Therefore, data were collected at three points of measurement between February and June 2010. Innovative work behaviour and its corresponding dimensions "opportunity exploration", "idea generation", "idea promotion", "idea realisation" and "reflection" were measured three times using a self-assessment questionnaire based on respondents' critical incidents with innovations (Messmann & Mulder, 2010); individual factors ("attitude towards innovations", "meaning of work", "perceived competence", "perceived autonomy", "perceived influence", "flexibility", "intrinsic motivation") and contextual factors ("collegial relatedness", "perceived support", "job demands", "job complexity", "job routines", "amount of collaborative work") were only measured at the first point of measurement using scales that had been used and proved satisfying in previous studies; teachers' background characteristics (age, gender, education, tenure, leading function, job field, type of employment) were also only assessed once.

Altogether, 1060 vocational teachers from 15 colleges could be addressed. The vocational colleges were selected because they were involved in projects or activities that could be associated with school development and innovations. The selected colleges represented the different job fields within the German vocational system. At the first point of measurement, N = 343 teachers completed the online-questionnaire. This results in an overall response rate of 32,4 % for all colleges. Therefore, we assumed that the sample was representative of the basic population of teachers that were addressed. If all three points of measurement are taken into account, the sample size dropped to N = 80 teachers from 12 vocational colleges. Consequently, with an overall response rate of 8,6 % for all colleges the representativeness of this sample was not that high anymore. However, since the longitudinal approach was applied in addition to the cross-sectional approach and since it provides opportunities to draw causal interpretations (De Lange, 2005) this limitation was accepted. Data will be analysed by applying structural equation modelling in order to capture the relations between innovative work behaviour on the one hand and individual and contextual factors on the other hand. Moreover, in a structural equation model, relations among the dimensions of innovative work behaviour and among the various explanatory variables can be modelled adequately as well.

Expected results

First results of a correlation analysis indicated that individual characteristics such as teachers' "attitude towards innovations" and "perceived influence" as well as variables related to the social work context such as "perceived support" and "collegial relatedness" are strongly related to the dimensions of innovative work behaviour; by contrast, for objective characteristics of work such as "job demands" or "job routines" only few significant relation were found. Based on these first results as well as on theoretical and empirical evidences, we expect that these tentative results will also be reflected by models that take into account complex relations among variables.

Selected references

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.
- De Jong, J. P. J. (2007). Individual innovation. The connection between leadership and employees' innovative work behavior. Doctoral dissertation, University of Amsterdam, Amsterdam, The Netherlands.
- Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. *Journal of Occupational and Organizational Psychology*, 73, 287-302.
- Kanter, R. M. (1988). When a thousand flowers bloom: Structural, collective and social conditions for innovation in organizations. *Research in Organizational Behavior*, 10, 169-211.
- Messmann, G., Mulder, R. H., & Gruber, H. (2010). Relations between vocational teachers' characteristics of professionalism and their innovative work behaviour. *Empirical Research in Vocational Education and Training*, 2(1), 21-40.
- Van Woerkom, M., Nijhof, W. J., & Nieuwenhuis, L. F. M. (2002). Critical reflective working behaviour: A survey research. *Journal of European Industrial Training*, 26, 375-383.

PAPER PRESENTATION

A Methodology for Enacting Professional Practice in the Technical Communication Classroom

Andreas Karatsolis, Carnegie Mellon University, Qatar

During the last decade, the ACM, the IEEE and other professional organizations have acknowledged that there is a problem with the way communication is taught in science-based curricula: the writing, speaking, and presentation skills students learn in the classroom do not match what is expected of them in the workplace. As a solution to this problem, many undergraduate colleges simply added a dedicated technical communication course to their curriculum. However, such courses most often focus on technical editing skills instead of engaging students in disciplinary practices and making the connection between the classroom and the workplace. This paper presents a framework for enacting professional practice within disciplinary technical communication classrooms. This approach is based on principles from situated cognition theory and is articulated over three layers: practice of technique in individual aspects of the communication act, simulation of actual communication deliverables and performance of actual communication for a real-world audience. Examples from two technical communication classrooms are presented as evidence of this model's potential to engage students in professional disciplinary practices and to support an authentic exchange between the academic and the professional context.

Since the mid 1990s there has been a sustained interest in promoting student-centered curricula [1], especially in disciplines (such as Computer Science) where self-directed learning is critical, as the knowledge base and skills required to succeed evolve rapidly. In fact, the question no longer seems to be whether a student-centered curriculum is preferable, but rather which tools (multimedia, intelligent tutors etc.) can be used to support such a curriculum, especially in terms of student engagement and active participation.

However, according to theories of situated learning, the distinction between a student-centered (or learning) curriculum and a teaching curriculum does not lie on student interest or engagement. A learning curriculum consists of situated opportunities for the development of new practice and evolves precisely out of participation in communities of practice [2]. This is not a novel idea for work done in the disciplines; for example, the ACM IEEE/CS Computing Curriculum report states that "mastery of the discipline includes not only an understanding of basic subject matter, but also an understanding of the applicability of the concepts to real-world problems" [3]. For the purposes of developing effective communication skills, such statements point directly to the need of engaging students with real audiences in real contexts through professional genres, as the field of technical communication has been advocating for years [4,5]. This turn towards practice might at first look problematic, especially since we have evidence that the interaction between clients and students (or participants and researchers) is often messy [6]. We do know that some practices lend themselves to an apprenticeship model, such as midwifery or tailoring or butchery, where novices learn from more experienced, full participants, but enacting such an approach in the classroom, or for a whole curriculum, seems more complicated, mainly because we have been lacking methodologies to bring the academic and the professional context closer together.

This paper presents such a methodology and provides evidence of its effectiveness for enacting authentic professional practice and making connections to real audiences and clients based on the experiences of two professional communication courses, one for Computer Science and one for Information Systems. The model itself is grounded on situated learning theory, where a tripartite framework is proposed: where one has to learn the technique (or acquire technical skills) first, then participate in simulated instances of the practice, and finally participate in real performances or real use. The first step (practicing technique) can be a solitary activity, the second part (simulation) can be based on imitation of practice by others and the third part (performance) can be supported by guided participation in use by more knowledgeable others [7]. In the next three sub-sections, each of the steps will be briefly elaborated upon.

Practicing Technique

The development of expertise in most fields requires a certain degree of technical skill which can only come through sustained practice. In music or in sports, it takes months or years of practicing technical skills before one can perform in a concert or a game. Similarly, in developing both courses, we decided that practicing technical writing and speaking skills was a critical step in enacting this model. Most technical communication courses make this the focal point of the work that students do, but in our case we decided that recitation sessions or online modules would allow students practice without taking up classroom time. These practice sessions were directly related to the patterns they were encountering in classroom discussions of different genres. For example, when discussing the problem/opportunity section of proposals requires a detailed narrative form, the technical skill practiced was nominalizations, in order to understand positioning characters and actions in the subject and verb position respectively.

Engaging in Simulation

The second step towards developing expertise with communication skills is to begin simulating the practice. In both courses, students work on projects where they have to simulate practice: for example, they have to develop job application materials in response to a job or internship advertisement, or they have to write a proposal on a technical

project in response to a request for proposals the instructors create for a real organization. Students, therefore, have to understand the affordances and constraints of real genres and produce responses for real audiences, with the exception that these audiences do not receive the materials or act upon them.

These opportunities to simulate practice are framed by discussions and instruction on the ways the genre is enacted in the world. After analyzing the effectiveness of published examples, students can imitate the most effective strategies and apply them in their own projects.

Performing

The last step of the model requires students to engage with real audiences ("clients") and perform in communication events which are evaluated both by the instructors for the purposes of the course, but also by the clients.

In the Computer Science technical communication course, students are introduced to real communicative performance through a user guide assignment. As user manuals are rarely targeting specific audiences, it is critical for some clients to find people who can help them rewrite or develop from scratch user guides for their constituents. For example, in the Fall 2010 semester students developed user guides for tools and technologies intended to assist people with disabilities. Their client is MADA, the center for assistive technologies in Qatar, but their audience (who they will have to interact with for feedback and requirements specifications) is disabled people. This interaction makes students feel accountable for the quality of documentation they are producing. At the same time, the clients (MADA in this case), expect artifacts they could utilize with little or no revision.

Finally, after presenting examples of how this methodology was enacted in these two professional communication courses, we will discuss the implications of such a framework for creating networks of coordinated activity between the academic and the professional world.

PAPER PRESENTATION

Technologies at work". A sociohistorical analysis of human identities and communication

Ingela Holmstrom, School of Humanities, Education and Social Sciences, Sweden; Sangeeta Bagga-Gupta, University of Orebro, Sweden

This paper presents preliminary results from an ongoing study that is part of Project-KIT, Communication, Identity and Technology. The project focuses the role that technology play vis-à-vis issues of communication and identity and is particularly interested in young peoples' everyday life inside and outside institutional school settings. Life spheres of deaf youngsters who have received cochlea implants (CI) are of specific interest. Project-KIT is also interested in the sociohistorical genesis and the role that technology has and currently plays in shaping issues of human identity and communication in different settings. Framed within sociocultural perspectives and postcolonial theories, the project is using ethnographic approaches with a two-fold empirical base. The study presented here relates to one of these: archival data. The second will comprise video documentation and field notes from studies of everyday social practices in a diverse range of settings where young people with CI are members. The contribution of the theoretical frameworks and the specific data chosen to understand issues related to communication and identity will be highlighted in this presentation. Deaf people have, in research, not uncommonly been focused from two dominating perspectives: a medical/psychological and a linguistic/cultural point of departure. These two will be used as a contrastive backdrop against which our analysis will be presented. Our empirically based exploratory analysis indicates, among other things, how technology impinges upon and shapes human identity in different ways over time. In addition, different languages also appear to become reduced to a "technology" by certain groups during different historical phases.

This presentation is built upon a paper-in-progress where preliminary results from a study that is part of the ongoing Project-KIT, Communication, Identity and Technology are presented. The project focuses upon the role that technology plays vis-à-vis issues of communication and identity and is particularly interested in young peoples' everyday life inside and outside institutional school settings. Project-KIT aims to increase knowledge about everyday life inside and outside school arenas for deaf children and young people with cochlea implants (CI). Our research focus is on interaction and social practices, not on the individual children and young people themselves. The project has a clearly defined interest also in the sociohistorical genesis and the role that technology has played in shaping issues of human identity and communication in institutional settings. Framed within both sociocultural perspectives and postcolonial theories, the ongoing and planned studies in this project use ethnographic approaches with a two-fold empirical base. The study presented here relates to one of these: archival data. The second empirical base will be built around studies of everyday social practices where young people with CI are members. The empirical base for the study presented here comprises of archival materials that span over a century: from the end of the 1800's to the present. More specifically the empirical materials include periodicals published by three different national NGO's. The

first periodical of these, published by the Swedish National Deaf Association, was founded in 1891, the second, published by the Swedish parent's national association was formally instituted in 1972 and the third NGO's periodical we have included in our study, is published by the parents association of children who have received CI was grounded in 1995. Documentary films and blogs that specifically cover the themes raised in this study from more recent years have also been incorporated in the empirical materials that are being analyzed.

The contribution of the theoretical frameworks and the specific data that has been chosen for trying to understand issues related to communication and identity will be highlighted in the presentation. Deaf children/adults (with or without CI) have, in research, not uncommonly been focused from two dominating normalizing perspectives: a medical/psychological and a linguistic/cultural point of departure. These two will be used as a contrastive backdrop against which our analysis will be presented. Preliminary findings of the large amount of data in this specific study give rise to a complex set of issues. Our exploratory analyses indicate, among other things, how technology impinges upon and shapes human identity in different ways over time and space. Among other things, we will show that different professional communities and interest groups tend to focus different types of technologies: While what can loosely be called "the hearing society", e.g. non-signing hearing parents of deaf children, non-signing hearing researchers, etc appear to primarily focus technologies that support and enhance audiological skills (e.g. telephones, hearing aids, surgically implanted hearing aids including CI) and have attempted to identify voice-based communication technologies, signing parents (deaf and/or hearing) and signing researchers (deaf and/or hearing) appear to have a different interest agenda. Our analysis of archival material suggest that the latter appear to be more focused upon visually oriented communication technologies. Interestingly, the Deaf community appears to have always had an explicit interest in various types of technologies and have often had a head-start in the usage of technologies. Furthermore, their interests appear to be attuned towards a non-hearing agenda. In other words, a central preliminary finding of our ongoing analysis of archival data suggests that different stake-holders within and around Deaf communities tend to focus different types of technologies. Our preliminary findings also suggest that different languages (for instance an oral language, a written language and/or a signed language) appear to become reduced to a "technology" by certain groups during different historical phases.

PAPER PRESENTATION

Toward the virtual music school? A study of artefact use in musicians' communities of practice

Nicolae Nistor, Ludwig-Maximilians-Universitat Munchen, Germany; Doris Lipka-Krischke, Ludwig-Maximilians-Universitaet Munich, Germany

Communication technologies reach domains such as music education, in which learning happens typically situated in communities of practice, and is supported by knowledge reification and the joint use of cultural artefacts (Wenger, 1999). In this context, we regard knowledge as including a fixed and a negotiable component (Assmann & Czaplicka, 1995). Correspondingly, we hypothesize artefacts to include fixed and adaptable components, used differently in the social practice. Knowledge reification and artefact use are likely to be affected by technology mediation; little research is available on these topics. Therefore, the present study explores the possibilities of a community-based virtual music school by examining (1) the use of cultural artefacts (here: sheet music) and (2) the effects of technology mediation. In case studies varying the communication medium, participants' expertise and their degree of acquaintance according to a 2x2x2 factorial design, we observe that artefacts are used in two ways: A fixed component corresponding to canonical knowledge is used in a way shared by the entire community; an adaptable component corresponding to newly negotiated knowledge is shaped as a result of knowledge reification. Technology affects the negotiation constraints and costs, and interacts with expertise and degree of acquaintance. Besides theoretical insight into the cultural artefact use, our contribution offers positive empirical evidence of the feasibility of community-based virtual music schools.

Rationale

Communication technologies presently reach domains such as music education, for which they seem to be inappropriate at first sight. Typically, musicians learn situated in communities of practice (Wenger, 1999), where knowledge communication is supported by reification and the joint use of cultural artefacts. There is little empirical evidence of the use of symbolic resources such as artefacts (Gillespie & Zittoun, 2010), and the effect of technological mediation on artefact use is even less studied. Therefore, our study explores the possibilities of a community-based virtual music school by examining (1) the use of cultural artefacts (here: sheet music) and (2) the effects of technology mediation.

Theoretical background

Cultural artefacts are objects with a special meaning in the context of a given practice. According to the activity theory (Engeström & Sannino, 2010), artefacts mediate the subject-object interaction. Wenger (1999) regards artefacts as

reified knowledge about the community practice, supporting certain “ways of doing things” and hampering others. In this sense, artefacts support the communication of cultural knowledge.

The use of cultural artefacts. Cultural knowledge, described by Wenger as related to the “ways of doing things” (i.e. procedural knowledge), consists of two components: (1) basic knowledge, shared by all the community members – not negotiable (canonical knowledge; Assmann & Czaplicka, 1995) and (2) newly constructed knowledge, shared only by a part of the community members. Correspondingly, we may hypothesize two components of the artefacts involved in the cultural knowledge communication: (1) a fixed component, i.e. reified basic knowledge, difficult to change (here: printed musical text) and (2) an adaptable component, shaped in the social practice (here: hand-made notes added to the printed musical text). Thus, the use of cultural artefacts will mainly consist of (1) community practice performance, as dictated by the canonical knowledge and supported by the artefact, which remains unchanged, and (2) knowledge construction and reification, resulting into the adaptable parts of the artefact.

Media effects. The communication medium determines the negotiation constraints and costs of the shared knowledge. A communication medium with lower social presence is expected to alter the quantity and quality of knowledge communication, including the artefact usage.

Research questions

Q1. How do participants use the printed musical text in face-to-face and mediated settings? (a) What types of notes do they add? (b) To what extent do the add-ons refer to procedural knowledge? (c) To what extent is the add-on content negotiated?

Q2. How do the participants perceive the negotiation of the musical performance in the face-to-face and mediated setting with respect to (a) grounding costs (b) satisfaction with the results?

Methodology

We conducted eight case studies according to a 2x2x2 factorial design, comprising the factors communication medium (face-to-face vs. e-mail), participants’ expertise related to Gregorian music (high vs. low) and their degree of acquaintance (high vs. low). The participants were eight adult musicians, individually invited to a face-to-face or mediated musical session with a singer, and asked to explain their interpretation idea of the antiphon “Salve Regina”. Printed text material was used, which could be annotated. The experiment was completed when both persons agreed on the musical interpretation. An interview and add-ons analysis followed, the latter was based on four categories: content, structure, emphasis, and procedural notes.

Results

Q1 (a). The added notes were placed between the printed lines, near to the passage to be explained (fig. 1), and consisted of conventional symbols, sometimes more detailed text. In the mediated setting, the participants – especially those with higher expertise – produced more add-ons. (b) All add-ons were procedural notes; emphasis notes could be subsumed to this category, as well. No media effects could be observed. (c) In the face-to-face setting, all add-ons were discussed with the singer, often using gestures. In the e-mail setting, the participants had made some notes only for themselves, which were not discussed. Expertise was associated with the occurrence of more technical terms, in-depth details and practical aspects of the performance. Acquainted participants referred also to common and private experience.

Q2 (a). The formulation, production and display costs were perceived higher in the mediated setting. This effect was attenuated by higher expertise. (b) The participants’ were satisfied with the results. No media effects could be observed in this respect. Higher expertise was associated with higher satisfaction.

Discussion

Participants’ use of cultural artefacts appears to focus on the fixed artefact components, and respectively on the musical knowledge reified into it, thus acknowledging the canonical character of the original text (Assmann & Czaplicka, 1995). All added notes refer to details surpassing the scope of the neume notation, and expressing personal views, locally negotiated and reified (Wenger, 1999). These observations sustain the hypothesis of fixed and adaptable artefact components, corresponding to the canonical, and respectively negotiable knowledge involved. The artefact use may thus be dichotomized in (1) an exact performance of the community practice, as dictated by the canonical knowledge and supported by the involved artefacts, while leaving the artefact unchanged and (2) construction and negotiation of new knowledge, and its reification into the adaptable artefact component.

The artefact use is obviously complicated by technology mediation; media effects appear to interact with expertise and acquaintance degree. Expertise is not only a condition of better practice, it also provides adaption flexibility – and predicts satisfaction.

The present experiment offers positive empirical evidence of the feasibility of a community-based virtual music school, which could be organized – similarly to the traditional one – around experts and cultural artefacts. Nevertheless, the small number of cases examined restrains the validity of our study; further research is needed to enlarge the empirical basis.

References

- Assmann, J. & Czaplicka, J. (1995). Collective memory and cultural identity. *New German Critique*, 65, 125-133.
- Engestrom, Y. & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, 5, 1-24.
- Gillespie, A. & Zittoun, T. (2010). Using resources: Conceptualizing the mediation and reflective use of tools and signs. *Culture & Psychology*, 16 (1), 37-62.
- Wenger, E. (1999). *Communities of practice. Learning, meaning, and identity*. Cambridge, UK: University Press.

PAPER PRESENTATION

Grammar at secondary school: how students build grammar concepts in a collaborative setting

Xavier Fontich, UAB - Universitat Autònoma de Barcelona, Spain

Studies conducted in the last decades in different countries like the UK, Canada, France or Spain propose to look at grammar as a necessary content for second language acquisition and written composition instruction. Some of these studies explore students' grammar concepts and point out the difficulty to separate language and reality or to integrate pragmatics, semantics and form. These obstacles are conceived of as a consequence of a transmissive instructional mode focused on formal descriptions of grammar phenomena. Our two research questions are: (i) How do students can build their grammar knowledge within a collaborative setting? (ii) How can we elaborate an analysis model for exploring it? The oral data that we analyze come from students' interactions in small groups in a natural classroom setting in Barcelona (Spain). Students explore the pronoun system in Catalan and Spanish through inter and intralinguistic analysis. We contrast an initial and a final dialogue in one of the sample groups. The instrument designed describes the discourse flow linking metalinguistic content and argumentative interaction. We can see that in the initial dialogue the group is stuck in a disputative talk. In the final dialogue the group is well able to develop an exploratory talk and metalinguistic notions are richer although students do not attain the final solution. Promoting a link between metalinguistic content and argumentative interaction seems to be a necessary although not sufficient condition for grammar learning.

School objectives in linguistic education refer to a communicative use of language on behalf of future citizens in a society with high literacy demands. In achieving these communicative skills, grammar plays an important role, according to studies conducted in the last decades in different countries like the UK, France or Spain. These studies propose to overcome the view on grammar as a peripheral scholar object and rather to look at it as a necessary content for SLA (Second Language Acquisition) and written composition instruction, as well as a content that can be studied in its own momentarily apart from the dynamics of communication (James, 2002; Trévisse, 2008; Camps, 2008). In this sense, we ought to explore altogether a model of a school grammar to be implemented in real classrooms, and a model of research procedures to explore the triggering processes of this implementation (Durán, 2009). This submission links a practice-based research and a research-based practice since activities are brought into the arena collaboratively by secondary school teachers in collaboration with researchers. The results of this cooperative action have an influence on educational policy in regard to both the role of grammar in the official curricula and teacher education.

Our study is inspired by research carried on in Canada, France and Spain in the last decade that explores the construction of the students' grammar concepts (Camps, 2000; Fisher, 2004; Camps & Zayas, 2006; García-Debanco & Paolacci, 2010). It points out that students find it difficult to separate language and reality, to integrate pragmatics, semantics and form, to overcome a simple and linear perspective on the sentence, or to integrate declarative and procedural knowledge. These obstacles are conceived of as a consequence of a transmissive instructional mode focused on formal descriptions of grammar phenomena. A new research emerges from this previous research based on the following objectives: to design and implement a new model of grammar teaching and to explore the argumentative discourse held by students under this model. Our two research questions are: (i) How do students build their grammar knowledge within a collaborative setting? (ii) How can we elaborate an analysis model for exploring it? Students in 4th grade of secondary school (15-16 years old) in Barcelona (Spain) deal with conflictive grammar

questions related to the pronoun system in Catalan and Spanish. These questions arise from inter and intralinguistic contrasts of data from two sources: automatic translators' results and speakers' sentences gathered by the students. They work in a collaborative setting and follow a lexical and pragmatic-semantic-formal approach to basic grammar phenomena (subject, verb, accusative, argument...). The oral data that we analyze come from the students' interaction in small groups in a natural classroom setting. We contrast an initial and a final dialogue in one of the sample groups. The first task was "Look at the sentences you have just analyzed and choose the easiest and the most difficult one, explaining why you think they are so". This group chose Dalí painted that portrait of Lincoln. The final task asked the students to discuss a sentence where the argument and its pronoun appeared altogether: "[Hi] anaven [a l'aula]" They used to go [there] [to the class]. In order to describe and interpret the interaction carried on we have designed an instrument that approaches the discourse flow from two complementary perspectives: metalinguistic content and argumentative interaction. The first one results from all those metalinguistic expressions used in order to reason about grammar problems, identified by the metalinguistic statement unit, ranging from pragmatics to semantics and form. The second one refers to the different ways in which argumentation is linguistically shaped, identified by the argumentative episode unit, which can be additive (explaining, expanding, adding, accepting, and concluding) or reactive (diverging, contradicting, clarifying, and challenge). Combining these two approaches we can approach the reflective process that is going on concerning both the collaborative construction of grammar concepts and the discursive moves that contribute to it.

As preliminary results of our analysis, we can see that in the initial dialogue the group is stuck in a disputative talk where grammar notions appear to be rigid and intuitive, although pertinent regarding the content of the activity. The statements of the dialogue are focused on whether "of Lincoln" is accusative or dative with a cumulative and disputative talk (Mercer, 2000). Certainly of Lincoln is not accusative neither dative but as an event noun portrait has an argument structure AGENT – PATIENT identical to the structure of the verb to portrait. Regarding the semantic and lexical perspective of our intervention we can read students' mistake as a partially attained solution, since they are being sensitive to semantics (an argument structure) and to pragmatics (Dalí is an agent, Lincoln is a patient). Students show a lack of metalinguistic repertoire concerning semantic dimension and that is why they use formal notions (dative, accusative) instead of semantic ones. They also show a lack of argumentative repertoire. In the final dialogue, after having worked within this model for a month, the group is well able to develop an exploratory talk and metalinguistic notions are focused from the three different perspectives: semantic, pragmatic and formal. Students do not attain the final solution but they do integrate this time a wide range of concepts: coreference, null subject, pragmatics, complementary distribution and syntactic function. We interpret exploratory talk as being at the same time cause and consequence of this larger repertoire of metalinguistic concepts. Students use more concepts and they can talk about many more phenomena and link them to one another. And a greater collaboration and a more versatile attitude enhance this integration of grammar knowledge.

We have argued that through a more collaborative interaction the group creates richer argumentative discourse and metalinguistic content becomes more ductile. At the same time we are able to analyze the communicative flow through an instrument that approaches metalinguistic content and argumentative interaction. In teaching grammar we must promote a link between these two perspectives as a necessary although not sufficient condition for grammar learning.

PAPER PRESENTATION

The state of cognitive and learning styles research within education: a critical review.

Carol Evans, University of Exeter, United Kingdom; Michael Waring, University of Loughborough, United Kingdom

This paper aims to clarify the state of styles research within higher education institutions and schools across a variety of cultural contexts through a systematic review of the associated literature between 1999-2010. The term 'styles research' is used to capture the range of literature within the styles field (learning styles, cognitive styles; approaches to learning, thinking styles, intellectually styles; dispositions to learning and learning patterns). The systematic review involved multiple phases: An advanced search of ERIC and screening of abstracts and titles; hand searching of six international peer reviewed journal special editions; screening of full papers; in-depth quantitative and qualitative review of 486 full papers as well as a further detailed layer of analysis of 130 full papers to consider the nature and impact of specific educational designs on learners from a styles perspective. Whilst there is evidence of strong pragmatic science combining rigour and relevance in styles research in educational settings, this needs to be developed further. Implications of this review for policy, research and practice are discussed in relation to developing and enhancing our understandings of how styles research, as part of the individual learning differences domain, can be used effectively and critically within educational settings to inform and enhance teaching and learning including assessment.

This paper explores the state of cognitive and learning styles research within educational settings (schools and higher education institutions), through the undertaking of a systematic literature review (1999-2010). This review is highly relevant to the EARLI community in considering how styles can be used with other individual learning difference (ILD) variables to enhance learning within a global networked society.

The review is timely given recent and highly significant outputs (Evans et al., 2010; Kozhevnikov, 2007; Peterson et al. 2009; Pashler et al 2009; Rayner & Cools, 2010; Zhang & Sternberg, 2009), seeking to move styles research forward by addressing key concerns: a lack of consensual theory; confusing terminology; difficulties in identifying valid and reliable measures; and vague practical implications (Coffield et.al., 2004; Sharp et al. 2008; Evans & Sadler-Smith, 2006). In undertaking this in-depth review, the authors are able to give a clear, accurate and thorough picture of how styles research is currently being used within educational contexts to inform future work to enhance the quality of learning environments. In addition, it is able to counter and question findings based on superficial analysis of the styles field (Pashler et al., 2009).

An automated advanced search of peer-reviewed journals (1999-2010) within the Education Resources Information Center (ERIC) adopting a broad definition of styles to include (learning styles, cognitive styles; approaches to learning, thinking styles, intellectually styles; dispositions to learning and learning patterns) was undertaken. The search yielded 14,661 peer-reviewed studies. Systematic review and screening of abstracts by two independent reviewers lead to selection of 486 full papers for further scrutiny which also included a further six international peer reviewed journal special editions focusing on styles research between 2004-2010. A second layer of analysis was undertaken to look in detail at specific styles interventions in relation to design of learning environments including e-learning environments as well as a focus on assessment. To ascertain the nature and impact of styles research within educational settings, for each paper, the following information was collected:

Nature: Journal type/subject area; lead author and country of origin of study; Higher education institution /School; style instruments used (including theoretical framework); focus of the article and reported outcomes.

Methodology: methods; research design; nature of sample; construct validity and reliability.

Impact: degree of collaboration within/across school(s)/HEI(s) nationally/internationally; capacity building; consolidation or development.

Descriptive statistics were employed to ascertain frequencies in relation to: journal distribution and dominance; distribution of articles per year; country of origin of articles; method; nature and number of styles instruments used; size of research samples; subject area of research. Thematic analysis (Braun & Clarke, 2006) involving the research foci and recorded outcomes of each of the articles was also undertaken. To identify aspects of capacity building (demonstrable growth of knowledge or skills of the research subjects following the research intervention or development of ideas from it) and consolidation or development (the extent to which it either replicates existing evidence or extends the evidence with new findings) it was necessary to cross reference the full articles with the broader established literature base associated with styles research.

The styles research field is a dynamic one (Evans, et al., 2010) particularly within the field of application of styles research to e-learning. There is a considerable volume of work considering styles in relation to design of learning environments although this appears to mainly preclude discussion of the relationship between cognitive styles and assessment excepting work within the students approaches-to-studying tradition (SAL).

There is substantial evidence of the robust and measured use of 'strong versions' of styles models (Sharp et al., 2008) with the majority of work (84%) emanating from a HEI context rather than a school context. 27% of studies focused specifically on the impact of the introduction of new approaches to teaching and learning; results were mixed. Whilst a broad range of cognitive and learning styles models were in evidence, the top five most cited models, (Kolb; 1976-99; Biggs, 1987-2001; Entwistle 1983-1998; Witkin, 1962-71; Felder & Silverman/Soloman, 1996-2007), were used in over 50% of the studies. Paradigm shift was in evidence in the growing number of qualitative and mixed methods within a field dominated by quantitative research methods. Rigour (reliability and validity) were strengths in over 50% of the articles. There are a number of implications of the findings of this review for policy development, research and practice. Researchers need to work collaboratively to help each other improve existing models and instruments, as well as to develop common definitions of concepts rather than profligate more models. More is needed on how different style constructs relate to one another and which are best suited for which specific contexts (Santo, 2008). In considering styles within educational contexts, connecting and strengthening understanding of styles in relation to relevant educational theory such as dual coding is important. In addition, considering styles holistically, working in tandem with other variables to impact on behaviour and performance is vital. A key finding of the research was the importance of addressing student beliefs and conceptions of learning when trying to affect changes to teaching and

assessment in order to achieve desired learning outcomes. Clarifying what a styles pedagogy constitutes is important and conceptual clarification in the form of the Personal Learning Styles Pedagogy (Evans & Waring, 2009) is a definite move forward in explaining how styles can be used in an expansive and integrated way (Zhang & Sternberg, 2009). The operation of a hierarchy of styles is important in explaining why certain styles matter in certain contexts (Kozhevnikov, 2007; Nosal, 1999). Fundamentally, the latest advances in our understandings of styles need to be able to be translated clearly to wider audiences. Explicit guidance supported by critical evidence-based research showing how one can effectively use knowledge of styles in real settings and in association with other approaches to enhance learning is in evidence moving beyond the overly simplistic matching hypothesis. Whilst there is evidence of good work, much more is still needed to confirm when and how styles matter though replication and refinement of studies both longitudinally and across contexts.

PAPER PRESENTATION

Between-class variability in student attribute effects on grades

Jan Hochweber, DIPF, Germany; Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany; Ingmar Hosenfeld, University of Koblenz-Landau, Campus Landau, Germany

Most measurement experts agree that grades should be based only on students' achievement. Nevertheless, research indicates that teachers use non-achievement factors in determining grades. Moreover, student background variables (like gender, SES) have been shown to influence grades controlling for achievement. In our study, based on a large and highly representative sample of eighth grade students, we focused on the impact of classroom environment variables on the relationship between students' mathematics achievement, motivation, and background and their mathematics grades. Classroom environment was represented by students' attributes aggregated to the class level and teachers' perceptions of achievement level, learning climate, and social background of their classes. Multilevel analyses with cross-level interactions were used to investigate whether these variables had an impact on the effects of student math achievement, interest, effort, and parental education on grades. Across all classes, student achievement was clearly the most important predictor of grades but interest and effort had significant effects over and above achievement. However, the student attributes' effects varied significantly and substantially between classes. Class achievement level was positively related to the student achievement slope. The impact of interest on grades was found to be higher in classes with an unfavourable learning climate, and lower in classes with high student achievement and interest. Effort was found to have a higher effect on grades in classes with an adverse social background and a low achievement level. An adverse social background and a low achievement level went along with a stronger grade bonus of students with high-educated parents.

Most measurement experts agree that grades should be based only on students' achievement (e.g., Brookhart, 1994, 2008). Nevertheless, research indicates that teachers use non-achievement factors in determining grades (e.g., Brookhart, 1993; McMillan, 2001). Moreover, student background variables (like gender, SES) have been shown to influence grades over and above achievement (e.g., Bennett, Gottesman, Rock & Cerullo, 1993). The relationship between grades and these various factors is likely to be influenced by both teachers' grading practices and the classroom environment; however, the large majority of studies has dealt exclusively with differences in teachers' grading practices (cf. Brookhart, 1994). In our study, we focused on the impact of classroom environment variables on the relationship between students' achievement, motivation, and background and their grades.

Research questions

We hypothesized the following relationships between classroom environment variables and the classroom-specific effects of student attributes: (1) Considered as a means to establish control (Pace & Hemmings, 2007), grades should be related more closely to student motivation in "difficult" than in easy-to-handle classes. Rakoczy et al. (2008) found that students' involvement contributed stronger to grades in classes with a negative student-teacher relationship. In a study by Howley et al. (2001), teachers in "troubled" schools tended towards an "ethos of effort", confounding effort and achievement when assigning grades. Thus, our first assumption was that student motivation is more closely related to grades in "difficult" classes (low levels of achievement and motivation; adverse social background). (2) Social psychological research indicates that judgment accuracy depends on task demands and available attentional resources (e.g., Kruglanski & Sleeth-Keppler, 2007). Target stimuli may be lengthy or complex and thus difficult to process; important information may go unrecognized if the judge is cognitively busy. Classrooms are busy places, characterized by a "multidimensionality" of events, by "simultaneity", "immediacy", and "unpredictability" (Doyle, 1986). The more cognitively demanding teaching a class is, the more likely it seems that a teacher misses or misinterprets information regarding student achievement. Accordingly, our second assumption was that the relationship between student achievement and grades is weaker in "difficult" classes. (3) Effects of student background variables on grades are typically explained in terms of expectancy effects (e.g., Jussim, 1989). These are more likely to occur if constraints are put on task-related interactions between teachers and students (Jussim, Smith,

Madon & Palumbo, 1998). If a teacher's cognitive resources are frequently used up by task-irrelevant interactions, e.g., attempts to establish an orderly learning environment, her or his judgments should be more susceptible to perceptual biases. Consequently, our third assumption was that the relationship between student background variables and grades is stronger in "difficult" classes. Finally, we assumed these moderating effects of the classroom environment themselves to be affected by teacher characteristics, specifically, classroom management abilities. Effective classroom managers are able to prevent and deal with inappropriate student behaviour, maximize time on task, and foster motivation to learn. We hypothesized that the impact of classroom environment on the relationships between student attributes and grades is diminished in well-managed classrooms.

Methods

Sample

We used data from a study aimed at testing the mathematics proficiency of all eighth grade students in a large German federal state. The highly representative sample consisted of 31,038 students in 1,470 classes. The assessment was supplemented by surveys among students, mathematics teachers, and school principals.

Instruments

Our outcome variable was the student-reported math grade assigned in report cards at the middle of eighth class. Four student attributes were used as predictors of these grades: math achievement (measured by a standardized test); interest in math; effort in math; and parents' education. Interest and effort were considered as aspects of student motivation, parents' education as a student background variable. Concerning classroom environment, a first group of predictors contained students' test achievement, interest, and parental education aggregated to the class level. Another group of predictors represented the teachers' view of their classes: The teachers had to estimate their classes' (1) achievement level. A (2) learning climate scale and a (3) social background scale were each composed of four factors the teachers reported as compromising their lessons. Finally, a classroom management scale was created based on four items from the student questionnaire.

Analyses

We applied multilevel analysis (level 1: students; level 2: classes), regressing the math grades on student attributes at the student level. To determine the extent of variation in these attributes' effects, and to explain this variation by the class level variables, random slopes and cross-level interactions were specified.

Results

Across all classes, student achievement was clearly the most important predictor of grades but interest and effort had significant effects over and above achievement. Parental education had only a weak effect on grades. However, these attributes' effects varied significantly and substantially between classes and were found to be related to aspects of the classroom environment. In line with expectations, class achievement level was positively related to the student achievement slope. The impact of interest on grades was found to be higher in classes with an unfavourable learning climate, and lower in classes with high average levels of student achievement and interest. Effort was found to have a higher effect on grades in classes with an adverse social background and a low achievement level. An adverse social background and a low achievement level went along with a stronger grade bonus of students with high-educated parents.

Finally, we examined whether these interactions were affected by classroom management. We found an increased bias in favour of children of high-educated parents when a weak achievement level and a flawed classroom management coincide.

Conclusion

Explaining differences in student attribute effects on grades may help to identify when inappropriate grading practices are more likely to occur. Our results indicate that it is worthwhile to take into account the specific demands and challenges that certain classroom environments pose to the teacher, as well as individual teachers' capability of dealing with particularly "difficult" classes. It might turn out that under certain circumstances, an improvement in teachers' classroom management skills would not only foster student learning, but also improve grading practices.

PAPER PRESENTATION

Planning Work Plans for Pupils - Interdisciplinary teacher team collaboration in a primary school

Nils Otto Steen-Utheim, University of Oslo, Norway

This paper reports on a study of interactions in an interdisciplinary teacher team constructing work plans for their pupils (age 11-13). The study aims to provide knowledge about what characterizes the teachers' team-talk and

interaction while they work on a shared artifact and how it contributes as a structuring resource for the teachers' working process. We ask: What characterizes the teachers' talk and interaction during planning and construction of the work plans? How does the work plan function as a structuring resource in the teachers' collaboration/talk and interaction? Transcripts from 15 interdisciplinary teacher team meetings are analyzed with the aim to identify team-talk patterns and how these emerge during planning and construction of work plans. Focus has been specifically on conversational moments that entail accounts of classroom experience and that signal problems of professional practice. Results from this study can be divided into three main findings: First, the teachers' collaborative talk is in a large degree oriented towards administrative and procedural aspects dominated by a pattern of coordination. Second, the work plans can be structuring the teachers' talk towards an orientation on learning content and joint reflection on problems of practice. Thirdly, this orientation is enabled by the fact that the teachers collaboratively construct the work plans, prompted by template structures in the work plans such as learning goals, assignments and subject resources.

Aims

This paper reports on a study of interactions in an interdisciplinary teacher team constructing work plans for their pupils (age 11-13). Work plans have become increasingly common in Scandinavian countries in the late 1990's. This study aims to provide knowledge about what characterizes the teachers' team-talk and interaction while they work on a shared artifact, i.e. work plans for pupils, and how it contributes as a structuring resource for the teachers' working process.

A work plan is a document that describes the students learning assignments within the different school subjects over a certain period of time (1 to 3 weeks). Time is allocated from the school subjects to work on work plans on the pupils' weekly schedules, during which the pupils can choose what, when and to some extent how they work on different assignments as described in the work plan (Klette, 2007). In this paper we take a socio-cultural perspective on learning (Vygotsky, 1978) and focus on how work plans can function as a structuring resource for their collaboration.

Much of the teachers' planning activities in primary schools in Norway are now conducted in interdisciplinary teacher teams. Such teams are often implemented in order to promote a collaborative mode of teaching and more comprehensive education for students. Another rationale for organizing the teachers in teams is to create a professional learning community with the ultimate goal to improve the pupils' learning (McLaughlin & Talbert, 2006). Researches on professional learning communities indicate that well-developed communities have positive impact on both teaching practice and student achievement (Little, Gearhart, Curry, & Kafka, 2003; Vescio, Ross, & Adams, 2008). On the other hand there are pitfalls. For example, Scribner et al. (2007) indicates that such collaborative structures may cultivate groupthink and unduly convergent thinking. At the same time it is pointed out that we in fact know little about how these teams actually work on a level of micro-ethnography and discourse analysis of interactional data (Havnes, 2009; Scribner et al., 2007). Hence, we ask:- What characterizes the teachers' talk and interaction during planning and construction of the work plans?- How does the work plan function as a structuring resource in the teachers' collaboration/talk and interaction?

Methodology

The empirical data is gathered from a primary school in a middle-class rural district with about 150 pupils. In this paper we draw on data from the team meetings where the teachers create and discuss work plans for the pupils. The core data consists of audio and video recordings from 15 team meetings over a period of 18 months whereas the sizes of the team vary from 4 to 8 persons due to organizational changes during this period. Each team meeting lasts for approximately 1 hour.

Transcripts from the meetings are analyzed with the aim to identify team-talk patterns and how these emerge during planning and construction of work plans. Focus has been specifically on conversational moments that entail accounts of classroom experience and that signal problems of professional practice (Horn & Little, 2010).

Findings

Results from this study can be divided into three main findings: First, the teachers' collaborative talk is in a large degree oriented towards administrative and procedural aspects dominated by a pattern of coordination. Second, the work plans can be structuring the teachers' talk towards an orientation on learning content and joint reflection on problems of practice. Thirdly, this orientation is enabled by the fact that the teachers collaboratively construct the work plans, prompted by template structures in the work plans such as learning goals, assignments and subject resources.

Theoretical and Educational significance

This study's theoretical contribution adds to the research literature on how collaboration on a shared artifact, in this case a planning tool, can be a structuring resource for professional development. In the same way Little et al. (2003) reports on how teachers looking at student work, the construction of work plans collaboratively seem to support as a structuring resource for professional development. This knowledge has educational significance for school leaders' and teachers' awareness on collaborative planning work in schools and contributes to understanding the interdependency between organizational and content aspects of planning work.

References

- Havnes, A. (2009). Talk, planning and decision-making in interdisciplinary teacher teams: a case study. *Teachers and Teaching: Theory and Practice*, 15(1), 155 - 176.
- Horn, I. S., & Little, J. W. (2010). Attending to Problems of Practice: Routines and Resources for Professional Learning in Teachers' Workplace Interactions. *American Educational Research Journal*, 47(1), 181-217.
- Klette, K. (2007). Bruk av arbeidsplaner i skolen – et hovedverktøy for å realisere tilpasset opplæring? [The use of work plans in school - a key tool for implementing individually adapted teaching?] *Norsk Pedagogisk Tidsskrift* (04/2007), 344–358.
- Little, J. W., Gearhart, M., Curry, M., & Kafka, J. (2003). Looking at Student Work for Teacher Learning, Teacher Community and School Reform. *Phi Delta Kappan*, 85(3), 184-192.
- McLaughlin, M. W., & Talbert, J. E. (2006). Building school-based teacher learning communities: Professional Strategies to Improve Student Achievement. New York: Teachers College Press.
- Scribner, J. P., Sawyer, R. K., Watson, S. T., & Myers, V. L. (2007). Teacher Teams and Distributed Leadership: A Study of Group Discourse and Collaboration. *Educational Administration Quarterly*, 43(1), 67-100.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80-91.
- Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

PAPER PRESENTATION

What is Learning to learn? An updated theoretical exploration.

Cristina Stringher, INVALSI, Italy

Within European policy, learning to learn is key to lifelong learning and to the maintenance of learning competences needed for the demanding and ageing knowledge-based economies (European Working Group on Basic Skills, 2002; European Council, 2005, 2006). However, limited agreement exists among researchers on a shared definition and on its constituents (European Network on Learning to Learn, 2006; Hoskins & Fredriksson, 2008). A recent attempt to assess this concept in European countries has come to the conclusion that more theoretical work is needed to ground assessment into a clear definition of learning to learn constituents (Kupiainen, S., Hautamäki, J., Rantanen, P., 2008). This theoretic exploration aims at a clarification of the concept, by analysing definitions and models from different paradigms and approaches, the ultimate goal being to extrapolate L2L qualities for lifelong learning. The methodology is a review of existing literature with a qualitative comparative analysis of 40 definitions sought, out of 90 studies examined. A two-step analysis is being presented: in the first section, a distinction is made between L2L and other related concepts; in the second section, possible differences and similarities in the conceptualization of L2L are detected and described by analysing definitions and models. The study output is a meta-definition together with a list of components which could form a basis for future L2L operationalization and assessment purposes. A concept map with relations among components as described in literature is also provided.

Empowering young people and creating favourable conditions for them to develop their skills, to work and to participate actively in society is essential for the sound economic and social development of the European Union, particularly in the context of globalisation, knowledge-based economies and ageing societies where it is crucial that every young person is given the possibility to fulfil his or her potential (European Commission, 2007). This is why learning to learn has been included among the eight key competences by the European Parliament (2006). Political attention at the European level matches and follows scientific interest in this concept: dozens of researchers worldwide have variably defined and explored it, sometimes from very different epistemological backgrounds, accounting for the diversity of approaches and the resulting interdisciplinarity (Bateson, G., 1977; Hounsell, D., 1979; Candy, P., 1990; Gibbons, M., 1990; Smith, R., 1990; Boekaerts, M., 1999; Hautamäki, J., 2002; Deakin, C.R., Broadfoot P., & Claxton G., 2004; to cite but those that attempted modeling this idea). According to anthropologist Jules Henry, learning to learn has been and still is Homo Sapiens' essential evolutionary task (Henry, J., cited in Smith R., 1990). Similarly, Edgar Morin maintains that knowledge of one's knowledge must appear as a primary necessity. Moreover: knowledge of one's knowledge, which implies the integration of the knowers into their own knowledge, must be a principle and a permanent necessity for education (Morin, 2001, 11 & 31). For Goleman (1999), the most basic

knowledge of all is how to learn. This opinion is shared by many scholars who refer to it as not only a concept, but an educational objective (Tuijnman, 1992); a fundamental competence, like numeracy or literacy (European Group on Basic Skills, 2003); the most urgent point in the agenda together with educational reform for the development of people (Candy, 1990); and even utmost ability for life in XXI century (Burgogne, 1998, cited in Claxton, 2002). Candy however warns the reader to make learning to learn a slogan at risk to lose its power for overuse. Twelve years after Coffield adds to it, stating that for too much time learning to learn remained an empty expression, not so much studied, a vacuum slogan, notwithstanding its unanimous utility, most of all if there is no consensus on its definition (Coffield, 2002).

Rationale of this essay is to contribute to some degree of order in the theory of learning to learn, avoiding the risk to reduce it to an umbrella term good for all purposes. The complexity of this task is however evident from the very beginning, not only for the wide disparity of definitions found in literature, but also considering that any meaning associated with learning to learn derives from how learning is conceptualised: considering that a recent publication has reviewed 41 influential frameworks on thinking and learning (Moseley et al, 2005), the burden seems unbearable. In addition, the components deserve an analysis on their own, since there is no agreement among scientists about what they actually mean and do.

The modest end of the paper is therefore to accurately describe learning to learn from definitions taken from the literature and identify those characteristics that contribute to a meta-definition. The author has been involved in a European study to measure L2L and this paper derives from contributions to the European L2L Network (Hoskins & Fredriksson, 2008; Kupiainen, S., Hautamäki, J., Rantanen, P., 2008) and from subsequent independent study. The methodology is a qualitative review of worldwide literature with a comparative analysis of four major L2L models and forty definitions sought out of ninety studies examined, accounting for a diachronic representation of learning to learn studies to date. The essay unfolds into three sections: in the first one, the priority has been setting boundaries for learning to learn and this is achieved by distinguishing learning to learn from other related concepts, with which it entertains multiple relations - some hierarchical, others horizontal. In the second section, learning to learn definitions and models are introduced in order to identify the characteristics of learning to learn, recognize common features in definitions and compile a components list. In the third section, a meta-definition and a concept map of L2L components with some of their relationships are provided.

The difficulty to define intelligence has not prevented scholars from trying and measuring this concept. A similar attempt can be made for learning to learn. The pairing of these two concepts is no coincidence, as they share several similarities like this analysis reveals, while differences are also highlighted.

The theoretical and educational significance of this research lies in the opportunity to set a new basis for learning to learn operationalization. Conclusions include broad strands of thought for future endeavours to assess its characteristics, as assessment seems preliminary to any effort to promote learning to learn across the lifespan.

PAPER PRESENTATION

Gender discrimination or differences in preschool? – empirical answers

Susanne Kuger, University of Bamberg, Germany; Katharina Kluczniok, Otto-Friedrich-University of Bamberg, Germany; Jutta Sechtig, University of Bamberg, Germany

The bases of this study are two (implicitly discussed) assumptions found in literature on early childhood education: a) gender-related differences in children's experiences and behaviour during the preschool years exist and b) these differences between boys and girls increase during the years of preschool attendance. Using data from the German longitudinal study BiKS-3-10 this paper analyses everyday activities of 96 boys and girls in their first and last year of preschool with regard to gender-specific differences in activity patterns, domains of child support, social setting, and type of teacher-child interaction. Moreover preschool teachers' educational recommendations about best time for school enrolment and individual strengths and weaknesses of the children are studied. Results display only few differences between boys and girls, which are not even in line with common stereotypes and most important, diminish during the preschool years. What seems most important to notice is that the few differences found are rooted in the children's own choice and initiative of activities. The preschool teachers encourage a very limited amount of gender-specific activity patterns only, although ascribing strengths and weaknesses more stereotype-like to boys and girls. Results are interpreted as caution not to reduce attention to possible problems, but to focus more closely on differential development between single children than groups of children.

Background and concern of the paper

The topic of 'gender' is as present in educational science and practice today as it has been for many years. Coming along you can find a number of problems, fears, and sometimes even implicit accusations. A review of the literature body shows that in contrast to discussions in the 1960ies to 1980ies, which focused on disadvantaged girls, latest developments concentrate on the boys' problems in learning achievement and overall educational success. The question is how to react. The range of possible educational settings, recommendations, and interventions to cooperate in solving the existing problems is large, yet the number of empirical research findings and evaluations is small, more even so when looking at the preschool level.

Looking at best-practice, there are numerous advisory guidelines debating on 'gender-sensitive' work in preschools. There are recommendations in curricula, gender-related preschool concepts and projects. They all follow the common goal to reduce gender stereotypes as well as gender-related disadvantages and thus foster gender-independent promotion of children. An underlying assumption of most of this work seems to be that the range of biological, genetic, and enculturational differences between boys and girls can be found in the children's and teachers' behaviour during everyday preschool life. Yet often you find that in the focus of attention of these papers is not the children's or teachers' behaviour with each other or in class itself, but other matter of fact gender-related differences such as an unequal proportion of male and female preschool teachers, uneven numbers of boys and girls in early or late school enrolment, or differential development of single developmental domains for the two sexes (e.g. interpersonal relations, socio-emotional adaptation, school achievement).

Two aspects seem to be discussed (implicitly): a) Gender-dependent differences in the boys' and girls' everyday preschool experiences and behaviour do exist and b) these differences increase during the preschool years. Searching for empirical foundations for these assumptions displays that the number of studies in preschool settings that focus on children's experiences and behaviour – with regard to gender-related differences – is rather small. The question if and if so what kind of gender differences in the children's and teachers' behaviour can be found still remains unanswered.

Research questions

The current study therefore analyses whether various aspects of gender-related behaviour differences in children and teachers are a topic in preschool education and if that were the case, how important that topic is. Using data of the German longitudinal study BiKS-3-10 two steps of analysis are conducted: 1) It is assumed that a teacher's educational behaviour towards a child is lead by his or her educational perception of that particular child: Do teachers ascribe gender-related strengths and weaknesses to children or else do they suggest different dates of school enrolment (early, regular, or late) for boys and girls? 2) Are there any gender-related differences in the children's preschool activities, in the developmental domains fostered by the children's everyday activities, in the social settings of boys and girls during preschool days, or in the teacher's role towards a child? Moreover this second step of analyses is divided in two. To cover different perspectives and agencies in everyday preschool, two actors – the child and its teacher – are studied: Do children choose activities or settings gender-related in their own initiative and/or do preschool teachers encourage gender-related activities or settings?

Design, sample and method

The data used was assessed observing a BiKS-3-10 subsample of 96 children and their preschool teachers in 51 German preschool settings during the children's first year (2006) and last year (2008) of preschool. The preschool teachers answered questionnaires regarding their perception of the children's strength and weaknesses at these two points in time and also their recommendations for time of school enrolment for every single child. The observational measure that was used discriminates 16 child activities, 22 domains of fostering child development, as well as seven types of interaction between child and teacher. Results were obtained via univariate difference tests for mean differences of boys and girls (ANOVAs) of relevant categories at both measurement points. Two paths of displaying the results are chosen: All difference tests are inspected in respect to their original outcome in order to uncover complex patterns of child and teacher behaviour. In addition the overall hypothesis of differences between girls and boys is looked into after adjusting results for multiple testing.

Results

The teachers' perceptions of the children's strengths and weaknesses display slight and more stereotype-like differences between boys and girls at both measurement points. School enrolment recommendations on the contrary display no such gender-related bias. The teachers' recommendations are not different for early, regular, or late enrolment for girls and boys at any point in time. The results for the children's activity patterns show only minor differences between girls and boys, which are not all in line with common stereotypes and even, diminish during the preschool years. Moreover the differences found are mainly the result of the children's own choice of activity and setting. Hardly at all do teachers encourage behaviour and settings in parallel to common gender stereotypes.

Interpretation and implications

Interpretations of results are concluded along the lines of heterogeneity of preschool experiences, the importance of influences other than institutional preschool settings, the onset and development of gender stereotypes in the course of child development, and teacher's intentions. The conclusions are that variance between single children is by far larger than variance between the sexes and that the problems boys are having in their school careers later on are not necessarily initiated in experiences and behaviours during the preschool years. Yet teachers and parents should be aware not to reduce their attention to and caution of beginning difficulties during the early years. As long as the sources of gender-related biases in frequency of failure during educational careers are unknown all those responsible during a child's preschool years should be aware of a large number of unknowns yet still focus more often on commonalities of boys and girls than on differences.

PAPER PRESENTATION

Systematic Observation and Documentation of Children's Learning – Effects on Child Care Quality

Corina Wustmann Seiler, Marie Meierhofer Institute for the Child, Switzerland; Heidi Dr. Simoni, Marie Meierhofer Institute for the Child, Switzerland

Systematic observation and documentation of children's learning processes is understood as a quality criterion of professional practice as well as an important professional competence (Tietze & Viernickel, 2007). The method of systematic observation and documentation of children's learning called "Learning Stories" developed by Carr (2001) in New Zealand and adapted for German-speaking countries by the German Youth Institute (Leu et al., 2007) is therefore commonly used in childcare centres as an instrument for promoting early learning processes of children. However, up to now there are no evidence-based findings on the extent to which systematic observation and documentation of children's learning further develop – as it is assumed and implemented in practice – the quality in the early childhood education and care system.

The study is based on a control and comparison group design with two measurement points: prior to the beginning of implementing systematic observation and documentation of children's learning (baseline t1, September 2009) and at the end (outcome t2, November 2010). The sample consists of 38 childcare centres: N=12 as intervention group working with "Learning Stories", N=13 as a waiting control group and N=13 as a comparison group working with another (different) observation and documentation method, developed by the German Infans Institute ("Infans Concept", see Laewen & Andres, 2007). Child care quality is assessed via standardized written questionnaires by the teaching personnel and childcare centre directors and via standardized external observations.

Systematic observation and documentation of children's learning processes is understood as a quality criterion of professional practice as well as an important professional competence (Tietze & Viernickel, 2007). Current key elements of early childhood education are to support the individual learning processes of the child and to create a stimulating learning environment. The method of systematic observation and documentation of children's learning called "Learning Stories" developed by Carr (2001) in New Zealand and adapted for German-speaking countries by the German Youth Institute (Leu et al., 2007) is therefore commonly used in childcare centres as an instrument for promoting early learning processes of children. The goal of the Learning Stories approach is to support the child in the development of an identity as being a "competent learner". The approach does not restrict attention to the children themselves but also includes teachers and parents. The method is directly integrated into the everyday practice of the childcare centre. The interplay of systematic observation and documentation, educational planning and reflection, and mutual exchange processes among all persons involved – children, teachers and parents – sensitizes all to become aware of individual learning processes and to better support stimulating learning environments in childcare settings.

However, up to now there are no evidence-based findings on the extent to which the "Learning Stories", as a method of systematic observation and documentation in early childhood education and care settings, further develop – as it is assumed and implemented in practice – the quality in the early childhood education and care system. Therefore the study aims to fill a research gap as to what dimension the Learning Stories method in fact has an effect on the quality of early child care and education. Following Tietze's (1998) structural-process model of child care quality, the aim is to shed light on whether and how changes manifest themselves in the different quality dimensions of process quality, orientation quality and structural quality. The following research questions are to be investigated:

- What effects do systematic observation and documentation of children's learning using the "Learning Stories" have on the quality of early child care and education?

- What specific effects can be found in the quality dimensions process quality, orientation quality, and structure quality?

It is assumed that (1) working with the "Learning Stories" leads to improvement and further development of child care quality and (2) childcare centres that implement systematic observation and documentation of children's learning show higher quality than childcare centres with no observation and documentation of children's learning.

The basis of the research project is the implementation of systematic observation and documentation of children's learning using the "Learning Stories" in selected Swiss childcare centres. The study has a control and comparison group design with two measurement points: prior to the beginning of implementing systematic observation and documentation of children's learning in childcare centres (baseline t1, September 2009) and at the end (outcome t2, November 2010). The sample consists of 38 childcare centres: N=12 as intervention group working with "Learning Stories", N=13 as a waiting control group and N=13 as a comparison group working with another (different) observation and documentation method, developed by the German Infans Institute ("Infans Concept of Early Child Care and Education", see Laewen & Andres, 2007). The implementation of systematic observation and documentation of children's learning using the "Infans Concept" already started in January 2009 with the comparison group (approximate half a year before the start of implementation in the intervention group).

Child care quality is assessed via standardized written questionnaires by the teaching personnel and childcare centre directors (structure and orientation quality; Nt1=515) and via standardized external observations (process quality) based on the German versions of the "Infant/Toddler Environment Rating Scale Revised" (Tietze et al., 2005), the "Early Childhood Environment Rating Scale – Revised Edition" (Tietze, Schuster, Grenner & Robbach, 2007), the "Early Childhood Environment Rating Scale-Extension" (Robbach & Tietze, in prep.) and the "Caregiver Interaction Scale" (Arnett, 1987).

The baseline results (t1) indicate significant group differences in some scales of orientation and process quality. In most of the scales the comparison group shows higher quality ratings than the intervention and control group. These results can be interpreted by the slight advance of the comparison group at baseline t1. Nevertheless, it already demonstrates effects of systematic observation and documentation of children's learning on the quality of early child care and education.

The paper will focus on the longitudinal results, based on the theoretical background, the methods and the research design. Finally implications for practice and research will be discussed.

PAPER PRESENTATION

Educational process quality in preschools on target-child-level

Wilfried Klaas Smidt, Bamberg University, Germany

The study refers to educational process quality on target-child-level, which goes more into detail than quality measured on preschool-class-level. Process quality, which can be covered with high-inferential quality ratings and low-inferential observations of children's and teacher's activities, is based on different theories. Nonetheless, there is still a lack regarding a strongly theory-based conceptualization of rated process quality. Moreover, little is known about the relation between process quality and observed activities. Therefore, the study considers how rated educational process quality can be conceptualized and how observed activities of children and preschool teachers covary with process quality. In all, 132 children and 64 teachers from 51 preschools in two German federal states participated. Data from the first, second and third year of preschool are used. To examine the conceptualization of process quality confirmatory factor analysis were conducted. The relation of children's and teacher's activities with process quality was examined using multiple regression analysis and conditional change score models. Results support a four-factor-model with focus on global and domain-specific contents. Teacher's scaffolding-behaviours and children's experiences, which can be subsumed under a "high-yield-activity" approach, are positively related with educational process quality. In sum, the study provides further evidence for the differentiation between global and domain-specific quality and the importance of activities representing scaffolding- and high-yield-activities-concepts for the educational process quality.

The study refers to educational process quality on target-child-level, which goes more into detail than quality measured on preschool-class-level. In contrast to measures of educational process quality on class-level (e.g., "Early Childhood Environment Rating Scale", Harms, Clifford, & Cryer, 2005; Sylva, Siraj-Blatchford, & Taggart, 2006) measurements focussing on educational quality on target-child-level (e.g., "Emerging Academic Snapshot" EAS, Ritchie, Howes, Kraft-Sayre, & Weiser, 2001) go more into depth and cover important details regarding dynamic every

day activities and interactions of individual children with peers and preschool teachers. Such educational processes can be covered with high-inferential quality ratings and low-inferential observations of children's and teacher's activities (e.g., Soar & Soar, 1982). Process quality can be conceptualized with reference to different theoretical approaches. With regard to domain-specific theories (e.g., Carey & Spelke, 1993; Wellman & Gelman, 1992) process quality can be differentiated into global (e.g., climate, care routines) and domain-specific contents (e.g., literacy, numeracy) (e.g., Cullen, 1999). Assumptions about the potential of certain experiences that foster children's cognitive development (e.g., pretend play, literacy) can be made with reference to "high-yield-activities" (e.g., Layzer & Goodson, 2006). The crucial role of preschool teachers in encouraging children in a developmentally appropriate manner is often specified with concepts such as "scaffolding" or "sustained shared thinking" (e.g., Siraj-Blatchford, 2009; Wood & Wood, 1996). Despite this substantial body of information for understanding the features of educational process quality only few studies have investigated a strongly theory-based conceptualization of rated process quality on target-child-level, especially with emphasis on domain-specific theories. Furthermore, considering the target-child-level there is still a knowledge gap about the relation between rated process quality on the one hand and observed children's activities (in terms of high-yield-activities) and preschool teachers scaffolding behaviours on the other hand. Therefore the study addresses two research questions: How can the rated educational process quality on target-child-level be conceptualized? How do the observed activities of children and preschool teachers covary with the process quality?

The study refers to data from the longitudinal study BiKS (educational processes, competence development and selection decisions in pre- and primary school age). Data from the first (spring 2006, $n = 102$ children), second (spring 2007, $n = 99$ children) and third year of preschool (spring 2008, $n = 96$ children) are used. In all, 132 children and 64 teachers from 51 preschools in the German federal states Bavaria and Hesse participated. Educational process quality on target-child-level was captured with a standardized time-sampling observation and rating instrument (Target Child Observation; Kuger, Pflieger & Rossbach, 2006a; 2006b). The Target Child Observation allows documentation of the daily experienced activities of individual target children in preschool classes. Several areas are taken into account (e.g., activities of the target child, role of the preschool teacher). Moreover, the Target Child Observation considers specific "domains of support", which represent several contents (e.g., literacy- and numeracy-related abilities), that can be supported by different activities (e.g., pretend play, gross motor). The coding procedure assumes that on a typical morning (8 a.m. to noon), two target children per preschool class were each observed three 20 consecutive one-minute intervals. Trained observers coded the frequencies of specific target-child- and preschool-teacher behaviours. If children and teacher were involved in more than one activity, the predominant activity was coded. With respect to the domains of support, a maximum of six domains could be coded per one-minute interval. Every 20-min period is supplemented with a 10-min block for rating the educational quality of the preceded observation phase on a seven-point scale from 1 ("inadequate quality") to 7 ("excellent quality"). Once the whole 30-min period was completed for the first child, observers shifted to the second child for the next 30-min period. This procedure was repeated three times. For conceptualizing the rated process quality a four-factor-model with two global factors with an emphasis on promotion of social and general cognitive abilities and two domain-specific factors emphasizing the promotion of literacy- and numeracy-related abilities was specified with confirmatory factor analysis (e.g., Brown, 2006; Bollen, 1989). For investigating the relationship between process quality and children's and teacher's activities, four theory-based clusters of children's and teacher's activities were created: "high-yield-activities" (e.g., pretend play, blocks), "high yield domains of support" (e.g., oral language, counting), "other domains of support" (e.g., gross motor, music), and "scaffolding" (role of teacher: e.g., helping, encouraging). The impact of children's and teacher's activities on the rated process-quality was examined cross-sectional using multiple regression analysis and longitudinal conducting conditional change score models (e.g., Menard, 2002; Finkel, 1995). Results support the hypothesized four-factor-model with focus on global and domain-specific contents. The specified model fits best in the first and third year of preschool and somewhat poorer in the second year indicating interference and change in the internal structure of educational process quality, especially with respect to the increasing importance of literacy- and numeracy-related contents for the day-to-day experiences of the target children which begins at that time. Teacher's scaffolding-behaviours and children's experiences, which can be subsumed under a "high-yield-activity" approach, covary with educational process quality. The cross-sectional and longitudinal results reveal, that scaffolding behaviours and high yield domains of support are positively related to the level of the global and domain-specific process quality and on its change over time, whereas the relation of the "other domains of support" is more often negative. To summarize, the study provides further evidence for the differentiation between global and domain-specific quality and the importance of activities representing scaffolding- and high-yield-activities-concepts for the educational process quality. The findings clearly stress the crucial role of preschool teachers, demanding a stronger emphasis on "scaffolding"-behaviours towards the children with goes along with a provision of a wide range of cognitive challenging high-yield-tasks.

PAPER PRESENTATION

Transition to primary school in Germany

Gabriele Faust, University of Bamberg, Germany; Jens Kratzmann, University of Bamberg, Germany; Franziska Wehner, University of Bamberg, Germany

Embedded in the longitudinal study BiKS 3-8 parents and teachers rated if school beginners had psychosocial problems respectively if they managed to start school successfully. Parents' ratings showed that except physical problems the psychosocial problems under study (anxiousness/ depression and attention problems) already prevailed nine and three months before school entry. Contrary to the widespread "Transition view" and in accordance with the "paradoxical theory" of Caspi and Moffitt and their coworkers these results point to rather long lasting personality and behavior problems and not to short term maladaptation during school start. Boys, the younger ones of the cohort starting school concordant with the official age regulations and children with poor prior knowledge were identified to start school less successfully. Transition programs therefore should not be limited to a short time period around school entry, but should start earlier. During the first weeks in school special attention should be given to the mentioned groups at risk.

Theoretical Background

General pedagogic and elementary school literature views school enrolment as an important and often problematic turning-point for a child and its parents (Griebel & Niesel, 2004; Speck-Hamdan, 2007; Brostßm, 2007; Margetts, 2000). One third to half the children are supposed to have transition problems (Griebel & Niesel, 2004; Grotz, 2005; Beelmann, 2000; Kienig, 2002).

The national and international accepted theoretical concept is the Transition Theory (Griebel & Niesel, 2004). It poses that school enrolment is one of the "critical, normative life events" which is tied to new challenges and is accompanied by a profound restructuring of identity (Filipp & Ferring, 2002; Griebel & Niesel, 2004). To help children in coping with those upcoming changes institutions like the family, kindergarten, and elementary schools should communicate about the transition in terms of a co-construction and accompany it with cooperation measures (Griebel & Niesel, 2004; Niesel, 2007; Margetts, 2003). National empirical research is rare, only a few and smaller international studies focused on the relationship between cooperation and school enrolment (Bowes et al., 2009; Brostrßm, 2000; Fabian, 2000). Next to cooperation measures family-factors and protective-factors on the child level should be included (e.g. high self-esteem or high social competence).

Because of rare existing empirical evidence and an existing alternative theory for explaining crisis-laden developments the Transition Theory should be questioned. According to the 'paradoxical' theory by Caspi and Moffitts, changes in personality and newly developing patterns of behavior are especially unlikely in periods of transition. Instead of changes, already-existing person-specific tendencies and familiar behavior are activated and reinforced (Caspi & Moffitt, 1993; Beelmann, 2006).

Thus, this paper is concerned with the following questions:

1. Do children show signs of "school enrolment crises"? How many children are thereby affected?
2. Which individual and/or contextual factors predict "school enrolment crisis"?
3. Which individual and/or contextual factors foster a successful school enrolment?

Method

This paper is based on data from the DFG research group BiKS ('Educational Processes, Competence Development and Selection Decisions in Pre- and Primary School Age') in Germany. The BiKS study analyses preconditions and processes of competency development in pre- and elementary school age as well as decisions involving the transition from kindergarten to elementary school. The longitudinal study started with 547 children at age 3 and data is collected every six months in spring and autumn. Our analyses are based on parents' and teachers' ratings. Measures are taken from child-centered questionnaires.

Three of the seven syndrome scales from the Child Behavior Checklist 4-18 by the research group CBCL (Dßpfner et al., 1998) were used to evaluate possible "school enrolment crises": Anxious/Depressed, Attention Problems and Somatic Complaints. The measurement was done nine months and three months prior to and three months and nine months after school enrolment.

Successful coping with school entry was measured with three scales after school enrolment. With regard to the FEES 3-4 (Measurement of Emotional and Social School-Experiences of Elementary School Children; Rauer & Schuck, 2003), questions on autonomy, willingness for exertion, and joy of learning were developed.

As causal variables characteristics on the family and child level as well as characteristics on the institutional level were taken into account. On the family level, the educational background of the parents was included in the analyses. On the child level, age upon school entry, gender and mathematic skills (K-ABC, Kaufman & Kaufman, 2003) prior to school enrolment were used. On the institutional level, the quality of the kindergarten was included which is measured by the kindergarten assessment scale (KES) (Tietze et al., 2007). Cooperation of kindergarten and elementary school is measured by questions about the child's participation in cooperation activities. Regression models were used to determine the occurrence of psychosocial "school enrolment crises" and a successful school entry by the influence of individual and contextual characteristics.

Results

Our analyses show that psychosocial problems do not initially arise in the context of school enrolment. The strongest predictors are the autoregressors, i.e. the same problem occurs at least nine months prior to school enrolment. Therefore, these are not "school enrolment crises" but continues personality- or behavioral problems. These findings are incompatible with assumptions of the Transition Theory. Rather, the theoretical concept of Caspi and Moffitt is reinforced: Not a missing "transition competence" is responsible but relatively stable personality traits and behavioral patterns that lower or foster the ability to take advantage of learning possibilities in kindergarten and elementary school.

The analyses of psychosocial problems as well as those of an unburdened, successful school entry show similar risk- and protective factors. Mostly, and with high impact, they occur at the level of individual characteristics. Gender, age upon school entry and precursory skills at preschool age have a strong influence. Boys start school less successful than girls. Older preschoolers cope better with school enrolment than younger children. Precursory skills have a preventive effect as regards to attention problems. They also predict autonomy and willingness for exertion.

Furthermore the global quality of the kindergarten prevents anxious-depressive adaption problems. On the other hand the transition accompanying measures in the context of cooperation between kindergarten and elementary school do not prevent psychosocial problems nor do they support an unburdened school entry. Based on these results, it is not advisable to focus accompanying measures too much on the period of the transition and on all preschoolers equally. If relatively stable personality traits and long-term behavioral problems rather than an assumed "transition competence" are responsible for a difficult school entry, it seems more important to foster the further development of the child as early as possible in the day-care center. Special attention needs to be given to first graders who are male, youngest, and have limited precursory skills.

PAPER PRESENTATION

Associations Among Achievement Goal Orientations, Emotions, and Self-efficacy

GONUL SAKIZ, MARMARA UNIVERSITY, Turkey

This study explored the associations among perceived mastery and performance approach goal orientations, academic enjoyment, academic anxiety, and academic self-efficacy beliefs reported by Turkish college students. A self-report survey was administered to 100 third-year undergraduate students taking Statistics course in a teacher training department of a major teaching and research university in Istanbul, Turkey. Structural equation modeling was used for data analysis. The results showed that mastery approach goal orientation was significantly positively related to academic enjoyment and academic self-efficacy beliefs and significantly negatively related to academic anxiety reported by students. Performance approach goal orientation, on the other hand, was significantly positively related to academic anxiety and academic self-efficacy. Academic anxiety was significantly negatively associated with academic self-efficacy. No significant association were detected between performance approach goal orientation and academic enjoyment and between academic enjoyment and academic self-efficacy. Overall, the structural model explained 21% of the variance in students' academic enjoyment, 22% of the variance in academic anxiety, 60% of the variance in academic self-efficacy beliefs.

Literature Review

Goal orientations influence students' attitudes toward learning. Students in learning environments adopt different goals. There are two major goal orientations identified in academic environments. One is mastery (intrinsic, learning) and the other is performance (extrinsic) goal orientation. Research shows that students who adopt mastery oriented goals use more effective learning strategies and prefer more challenging tasks whereas students who adopt performance oriented goals use less effective learning strategies and prefer easy tasks (Ames & Archer, 1988). Mastery oriented students focus more on learning, development, improvement, and understanding whereas performance oriented students focus more on doing better than others, demonstrating behaviors that would lead to public recognition, praise, and positive attributions toward one's ability (Ryan, Pintrich, & Midgley, 2001). Elliot and

McGregor (2001) subcategorized mastery and performance goals as approach and avoidance goals. Individuals who adopt approach goals aim at approaching success and desired outcomes whereas those who adopt avoidance goals aim at avoiding failure. For example, students adopting performance approach goals may aim at doing better than others or wishing to be perceived more able than others while students adopting performance avoidance goals may aim at avoiding seen less able than others. Students adopting mastery approach goals aim at understanding the subject content and improving the acquisition of new skills while students adopting mastery avoidance goals try to avoid failing to comprehend the content or material and acquisition of skills. Avoidance goals in general are accompanied by anxiety, distress and worry towards the new challenge. Although there has been a few research conducted in the past to investigate the influence of goal orientations on students' academic emotions and academic self-efficacy beliefs, the participant selection in those studies were dominantly limited to middle school students especially studying in the United States. Therefore, exploring the associations among given variables through the consideration of different developmental levels and cultures by using diverse methodological techniques would be beneficial. Besides, understanding the consequences of different types of goal orientations on college students' emotional and motivational outcomes would help us develop better instructional designs stimulating the development or enhancement of proper goal orientations for students.

Research Question

The current study examined the following research question: What are the relationships among Turkish undergraduate students' achievement goal orientations and their reported academic enjoyment, academic anxiety, and self-efficacy beliefs? For this exploration, only mastery and performance approach goals were included in the investigation because research reports reveal more influential role of approach goals on motivation and learning and, therefore, recent studies mainly use approach goals in their investigations (Phan, 2010). Besides, because avoidance goals include emotional features like worry, distress, fear, and/or anxiety within them, there would be a strong association among avoidance goals and emotional factors included in the structural design and would cause overlooking at other potential significant associations among variables.

Method

Participants and Procedure

One hundred junior college students majoring in Education in a university in Istanbul, Turkey participated in the study. The average age of participants in the study was 21.60 (SD = 1.74). Because the particular department involved in this study mainly preferred by female students a greater number of female students (n = 91, 91%) than male students (n = 9, 9%) participated. Students responded to the survey items with respect to their Statistics course. Each item was responded on a 7-point Likert type scale ranging from "not at all true of me" to "very true of me".

Goal orientations. Three items in mastery approach goal orientation subscale and two items in performance approach goal orientation subscale were taken from the Achievement Goal Orientations Questionnaire (Elliot & Murayama, 2008). **Academic anxiety.** Three items in academic anxiety subscale were taken from the Academic Emotions Questionnaire (AEQ, Pekrun, Goetz, & Perry, 2005). Five items in this subscale were taken from the Reactions to Tests (RTT) scale (Sarason, 1984). One item was taken from the Motivated Strategies for Learning Questionnaire (MSLQ, Pintrich, Smith, Garcia, & McKeachie, 1991, 1993).

Academic enjoyment.

Four items in academic enjoyment subscale were taken from the Parental Locus of Control Scale (PLOCS, Campis, Lyman, & Prentice-Dunn, 1986). Self-efficacy. Six-item self-efficacy subscale was taken from the Motivated Strategies for Learning Questionnaire (MSLQ, Pintrich, Smith, Garcia, & McKeachie, 1991, 1993). Data Analysis Structural equation modeling (SEM) was performed using AMOS. Results The internal consistency reliability estimates for the Mastery Goal Orientation ($\alpha = .830$), the Performance Goal Orientation ($\alpha = .809$), the Academic Anxiety ($\alpha = .929$) the Academic Enjoyment ($\alpha = .915$), and the Academic Self-efficacy ($\alpha = .886$) were all satisfactory. The Measurement Model

The full measurement model provided an adequate fit to the data. The factor correlations are presented in Table 1. The Structural Model The hypothesized model provided an adequate fit to the given data [$\chi^2(240, N = 100) = 436.765$, $p = .00$, CFI = .967, TLI = .959, RMSEA = .091 (with 90% CI lower bound = .078 and upper bound = .105)]. As depicted in Figure 2, mastery approach goal orientation was significantly positively related to academic enjoyment [$b = .448$, $p < .05$]. Academic enjoyment was not significantly associated with academic self-efficacy [$b = .059$, $p > .05$]. Academic anxiety was significantly negatively related to academic self-efficacy [$b = -.242$, p

Educational Implications Nurturing mastery approach goal orientation in teacher training programs is especially important. Teacher goal orientations have been reported to have significant influence on students' adopted goal

orientations (Roeser et al., 1998) which means the more mastery oriented the teacher, the greater possibility that their students will become the mastery oriented. Therefore, the instructors in teacher training departments need to put more emphasis on mastery goal orientation by encouraging challenge, effort, participation, understanding, interaction, and peer collaboration.

PAPER PRESENTATION

The mediating role of mastery goals between the learning environment and school investment

Jaap Schuitema, University of Amsterdam, Netherlands; Thea Peetsma, University of Amsterdam, Netherlands;
Ineke van der Veen, University of Amsterdam, Netherlands

This study investigated the relationship between developments in students' mastery goals, their perception of the learning environment and their investment in school. Mastery goals have been associated with several positive outcomes, such as effort and persistence in learning and may, therefore, be an important mediating factor in the relationship between the learning environment and school investment. 648 first year students in secondary education participated in the study (age 12). A self-report questionnaire was administered four times. The first measurement was at the start of secondary education, the second half way through the first year, the third measurement at the beginning of the second year of secondary education and the fourth half way through second year. The questionnaire included scales to assess investment in maths and English and mastery goals concerning maths and English. In addition, two aspects of the learning environment were measured: students' perceptions of autonomy support and the extent to which teachers stressed the relevance of what is being learned. The results indicate that developments in students' perceptions of the learning environment during the first year of secondary education were positively related to developments in both mastery goals and school investment. Further analysis showed that mastery goals partly mediated the effect of the learning environment on students' investment in school.

It is increasingly recognized that the learning context is an important factor in explaining students' motivation for school (Pintrich, 2004). Several aspects of the learning environment, such as autonomy support and the emphasis given by teachers to the relevance of what is being learned, have been found to have a positive effect on students' motivation and learning behaviour (e.g. Assor Kaplan & Roth 2002). In addition, research has identified individual motivational factors that affect learning behaviour in school. The higher students' mastery goal orientation the more they self-regulate their learning and the higher their academic achievement (Urdu & Midgley, 2000). Little is known, however, about how these aspects of the learning environment and students' mastery goals are related to each other. Even less is known about how these relationships develop over time. In this longitudinal study we aimed to give more insight into the relationships between developments in students' mastery goals, their perception of the learning environment and their investment in school. We investigated to what extent the development in mastery goal orientation mediates the effect of the learning environment on school investment.

Theoretical background

Achievement goal theory proposes a distinction between mastery goals and performance goals (Schunk, 1996). Mastery goal oriented students focus on the mastery of learning tasks and developing competence. In contrast, performance oriented students are concerned with demonstrating their ability to others. Mastery goals more than performance goals have been associated with several positive outcomes, such as effort and persistence in learning (Wolters 2004). Mastery goal orientation, therefore, may be an important mediating factor in the relationship between the learning environment and students' investment in school. In this study we focused on two aspects of the learning environment that we expected to be related to a mastery goal orientation and investment in school. The first aspect is the amount of support for student autonomy. Students need a sense of freedom of choice about their own learning process. Autonomy for students is considered to promote their interest in learning and their focus on the mastery of skills (Deci & Ryan, 2000). Secondly, we argue that students are more inclined to adopt a mastery goal orientation if they perceive what is being learned as relevant to their own lives. It is important for teachers to help students understand the relevance of a certain learning task to themselves and to relate the content to their prior knowledge.

Method

648 students in secondary education participated in the study. The students were from all levels of secondary education and at the start of the study the students were on average 12 years old. A self-report questionnaire was administered four times: The first at the start of secondary education, the second half way through the first year, the third measurement at the beginning of the second year of secondary education and the fourth half way through second year. All items in the questionnaire were rated on 5-point Likert scales. Perceived autonomy support was measured with the short form (six items) of The Learning Climate Questionnaire (William & Deci, 1996). To measure the emphasis given by teachers to the relevance of what is being learned we combined three items from the Teacher

as a Social Context questionnaire (TASC; Belmont, Skinner, Wellborn & Connell, 1988) with three items of a scale measuring 'connection to students' worlds' adapted from Thoonen, Slegers, Peetsma and Oort (in press). As most motivational constructs show subject-specificity, we investigated mastery goals and students' investment concerning two different subjects. Maths and English were selected because all students take these subjects, and they are usually considered important. We used five items of the school investment scale from Roede (1989) to assess, maths investment and English investment. This scale measures the onset of student action, the degree of intensity of action and perseverance with the action. Mastery goal orientation was also measured for both maths and English. We used the scale 'task orientation' of the Goal Orientation Questionnaire of Seegers, van Putten and de Brabander (2002). The data were analysed using multivariate latent growth curve modelling with Mplus. The rate and level of growth of the different variables were related to each other. We examined models in which the effects of changes in perceptions of the learning environment on developments in school investment are mediated by developments in mastery goal orientation. We fitted separate models for maths investment and English investment and we controlled for gender and ethnic background differences and school level.

Results

The data of the first two measurements in the first year of secondary education have been analysed. The results indicate that developments in students' perceptions of the learning environment were positively related to developments in both mastery goals and school investment. Moreover, further analysis showed that mastery goals partly mediated the effect of the learning environment on students' investment in school. An additional direct effect of emphasis on relevance was found on maths investment and an additional direct effect of autonomy support on English investment. In the paper we include the analyses of the third and fourth measurement.

PAPER PRESENTATION

Investigating the link between social goals and learning strategies

Ronnel King, The University of Hong Kong, Hong Kong; Dennis McInerney, Hong Kong Institute of Education, Hong Kong; David Watkins, University of Hong Kong, Hong Kong

Research in cross-cultural psychology has indicated that people from different cultures are motivated by different types of goals. In collectivist cultures, the power of social goals may be especially salient. However, studies on student motivation usually focus only on two types of goals: mastery and performance goals, thus neglecting the potential role of social goals. The aim of the present study was to investigate how different types of social goals, i.e. social affiliation, social approval, social concern, and social status goals were related to learning strategies in a collectivist culture. 697 secondary students from Hong Kong answered the relevant questionnaires. Results indicated that social concern and social status goals were the most adaptive type of social goal. Implications are discussed.

Introduction

Achievement goal theory has become a dominant paradigm for examining student motivation (see Maehr & Zusho, 2009 for review). However, a weakness of this body of research, particularly that emanating from goal theory, is that it limits itself to examining two types of goals, usually mastery and performance goals, while failing to account for social goals, which may also be powerful constructs in explaining student motivation. This might prove constricting given that research has shown that students pursue multiple goals in the classrooms (Boekaerts, 2009) and that schools are inherently social domains (Martin & Dowson, 2009). Moreover, this limitation is even more glaring in the collectivist Chinese cultural context where academic motivation is inherently social (Yu & Yang, 1994). A better model for examining a range of goals and their potential impacts is Personal Investment Theory (Maehr & Braskamp, 1986; Maehr & McInerney, 2004) which posits a broader range of goals including task, ego, social solidarity and extrinsic goals, with the latter three having a social dimension.

The aim of this paper is to examine how four different types of social goals (social affiliation, social approval, social concern, and social status) drawn from Personal Investment Theory influence adaptive and less adaptive learning strategies (deep, surface, and achieving) in a collectivist non-Western context.

Method

The respondents were 697 Hong Kong secondary school children. To measure their social goals and learning strategies, the students were given two self-report instruments: the Chinese versions of the Inventory of School Motivation (ISM-C) (Watkins, McInerney, & Lee, 2002) and the Learning Process Questionnaire (LPQ, Biggs, 1992).

Social goals. Four types of social goals were measured using the ISM-C:

- O Social Affiliation: Interest in belonging to a group when doing schoolwork (e.g. "I can do my best work at school when I work with others.")
- O Social Approval: Seeking praise and recognition for schoolwork (e.g. "At school I work best when I am praised.")
- O Social Concern: Concern for other students and a willingness to help them with their school work (e.g. "It is very important for students to help each other at school.")
- O Social Status: Seeking social power and status through schoolwork (e.g. "I work hard at school to be put in charge of a group.")

Learning strategies. Three types of learning strategies were measured using the LPQ

- O Deep Strategies: Understanding what is to be learnt through inter-relating ideas and reading widely (e.g. "I try to relate what I learn in one subject to what I have learned in other subjects.").
- O Surface Strategies: Reproducing bare essentials often using rote learning (e.g. "In most subjects I try to do enough just to make sure I pass, and no more.").
- O Achieving Strategies: Securing high performance by using regulatory schemes like study skills, time management, and exam-oriented techniques (e.g. "When a test is returned, I correct all the errors I made and try to understand why I made them.").

In the preliminary analysis, we first examined the descriptive statistics and alpha estimate of internal consistency for each scale. We used structural equation modelling (SEM) to test the relationship between social goals and learning strategies with social goals as predictors. We began by establishing the measurement portion of the model within a CFA framework (Anderson & Gerbing, 1988) and then proceeded to the full SEM.

Results

The internal consistencies (α) of all measures were all acceptable (range of $\alpha = .66 - .84$) except for the surface strategies scale ($\alpha = .54$). The measurement model indicated good fit to the data ($\chi^2/df = 2.70$, $p < .001$, CFI = .922, TLI = .903, RMSEA = .049). The correlations show that almost all the social goals were unrelated to surface learning strategies, while being positively related to both deep and achieving learning strategies.

Personal Investment Theory claims that students' goals are proximal predictors of various learning strategies and other educational outcomes (see Maehr & McInerney, 2004;). Consistent with this line of reasoning, we hypothesized that social goals would act as predictors of different learning strategies. We first tested a model where all the social goals had paths going to the three types of learning strategies.

Results indicated that Model 1 ($\chi^2/df = 2.704$, $p < .001$, CFI = .922, TLI = .903, RMSEA = .049) fit the data well; however there were some non-significant paths. We deleted these non-significant paths and came up with Model 2 ($\chi^2/df = 2.656$, $p < .001$, CFI = .921, TLI = .905, RMSEA = .049). Since Model 2 was nested within Model 1, we performed a chi-square difference test (Loehlin, 2004). Results indicated that Model 2 was not significantly different from Model 1 (change in $\chi^2 = 10.545$, change in $df = 7$, $p = .59$), thus we adopt Model 2 since it is more parsimonious (See Figure 1).

The final model indicates that social concern goals are positive predictors of deep and achieving strategies and negative predictors of surface learning strategies. Social status goals are positive predictors of deep and achieving strategies. Social affiliation and social approval goals were not significant predictors of any of the learning strategies.

Conclusion

The aim of this study was to explore how different types of social goals are related to various adaptive and less adaptive learning strategies. Social concern and social status goals were positively related to deep and achieving strategies and social concern negatively related to surface strategies. Apart from this latter finding no other social goal was related to surface strategies. Neither social approval nor social affiliation goals were related to any of the learning strategies. Of the social goals considered, only two appear to exert a proximal influence on the learning strategies that students adopt.

These findings will be elaborated upon in the PAPER PRESENTATION, with implications for practice and research being drawn.

PAPER PRESENTATION

Students' multiple goals in the classroom: an exploratory study on goal salience and motivation

Karin Smit, University of Leiden, Netherlands; Monique Boekaerts, Leiden University, Netherlands; Frank Busing, Leiden University, Netherlands

The goals that students pursue in the classroom influence their educational outcomes and well being. Recently, several researchers (e.g. Boekaerts, 2008) urged to shift the focus from studying learning goals to a range of goals for a better fit between goal theory and students' reality. In this study 487 students from pre-vocational secondary education completed the Goal Identification and Facilitation Inventory (Boekaerts, 2009), registering students' preferences for 16 different types of goals, based on Ford and Nicholl's goal taxonomy. The Intrinsic Motivation Inventory (Ryan & Deci) is used to determine students' motivation. Multidimensional unfolding techniques and first order correlations revealed the empirical structure of goals. Preliminary results show that ego goals (superiority, individuality, material gain) are ranked least important and show no relation or a negative relation with motivation. Students rank personal wellbeing goals as most important. These goals are moderately related to motivation. Goals connected with learning are ranked in between personal wellbeing goals and ego goals. Their relation with motivation is relatively strong. These results will be completed in January 2011 using additional restricting variables in the unfolding model to make the interpretation more profound (Busing, 2010). Furthermore, a cross validation will test the results that are obtained by the unfolding analyses. The consequences of these findings for interventions to utilize students' goal preferences in the classroom and to bridge the gap between non-learning goals and learning goals will be discussed.

Extended summary

Aims

In pre-vocational secondary education, interest in schoolwork does not always come naturally. To enhance students' motivation, teachers try to provide students with goals related to school activities. Urdan (2004) argued, however, that many teachers send mixed and contradictory goal messages. Apparently, we have little knowledge about the multiple goals that students bring into the classroom and how they interact. Therefore, we need a shift from studying a single type of goal (learning goals) to a wider range of goals.

Boekaerts (2008) developed the Goal Information and Facilitation Inventory (GIFI) based on Ford and Nicholl's taxonomy of goals, to examine 16 different types of goals, including learning goals, personal wellbeing goals, task goals, social goals and ego goals. This study aims to further develop the goal model proposed by Boekaerts.

Method

Sample. A sample of 487 students (211 boys, 256 girls, 20 missing) from the third and fourth years of pre-vocational secondary education across four schools in an urban area in the Netherlands took part in this study. Students were on average 16.1 years old ($SD = .82$).

Instruments. Students received a self report questionnaire (GIFI) and made a ranking order with the 16 types of goals from most important to least important. These goals are Tranquility (I don't want to feel stressed at school), Equity parents (I want to get along with my parents), Belongingness (I want to be liked by classmates), Positive self evaluation (I want to feel good about myself), Social responsibility (I want to be respectful to classmates and teachers), Self determination (I want to have a choice in what I do at school), Management (I want to be organized), Mastery (I want to understand the learning material), Resource acquisition (I want to receive help when I need it), Material gain (I want to have pretty clothes), Resource provision (I want to give help to classmates when they need it), Safety (I don't want to take risks), Individuality (I want to be different), Entertainment (I want schoolwork to be fun), General equity (I want to keep my promises) and Superiority (I want to be better than others).

Motivation was measured using the Intrinsic Motivation Inventory (IMI) by Ryan & Deci with four items on Pleasure (e.g., I think schoolwork is interesting), Cronbach's alpha was .90, and five items on Effort (e.g., 'I put a lot of effort into schoolwork'). Cronbach's alpha was .70. Both scales were scored on a five point Likert scale from 'I fully agree' (5) to 'I don't agree at all' (1).

Analyses

Multidimensional unfolding is an exploratory technique and results in a spatial configuration in which the preference from each student for each goal is taken into account to determine which of the 16 goals are most dominant in the ranking and which goals are negligible in terms of the ranking (Busing, 2010). A first order correlation analyses is used to look at the relations between goals and motivation.

The unfolding method showed that most students in our sample ranked the personal wellbeing goals Equity parents and Positive self evaluation as their most important goals. Both goals are weakly related to motivation. Ego goals (Superiority, Individuality, Material gain) were ranked as least important by most students. This is in accordance with Boekaerts (2008) who found a clear distinction between ego goals and the other goals that students bring into the classroom. Furthermore, Superiority showed no relation with motivation. Material gain showed a very weak, negative

relation with motivation. Individuality also showed a very weak, negative relation with Effort. Goals connected with learning (e.g. Mastery, Management) were ranked in between personal wellbeing goals and ego goals. Their relation with motivation is relatively strong.

The results of this study will be completed in January 2011 using additional restricting variables in the unfolding model (Busing, 2010), showing the position of pleasure and effort in relation to the multiple goals. Furthermore, results that are obtained by the unfolding analyses will be tested by means of a cross validation.

Discussion

It is clear that wellbeing, especially related to oneself and to parents, is important to students. Goals related to learning, on the other hand, are not very prominent, even when reported in a school context. In the light of the Dual Processing Self-regulation Model (Boekaerts & Niemivirta, 2000) these are important findings. According to this model students who are mainly concerned with their wellbeing, are active on the wellbeing path, using their energy to prevent negative events from occurring in the learning environment (prevention focus). Students, who are mainly concerned with learning and task related goals, focus on learning and mastery goals and are active on the mastery path.

This study enables us to set up interventions to help students to become aware of the goals they bring into the classroom and how these goals are entangled, and focus on volitional strategies and coping strategies that students can use to shift their attention from the wellbeing path to the mastery path. We assume this will enhance and increase students' motivation, persistence and achievement.

References

- Boekaerts, M. (2009). Goal directed behavior. In K.R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation in the school* (pp. 105-122). Routledge.
- Boekaerts, M. (2008, August). Content goals tell us what students want to attain in the classroom. In M. S. Lemos (Chair), *The nature and dimensions of students' goals*. Symposium conducted at the 11th EARLI conference (SIG 8), Turku, Finland.
- Boekaerts, M., & Niemivirta, M. (2000). Self-regulated learning: Finding a balance between learning goals and ego-protective goals. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 417-451). San Diego, California: Academic.
- Busing, F. M. T. A., (2010) *Advances in Multidimensional unfolding*. Doctoral dissertation, Leiden University.
- Ryan, R. M. & Deci, E. L. (n.d.). *Intrinsic Motivation Inventory (IMI)*. Retrieved June 15, 2001, from <http://www.psych.rochester.edu/SDT/measures/word/IMIfull.doc>
- Urda, T. C. (2004). Using multiple methods to assess students' perceptions of classroom goals structures. *European Psychologist*, 9 (4), 222-231.

PAPER PRESENTATION

Strategies of selection, optimisation, and compensation of teachers over their career cycle

Anja Philipp, University of Frankfurt, Germany; Mareike Kunter, Goethe-University, Institute of Psychology, Germany

Approximately one-third of German teachers feel burned-out (Schmitz, 2004). At the same time, 17% of the 7600 German teachers Schaarschmidt and Kieschke (2007) investigated feel engaged. Continuous exposure to the demands associated with teaching can take its toll and if teachers are not able to conserve their resources they might burn-out. The theory of selective optimisation with compensation (SOC; e.g. Baltes & Baltes, 1989) states that individuals who allocate their resources effectively are able to counterbalance demands. The question arises which SOC strategies teachers use to invest their resources so that they can remain engaged. The goal of this study was to investigate whether teachers increasingly focus on their primary goals and give up related tasks (selection), optimise their time spent on preparation, correcting tests or evaluation of students and compensate by appreciating cooperation with colleagues. Results from a questionnaire study in which 1748 German teachers reported on their professional activities and well-being indicate that the number of tasks teachers engage in does not change over the career cycle. However, there seems to be a shift in the priority of tasks and a selection occurs. More experienced teachers rather spend more of their time for administrative tasks than for activities such as excursions or school projects. The results indicate that it is necessary to have a flexible system at each school which allows teachers from the age of 55 to spend more time on selected tasks (e.g. administrative tasks).

Approximately one-third of German teachers feel burned-out (Schmitz, 2004). At the same time, Schaarschmidt and Kieschke (2007) show that 17% of the 7600 German teachers they investigated feel engaged. The question arises if teaching leads inevitably to burnout or if it is possible for teachers to invest their resources in a way so that they

remain engaged. The theory of selective optimisation with compensation (SOC; e.g. Baltes & Baltes, 1989) states that individuals who allocate their resources effectively are able to counterbalance demands. First, individuals can select certain goals they want to achieve. Teachers could focus on teaching itself as the primary task of their profession and give up other related activities such as going on excursions, taking part in school projects or to supervise students during their breaks. Second, SOC theory points out that individuals can choose how they allocate or optimise their resources to achieve their goals. Teachers as knowledge workers could optimise their time spent on preparation for class, time spent on correcting tests or evaluating students. And third, individuals can compensate for lost resources by using alternate means to achieve their goals. Teachers could rely more on cooperation with their colleagues as a buffer against constantly high demands. With increasing age, the continuous exposure to the high demands associated with teaching can take its toll and if teachers are not able to conserve their resources successfully they might burn-out. The following research question arises: Do teachers increasingly focus on their primary goals and give up related tasks, optimise their time spent on preparation, correcting tests or evaluating students and compensate by being ready to cooperate with colleagues with increasing age?

Method:

Sample 1748 of the 1940 teachers who took part in the first wave of the COACTIV study ("Professional Competence of Teachers, Cognitively Activating Instruction, and the Development of Students' Mathematical Literacy") are the basis for the current analysis. COACTIV is a complementary study to the German PISA study (wave 2003/2004). The mathematics teachers of the PISA pupils filled in questionnaires on different topics such as their professional competence or well-being. Teachers came from 198 schools which were representative of German secondary schools in terms of state and school track; they were 25 to 65 years old ($M=47.25$; $SD=9.35$) with a high percentage of older teachers (48% > 50 years); 49.8% of them were female and 71.2% worked part-time. 192 questionnaires had to be discarded due to more than 30% of missing values in the relevant variables. Missing values of the remaining participants were imputed using expectation-maximisation algorithm (EMA) by the Software Norm (version 2.03). Instruments A list of tasks (individual preparation, preparing and correcting tests, evaluating students, meetings, taking part in school projects, excursions, individual training, administrative tasks and school conferences) was provided and teachers were asked how many hours they spent on each task within one week. Also, a ratio was calculated to which percentage teachers spent their time each single activity and included in single regression analyses. Appreciation of cooperation in school was assessed with a scale especially designed for the COACTIV study containing 4 items. Items were prompted by the instruction: "What do you especially appreciate at your school?" (example: "the cooperation on pedagogical questions."). Statistical Analysis Regression analyses in Mplus (version 5) were conducted to examine changes with increasing age under control for school as cluster variable. To assess curvilinear changes, age square was calculated and included in the regression.

Results

Selection) With increasing age, there was no change in the overall number of tasks. At closer examination of the ratio of time spent on different tasks it became clear that with increasing age teachers spent more time on excursions, but then again a decline from the age of 55 (quadratic trend, $\beta_{age^2}=-0.49$; $p_{age^2}=.49$, $p_{age}=.09$, $p_{age}=.20$, $p_{age}=.11$, $p_{age}=.58$, $p_{age^2}=.48$, $p_{Optimisation}$) Teachers invested less time in the preparation ($\beta_{age}=-.58$, $p_{age}=.44$, $p_{Compensation}$) Teachers of all ages similarly appreciated cooperation. Discussion The number of tasks teachers engage in does not differ over the career cycle. Overall, there seems to be a shift in the priority of tasks and a selection occurs. The results indicate that teachers rather spend more of their time for administrative tasks than for activities such as excursions or school projects. There seems to be a trend away from the demands of teaching towards administrative tasks for teachers from the age of 55. Interestingly, they spend more time in meetings with parents which many teachers regard as quite demanding. Also, teachers as knowledge workers have the potential to optimise their time spent on preparation and by doing so they gain time to focus on other activities. Teachers of all ages appreciate cooperation similarly which can be regarded a resource. These results indicate that it is necessary to have a flexible system at each school which allows teachers from the age of 55 to select certain goals, e.g. by giving them more time for administrative tasks.

References

- Baltes, P. B., & Baltes, M. M. (1989). Optimierung durch Selektion und Kompensation: Ein psychologisches Modell erfolgreichen Alterns [Selective optimization with compensation: A psychological model of successful aging]. *Zeitschrift für Pädagogik*, 35(1), 85-105.
- Schaarschmidt, U., & Kieschke, U. (2007). Gerüstet für den Schulalltag. Psychologische Unterstützungsangebote für LehrerInnen und Lehrer. [Prepared for everyday school life. Psychological support for teachers]
- Weinheim: Beltz. Schmitz, E. (2004). Burnout: Befunde, Modelle und Grenzen eines populären Konzepts. In A. Hillert & E. Schmitz (Hrsg.), *Psychosomatische Erkrankungen bei Lehrerinnen und Lehrern Ursachen, Folgen, Lösungen* [Psychosomatic disorders in teachers. Causes, effects, solutions]. (S. 51-68). Stuttgart: Schattauer.

PAPER PRESENTATION

Measuring Procrastination in Fifth and Sixth Grade

Lisa Roese, Bergische Universität Wuppertal - Fachbereich G, Germany

A step towards the developmental perspective on procrastination behavior was explored in the current study by examining the interindividual tendencies of procrastinating behavior among students of fifth and sixth grade. In this study a slightly modified questionnaire by Helmke und Schrader (Aitken Procrastination Scale, Aitken, 1982, German translation by Helmke & Schrader, 2000) with additional items of Tuckman Procrastination Scale-Deutsch (TPS-D by Stßber, 1995) was administered to assess trait procrastinating behavior. $n=84$ participants rated the extent to which they engage in procrastinating behaviors. The test took place at school during a method training week (regarding learning strategies and not on how to prevent procrastination, so no impact on procrastinating behaviors was expected) and after an interval of four months. Procrastination behavior occurred on both occasions with statistically similar means and standard deviations $x_1=48.59$, $SD_1=10.74$ and $x_2=48.48$, $SD_2=10.20$, suggesting stability over a period of four-months ($T(80)=.118$, $p=.90$). The relationship between the whole scale of procrastinating behavior on occasion I and occasion II yielded a correlation of .67. The internal consistency of the whole scale was $\alpha=.76$ for both occasions. The factor analysis of procrastination on occasion I matched well regarding Helmkes & Schraders (2000) suggestion with three main factors, on occasion II the structure was different. Further research is required, especially regarding a larger sample.

Researchers have dealt with studies on procrastination since thirty years, including studies on correlates and the nomological web of procrastination, its consequences and up to designing intervention programs for procrastinators who suffer on their procrastination.

Steel (2007) summarizes the state of the art in his meta-analysis. Not yet examined is, at which age students start to procrastinate and how stable procrastination at this age is. Knowledge concerning the starting point of procrastination is important for developing guidelines on prevention of procrastination and successful intervention programs, e. g. at school.

Aim of this study was to identify procrastination within fifth and sixth graders and investigate its structure and long-term stability. The administered questionnaire consisted of 20 items of German translations of Aitkens Procrastination Inventory by Helmke and Schrader (2000) and of Tuckman Procrastination Scale (Tuckman, 1991; Tuckman Procrastination Scale-Deutsch, Stßber, 1995), using a five-point scale for responses which ranged from never to always. The items were slightly modified to make sure that all students understand each question and to relate the content to the students' school life and studying. To avoid acquiescence nine items had a reversed polarity. The test was administered twice at school with a retest interval of four months. A total of 84 students participated on both occasions.

Descriptives and Cronbachs Alpha were used to decide which items were applicable to measure procrastination in students at this age. T-tests for paired samples and Pearson's correlation coefficients were used to assess stability of items and total scores. Separate factor analyses were made for both occasions to identify the structure of procrastination. Two items were deleted for structural reasons during the analysis.

Procrastination occurred on both occasions with similar means and standard deviations regarding the total scores $1=48.59$, $SD_1=10.74$ and $2=48.48$, $SD_2=10.20$, suggesting an overall stability over a period of four months ($t(80)=.118$, $p=.90$). The item scores were also stable.

The correlation between the total scores on the two occasions was estimated at $r = .67$. Elliot had found a correlation of .77 with a hiatus of 10 years in his study (Elliot, 2002, cited in Steel, 2007).

The correlations between the items on occasion I and II varied between .25 and .58, with an average of .37. Correlations of 4 items of 18 were not significant (Item 3, Item 9, Item 11 and Item 13).

The internal consistency of the total scale was estimated at $\alpha=.76$ for both occasions. Deletion of another item wouldn't have improved the internal consistency any further.

Tuckman Procrastination Scale was regarded to be unidimensional (Tuckman, 1990). Helmke and Schrader (2000) put forth that a three-factor structure is adequate for their instrument, with Delay (e. g. "I postpone my tasks, even when I know they need to be done."), lack of foresight (e. g. "I use breaks in between classes to start doing my homework.")

and punctuality (e. g. "I'm late for class."). Tuckmans items matched the content of the first two factors of Helmke and Schrader (2000) and therefore, we expected a three-factor structure for our questionnaire.

Separate factor analyses for the data on both occasions were not entirely consistent with the suggestion that a three-factor structure is adequate for our instrument. In both our analyses (occasion I and II) we found a method factor with loadings of the items with reversed polarity. Items with reversed polarity to reduce acquiescence have to be carefully used with procrastination questionnaires with students of this age in further studies. With this sample, reversely polarized items influenced the factorial structure of the instrument.

Nevertheless, the instrument appears to be a reliable tool to repeatedly assess trait procrastination among fifth and sixth graders. The factor structure might be different in this sample with younger students, compared to university students. Further research regarding age differences in procrastination and stability is required.

PAPER PRESENTATION

Daily stressors and resources of beginning teachers: Content, appraisal & the role of self-regulation

Uta Klusmann, Christian-Albrechts-Universität Kiel, Germany; Mareike Kunter, Goethe-University, Institute of Psychology, Germany

The relevance of teachers' stress experiences to their health and to student outcomes has been demonstrated in various studies (Melamed et al., 2006; Klusmann et al., 2008). The present article aims to identify which work-related positive and negative events contribute to beginning teachers' stress on a daily basis. Additionally, we investigate whether personal teacher characteristics such as self-regulation skills are associated with the experience and with appraisal of these positive and negative events. The data base consists of daily reports obtained from 376 beginning teachers over 14 days. Results revealed that positive and negative events most often correspond to lessons given, preparation work or interactions with colleagues. Events that were appraised as particularly meaningful related to professional development and interaction with principals and mentors. While teachers' self-regulatory skills were related to the appraisal of the events, content and frequency of daily events were not. The results underline the importance of taking into account the day-to-day perspective, and of expanding research to the person-environment interaction rather than focusing exclusively either on personal or environmental characteristics.

Theoretical background and aims of the Study

Teaching is among the professions most often examined by researchers interested in negative emotional and motivational work-related experiences such as chronic stress and burnout (OECD, 2005; Klusmann et al., 2008; Schaufeli & Enzmann, 1998). Although burnout is conceptualized as a long-term consequence of job stress, previous research has shown that the first classroom experiences can already be particularly stressful (Fives, Hamman, & Olivarez, 2007; Veenman, 1984). In explaining motivational and emotional experience at work, previous research has mostly concentrated on either broad personality characteristics (e.g. self-efficacy or emotional stability) or on general characteristics of the work environment (e.g. work load, experience of support). In our study, we focus on the day-by-day experiences of beginning teachers and aim to identify daily stressors as well as resources for well-being. In so doing, we aim to learn more about the everyday situation of beginning teachers and to go beyond single-measurement assessment of the work environment. Additionally, we used an idiographic-nomothetic approach by applying an open answer format in order to avoid offering a particular set of resources and stressors. Based on Transactional Stress Theory (Lazarus & Folkman, 1984) we assume that particular personal characteristics influence the appraisal of daily stressors as well as resources. Previous research has suggested teachers' self-regulation to be of particular importance for occupational well-being (Klusmann et al., 2008). Based on Conservation of Resources Theory (Hobfoll, 1989), the optimal balance between work engagement and distancing oneself from one's work (resilience) is the most adaptive self-regulatory style in the work context (Hobfoll & Shirom, 2001). We thus address the following two research questions: (1) Which daily stressors do beginning teachers experience and what are their resources to cope with them? a. What is the nature of daily positive and negative events and how frequently do they occur? b. Does appraisal of positive and negative events depend on the particular nature of the reported event? (2) What role do teachers' self-regulation skills play in the experience of daily stressors and resources? a. Do teachers experience different stressors and use different resources depending on their self-regulatory patterns? b. Does teachers' appraisal of the stressors and resources differ depending on their self-regulation?

Method

Procedure

The present study is part of a larger project investigating the development of student teachers' professional competence in Germany. Participants in the main study were invited to take part in a 14-day online-diary study on their emotional and motivational experience. The sample consists of 376 student teachers in the first and

second year of the compulsory induction programme that follows the first, university-based, phase of teacher training in Germany (52% female, mean age = 27 years, SD = 4.2). On average, 291 student teachers completed an online questionnaire each day. Measures In a prequestionnaire Self-regulation was measured by the scales Engagement and Resilience from the Occupational Stress and Coping Inventory (AVEM; Schaarschmidt et al., 1999). Work engagement reflects the willingness to invest energy and time and resilience reflects the ability to distance oneself from work and to cope with failure. Latent profile analyses of the engagement and resilience subscales were used to identify the different self-regulatory patterns (Klusmann et al., 2008). In the diary phase participants were asked to name the positive and negative events occurring during the day. Afterwards, each event was appraised in terms of personal importance on a 4-point scale. The open answers were coded into 23 categories by two trained raters and further summarized into 8 categories for the present analysis.

Results

The participants reported a total of 10,512 work-related events. Of these, 4,261 were negative, 6,251 positive. The most frequent occurrence of positive events was "Within Lesson" (26%; e.g. "managed to handle the difficult eighth grader"), "Preparing Lesson" (17%; e.g. "good idea for my next maths lesson") and "Interaction with colleagues" (17%; e.g. "laughing with colleagues during break"). The most frequently reported negative events were related to "Within Lesson" (32%, e.g. "many interruptions during German class") and "Preparing Lesson" (30%, e.g. "did not finish my preparation"). However, not all events were appraised as equally important: Most important among the positive events was 'professional development in school' (e.g., "interesting lesson of my mentor observed", $M = 3.61$, $SD = .66$), 'Interaction with principals and mentors' (e.g. "positive feedback of my mentor", $M = 3.32$, $SD = .74$) and 'within Lessons' ($M = 3.12$, $SD = .70$). Out of the negative events the subjective meaning was highest among events in the same content categories: 'professional development in school' ($M = 3.27$, $SD = .69$), 'Interaction with principals and mentors' ($M = 3.54$, $SD = .58$) and 'within Lessons' ($M = 3.52$, $SD = .58$). Secondly, teachers' self-regulation was neither related to the overall frequency of positive and negative events nor to a particular content area. But teachers' self-regulation was related to the appraisal of the positive and negative events. On average beginning teachers with adaptive self-regulation, i.e., with high engagement and high resilience, rated positive events more important and negative events less negative than teachers who showed low resilience.

Discussion and Implications

The major aim of the present study is to gain deeper insights into student teachers' daily experience by going beyond single-measurement assessments of situational and personality characteristics. The results indicate, first of all, that the most frequent positive and negative events are not automatically the most important. Secondly, one and the same content area, e.g. preparation of lessons, can be stressful as well as uplifting. Thirdly, personal characteristics like teachers' self-regulation are relevant for the appraisal of everyday situations. The study has several implications for research and practice. Whereas most studies to date have focused either on personal or situational factors in the stress process, we considered the interplay between these factors. In practice, awareness of beginning teachers' typical daily stressors and resources can help to improve pre-service and in-service training and provide mentors and principals with valuable insights. References see appendix for references

PAPER PRESENTATION

Assessing Enterprise Capability in Secondary Schools

Peter Davies, University of Birmingham, United Kingdom; Amanda Hughes, Staffordshire University, United Kingdom

Three strands of enterprise capability have been identified in the literature: aspiration to run a (for-profit or not-for-profit) enterprise (e.g. Kourilsky and Walsatd 2007), self-efficacy towards enterprise (e.g. Shapero 1975, Zhao et al., 2005) and understanding factors likely to affect the success of an enterprise (e.g. Kourilsky and Walstad 2007). Previous research assessing students' enterprise capability have addressed one or two but not all three of these dimensions. This study presents a new tool for assessing enterprise capability in secondary schools which includes all three dimensions. Some key findings are (i) four subscales within enterprise self-efficacy: project planning; working with people and information; risk evaluation and management; pricing and profit; (ii) findings of previous research on the distinctiveness of (and gender differences in) aspirations towards for-profit and not-for profit organisations is supported; (iii) aspiration to running for-profit and not-for-profit organisations is significantly associated (through multivariate regression) with higher enterprise self-efficacy but only weakly associated with whether either parent owns their own business; (iv) the items measuring enterprise understanding displayed reasonable levels of discrimination except for those referring to sunk costs which higher scoring students believed were as relevant to decision-making as lower scoring students; (v) no statistically significant association was found between the measurement of 'enterprise' understanding and aspiration to run an organisation; (vi) There was a weak negative association ($p = .066$) between self-efficacy towards enterprise and the measure of enterprise self-efficacy.

Aims 1. To develop a new tool for assessing enterprise capability in secondary schools which includes dimensions for self-efficacy, aspirations, knowledge and awareness. 2. To investigate subscales within these dimensions and relationships between dimensions.

Methodology

Three strands of enterprise capability have been identified in the literature: aspiration to run a (for-profit or not-for-profit) enterprise (e.g. Kourilsky and Walsatd 2007), self-efficacy towards enterprise (e.g. Shapero 1975, Zhao et al., 2005) and understanding factors likely to affect the success of an enterprise (e.g. Kourilsky and Walstad 2007). This paper presents results from the development of an exploratory instrument which is sufficiently short to be practicable for schools to use to assess each of these three strands of enterprise capability. Previous self-efficacy scales in relation to enterprise (e.g. Zhao et al. 2005) have been developed for use with graduates, notably those enrolled on MBA programmes and have used a definition of enterprise which is restricted to 'for-profits'. Whilst drawing on this literature we have developed a new set of items more suited to school age students and embracing self-efficacy towards not-for profit activities. Our items on aspirations follow Kourilsky and Walstad (2007) include items on for-profits and not-for profits and this differentiated is supported by exploratory factor analysis (Maximum Likelihood with oblique rotation). Our items to assess understanding take the form of posing an enterprise problem and asking students whether each of a series of items would provide information relevant to deciding about this problem. We developed the instrument using a sample of 436 15-16 year old students in three schools. Some changes were made to the instrument on the basis of results from each of these schools. This paper focuses on the items common to the whole sample and the understanding items which were introduced only for schools two and three (n=340).

Findings

Some key findings are (i) The data suggest four subscales within enterprise self-efficacy: project planning; working with people and information; risk evaluation and management; pricing and profit; (ii) findings of previous research on the distinctiveness of (and gender differences in) aspirations towards for-profit and not-for profit organisations is supported; (iii) aspiration to running for-profit and not-for-profit organisations is significantly associated (through multivariate regression) with higher enterprise self-efficacy but only weakly associated with whether either parent owns their own business; (iv) the items measuring enterprise understanding displayed reasonable levels of discrimination except for those referring to sunk costs which higher scoring students believed were as relevant to decision-making as lower scoring students; (v) no statistically significant association was found between the measurement of 'enterprise' understanding and aspiration to run an organisation; (vi) There was a weak negative association ($p=.066$) between self-efficacy towards enterprise and the measure of enterprise self-efficacy.

Theoretical and educational significance

Policy interest in enterprise education (e.g. Davies 2002, European Commission 2004) derives from expectations about its impact on the number of future, successful, for-profit businesses and not-for-profit social enterprises. Whilst, the formation and contribution of small businesses has been the traditional policy concern, the role of social enterprises has been rising in prominence, notably in the light of initiatives such as the 'Big Society' idea promoted by the Coalition Government in England (Cabinet Office 2010). However, school-based initiatives in Europe to improve enterprise capability generally take place without any measurement of effects on students. The data from this study indicate that this instrument has properties which make it a useful tool for measuring students' enterprise capability. The identification of subscales also indicates areas of knowledge and awareness as well as self-efficacy and aspiration which are appropriate to address in enterprise curricula in schools.

References

- Bandura, A., Barbaranelli, C., Caprara, G.V. and Pastorelli, C. (2001). Self-efficacy beliefs as shapers of Children's Aspirations and Career Trajectories, *Child Development*, 72, 1, pp. 187-206.
- Cabinet Office (2010). Building the Big Society. London. The Cabinet Office. Available online at <http://www.cabinetoffice.gov.uk/media/407789/building-big-society.pdf>
- Davies, H. (2002). Enterprise and the Economy in Education. London: Her Majesty's Stationary Office.
- European Commission (2004). Action Plan: The European agenda for Entrepreneurship. Brussels. Commission of the European Communities. Available online at ftp://ftp.cordis.europa.eu/pub/incubators/docs/action_plan_on_entrepreneurship.pdf.
- Kourilsky, M. L. And Walstad, W.B. (2007). The Entrepreneur in Youth. Chaltenham, Edward Elgar.
- Lyons, E. And Breakwell, G.M. (1993) Self-concept, enterprise and educational attainment in late adolescence, *Journal of Education and Work*, 6, 3, pp. 75-84.
- Shapero, A. (1975). The displaced, uncomfortable entrepreneur. *Psychology Today*, November 9, 83-88.
- Zhao, H., Seibert, S. E. And Hills. G.E. (2005). The Mediating Role of Self-Efficacy in the Development of Entrepreneurial Intentions. *Journal of Applied Psychology*, 90, 6, pp. 1265-1272.

PAPER PRESENTATION

Big fish in a little pond aspire less: Cross cultural generalizability and mediation

Benjamin Nagengast, University of Oxford, United Kingdom; Herb Marsh, University of Oxford, United Kingdom

Being schooled with other high-achieving peers has a detrimental influence on student's self-perceptions: School-average and class-average achievement has been consistently shown to have a negative effect on academic self-concept and career aspirations, the Big-Fish-Little-Pond-Effect. Individual achievement, on the other hand, predicts academic self-concept and career aspirations positively. Research from western and developed countries implies that the negative contextual effect on career aspirations is mediated by academic self-concept. Using data from PISA 2006 (397,500 15-year-old students from 57 countries), we test the generalizability of this mediation model in science using a general multilevel structural equation modeling framework. Individual achievement was positively related to academic self-concept and career aspirations in almost all countries. The positive effect on career aspirations was mediated by self-concept in 54 countries. The negative effects of school-average achievement on self-concept and career aspirations were evident in the large majority of the countries in our sample. After controlling for self-concept at the school-level, the direct effects were substantively reduced in most of the countries – evidence for total and partial mediation of the contextual effect of school-average achievement on career intentions.

Aims

Academic self-concept, the perception of one's own academic performance, is a desirable academic outcome and an important predictor for future academic achievement and engagement. While individual achievement is positively related to academic self-concept, school-average achievement is negatively related to academic self-concept: Being schooled with higher-ability peers substantially reduces academic self-concept, all other things being equal, the Big-Fish-Little-Pond-Effect (BFLPE, see Marsh, Seaton et al., 2008). Similarly, negative contextual effects of school-average achievement have been found on the intentions and aspirations of pursuing further education or careers in a subject area (Alwin & Otto, 1977). Academic self-concept has been shown to mediate this relationship (Marsh, 1991): The negative effect of achievement on career aspirations disappears when self-concept is controlled for. While the BFLPE for academic self-concept is known to generalize to a wide range of countries and cultures (e.g., Seaton et al., 2009), less is known about the generalizability of the negative contextual effect of achievement on career aspirations and the mediation of this effect by academic self-concept. The present study fills this gap by focusing on achievement, academic self-concept and career aspirations in science, a subject with important policy implications for developed and developing countries.

Methodology

The BFLPE, the negative contextual effect of school-average achievement on academic self-concept and career aspirations, is tested with data from the Program for International Student Assessment (PISA) 2006. The subject focus is on achievement and motivation in science. The study uses nationally representative samples of a total of 397,500 15-year-old-students from 57 countries that vary in their cultural orientation and developmental status. Tests of the Big-Fish-Little-Pond Effect are implemented with doubly-latent multilevel structural equation models (Marsh et al., 2009). The mediation effect of academic self-concept on the relations between achievement and career aspirations at the individual and school-level is implemented within the general multilevel mediation framework introduced by Preacher et al. (2010). This framework allows the separation of direct, indirect and total effects of achievement on career aspirations on the student- and school-level. The main hypotheses are tested in the total sample and in multigroup analyses in each of the countries separately. The country-specific effects obtained in these analyses are related to country-level predictors (cultural orientations and economic development level).

Findings

Total sample: As expected, individual achievement was positively related to both academic self-concept and career aspirations in science. In line with previous research on the Big-Fish-Little-Pond-Effect, there were significant negative contextual effects of school-average achievement on both variables. The multilevel mediation analysis (see Figure 1) showed that the effect of individual achievement on career aspirations was completely mediated by academic self-concept. The negative contextual effect of school-average achievement on career aspirations was partially mediated by academic self-concept.

Multigroup analysis: These findings generalized well over the 57 countries: The effects of individual achievement were positive and statistically significant in 51 (academic self-concept) and 43 countries (career intentions) respectively. Both effects were correlated with economic development and individualistic cultural orientation at the country-level. The contextual effects of school-average achievement were negative and significantly different from zero in 51 (academic self-concept) and 34 countries (career intentions) respectively. Only the contextual effect on academic self-

concept was negatively related to both country-level individualism and economic development. Generalizing the mediation effects found in the total sample, there were significant indirect effects of achievement (i.e. mediated by academic self-concept) on career intentions at the individual level (54 countries) and the contextual level (37 countries). Furthermore, there was evidence that the total effects of achievement on career intentions were only partially mediated by academic self-concept in some countries: The direct effect of individual achievement after controlling for academic self-concept remained positive and statistically significant in 24 countries. Similarly, the contextual direct effect remained negative and statistically significant in 16 countries.

Theoretical and educational significance

Our results demonstrate the negative effects of school-average achievement on self-concept and career aspirations in science in the largest and most comprehensive set of countries to date. More importantly, they show that the negative effect on career aspirations is partly mediated by academic self-concept. These effects generalize across a wide-range of countries with diverse cultural and developmental backgrounds attesting their universal nature. These findings run counter to the prevailing practice in many educational systems that stream or track students into classes or selective schools based on their abilities. While the presumed beneficial effects on achievement are modest at best (e.g., Hattie, 2002), academic self-concept suffers compared to comprehensive schooling and the intentions to pursue science-related careers are markedly reduced. As there is a growing shortage of students pursuing science-related subjects in higher education in many industrialized countries (OECD, 2007) and this trend has been much lamented for its economical and societal consequences, our results point to the potential of increasing students' self-concepts for solving this crisis.

References

- Alwin, D.F., & Otto, L.B. (1977). High school context effects on aspirations. *Sociology of Education*, 50, 259-273.
- Hattie, J.A.C. (2002). Classroom composition and peer effects. *International Journal of Educational Research*, 37, 449–481.
- Marsh, H. W. (1991). Failure of high-ability high schools to deliver academic benefits commensurate with their students' ability levels. *American Educational Research Journal*, 28, 445–480.
- Marsh, H.W., Lüdtke, O., Robitzsch, A., Trautwein, U., Asparouhov, T., Muthéén, B.O., & Nagengast, B. (2009). Doubly-latent models of school contextual effects: Integrating multilevel and structural equation approaches to control measurement and sampling error. *Multivariate Behavioral Research*, 44, 764–802.
- Marsh, H. W., Seaton, M., Trautwein, U., Lüdtke, O., Hau, K. T., O'Mara, A. J., & Craven, R. G. (2008). The big-fish-little-pond effect stands up to critical scrutiny: Implications for theory, methodology, and future research. *Educational Psychology Review*, 3, 319–350.
- OECD (2007). PISA 2006 science competencies for tomorrow's world. Paris: Author.
- Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods*, 15, 209-233.
- Seaton, M., Marsh, H. W., & Craven, R. G. (2009). Earning its place as a pan-human theory: Universality of the big-fish-little-pond effect across 41 culturally diverse countries. *Journal of Educational Psychology*, 101, 403-419.

PAPER PRESENTATION

Development of Academic Self-Concept and Mathematics in Adolescence

Johan Korhonen, Abo Akademi University, Finland; Karin Linnanmäki, Abo Akademi University, Finland;
Pirjo Aunio, Niilo Mäki Institute & University of Helsinki, Finland

This paper reports a longitudinal study on students' mathematical skills and academic self-concept in the end of compulsory school and secondary education. The preliminary analysis was done with data from grade 9 and the main analysis will include data from secondary education (Autumn 2010). Students' mathematical skills and academic self-concept were highly related at time point 1. Students aiming for the more academic track (upper secondary) have higher academic self-concept, higher mathematical skills, and higher parental education level. There are no gender differences in mathematical skills and academic self-concept. The preliminary results show the importance to follow these students in their transition to secondary education to find out if these groups also differ in terms of development in academic self concept and mathematics skills.

Introduction

Mathematics is an important skill in everyday life. Students' mathematics achievement and positive academic self-concept are quality indicators of work-force preparation in the global marketplace (Evans, 2005). Students' self-perceptions of their competence or ability are at the core of several psychological theories aimed at explain learning gains and achievement-related choices. Academic self-concept is defined as mental representations of one's abilities in academic domains (Marsh & Craven, 1997). Academic self-concept has been found to be highly related to

achievement, even after controlling for prior achievement (Eccles, Wigfield, Harold, & Blumfeld, 1993; Trautwein, Ludtke, Köller, & Baumert, 2006). The relationship is problematic when trying to establish which skill affects the other. Marsh, Hau and Kong (2002) argue that academic self-concept and academic achievement are reciprocally related and mutually reinforcing: improved academic self-concept will lead to greater achievement, and greater achievement will lead to improved academic self-concept. The reciprocal model needs to be reconfirmed in other cultural settings because the main support for the model has been largely based on responses from students from English-speaking countries like Australia, Canada and the United States (Marsh et al., 2002). The development of mathematic skills and mathematical learning difficulties in adolescent has gotten far less attention than variation in mathematical development in younger children (Aubrey & Godfrey, 2003; Aunola, Leskinen, Lerkkanen & Nurmi, 2004; DeSmedt, Janssen, Browens, Verschaffel, Boets & Ghesquiöre, 2009; Fayol, Barrouillet & Marinthe, 1998; Passolunghi, Mammarella & Altođ, 2008). Taipale (2009) shows that there are significant differences in mathematical skills between the two different educational tracks (secondary education) in the Finnish school system. Students attending the more academic track, upper secondary school, outperform their peers who attend vocational education.

Aims

The main aim of this study is to examine the relationship between academic self-concept and mathematical skills and how these develop from compulsory school to secondary education. The intentions of the study are twofold, firstly it offers a chance to enhance the generalisability of the Marsh et al. model and give valuable information about mathematical development in adolescent students. Secondly, on national level there is a need of specific information about how our dual secondary education system affects Swedish speaking students' mathematical development and the development of their academic self-concept.

Methodology

Participants. In present study the sample from the first data collection (2008) consists of 980 students (boys N=476 and girls N=501) from 14 different compulsory schools in Swedish speaking areas in Finland. All students were measured at the end of ninth grade (mean age 15,8 years, SD 4.94). The second data collection will take place in autumn 2010 when the students are attending either vocational or upper secondary education.

Methods of data collection. Mathematical skills of students were assessed with the KTLT-test (Räsänen & Leino, 2005), which is a standardized test for grades 7-9 (13-16 years). The test identifies students with difficulties in basic mathematics and difficulties in applying these abilities in a context. A low score in the test indicate low achievement in mathematics. The test consists of 40 tasks. The tasks are not placed in difficulty order, although the more difficult tasks tend to be in the end of the test. The test is a paper and pencil test and the students have 40 minutes to do the test. The reliability estimate of the mathematical achievement test at time point 1 was 0.89. Academic self-concept was measured with items from the Perceived Competence Scale for Children (Harter, 1982), loading on the academic self-concept subscale (8 items). The test was translated to Swedish by multilingual research team. The reliability estimate for the academic self-concept subscale at time point 1 was 0.84. Information about the students' family background was and will be collected on both measurement times and school type (vocational or upper secondary) will be confirmed at the time of second data collection.

Procedure. The present study is part of a longitudinal study following the students over a period of four years. The study started with permission to test students from 14 different schools in Swedish speaking areas in Finland. A pilot study was first conducted to ensure the quality of measurements. The main data collections are done by trained research assistants. The mathematics test was done with group of students in their regular mathematics lesson. The academic self concept scale was done in similar way with group of students during a regular lesson.

Findings

The preliminary results with the data from the first measurement show that academic self-concept and mathematical skills are related ($r = .44$, $p = .12$, $p = .17$, $t(812) = -12.819$, $p = .84$), higher mathematical skills ($t(828) = -12.999$, $p = .84$), and higher parental education level ($t(688) = -5.812$, $p = .45$). There are no gender differences in mathematical skills ($t(828) = 1.338$, $p = .181$, $d = .09$) and academic self-concept ($t(812) = -.444$, $p = .657$, $d = .03$). In Earli 2011 we will present results based on longitudinal data with two measurements point by using Latent growth curve analysis with parallel processes and time-invariant (parental education, gender) and time-varying (type of secondary education) covariates.

Theoretical and Educational Significance

In comparison to existent research literature this study examines the development of mathematical skills in adolescent that has not got that much attention. Furthermore, the reciprocal model of academic self-concept and academic achievement has not been verified in a Nordic setting before. The literature offers two competing theories

of self-concept development in male and female (for a review see Nagy et al., 2010) and this study will give valuable information about these issues. The preliminary results indicate that students aiming for upper secondary education have higher levels of mathematical skills and academic self-concept. It is important to follow these students in their transition to secondary education to find out if these groups also differ in terms of development in these two domains. In the Finnish school system emphasis lies on the training of basic skills and little effort is set on enhancing students' academic self-concept. This study can provide evidence for the benefits of focusing on both domains in Finnish compulsory and secondary education.

PAPER PRESENTATION

The Reciprocal I/E Model: An Integration of Relations Between Academic Achievement and Self-concept

Jens Moller, University of Kiel, Germany; Jan Retelsdorf, IPN - Leibniz Institute for Science and Mathematics Education, Germany; Herb Marsh, University of Oxford, United Kingdom; Olaf Koller, IPN, Germany

This paper proposes the integration of two of the major models of relations between academic self-concept (ASC) and achievement— the reciprocal effects model (REM) and the Internal/External frame of reference model (I/EM) and— and tests the resultant reciprocal I/E model (RI/EM). The model predicts (a) positive effects of mathematics and verbal achievement and ASCs on subsequent mathematics and verbal achievements and ASCs within the same domain and (b) negative effects of mathematics and verbal achievements and ASCs on subsequent achievements and ASCs across domains. Drawing on a representative sample of $N = 1508$ students, the authors investigated the development of mathematics and verbal grades and ASCs from grade 5 to grade 8 (using three waves of data collection). Structural equation modeling supported the validity of the RI/E model, revealing positive longitudinal effects of prior achievements and ASCs on subsequent achievements and ASCs within domains and negative longitudinal effects of prior achievements on subsequent ASCs across domains. There were also small negative effects of prior ASCs on subsequent achievements across domains. The results are interpreted as indicating a strong domain specificity of academic achievements.

In this paper, we propose and test a comprehensive model that integrates two of the major theoretical models in the field: the reciprocal effects model (REM) and the Internal/External frame of reference model (I/EM; Marsh, 1986).

The Reciprocal Effects Model

The REM proposes: (a) strong positive paths from prior measures of achievement and ASC to subsequent measures of the same construct, (b) positive paths from prior ASC to subsequent achievements, and (c) positive paths from prior achievements to subsequent ASC. Most REM studies have provided empirical support both the effects of prior achievement on subsequent ASC and the effects of prior ASC on subsequent achievement in diverse subjects. However, the REM is restricted to longitudinal relations between ASC and achievements within domains. Here, we extend the REM to incorporate more than one domain.

The Internal/External Frame Of Reference Model (I/EM)

Empirical research has shown that mathematics self-concepts (MSCs) and verbal self-concepts VSCs are nearly uncorrelated, whereas mathematics achievement (Mach) and verbal achievement (VAch) are substantially correlated. Marsh proposed the I/EM to account for this unexpected pattern of relations. The I/EM proposes (d) high positive correlations between mathematics and verbal achievements; (e) small or near-zero correlations between MSCs and VSCs; (f) strong positive paths from achievements to corresponding ASCs; (g) weak negative paths from achievements to contrasting ASCs.

The Present Investigation: Integration of the I/EM and REM: The Reciprocal I/E Model

Testing the complete RI/EM requires longitudinal data sets with repeated measures of ASCs and achievements in more than one domain. Based on the RI/EM, we formulated the following additional predictions for the combination of both domains across all three waves of data (h) support for the REM generalizes over the mathematics and verbal domain when both domains are considered in the same model; (i) support for the I/EM generalizes over time when longitudinal data are considered; (j) weak negative effects of ASCs on contrasting achievements (controlling for prior achievement and ASCs).

Method

Sample

The initial sample comprised $N = 1508$ grade 5 students (49% girls; age at T1: $M = 10.88$ years, $SD = 0.56$) from 60 schools who were representative of the federal state of Schleswig-Holstein, Germany.

Measures

School Grades. We obtained students' grades on their last report card in grades 5 (T1), 6 (T3), and 8 (T5) for German as (first language) and mathematics.

Self-Concept. We defined domain-specific self-concepts as the general belief of doing well or poorly in the corresponding domain (e.g.: ?In math, I do quite well?). Reliabilities (Cronbach's α) of the domain-specific self-concepts were good (German: T2: .85; T4: .88; T6: .90; mathematics T2: .90; T4: .90; T6: .91).

Analytical Issues

Missing Data. We used the STATA routine ICE to create $m = 5$ complete data sets. All information available (SES, cognitive abilities, etc.) was used to improve the imputation model. Subsequent analyses were then conducted five times and the results were combined.

Structural Equation Modeling (SEM). We estimated structural equation models (SEM). All self-concept constructs were specified as latent variables. School grades, however, were measured with a single indicator and included as manifest variables in all models.

As our sample consisted of students nested in classes, we corrected standard errors (Mplus option: type = complex) to account for this fact in all of our analyses.

Results and Discussion

Reciprocal Effects Model (REM)

Our analyses of the links between mathematics achievement and MSC supported the REM, $\chi^2(37) = 337.90$; CFI = .969; TLI = .944; RMSEA = .073; SRMR = .037 for math as well as for the verbal domain, $\chi^2(37) = 360.25$; CFI = .963; TLI = .934; RMSEA = .076; SRMR = .035. Hypothesis (a-c) were supported.

The Internal/External Frame Of Reference Model (IEM)

As predicted, the two horizontal paths (mathematics achievement to MSC; verbal achievement to VSC) were consistently substantial and positive, whereas the two cross paths (verbal achievement to MSC; mathematics achievement to VSC) were consistently negative. Together with the positive correlations between the two achievements and the weak correlations between the two self-concepts, these results support hypotheses d-f.

The Reciprocal I/E Model (RI/EM)

The goodness of fit indices were satisfactory for the full model based on the total sample—mathematics and verbal constructs over all waves of data collection, $\chi^2(182) = 1142.84$; CFI = .954; TLI = .931; RMSEA = .059; SRMR = .039. The new prediction formulated on the basis of the RI/E model was that the cross-domain effects of prior ASCs on subsequent achievements would be weakly negative. For example, the effects of T2 VSC on T3 MAch (-.06) and the effects of T2 MSC on T3 VAch (-.08) were both negative, but both effects were marginally nonsignificant (.10 p p

In summary, there is some support for the prediction that prior ASCs would have small negative effects on achievements in the noncorresponding domain (prediction j). Although the support for the prediction of negative effects is not strong, there is no evidence that the effects are positive.

PAPER PRESENTATION

Predicting Expert Ratings of Essays Quality: A Coh-Metrix Analysis

Scott Crossley, Georgia State University, United States; Danielle McNamara, University of Memphis, United States

This paper reports on a series of studies in which human judgments of essay quality are assessed using Coh-Metrix. The goal of these studies is to better understand the relationship between linguistic features of essays and human judgments of writing quality in terms of linguistic features of text related to coreference, connectives, syntactic complexity, lexical diversity, spatiality, temporality, and lexical characteristics. These studies have analyzed essays written by both first language and second language writers. The results support the notion that human judgments of essay quality are best predicted by linguistic indices that correlate with measures of language sophistication such as lexical diversity, word frequency, and syntactic complexity. In contrast, human judgments of essay quality are not strongly predicted by linguistic indices related to cohesion. Overall, the studies portray high quality writing as containing more complex language that may not facilitate text comprehension.

AIMS

The quality of a writing sample rests in the judgments made by an expert rater. In most cases, trained raters assess writing quality and the value they assign to that writing can have important consequences to the writer. Such consequences are especially evident in the values attributed to writing samples used in student evaluations (i.e., class assignments) and high stakes testing.

Our goal in this paper is to better understand how the linguistic features present in writing samples help explain human judgments of text quality for both first language (L1) and second language (L2) writers of English. We focus on the interrelations between holistic essay scores and the incidence of linguistic features as reported by the computational tool Coh-Metrix (Graesser, McNamara, Louwerse, & Cai, 2004). Understanding the linguistic features that underlie text quality can assist in understanding the linguistic processes involved in essay rating as well as help improve the type of feedback that writers.

METHODOLOGY

We report on a variety of studies in this paper that examine how linguistic features in text predict judgments made by expert raters. In all cases, trained, expert raters evaluated essays using holistic scoring rubrics. Comparisons between the human ratings and the linguistic indices reported by Coh-Metrix examined relationships between the textual features of the essays and the quality scores assigned to the essays. A variety of statistical analyses were conducted including multiple regressions to predict holistic essay quality scores and discriminant function analyses (DFA) to classify high and low proficiency essays.

FINDINGS

Human judgments of essay quality (native speakers of English)

McNamara, Crossley, and McCarthy (2010) investigated the potential for Coh-Metrix features to explain human judgments of essay quality for 120 untimed argumentative essays. Statistical analyses demonstrated that three linguistic indices, the number of words before the main verb, the measure of textual lexical diversity (MTLD), and CELEX logarithm frequency including all words, were predictive of essay quality. A DFA using these variables correctly classified 52 of 80 essays in a training set ($df=1$, $n = 80$) $\chi^2 = 7.16$, p $df = 1$, $n = 40$) $\chi^2 = 6.20$, p $F(1, 118) = 15.85$, p $r = .47$, $r^2 = .22$, adjusted $r^2 = .20$. Higher scored essays were characterized by greater linguistic sophistication (i.e., more sophisticated lexical features and more complex syntax).

Human judgments of essay quality (non-native speakers of English)

Crossley and McNamara (in press) examined the predictive ability of Coh-Metrix to estimate essay quality in a corpus of 514 scored argumentative essays written in English by native speakers of Cantonese under timed conditions. A linear regression analysis using selected Coh-Metrix variables and 344 essays in a test set yielded a significant model, $F(5, 338) = 28.278$, p $r = .543$, $r^2 = .295$. Five variables were significant predictors in the regression: D (lexical diversity), word familiarity, CELEX content word frequency, word meaningfulness, and aspect repetition. The model for the test set ($n = 170$) yielded $r = .454$, $r^2 = .206$. The model for the entire data set yielded $r = .509$, $r^2 = .259$. Similar to McNamara et al. (2010), higher writing quality was a function of increased linguistic sophistication in the text and also decreased cohesion.

Writing development as a function of grade level (first language writers)

Crossley, McNamara, Weston, and McLain-Sullivan (under review) investigated the strength of Coh-Metrix indices distinguish differences in human judgments of essay quality as a function of grade level (9th grade, 11th grade, and college freshmen essays). Untimed, argumentative essays were collected from 202 students. An ANOVA showed significant differences in human assessments of essay quality between the three levels of writers, $F(2, 201) = 80.056$, p $2 = .446$. Essays written by 9th grade students received the lowest score ($M = 1.653$; $SD = 0.766$) followed by 11th grade essays ($M = 2.979$; $SD = 1.133$) and essays written by college freshmen ($M = 3.757$, $SD = 0.924$). Nine Coh-Metrix indices (number of paragraphs, word concreteness, CELEX word frequency for all words, incidence of positive logical connectives, D (lexical diversity) average number of modifiers per noun phrase (syntactic complexity), content word overlap, and average word polysemy) were used as variables in a DFA to classify the essays based on grade level. The DFA correctly allocated 95 of the 135 essays in a training set ($df=4$, $n=135$) $\chi^2 = 95.325$, p $n=67$) $\chi^2 = 58.104$, p

THEORETICAL AND EDUCATIONAL SIGNIFICANCE

The results from these studies indicate that human judgments of text quality are best predicted by linguistic indices that correlate with measures of language sophistication such as lexical diversity, word frequency, and syntactic complexity. By contrast, human judgments of text quality are not strongly predicted by linguistic indices related to cohesion or models of text comprehension. Broadly speaking, the studies reported in this paper portray high quality writing as containing more complex language that may not facilitate reading rate or text comprehension.

Overall, we find that the use of the text evaluation tool Coh-Metrix can help us better understand the interplay between linguistic features and human judgments of essay quality. Understanding how linguistic features in an essay may influence human judgments of quality may lead to better models of writing development and help promote

writing competency in developing writers. The use of automatic text assessment tools to predict essay quality may also prove useful in providing automatic feedback to classroom students and users of intelligent tutoring systems.

References

- Crossley, S. A., & McNamara, D. S. (in press). Predicting second language writing proficiency: The role of cohesion, readability, and lexical difficulty. *Journal of Research in Reading*.
- Crossley, S. A., McNamara, D. S., Weston, J., & McLain-Sullivan, S. (under review). The development of writing proficiency as a function of grade level: A linguistic analysis.
- Graesser, A. C., McNamara, D. S., Louwerse, M., & Cai, Z. (2004). Coh-Metrix: Analysis of text on cohesion and language. *Behavior Research Methods, Instruments, & Computers*, 36, 193-202.
- McNamara, D. S., Crossley, S. A., & McCarthy, P. M. (2010). Linguistic features of writing quality. *Written Communication*, 27, 57-86.

PAPER PRESENTATION

Improving L2 Writing Quality – A series of Two Intervention Studies

Phuong Nam Nguyen, UvA, Netherlands; Wilfried Admiraal, University of Amsterdam, Netherlands; Gert Rijlaarsdam, University of Amsterdam, Netherlands

Vietnamese EFL higher education faces challenges as a result of conflicting cultures reflected in different writing genres and pedagogies. For instance in L1 (Vietnamese) writing, the genre of argumentative writing does not even exist. L1 learners write on a literature theme to prove their understanding and development of moral and community values. Writers' own voice is not asked for. Content for L1 essay writing is prepared in pre-writing classroom activities as an agreement between teachers and learners. This implies that activities like free writing advocated in ESL methodology do not fit the learners: they experience free writing as unproductive.

We set up two intervention experiments (pretest-posttest control design with switching replications) with 66 EFL intermediate students.

The first intervention, model analysis, was based on text pattern knowledge and its efficacy in probing ideas and structuring text organization (Reynolds & Perin, 2009). We observed a positive effect on the perceived value of idea generation in free-writing: after the intervention, students used more of the generated ideas in their final text.

The second experiment was to test the efficacy of collaborative writing and free-writing in students' enriching arguments and voice. An effect of collaborative writing was observed on various aspects of argumentation, however, this effect was at the cost of the quality of voice. In free writing, students displayed a tendency to increase their own voice, however with a lower quality of argumentation, less counterarguments, multi-faceted arguments, and lower text organization cohesion compared to the small-group discussion condition.

Objective and background

Two main challenges in L2 argumentative writing in Vietnam are 1) the genre with specific requirements for an own stance in an issue at stake, voice, and a particular structure of text does not even exist in L1 Vietnamese writing 2) L1 and L2 writing pedagogy gap does exist. L1 writing focuses on literary themes for moral development and does not require a strict essay writing organization with a tree structure, topic sentences and then supporting sentences cohesively connected and developing the topic sentence. Additionally, L1 writing content is fully prepared in advance as a negotiation between teachers and learners and does not require learners' own voice/or own ideas. Learning activities designed in L2 writing course books like free writing does not show to be effective because students expect something to be productive for their end writing product.

Interventions

The first intervention, model analysis, was based on text pattern knowledge and its efficacy in probing ideas and structuring text organization (Reynolds & Perin, 2009). Students examined an argumentative text for how ideas were organized in a hierarchy/tree structure with topic sentences and supporting sentences, how the stance of the author was stated, and how those features related to intention of the author. In the control group, students were instructed about organizational structure, cohesion and unity of an academic essay following the guidances from the coursebook of their writing class, without analyzing a sample.

The second intervention, collaborative writing, was based on research on small-group discussion in promoting creativity (Mouchiroud & Bernoussi, 2008). Students worked in small groups discussing pro and con arguments, level of importance and relevance of the arguments, planning the organization of the target text. In the control group students looked at the picture depicting the issue as a prompt for them to do free-writing. They selected information

from the free-writing version that they found relevant, important, took a position on the issue and arranged the ideas in a text organization scheme

Research design

Both experiments were carried out in eight weeks (six meetings per week of 2.30 hrs each) in Tra Vinh University, Mekong Vietnam. Subjects (66 students of EFL intermediate level, aged 22-27) were randomly divided into two groups. Both interventions were evaluated using a pretest-posttest control group design with switching replications (Shadish, Cook, & Campbell, 2002).

In experiment 1, both groups received the experimental treatment, but on different moments of time. One group got the intervention (model analysis), and then did free writing on the topic and built a text content structure for themselves using the ideas they highlighted as worthwhile in their free writing. The other group did the free-writing activity without the experimental treatment and served as control group. Then both groups swapped: the second group got the experimental intervention, while the first group did not. Texts were administered before the experiment, in between and after groups swapped. Free-writing productions and argumentative text productions were rated for (i) fluency (free-writing productions, text productions; (ii) idea generation (number of ideas), (iii) perceived value of free-writing (ideas selected for final text production; (iv) text quality (quality of argumentation, voice, and overall quality). Perceived self-efficacy of writers on their meta-cognitive writing strategies was measured with questionnaires

In experiment 2, both groups received the experimental treatment, but again in different moments of time. The first group worked collaboratively and the second group did free writing individually and served as control group. Then both groups swapped: the second group got the experimental intervention and the first group did free writing individually. Free-writing productions and argumentative text productions were rated for the same variables as in the first experiment, with a more detailed analysis of argumentation (acceptance, relevance, and sufficiency of arguments; anticipating and refuting counterarguments; argument organization) and quality of voice in terms of assertiveness and self-identification of writers.

Results

The first intervention proved that model analysis worked out well on writers' idea generation. In both panels the experimental group profited from the independent variable. In panel 1, group A(experimental) gained benefits from the intervention. They created a significant gap with group B (control) in the total number of marked idea clusters in free-writing 1 ($t(60)= 3,448$; $p=0,001$). In panel 2 , after swapping conditions, group B who was now experimental group increased significantly in the total number of marked idea clusters in free-writing 2 and sealed the gap with group A ($t(63)=-,408$; $p=0,685$). More importantly, in both panels, the intervention created a significant effect for experimental group in the proportion of number of idea clusters in free-writing used in the final text. In the first panel group A (experimental) created a significant difference with group B (control) in free-writing 1 ($t(54)$; $F=8,801$; $p=0,005$; $\eta^2= 0,142$). After swapping, in panel 2, group B (experimental) benefited from the intervention and created a similar proportion of ideas coming back with group A ($t(52)$; $F=0,005$; $P=0,815$, $\eta^2=0,001$)

Although a dramatic and sustained improvement in fluency and self-efficacy of both groups was found during the course of experiment, there was no direct effect of the first intervention upon the improvement. Regarding intervention 2, we are in the process of interrater between 7 M.A. graduates in English for substantial reliabilities of results involving argumentation, voice, and overall text quality so official statistics and final results should come later. Within the boundary of our first rounds of rating the texts collected we claim that different writing classroom conditions could create an upward trend of the argumentative quality or of voice expression. Collaborative writing offered writers more complex argumentation (more counterarguments, multi-faceted reasoning, and higher level of text organization cohesion) at the cost of voice; while free-writing offered a stronger voice reflected in self-identity and assertiveness, however a downward trend in argumentation and text cohesion.

References

- Mouchiroud, C., & Bernoussi, A. (2008). An empirical study of the construct validity of social creativity. *Learning and Individual Differences*, 18, 372-380.
- Reynolds, G. A., & Perin, D. (2009). A comparison of text structure and self-regulated writing strategies for composing from sources by middle school students. *Reading Psychology*, 30(3), 265-300.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi experimental designs for generalized causal inference*. Boston: Houghton Mifflin Company.

PAPER PRESENTATION

Textual Production: What is the impact of linguistic and metalinguistic competences?

Ana Cristina Conceicao Silva, ISPA, Portugal

Dimensions of linguistic development, such as lexical and syntactic development, and metalinguistic competences, such as morphological and syntactic awareness, have been associated, by literature, to writing and textual production, but there are no studies analyzing, specifically, the impact of these knowledges and competences in textual production's quality.

The participants were 47 children frequenting 4th grade, all from high social-cultural classes. These children were evaluated in tasks measuring lexical development, syntactic development, morphological awareness development and syntactic awareness development. It was also asked to the children to write a composition about a theme previously selected. These compositions were evaluated by two independent judges according to defined criteria. The results point to the inexistence of correlations between linguistic knowledge and textual production's quality and to the existence of medium level correlations between metalinguistic knowledge and textual production's quality. It was also detected positive and significative correlations between linguistic and metalinguistic tasks.

The conceptual and structural dimensions of narrative must be transformed in text and, in that process, linguistic and metalinguistic know ledges (and the level of children's development in those competences) will be, necessarily, involved and will have implications in textual quality. Thus, for example, the cohesion and continuity of narrative depends on the form how children are able to use connectors, pronouns and conjunctions, and on the children's capacity to reflect about its adequacy in the text. Children begin to acquire narrative cohesion primarily in an oral level and only after in written texts. These two dimensions appear to be correlated (Cox, Shanahan & Sulzby, 1990).

Several studies that analyze written compositions' in school context, refer the importance of lexical development in texts' quality (Berninger & Swanson, 1994). The textual production also implies, the capacity to group words in way to constitute phrases that express in a correct way what is intended to write. In this way, the syntactic construction is one of the processes inherent to textual production (Torrance & Jeffery, 1999).

Metalinguistic development is particularly associated to processes of revision that occur during writing and in post writing moments, because it facilitates much more fine judgments about the various dimensions of a text. The revision implies processes of change in texts to adequate it to writing conventions, namely orthographic, syntactic and also to the coherence of the text. In that way, revision requires from the text's author a conscious linguistic knowledge about words and its morphological structure, phrases and speech. When children enter school they tend to effectuate mechanical changes in word's choice, while older children make alterations at a word's orthography level and in phrases in order to improve cohesion and coherence.

One of the dimensions that is object of analysis during writing and revision is orthography. Several authors refer the importance of morphological awareness in orthographic knowledge (Gombert, 2003; Nunes & Bryant, 2004; Nunes & Bryant, 2006).

Syntactic awareness is influent in textual production's process because it has also implications in the revision of texts. According to several authors, performs a important role in textual production's quality (Hacker, Plumb, Butterfield, Quathamer & Heineken, 1994; Graham, Schwartz & MacArthur, 1995; Graham, De la Paz & Swanson, 1998). In fact, the quality of revision, as a process that allows the writer to reflect and make changes in the text with the objective of approximating the text to the sense wanted (Singer & Bashir, 2004), seems to depend on the capacity to reflect about grammatical structure of a phrase and to correct it according to the sense that the author wants to give to his text, capacity related to syntactic awareness's development (Capovilla, Capovilla & Soares, 2004).

Dimensions of the linguistic development, such as lexical and syntactic development, and metalinguistic competences, such as morphological and syntactic awareness, have been associated, in several studies present in literature, to writing and textual production, but none of these studies tried to analyze, specifically, the impact of these several competences in the quality of textual production.

The aim of this study is analyze the relations lexical and syntactic development, and metalinguistic competences, such as morphological and syntactic awareness, and textual production's quality.

The participants were 47 children frequenting 4th grade, all from high social-cultural classes. These children were evaluated in tasks measuring lexical development, syntactic development, morphological awareness development and syntactic awareness development. It was also asked to the children to write down a composition about a theme previously selected.

The analysis of children's performance in linguistic and metalinguistic tests points to high levels of success in all tasks. The use of Pearson's correlation test showed the inexistence of significative correlations between the variables relative to lexical and syntactic development and textual production's quality

The results with the same test showed the existence of a positive and significative correlation of medium level, for a significance level of 0,01, between the variables relative to syntactic awareness development and textual production's quality and the existence of a positive and significative correlation of medium level, for a significance level of 0,01, between the variables relative to morphological awareness development and textual production's quality.

Some of the literature reviewed points to the idea that lexical and syntactic development positively influences writing in general (MacArthur, 2001, cit. Singer & Bashir, 2004; Singer & Bashir, 2004; Berninger & Swanson, 1994), but none of the studies found were centered specifically in the matter of textual quality. In fact, this type of relations between oral language development and writing has been detected mostly in initial phases of writing learning (Shanahan, 2004).

The correlation obtained between morphological awareness development and textual production's quality can be explained by the role played by morphological awareness in aspects related to orthographic knowledge and with the ability to mobilize that knowledge, in a conscious way, according to the objectives that the writer has for his text (Gombert, 2003; Nunes & Bryant, 2006). In a less direct way, some of the literature puts the hypothesis of the existence of the influence of morphological awareness development in dimensions relative to narrative coherence, that remits to the ability of the subject to reflect about the meaning of words, defining and adjusting its meaning to the intentionality and communicative situation of the text (Koch, 2002).

About the correlation obtained between syntactic awareness development and textual production's quality, this can be explained by the positive influence that this type of development seems to have in aspects related to global cohesion of a text (Curto, Morillo & Texidô, 2000, cit. Martins, 2009). This idea allow us to conceive also the possibility of the existence of the influence of syntactic awareness development in the quality of causal and temporal relations expressed in the text, in the quality of exposition of a possible conflict and its resolution and in the quality of the episodes written, influencing indirectly the textual coherence.

PAPER PRESENTATION

Improving academic writing skills: effects of online teaching modeling

Maria Beatrice Ligorio, University of Bari, Italy; Paola Francesca Spadaro, University of Bari, Italy; Cesarea Giordano, University of Bari, Italy

In this presentation the case of a blended university course on E-learning at a specialized level for Work Psychology is discussed. During such course third-six students first read the material assigned to them, then they posted online critical reviews about the readings. After getting feedback from their teachers, the students later share and discuss about teachers' comments on some of the reviews. The course was structured into four units; for each of them this activity was repeated. A complex category system was built to assess the quality of the reviews. We found that: a) the pick of improvement was recorded from the first to the second unit, b) students benefitted most when getting vicarious feedback on their writing, c) the most sensitive dimension to change was grammar, which reported the highest frequency of errors at the start of the course.

Introduction

University students often do not display adequate academic writing skills. Especially in the Italian university contexts, this is due to the fact that students are very seldom required to write. Most of the time students face the task of writing a dissertation of the end of their academic journey without never been required to write an essay in three or four years. AimsThis study is aimed at exploiting the effects on university students' academic skills of a blended course inspired to socio-constructivism (Allen & Seaman, 2006; Bonk & Graham, 2006). We are convinced of the fact that some of the suggestions coming from collaborative learning (Joiner, Littleton, Faulkner, Miell, 2000) and teaching how to write (MacArthur, Graham & Fitzgerald, 2006) can be empowered when applied into a well-designed blended context.

Context

This blended course was offered at the University of Bari (IT), during the academic year 2009-10. The subject was on E-learning and it was part of the specialized curricula of Work Psychology. Thirty-six students attended the course, 9 male and 27 female. The participants' average age was 24. Students were organized in four 9-members random groups. The course lasted thirteen weeks and it was divided into four units. The course had a jigsaw structure: each

group got nine different readings, one per member; all four groups received the same readings. Students from different groups reading the same material were called "alter-ego". The digital version of the material was posted online. The teacher assigned a research question for each unit. Student had to read the assigned material and write a short critical review (300 words maximum) about it reporting (a) the main points, (b) the contribution to the research question, (c) the unclear and underdeveloped points, (d) a personal opinion, and (e) a comparison with previous material read. 'Alter-ego' students could discuss and compare their impressions on the reading and about their reviews drafts via the online platform. All the reviews had to be posted online and students had to read them. This was an important starting point, because it was supported the idea that a good answer to the research question was possible only after combining – as in a puzzle – all the material distributed within the group. For each unit, the teacher gave feedback online randomly on two reviews for each group. All students were required to read the commented reviews in order to see the types of corrections and to transfer them to their own writing. In this way, teachers' comments were socialized and discussed.

Analysis and findings

144 reviews were produced during this course. They were all analyzed with a category system composed by the following three areas: a) grammar; b) formal academic features (citations and references); c) linguistic style; d) critical skills (capability of reporting the core point of the material read; well-argued the personal point of view, and quality of the contribution to the research question). Three analysts coded independently 40% of the data; discordances were discussed and later two of them coded the whole data set. A 5-point-Likert scale was used to assess each review. An overview of the results at the first unit shows that all students reported some of these errors. The highest mean was reached by the grammar mistakes: 2.93 against the 2.26 of academic features errors, 1.99 on language style and 1.32 on critical skills. In order to assess a quality increase during the course, the total score of the reviews of each unit was compared. Contrasting reviews of the first unit to those produced during the last unit, we found: a) a remarkable decrease of grammar errors ($t(51,3)=4.96$; $p(t(73))=-2.916$; $p(t(73))=3.33$; although those using a colloquial style hardly changed during the course; c) however, the critical skills, especially in reference to the contribution to the research question, did not improve significantly. For all these dimensions the pick of improvement was recorded at the passage from the first to the second unit. We also looked at the specific effects of teachers' comments by comparing the quality of the reviews produced by: a) the students that had a review commented in the previous unit; b) the so-called "alter-ego"; c) all the other students. The students most decreasing their errors were the "alter-ego", followed by the students whose reviews were commented in the previous unit. Other students had the highest presence of errors.

Discussion, educational significance

From our results we learn that: a) the pick of improvement was recorded at the passage from the first to the second unit, b) "alter-ego" students are the ones benefitting most from the teacher modelling, c) the most sensitive dimension to change was grammar, which reported also the highest frequency of errors at the start of the course. One of the practical implications from this study concerns the positive effects of teachers' feedback as modeling. Second, the benefits of the jigsaw course structure for the purpose of enhancing writing skills. Third, the fact that different allocated students in the course structure (subjects of feedback, alter-egos, the others) benefitted differently from this sort of feedback. Fourth, the promise of workload reduction for the teachers in terms of reducing the need of giving feedback to each an every single student, since the vicarious feedback seems to be the most effective one in terms of leading to students' self-regulation.

References

Allen, E., & Seaman, J. (2006). Making the grade: online education in the United States. Retrieved from: http://www.sloan-c.org/publications/survey/making_the_grade_southern06 Bonk, C. J., & Graham, C. R. (Eds.) (2006). The Handbook of Blended Learning: Global Perspectives, Local Designs. Pfeiffer Publishing, San Francisco Joiner, R., Littleton, K., Faulkner, D., & Miell, D. (2000). Rethinking Collaborative Learning. London: Free Association Books. MacArthur, C. A., Graham, S., Fitzgerald, J., (2006). Handbook of Writing Research, Guilford Press, 2006

PAPER PRESENTATION

How student teachers learn in relation to the quality of their teaching

Maaïke Endedijk, University of Twente, Netherlands; Mieke Brekelmans, Utrecht University, Netherlands; Paulien Meijer, Utrecht University, Netherlands; Jan Vermunt, Utrecht University, Netherlands

One of the aims of preservice teacher education programs is to develop student teachers' conceptions and skills necessary for their further professional development as a teacher. Although a widespread assumption is that an independent meaning-oriented way of learning is needed to become an expert teacher, empirical evidence on the relation between student teachers' learning and the quality of their teaching practice is lacking. The current study adds to the existing body of knowledge by investigating this relation. Student teachers' learning orientations were

studied with the revised version of the Inventory Learning to Teach Process (ILTP). Student perceptions of teacher Control and Affiliation, perceptions of teachers themselves, and teacher awareness of student perceptions as measured by the Questionnaire on teacher interaction (QTI) were used as indicators for quality of teaching practice. All full-time student teachers of a Dutch school-based teacher education program for subject-teaching in upper secondary school were asked to volunteer in this study. This resulted in a set of 126 cases (90%) with both QTI and ILTP scores. Results show that student teachers having problems with directing their own learning also have problems in creating an effective classroom climate. Results of this study may imply that a possible approach to support student teachers with severe classroom management problems is to help them developing their learning orientation in order to become more proficient in acquainting the conceptions and skills to develop their expertise.

Aims

Preservice programs, especially one-year post-graduate teacher education programs form a time-limited intervention in the professional development of teachers. Therefore, one of the aims of many preservice teacher education programs is to develop student teachers' conceptions and skills necessary for their further professional development during the teaching career. Multiple studies have suggested that an independent and meaning-oriented way of learning is regarded as being preferable for becoming an expert teacher: Student teachers engaging in this type of learning are expected to learn successfully in and from a combination of theory and practice (Mutton, Burn, & Hagger, 2010), to be able to continue lifelong learning after graduation (Cornford, 2002), and to handle the challenges of the complex and dynamic learning environment of everyday practice (Hammerness, et al., 2005). Consequently, the quality of student teachers' learning is expected to be related to the quality of their teaching practice. Nevertheless, as Fallon (2008, p. 837) has concluded, "the field of teacher education and teacher learning is deep and rich in normative and logical reasoning, but shallow in empirical knowledge". Although a widespread assumption is that an independent meaning-oriented way of learning is needed to become an expert teacher, empirical evidence on this relation is lacking. Therefore the main research question of this study is: What the relation is between student teachers' way of learning and quality of their teaching practice?

For the context of school-based preservice teacher education, Oosterheert and Vermunt (Oosterheert & Vermunt, 2001) used the concept of learning orientation to denote typical combinations of learning conceptions, and learning- and regulation activities. Their research has shown that individual differences in learning to teach could be categorised in four learning orientations: survival-oriented learning, reproduction-oriented learning, dependent meaning-oriented learning, and independent meaning-oriented learning. Quality of teaching can be indicated by means of different aspects of teaching (such as subject specific-, organisation of learning-, moral-, interpersonal aspects). An important factor for student learning is classroom social climate. How students perceive the social climate of their classroom, and especially the way students perceive their teachers interpersonally, is strongly related to student academic achievement and well-being (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006). According to interpersonal theory Control and Affiliation are primary to all interpersonal perceptions. In this study we will use student perceptions of teacher Control and Affiliation, perceptions of teachers themselves, and teacher awareness of student perceptions (discrepancy between self- and student perceptions) as indicators for quality of teaching practice.

Methodology

Student teachers' learning orientations were studied with the revised version of the Inventory Learning to Teach Process (ILTP), developed by Oosterheert, Vermunt, & Denessen (2002). The instrument consists of ten scales with Likert-type items reflecting learning conception of student teachers, preferences for learning and regulation activities, and emotion regulation. Perceptions of Control and Affiliation were estimated with the Questionnaire on teacher interaction (QTI, Wubbels et al. 2006). Both student and teachers filled in the QTI, resulting in student ratings, teacher self ratings, and discrepancy ratings (absolute value of self rating score minus student rating scores). By aggregating ratings of students from the same class, students were treated as multiple observers of the quality of the teaching practice of their teachers. Internal consistency of both dimensions was sufficient. To study the relation between learning orientation and the scores on the dimensions of the QTI, analyses of variances were applied.

Student teachers' learning and their teaching practice has been studied in a Dutch postgraduate one-year teacher education program preparing for subject-teaching in upper secondary school. In this program, student teachers spend half of their time doing practice either as an intern or while having a paid job as a teacher. The other half of their time they spend learning at the university. All full-time student teachers of this program were asked to volunteer in this study. This resulted in a set of 126 cases with both QTI and ILTP scores. Five student teachers had cancelled their participation, because of lack of time, illness, pregnancy, other expectations, and one left the teacher education program.

Findings

Based on the scores of the ILTP-scales, all student teachers were categorized in one of the learning orientations. In total, 21.4% of the student teachers had a survival-oriented way of learning, 25.4% a reproduction-oriented way of learning, and 20.6% a dependent meaning-oriented way of learning. The largest group (32.5%) had an independent meaning-oriented way of learning. Results show that there were no significant (p

Theoretical and educational significance

The aim of this study was to explore the relation between student teachers' learning and the quality of their teaching. Results indicated that survival oriented student teachers, who have problems with directing their own learning, also had problems with creating and maintaining an orderly classroom social climate. Since this study was a descriptive study with one measurement occasion, the question whether (1) a survival-oriented way of learning leads to less quality of teaching, or (2) problems in creating a positive classroom management leads to a survival way of learning, or (3) a third factor is responsible for the found relation between student teacher learning and their teaching practice (e.g., personality factor, quality of educational program) remains unanswered and demands further investigation. Results of this study may imply that a possible approach to support student teachers with severe classroom management problems is to help them developing their learning orientation in order to become more proficient in acquainting the conceptions and skills to develop their expertise.

PAPER PRESENTATION

Promoting strategic knowledge in teacher training: cognitive modelling in video-based cases

Jan Henning, University of Regensburg, Germany; Bernd Meidenbauer, University of Regensburg, Germany;
Klaus-Peter Wild, University of Regensburg, Germany

This study investigated how the acquisition of strategic knowledge in teacher education can be promoted. Strategic knowledge is understood here as a type of practical knowledge that explicitly features the reflexive use of theoretical knowledge. The acquisition of strategic knowledge is an important goal in teacher education because this knowledge is assumed to enable student teachers to effectively deal with problems of classroom practice. Recent research indicates that the acquisition of strategic knowledge can be supported by learning from video-based cases, however with somewhat limited success. In this study, these recent approaches are complemented by an additional instructional method, namely cognitive modelling. Therefore, the research question addressed in this study is: Does the use of cognitive modelling in video-based case studies enhance prospective teachers' acquisition of strategic knowledge? To answer this question an experimental field study with a between-subjects design was conducted. Participants (N=175) were student teachers attending an online pedagogical introductory course. Participants were randomly assigned to a treatment group, which received video-based cases along with cognitive modelling, and a control group, which received video-based cases with a textual description of the teacher's actions. As expected, results showed significantly higher scores on strategic knowledge in the treatment group with medium effect sizes. These findings suggest that cognitive modelling is an effective instructional method to improve the acquisition of strategic knowledge by the use of video-based cases in teacher training.

Aims

Theory and research stress the importance of knowledge as a central element of the teaching profession. Thus a great deal of teacher training is committed to impart knowledge via lectures and seminars. Yet, this theoretical knowledge often is prone to stay inert, that is, it cannot be used or applied in practical situations. Therefore it is argued that a knowledge base of teaching also has to comprise practical knowledge (Verloop, van Driel & Meijer, 2001). The acquisition of practical knowledge, however, is also difficult, because student teachers often fail to interrelate this practical knowledge with theoretical knowledge. In response to this problem the promotion of strategic knowledge (Shulman, 1986; de Jong & Ferguson-Hessler, 1996), is important. Strategic knowledge can be considered as a type of practical knowledge that explicitly features the reflexive use of theoretical knowledge. Hence, this knowledge enables student teachers to effectively arrange an organized line of action to solve a problem of classroom practice by making use of relevant theoretical knowledge. Thus the question arises how strategic knowledge can be fostered in teacher training.

A common approach to foster practical knowledge in teacher training is the use of video-based cases. Research yielded positive findings for different instructional uses of video-based cases. However, the use of video-based cases alone often failed to promote longer term transfer of theoretical principles into practice (Moreno & Valdez, 2007). This might be due to the limited feasibility of video-based cases to promote strategic knowledge. The arrangement of particular necessary procedures to solve a problem of classroom practice is a mental process, which cannot be observed and seldom is articulated by teachers. Therefore video-based cases lack the capability of revealing the

strategic knowledge that teachers bring to bear tacitly when they encounter certain problems in the classroom. To this end, additional instructional methods are required.

Cognitive modelling is particularly suitable for the direct and transfer-oriented imparting of strategic knowledge (Mandl, Gräsel, Fischer, 2000). It usually involves that a skilful model demonstrates solving a typical problem of a particular domain in a realistic context. The model articulates its cognitive processes at planning and performing necessary actions and expounds possible implications. By this externalization (e. g. thinking aloud) the cognitive processes that determine a particular behaviour are revealed and made communicable. Research findings provide evidence for the effectiveness of cognitive modelling in central educational settings (e. g. Pedersen & Liu, 2002). Yet only a few attempts have been made to implement cognitive modelling techniques in teacher training. Despite showing encouraging results, these efforts did not make use of the full potential of the instructional method. They either did not reveal the cognitive processes underlying the models actions (Moreno & Ortegado-Layne, 2008) or used a cognitive modelling technique in an unrealistic and decontextualized presentation format (Nirula & Paskin, 2008). Therefore, the research question addressed in this study is: Does the use of cognitive modelling in video-based case studies enhance prospective teachers' acquisition of strategic knowledge?

Methodology

To answer the research question a field study with an experimental between-subjects design and an intended sample size of 200 participants was conducted. Participants were student teachers that attended a pedagogical introductory course in a multimedia web-based learning environment. Student teachers from three consecutive terms were sampled. As homogeneity of variance was given for all variables, the data from the terms was aggregated. Participants (N=175) were randomly assigned to a treatment group, which received video-based cases along with cognitive modelling, and a control group, which received video-based cases with a textual description of the teacher's actions. Strategic knowledge was assessed by participants' written solutions to a video-based case, which they independently had to work on. A coding rubric was used to quantify the data. To control possible moderating factors participants' study motives, general study interest and specific study motivation were measured by questionnaire at the outset of the term. Additionally, online questionnaires captured participants' topic-specific interest, prior knowledge, perceived practical relevance and self-efficacy as well as the perceived case-related self-efficacy before and after the treatment. To analyse the data ANOVAS and general linear models were computed.

Findings and educational significance

As expected, results showed significantly higher scores on strategic knowledge in the treatment group with medium ($d=0.51$) effect sizes. Furthermore, analyses showed no significant moderating effect for any of the included control variables. The results suggest that cognitive modelling is an effective instructional method to improve the acquisition of strategic knowledge by the use of video-based cases in teacher training. During the presentation the theoretical framework and further findings of the study will be elaborated.

References

- De Jong, T., & Ferguson-Hessler, M. G. M. (1996). Types and Qualities of knowledge. *Educational Psychologist*, 31, 105-113.
- Mandl, H., Gräsel, C., & Fischer, F. (2000). Problem-oriented learning: Facilitating the use of domain-specific and control strategies through modeling by an expert. In W. J. Perrig & A. Grob (Eds.), *Control of human behavior, mental processes, and consciousness. Essays in honor of the 60th birthday of August Flammer* (pp. 165-182). Mahwah, NJ: Erlbaum.
- Moreno, R., & Ortegado-Layne, L. (2008). Do classroom exemplars promote the application of principles in teacher education? A comparison of videos, animations, and narratives. *Educational Technology Research and Development*, 56, 449-465.
- Moreno, R., & Valdez, A. (2007). Immediate and delayed effects of using a classroom case exemplar in teacher education: the role of presentation format. *Journal of Educational Psychology*, 99, 194-206.
- Nirula, L., & Peskin, J. (2008). The name assigned to the document by the author. This field may also contain sub-titles, series names, and report numbers. Bringing expert teachers into the educational psychology classroom: Using video-captured insights in case study analysis. *Teaching Educational Psychology*, 4(1), 1-23.
- Pedersen, S., & Liu, M. (2002). The effects of modelling expert cognitive strategies during problem-based learning. *Journal of Educational Computing Research*, 26, 353-380.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- Verloop, N., van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research*, 35, 441-461.

PAPER PRESENTATION

Starting points to integrate information and communication technology into teaching

Susanna Pontinen, University of Eastern Finland, Finland; Stina Hacklin, University of Eastern Finland, Finland

Nowadays information and communication technology (ICT) is part of everyday life. Children, adolescent, working age and elderly persons use ICT and with the exception of the elderly ICT is seen as natural part of generations' life. However, at school the meaning of ICT is not as important as outside school. Why school differs from the rest of society? We are interested in this issue and explore how in teacher education context in Finland first-year elementary school student teachers construct their meanings about using ICT in education. In our research we used discourse analysis and analyzed class teacher students learning diaries in order to find out how they construct their generation as "digital natives". We also analyzed how they describe their ideas to integrate ICT in education. We found that it is not obvious for all the student teachers to be classified as a member of "digital natives". Student teachers value their technical competences but they do not necessarily construct the connection between everyday life and school life competences. They also construct differences between themselves and their own school teachers and between everyday technology and suitable school technology. Student teachers construct the meaning of educational use of ICT in three ways - as inclusion to the society, as improving pupils' learning and as a new possibility to teaching and learning.

Nowadays information and communication technology (ICT) is part of everyday life. Children, adolescent, working age and elderly persons use ICT and with the exception of the elderly ICT is seen as natural part of generations' life. However, at school the meaning of ICT is not as important as outside school. Why school differs from the rest of society? We are interested in this issue and explore how in teacher education context in Finland first-year elementary school student teachers construct their meanings about using ICT in education.

Recent educational research on learning and technology has paid attention how to integrate information and communication technology into the learning environment. A broad definition of a learning environment includes teachers, students and other people, the computers and their roles. Studies have shown that teachers' pedagogical perceptions play important role in the integration process. This means that technological infrastructure is only starting point to use ICT in education but not a guarantee. Digital technologies have also raised questions about differences between the people in the learning environment. Teachers and students are classified into different generations according to their use of ICT – nowadays students are seen as the first "digital natives" and teachers as "digital immigrants". In the context of teaching and learning differences between generations are too wide and more attention should be paid on variation within the generations.

The aim of our research was to find out how student teachers construct their generation as "digital natives". We also analyzed how they describe their ideas to integrate ICT in education. As a research data we had student teachers' learning diaries which they wrote as a part of students' obligatory course on ICT in education at the University of Joensuu (now University of Eastern Finland). Learning diaries included student teachers description of their aims for the course, their reflections about their competences to use ICT in education and their school experiences about educational use of ICT.

The course was conducted at the end of their first semester when student teachers' pedagogical studies were just beginning. The course consisted of lectures (5 hours), working in groups (10 hours) and a written examination. On this course, the students were instructed to design a learning module, i.e., a project or a smaller learning unit, such as one lesson. In the learning module students were guided to integrate ICT into the learning and teaching processes in a school context. The students were given a free hand with the task. In other words, they could choose the topic and the age of the target pupils based on the Finnish National Core Curriculum for Basic Education. The only guideline was that the learning module should employ ICT in any form they seemed suitable. Students documented learning modules and wrote descriptions about the intended progress of pupils' learning. These descriptions are analyzed earlier and the results indicated that student teachers just tend to "update" familiar teaching methods by adding new technologies.

In order to better understand student teachers' choices just "update" their teaching methods learning diaries were analyzed more deeply. In our presentation we focus to show the results of this analysis. In our research we used discourse analysis. Discourse analysis is a research approach to examine how student teachers construct social world, thus how they talk about integration of ICT in education. By talking students do not only report their thoughts, they also construct things and also written documents can be seen as spoken language because those text are written at least for the student her/himself. In analyzing process we concentrated on student teachers rhetorical strategies they use in learning diaries.

As a result of our analysis we found that it is not obvious for all the student teachers to be classified as a member of "digital natives" and membership of the new generation does not mean that all the teacher students are equal and confident to use ICT in education. Student teachers value their technical competences but they do not necessarily construct the connection between everyday life and school life competences. They also construct differences between themselves and their own school teachers and between everyday technology and suitable school technology. Student teachers construct the meaning of educational use of ICT in three ways - as inclusion to the society, as improving pupils' learning and as a new possibility to teaching and learning.

The results indicate student teachers cannot directly transfer their technical competences to their pedagogical thinking and educational use of ICT is partly based on hesitation. Students also maintain the culture of uncertainty and see ICT integration as a new way to teach. Despite of these challenges most of student teachers are eager to use ICT in education and they are satisfied with their ideas to integrate ICT in education. The results conform previous research results but also raise interesting questions for future research. How student teachers describe social inclusion in other contexts? How student teachers maintain and accept uncertainty in other contexts? How student teachers ideas to integrate ICT in education develop during teacher education?

PAPER PRESENTATION

Student Teacher Reflections and Actions in Preservice Teacher Education, a Curriculum Framework

Sari Yrjanainen, University of Tampere, Finland; Eero Ropo, University of Tampere, Finland

Purpose of the study is to investigate student teachers' reflections and actions during preservice teacher education. Theoretical framework for the data collection and analyses is based on the curriculum model developed for the university teacher education.

We apply a three-stage model in describing the teacher student learning processes during the teacher education. This model is under construction to become a curriculum model for the teacher education program. On the first level of the model are the autobiographical and individual identity development processes. Second level describes social processes of becoming a member of the profession and teacher community. Third level describes learning processes at the cultural and contextual level.

The informants of the study were math and sciences teacher students (n=121, in 2005-2008) in the secondary teacher education program. Data were collected by interviews, observations of lessons and the narratives that the students wrote.

The methodology of analyses is qualitative and we can call it like "bricolage".

General description

Purpose of the study is to investigate student teachers' reflections and actions during preservice teacher education. Theoretical framework for the data collection and analyses is based on the curriculum model developed for the university teacher education.

Teacher education is traditionally based on three cornerstones, namely subject matter knowledge, educational theory, and teaching practice. In Finland, preservice secondary teacher education, consists of subject studies and pedagogical studies. Students preparing for teacher profession study their major subject(s) for the first three years of their candidate and master level studies at the subject departments. Pedagogical studies (60 ECTS) is done at the faculties of education.

Pedagogical studies consist of two parts. Theoretical studies consist of courses dealing with, for instance, society and school, individual development and learning, and curriculum and instruction. Shulman's (1987) theorizing of the pedagogical content knowledge is important in analyzing the student teacher learning in different domain areas. It contains content knowledge, knowledge of educational goals and purposes (curriculum), and knowledge of teaching methods and didactics.

Teacher practice is typically done in a university practice school. Students give about 30 lessons during their teacher studies. What those lessons in the actual school situations are, depend on several contextual, situational and autobiographical factors (Ropo 2004, Connelly & al. 1997; Meijer & al. 1999, Sotto 1994, Grossman, 1995).

We apply a three-stage model (Ropo 2009) in describing the teacher student learning processes during the teacher education. This model is under construction to become a curriculum model for the teacher education program. On the first level of the model are the autobiographical and individual identity development processes. The student has to

develop a personal teacher identity, applicable knowledge and skills to teach and reflect (cf. Schön 1983, 1988; Rodgers 2002a, 2002b). Second level describes social processes of becoming a member of the profession and teacher community (see e.g. Ropo 2004, Ropo & Värri 2000). Third level describes learning processes at the cultural and contextual level. It is necessary to understand why education is needed and schools exist.

We apply this curriculum model into the analyses of empirical data of student narratives and observations of teacher practice. The studied empirical questions were the following:

- 1) How do the different curriculum levels appear in the teacher student written narratives about school and their own learning as teachers
- 2) How do the curriculum levels appear in the teacher student actions and reflections about actions in teacher practice

The above questions are closely related to our overall purpose to describe and understand the teacher students' emerging perspectives on the role of classroom and school discourses in shaping their identity, conceptions of science and knowledge, and their understanding of schools as educational institutions.

Concerning actions in the teacher practice we apply the concepts of positioning and affordance. Positioning is understood in this paper as a discursive concept. It refers to communication strategies a student applies towards a partner of a discourse. It is sometimes described as a role that the student takes in a specific situation but it is more dynamic and varying (see Van Langenhove & Harré 1999). Positioning is not, however, possible without perception of affordances in the discursive situations. Tanner and Jones (2002) defined an affordance as "a potential for action, the capacity of an environment or object to enable the intentions of the student within a particular problem situation". We also apply the discourse concept in understanding the structure of lessons. The word "discourse" is shorthand for "discursive formation," which is what Foucault (1972) called communication that involves specialized knowledge of various kinds. Foucault's definition of discourse is "systems of thoughts composed of ideas, attitudes, courses of action, beliefs and practices that systematically construct the subjects and the worlds of which they speak". Discourse according to Foucault (1977, 1980, 2003) is related to power as it operates by rules of exclusion. Discourse is therefore controlled by objects, what can be spoken of; ritual, where and how one may speak; and the privileged, who may speak.

Methods

The informants of the study were math and sciences teacher students (n=121, in 2005-2008) in the secondary teacher education program. Data were collected by interviews, observations of lessons and the narratives that the students wrote.

After their first teacher practicum they wrote novice teacher essays in which they reflected on their ideals and efforts in the classroom activities during the practice teaching. The data of the selected students (15) were collected by videotape during the authentic teaching situations at the practice schools. After the video recording the researcher watched the recording with each student using the think-aloud method. In this session the students were asked to reflect their solutions and reasoning during the lesson. This discussion was tape-recorded. The analysis is based on the hermeneutical and autobiographical approach and we have used discourse analysis also (Bruner, 1996; Pinar, 1978; Riesmann 2002; Roth, 2005). The methodology of analyses is qualitative and we can call it like "bricolage" (Berry 2006).

Results

The results show that student reflect in their narratives mostly issues and developmental processes related to the levels one and two in the curriculum model. Myself as a teacher (level one) and myself as a teacher in the school (level two) were the most common themes. Level three were not reflected or there were only random reflections concerning that level.

The teacher students converse with themselves, reflectively. These processes can be described as the first level processes in the above mentioned curriculum model.

In the student practice and interviews concerning the practice sessions students reflected mostly level one (how sure they were about themselves as teachers in the practice sessions), and level two processes (what is their own role and what kind of positions to take in the practice teaching situations). Level three processes appeared in the relation to

individuality of pupils in the practice classes. They were interesting differences between the students in how much teacher students were able to individualize their instruction. We will report more explicitly results from four cases representing different action types in respect to practice teaching. These results report the applied the discourses, affordances and positions in the practice sessions. Implications of the study for teacher education will be discussed in the paper.

PAPER PRESENTATION

An investigation into the analogies used for teaching the mole in secondary classrooms

Chemistry, Science Education, Secondary school

Su Chi Fang, The University of Melbourne, Australia; Christina Hart, The University of Melbourne, Australia;

David Clarke, University of Melbourne, Australia

The mole is a fundamental concept in chemistry. Using analogies when introducing the mole is common in textbooks. However, what type of analogies and how they are used in introducing the mole in classrooms needs to be investigated.

This paper is part of my PhD research program in which I intended to look into the reasons why the mole concept is difficult to be taught and learned by comparing two countries (Australia and Taiwan). Data included video records of the lessons and the chemistry teachers' and students' interviews. The aims of this paper are (1) to explore what are the analogies used to introduce the mole concept, and (2) to inquire into how these analogies play a role in helping learning the mole concept.

The findings showed that using analogies in introducing the mole was popular in secondary classrooms. The analogy of 'a dozen' was employed the most frequently. In addition, a second group of analogies like 'packages of rice' or 'trucks of oranges', and a third group related to chemical reactions were also used in classrooms. In fact, different analogies highlight different aspects of the mole concept. However, it seems that these analogies were used without making explicit the aspect they actually address. Moreover, the essence of the mole concept, that it depends on a proportional relationship, was not conveyed by these analogies. Suggestions about effectively using analogies in teaching the mole concept are also presented.

Using analogies in teaching and learning chemistry is deemed a powerful strategy because analogies provide a bridge connecting between the unfamiliar target concept and familiar analogy (Duit, 1991). Previous research has showed that generally in textbooks the mole concept was introduced with analogies, such as a dozen (Staver & Lumpe, 1993). However, what kinds of analogies are used and how they are used in teaching and learning in classrooms has not been previously explored. Therefore, the aims of this paper are (1) to identify what analogies are used to introduce the mole concept. (2) to inquire into the role these analogies may play in helping students' learning of the mole concept. This study is positioned as a classroom study, based on the perspective that learning science is not only a personal meaning making process but also a social interactive activity. Seven chemistry classrooms were participating in this study, including two year-8 and three year-10 classrooms in Taipei, and two year-11 classrooms in Victoria. Data generation included videotaping the lessons, teacher and student interviews. Analysis of the empirical data was based on a content analysis of the mole concept.

In these seven classrooms, a dozen was the most frequently used analogy in the lessons on the mole. The analogies could be categorised into three different groups: (1) The number group, (2) The mass group (3) The chemical reaction group. The number group includes analogies such as a dozen, a box etc, and they stress the point that the mole represents a number, 6×10^{23} . The analogies in this group suggest that it is possible to count and know exactly what the number is. The mass group comprises analogies like trucks of oranges and packages of rice. The mass group of analogies emphasized the situation where the number involved is huge, so 'weighing' is used as a strategy to quantify the amount. Therefore, within this context, 'weighing instead of counting' is the point and exactly how many there are is NOT important. The analogies in the chemical reaction group are not directly related to the mole concept, but implicitly involve the application of the mole in chemical reactions, for example, monkey and banana, and the process of baking a cake.

Teachers used one or more of these analogies at the time when they introduced the mole. However, it appeared that their students accepted the number group most readily. The number group of analogies seemed to be easier to grasp because the connections between the analogy 'dozen' and the target 'mole' are straightforward (Duit, 1991). In other words, it is simple to relate a number to the term, 'mole', just like we relate 12 to a dozen. In contrast, the connections between the analogy 'packages of rice' and the 'mole' were not explicit. Also whenever the mass group of

analogies was presented, the teachers did not explicitly make the link with the mole. The teachers alluded to 'weighing instead of counting', but they did not explain how this strategy works with the mole in chemistry. Consequently, the students could not actually see the connection between these analogies and the mole and in interviews they did not refer to them as helpful for their learning. The third group of analogies seems to be more problematic because the analogies concern the ratio between reactants and products in chemical reactions and not the mole concept itself. This connection, again, was not made explicit and the students did not appear to find this type of analogy meaningful.

Nevertheless, these analogies used in the classrooms do not perfectly match the mole concept. They were limited in that they did not explain the proportional relationships between 12C and other elements. An activity that is more analogous to the use of the mole concept in chemistry will be provided. Two significant issues pertaining to how teachers can use analogies more effectively in science teaching are discussed. First, the connection between the analogue and the target should be made as explicit as possible to the students. In other words, students' attention should be guided and directed to the intended way of using the analogy (Coll, 2006), otherwise students might see and interpret analogies in a different way from their teachers (Treagust & Harrison, 2006). Second, it is important that teachers discuss "the scope and limitations of an analogy" (Justi & Gilbert, 2006, p. 128) with students. For instance, in the case of mole, although 'a package of rice' is a promising analogy for students to learn the mole, the meaning it conveys is still limited, since this analogy cannot reflect the essence of the use of the mole in chemistry. Therefore, as Justi and Gilbert (2006, p. 129) suggested, teachers might adopt "discuss and guide" approach rather than "show and tell" when they teach with analogies.

PAPER PRESENTATION

A Practice of Science as Varied as the Members of the Science Classroom Community Culture and Education, Inquiry learning, Science Education

Michele Koomen, Gustavus Adolphus College, United States

This paper reports on a qualitative study of nine culturally, linguistically and academically diverse students as they studied insect biology and ecology in their inclusive seventh grade life science class. Three fundamental data collection methods of qualitative research (student observations, interviews and artifact analysis) framed the data collection portion of this study. Constant comparative and microanalysis frameworks for grounded theory were used to systematically analyze the data set resulting in a practice of science that is different for each of the nine youth: A practice of science that is fragile and tentative and tied with the language of science; a practice of science that is dutiful and pragmatic although absent in passion or curiosity, and a practice of science positions one student to be dis/abled. Implications of this study to the greater research community and insights for instructional practice and structure of learning opportunities for all students are discussed.

Aims/Purpose

Many, many science classrooms across the world represent our global society and as such are rich in diversity, language, culture and ability. The United States is no exception to this new normal where 20 percent of school-aged children have at least one parent who is an immigrant and 5 percent of the students were immigrants themselves with language minority students speak an amazing 400 + languages (Nieto, 2004). On top of the growing linguistic and cultural differences in the school age population, science classrooms increasingly are places where students with exceptionalities are mainstreamed (Hobbs & Westling, 2002) as a result of legislative initiatives such as the Individuals with Disabilities Education Act (IDEA, 1990) and subsequent amendments (IDEA, 2004). Science for all Americans (AAAS, 1989, 1993) call for egalitarian access to science education is based on beliefs that all youth can learn science. The theme of the 2011 EARLI conference is "Education for a Global Networked Society." If our science classrooms illustrate the richness of our global society, doesn't it make sense that we try to understand how some members of that global diversity contextualize and experience learning as we position ourselves to embrace education for a global networked society? This paper will describe a research study focused on learning for students from diverse backgrounds who have been underserved in the education system (Basu & Barton, 2007; Upadhyay, 2008).

Theoretical Frameworks

Research featuring members of our global society by nature would be complex and necessitate interdisciplinary theoretical frameworks including: 1) science for all; 2) critical feminist theory; 3) a practice of science using inquiry and 4) public policy. Science for all Americans (AAAS, 1989, 1993) call for egalitarian access to science education based on beliefs that all children can learn science. If science is to be for all a research lens using critical feminist theory is appropriate because critical theory does not merely describe a situation, place or practice but attempts to "realize a society that is based on equality and democracy for all its members" (Cohen, Manen and Morrison, p. 28). Researchers would agree that inquiry is defined as a process of posing questions, generating and analyzing data, drawing

conclusions, communicating the results, applying the conclusions back to the original question and perhaps following up with a new question (Sandoval, 2005; Cuevas, P., Lee, O., Hart, J., & Deaktor, R, 2005). Science is considered to be one of the most valuable subjects for inclusion of students with exceptionalities because they, like all students, can benefit greatly by the systematic study of the universe with promotion of scientific reasoning and inquiry (Mastropieri & Scruggs, 1992 & 1994; Bell, 2002).

Methodology

This study featured nine students who represent as a group: diverse cultures (Hmong and African-American); second language acquisition (Hmong); special education (LD and EBD) and gifted and talented who attended a public middle school in an urban metropolitan area with 88 percent students of color. An interpretive research design was guided by the following research question (a) What are the experiences of learning and the underlying contexts and structures for the nine students in their science classrooms? On-site data collection included 19 video taped science teaching and learning episodes across 13 weeks with extensive field notes, individual semi-structured interviews of students (3) and teacher (2) over the course of the research, and examination of student artifacts and projects. The analytic process was based on immersion within the data with repeated sorting, coding, and constant comparison characteristic of the grounded theory method (Morrow & Smith, 1995).

Results

Several important findings illuminate a practice of scientific inquiry that is as varied as the students who make up the class. Inquiry for William and Dion is experienced as fragile and tied to language arts. Their perception of practicing science is that it is more about understanding the words of science and moderated by their academic difficulties that make it seem that all they ever do is have "boring long lectures" or "whole packets to read." For Mai, her practice of science is pragmatic. Her desire is simply to look "good" in the classroom by taking on a "bored" affect about science, getting her work done and "listening to my teacher." Her practice of science is dutiful and devoid of passion and curiosity.

Finally, the practice of science for Dion is dis/abled. At the surface, Dion appears to realize the intent of the reform efforts of science for all, however, taking a closer look at the meaning of these experiences finds that Dion is positioned in this class as dis/abled with an identity that is compromised and negative. His teacher, Maren does many things well. She has high expectations and strong beliefs that all of her students can learn. However, Maren, unintentionally, positions Dion as dis/abled rather than able by assigning other adults to work with Dion and assigning him a front row center seat near the overhead projector where she can keep an "eye" on him. Skrtic (1991) describes this view as a naive pragmatism or "a mode of analysis and problem resolution that is premised on an unreflective acceptance of the assumptions that lie behind social practices" (p. 150). In this case, this naive pragmatism reproduces a status quo for Dion that positions him at a "functional" level and places him within a classroom learning community as dis/abled.

Significance

This study sheds some light on how we might re-imagine what we mean by science for all. First of all, we need to think reflectively as to how we position our more challenging students within the classroom culture. It might be easier to keep an eye on a student by placing him or her front and center, but what message does this present to the other students within the classroom about said students. Secondly, inquiry science still encompasses reading and literacy skills. How can these skills be de-emphasized so that our students with exceptionalities are not excluded from the meaning and intention of an equitable science for all? These findings may help us to design instructional programs that better meet the needs of our complex and diverse classroom populations as we move toward more culturally responsive teaching pedagogies.

PAPER PRESENTATION

Scaffolding teachers in inquiry-based learning and teaching through design

Computer supported Learning Environments, Inquiry learning, Science Education

Alexia Sevastidou, University of Cyprus, Cyprus; Costas Constantinou, University of Cyprus, Cyprus; Eleni Kyza, Cyprus University of Technology, Cyprus

This study explores teachers' ability to make the transfer from inquiry-based learning to inquiry-oriented science teaching. Prior research has demonstrated that teachers encounter many challenges in conceptualizing inquiry-based approaches. The purpose of this study is to give evidence, through the cases of two pairs of pre-service teachers, about constraints and affordances of design-based learning as a method for enculturating teachers in an inquiry-based learning and teaching framework in science. Our research was conducted during a professional development course about new technologies and learning in science. Participants were presented with the task of designing web-based

inquiry learning environments on a specific platform that offers tools for reflective inquiry; they received scaffolding for this task through their participation in the course and through their interaction with a web-based teacher learning environment. Data is drawn from two cases of participants who shared similar characteristics, namely in educational background, age and teaching experience, but displayed markedly different performance: one case succeeded in working with relevant scaffolding and in translating challenges with inquiry-based learning into design knowledge; the other case failed to do so. We discuss the implications of this study for efforts to engage teachers in complex design tasks, with the intent to help them grapple with the nature and complexity of inquiry-based pedagogy. Even in the cases where teachers do not find their way around the design task, they gain valuable experiences and insights into inquiry as a teaching and learning framework.

Background

As inquiry-based teaching and learning in science education is increasingly becoming a more consistent paradigm with the needs of today's societies (Sawyer, 2006), exploring ways for introducing teachers in this framework has become a significant task.

Inquiry, the pursuit of open questions, is a fundamental scientific practice, and it is also recognized as a valuable, authentic context for science learning. Required teacher competencies for teaching science as inquiry include scaffolding students in complex tasks like framing questions, grappling with data, creating and critiquing explanations, in some cases, publicly (Crawford, 2007). As reported in prior studies, teachers encounter many challenges in adopting an inquiry learning and teaching framework: they are not prepared for the role of giving students intellectual space as well as structure in open-inquiry approaches; even when they intend to use scaffolding, they hardly listen to students, they tend to be directive, they have trouble in supporting the negotiation of ideas and conceptual evolution and, at the same time, introduce students to inquiry processes (van de Valk & de Jong, 2009; Holbrook & Kolodner, 2000).

Purpose

The purpose of this study was to explore the transfer from teachers' own learning to designing teaching and to identify affordances of a design-based learning approach as a way to scaffold teachers in developing an inquiry-based learning and teaching framework. Our main research questions were: a) what are the challenges that teachers encounter when asked to design an inquiry-based learning environment with scaffolding features? b) How do teachers respond to tools that aim to scaffold their design process?

Method

Participants were ten science teachers enrolled in 13 three-hour sessions of a professional development course about new technologies and learning in science. The course assumed a design-based learning approach and was structured around three key features: a) a design task that engaged teachers in the design of inquiry-based learning environments, b) a design tool, STOCHASMOS, a web-based authoring tool that employs inquiry scaffolding features and c) design scaffolds, provided through a web-based teachers learning environment, in the form of (i) design principles, through the structured presentation of research-derived theoretical and practical information, (ii) prompts for planning and reflecting on the design task and (iii) web-based peer collaboration activities. Throughout the course, participants were grouped in pairs. Each pair developed a web-based inquiry-learning environment, which they submitted as an assignment at the end of the course.

Data collection and analysis

The study used data from multiple sources including: (a) researcher's notes from participants' observations; (b) teachers' written definitions of inquiry; (c) log files recording participants' interactions with the scaffolding provided on the course web-based environment; (d) participants' final learning products, the web-based learning environments that they designed as part of their course work, (e) interviews with teachers after the completion of the course.

Data were analyzed qualitatively using the constant comparative method (Glaser & Strauss, 1967). Different kinds of analyses (e.g. the analysis of the teachers' definitions, the analysis of their final learning product) were synthesized to triangulate findings. In each of these, we tracked the emerging themes for each pair of participants and iteratively compared them to the themes emerging from the analysis of the other pairs.

Findings

The data analysis showed that challenges with inquiry-based learning and teaching were exemplified in the learning environments that teachers designed. Teachers' difficulty in balancing between space and structure was evident in the way they designed scaffolding for students, and in the underlying inquiry patterns on which they structured their environments' activity sequences. Subsequent analysis, which drew on the framework proposed by Quintana et. al (2004), revealed that all pairs followed the same trend in the distribution of the three types of scaffolding prompts

across their environments (figure1,2): process management prompts presented more than the 50% of all prompts provided, reflection and articulation prompts were used at a lower frequency, while sense making prompts were scarcely employed. Teachers seemed to be concerned about the flow of activities and over-emphasized the sequence of steps that students needed to follow; in effect, they often prescribed situations rather than designing opportunities for learning; they used many routine directions as scaffolding prompts, in a way that is inconsistent both with inquiry and with the platform's designer intentions.

Another finding was that four out of five pairs of teachers responded in a common way to the scaffolding provided by the web-based environment: they accessed scaffolding, submitted reflections but did not engage in a constant reviewing process of their design judgments. Data from two cases of participants capture the range of the affordances and constraints of design-based learning as a method of enculturating teachers in an inquiry-based learning and teaching framework. Even though these two pairs shared similar backgrounds, they had contradicting performances and experiences with design-based learning. According to our analysis pair1 produced the least coherent whereas pair5 the most coherent inquiry-learning environment (table 1). Their experiences with design-based learning are illustrated in the excerpts below:

...we realized that this (design) was a recurring process, although at first we were thinking that we finished with our driving question and so we will move on... somewhere along the process you realize that all stages are interconnected and affect each other, and we returned, reviewed and moved forward (pair5, interview)

...recording our design decisions was not helpful for us...many times we wrote that we will do something and then we found out that it doesn't work. This was stressful. We had to do it because we already described it... (pair1, interview)

Conclusion

The teachers who participated in our design-based learning approach faced similar challenges in designing inquiry-based learning. Four out of five pairs interacted with the reflective scaffolding provided in a similar way. Design as a task was useful in exemplifying challenges with inquiry-based learning and teaching, giving them a more tangible than theoretical character. Being reflective through the whole process of design allowed one pair of teachers to overcome challenges brought about through the design task. As prior research informs us that teachers' ability to teach science as inquiry is affected by the complex interactions of contextual or personal factors, there is further need to explore approaches that engage teachers in reflective practices, like design, as a means of enculturating them with inquiry as a teaching and learning framework.

PAPER PRESENTATION

Exploring the graphical representations in the high-school Earth Science textbooks

Comprehension of Text and Graphics, Instructional Design, Science Education

Yi-Chun Chen-, National Taiwan Normal University, Taiwan, Province of China; Fang-Ying Yang, National Taiwan Normal University, Taiwan, Province of China

By classifying graphical displays, the main purpose of this study is to examine the graphical representations in earth science textbooks used in the senior high school in Taiwan. The material to be analyzed is the tenth-grade earth science textbooks. There are 5 versions of the textbooks. Three versions with highest rates of adoption in schools are involved in the study. Based on previous studies and considering the structure of scientific knowledge (Duschl, 1990), each graphic is classified with respect to its form and content aspects. There are four categories regarding the form of graphical representation: Real Photo, Apparatus Photo, Diagram and Graph. To analyze the content of each graphic, we adopt the goal-of-science hierarchy for teaching science proposed by Duschl (1990). Accordingly, five content categories are applied to the analysis, namely Data, Concept, Relation, Theory and Map or Figure. In so far, we have examined one version of the to-be-analyzed textbooks. Some preliminary findings are presented here. First, it was found that the highest number of the category in form is Graph. Second, regarding the content of graphical representation, our analysis shows that the proportion of each category differs in topics. Considering the first four categories in the content of graphical representation, Concept is dominating in every topic. Such a result implies that concept teaching takes up the highest proportion of the knowledge organization in the textbook. The topic characteristics also affect the proportion of the distribution. The study is still in progress. More findings will be presented in the conference.

Objective

By classifying graphical displays, the main purpose of this study is to examine the graphical representations in earth science textbooks used in the senior high school in Taiwan.

Theoretical Background

According to the constructivist theory of learning, students develop their own understanding by internalizing information either through words or graphics in science textbooks. Words and graphics are different systems of knowledge representation. They differ not only in the displayed form but also in the internal structure. Compared to words, graphics are composed of discrete and easily identified elements that are polymeric or nonnotational (Vekiri, 2002). Paivio's (1986) dual coding theory suggests that verbal information and pictorial information are processed in different cognitive systems and stored in different memory areas (Anderson, 1995). Accordingly, the graphics along with texts would bring about additive effects on learning. The "visual argument" theory also supports that graphics communicate information more effectively in that they insert low demands on working memory (Vekiri, 2002). However, the use of graphics is not always beneficial for the acquisition of knowledge. Schnotz & Bannert (2003) found that reading of graphics is task-dependent, and individual difference must be considered. They argued that graphics facilitate learning only if individuals have low prior knowledge or if the subject matter is visualized in a task-appropriate way. These dissimilar results may be owing to the problems regarding definitions and entities of graphic representations. In literature, there are few relevant studies (Vekiri, 2002). Thus in the study, an attempt is made to examine the graphical representations in the high-school earth science textbooks.

Methodology

Material The material to be analyzed is the tenth-grade earth science textbooks. There are 5 versions of earth science textbooks used in the senior high schools in Taiwan. Three versions with highest rates of adoption in schools are involved in the study. Currently, four topics related to "Global Warming" are being analyzed, including Atmosphere, Ocean, Natural Hazard and Climate Change. **Method** Based on previous studies and considering the structure of scientific knowledge (Duschl, 1990), each graphic is classified with respect to its form and content aspects. The classification details are interpreted as follows:

1. The form of graphical representation There are four categories regarding the form of graphical representation: Real Photo, Apparatus Photo, Diagram and Graph. Apparatus Photo means that the graphic is photo taken by equipments such as telescope, microscope, satellite and so forth. In other words, it can't be read by raw eyes (Real Photo). Diagram is the part, structure, simulation or operation of real objects, abstract entities or processes (Vekiri, 2002). The water cycle and the formation process of a typhoon belong to this category. Graph is the relation, sequence, statistics or values showing how two or more variables are related to each other. Noticeably, some textbook authors used more than one form in creating graphics.

2. The content of graphical representation To analyze the content of each graphic, we adopt the goal-of-science hierarchy for teaching science proposed by Duschl (1990). The bottom of the hierarchy is data collection where all science investigations begin. After collecting sufficient data, scientists would seek the lawlike relationships or patterns in collected data to develop science theory. The process is a rational feedback loop which suggests that scientific theory is subject to change. New theories would either emerge from different interpretations on existing data because of the development of new technology or from newly found data. In either case, the theory development restarts from data collection. Based on the hierarchy, the content of graphics was sorted into five categories, namely Data, Concept, Relation, Theory and Map or Picture. The first four categories are adopted from the themes of the goal-of-science hierarchy. Notably, since in textbooks, data are usually presented to students in lawlike patterns, Relation in our coding scheme indicates the relation between science concepts. The category of Map or Picture is an additional category. According to Vekiri (2002), Map is the feature (or data) and their location (or distribution) in real territory while Picture shows people, objects or scenes. Each graphic is allowed to be assigned to more than one category if necessary. **Data analyses** After coding, descriptive and Chi-square analyses are employed for further statistical analysis.

Results and Discussion

The study is still in progress. In so far, we have examined one version of the to-be-analyzed textbooks. Some preliminary findings are presented here. As shown in Table 1, numbers of graphics in each topic are not equally distributed. Across the four topics, the highest number of the category in form is Graph, followed by Diagram, but in the topic of Natural Hazard, it is Apparatus Photo (25.00%) coming in the second place. Regarding the content of graphical representation, our analysis shows that the proportion of each category differs with topics. For instance, Map or Picture is most frequently seen in Natural Hazard but in Atmosphere, it is Concept that appears most often. Besides, different topics have different scopes and aims. For example, in the topic of Natural Hazard, the textbook is full of real disaster photographs, satellite photographs, weather map etc. Whereas, the topic of Atmosphere and Ocean focuses more on illustrating relevant concepts. Considering the first four categories in the content of graphical representation, Concept is dominating in every topic. The result implies that concept teaching takes up the highest proportion of the knowledge organization in the textbook. The topic characteristics also affect the proportion of the

distribution. For example, the percentage of Theory in Climate Change is higher than those in other three topics because theories about climate change are by nature uncertain. Consequently, a lot of graphics in this topic are devoted to making predictions and building theoretical models. As mentioned before, some graphics may carry more than one category of form or content. Table 2 shows the numbers of categories found in individual graphics as well as their counts and proportions. In the form aspect, no more than 2 categories are ever found in one graphic while there might be up to four categories found in the content of a graphic. As seen in the Table 2, Climate Change and Natural Hazard have the highest variety in the number of categories. The results suggest that since the two topics deal with multi-dimensional problems, the use of multiple representations in graphics is necessary to convey relevant knowledge.

PAPER PRESENTATION

The Speed of Data Extraction from Decorated Graphs

Irit Aharon, University of Hifa, Israel; Billie Eilam, Faculty of Education, University of Haifa, Israel

Quantitative graphics combine quantitative information with pictorial elements. One example is the decorated graph, commonly used for communicating quantitative information in mass media and school textbooks. This prevalent mode of representing information calls for the examination of possible effects of decorative pictorial elements on individuals' ability to read the graph. Therefore, the present study investigated students' response time, required for extracting simple data from different types of decorated graphs. Participants comprised 9th graders (n=86 boys and girls). Three sets of graphs were used, each containing 24 items, presented successively in a random sequence on a computer screen: (a) pie graphs, (b) bar graphs, and (c) scatter graph. Each set comprised 6 different graphs, each presented in four different types of graphical design: a plain graph lacking any decorative elements; a graph placed on a background picture; a graph with a picture beside it; and a graph composed of illustrated specifiers. For each graph, students responded to a dual-choice question by pressing one of two assigned computer keys. Differences were found between students' response time to the different graphic types. Furthermore, for plain graphs but not for decorative ones, response time shortened as the number of data points increased. Findings suggest that decorative elements change students' focus of attention, requiring additional time for processing the perceived information. This extra time is required for distinguishing presented quantitative data from accompanying decorations. These findings bear direct implications for the design of learning materials, including, textbooks, tasks sheets, tests, and computer programs.

Graphs are powerful tools for presenting and analyzing quantitative information. As such their use and comprehension by students are extensively researched (e.g. Shah & Hoeffner, 2002). In the last few decades, due to the accessibility of graphical tools, the display of quantitative data has undergone a revolution. Pictorial elements are combined with quantitative information to create decorated graphs that are more appealing to the casual observer (Tufte, 1983). This mode of presenting quantitative information has become prevalent in mass media and textbooks. Some assume that these decorative elements enhance observer's ability to identify patterns, group visual elements into an object or a figure, and elicit semantic contexts relevant to the information presented in the graph, thus decreasing time on task. Others claim that these additions to the display divert observer's attention from the main information and increase the time required for its extraction (Kosslyn, 1994; Tufte, 1983;). Nevertheless very little research has been done on the effect of decorative elements on the interpretation and comprehension of graphs. The aim of the present study was to assess the effect of pictorial elements on the speed of students' extraction of simple data from different types of decorated graphs

Method

Participants: Eighty two students (33 boys and 49 girls) ages 14-15 participated in the study. They all learned in the ninth grade, at a private school in northern Israel. All students were of medium-class background.

Instruments and variables:

Graph types, graphic types and complexity. Three sets of graphs, each containing 24 items, were presented successively but in a random order, on a computer screen: (a) pie graphs, (b) bar graphs, and (c) scatter graph. Each set consisted of 6 graphs differing in their complexity, expressed in an increase in the number of data points. Every graph was presented in four different types of graphical design: a plain graph lacking any decorative elements; a graph placed on a background picture; a graph with a picture beside it; and a graph composed of illustrated specifiers.

Speed of data extraction. For each graph students responded to a dual-choice question, by pressing one of two assigned computer keys. Time (response time) between the appearance of each graph and the pressing of the appropriate key was measured in seconds (accuracy of ± 0.1 sec) Correct responses were distinguished from erroneous ones.

Spatial ability was assessed using the following tests from the Kit of Factor-Referenced Cognitive Tests (Ekstorn, French, Harman & Dermen, 1976): The Flexibility of Closure tests (CF): hidden figures (CF-1) and hidden pattern (CF-2); and the Speed of Closure tests (CS): Gestalt completion (CS-1) and snowy pictures (CS-3).

The spatial ability tests were administered prior to the graphs task with a week interval between each test. Students were classified as having low (bottom 25% of the distribution of students' scores), average (middle 50%) and high ability score (top 25%) for each separate ability.

Findings

Average response time to data extraction questions for the full graphs set, and the total number of errors were calculated for each student.

Average response time was significantly longer for low-spatial ability students with regard to CF(1+2) tests ($F(1,38)=4.745$, $p(1,43)=4.078$, $p \leq 0.05$) but not with regard to the CS-1 test ($F(1,24)=0.389$, $p>0.05$). No significant differences were found between low- and high- spatial ability groups with respect to the total number of errors. As may be expected, correlation between average response time and total number of errors show a significant increase in number of errors as the average response time decreases ($r(80) = -.315$, p

A general linear model for repeated measures was conducted to determine differences in response time with regard to within-subject variables of graph type, graphic type and complexity; and between subject variables of spatial ability: CF and CS-3. Differences were found in students' response time to the different graphic types (Pillai's Trace $F(2,77)=60.682$, $p(3,76)=5.501$, $p(5,74)=74.000$, p

Conclusions

Findings indicate that decorative elements have a certain affect on the speed of data extraction from graphs. Longer response time for extracting data from decorated graphs especially those with a picture on the side suggests that decorative elements change students' focus of attention and thus require additional time for processing the perceived information. Moreover, the decrease in time response with increase of number of data points in plain graphs may hint at students' application of Gestalt grouping processes during data extraction. The absence of the effect in the decorated graphs suggests a possible interference between decorating elements and grouping processes. Altogether, the present data may imply that excess time is needed for distinguishing presented quantitative data from accompanying decorations.

These findings bear direct implications to the design of learning materials including textbooks, tasks sheets, tests and computer programs. Students at all ages and levels of education encounter major difficulties while reading and comprehending graphs (e.g. Shah & Hoeffner, 2002;). It seems that the addition of decorative elements to the graphs would present little assistance in coping with these difficulties and could lead to their enhancement. Further research is needed to assess the possible affect of decorative elements on graph comprehension.

References

- Ekstorn, R. B., French, J. W., Harman, H. H., & Derman, D. (1976). Manual for Kit of Factor-Referenced Cognitive Tests. Princeton, NJ: Educational Testing Service.
- Kosslyn, S. M. (1994). Elements of graph design. New York, NY: W. H. Freeman and Company.
- Shah, P., & Hoeffner, J. (2002). Review of graph comprehension research: Implication for instruction. Educational Psychology Review, 14(1), 47-69.
- Tufte, E. R. (1983). The visual display of quantitative information. Cheshire, Co: Graphics Press.

PAPER PRESENTATION

Educational and school effectiveness for different groups of students in China

Assessment methods, Secondary school, The role of research on learning and instruction in developing education systems

Sally Mary Thomas, University of Bristol, United Kingdom

This paper reports key findings from a UK DFID/ESRC funded study: Improving Educational Evaluation and Quality in China. In collaboration with key stakeholders (national and local policy makers, teachers, students) the study aims to develop innovation in school evaluation and guidelines for implementation to enhance school improvement efforts in mainland China. The specific focus of this paper will explore the nature and extent of educational effectiveness in mainland China, using innovative quantitative methodology (multilevel modelling) to analyse longitudinal examination, student background, school process and context data from 120+ senior secondary schools. The findings indicate significant differences in effectiveness between schools and regions in China as well as significant differential effectiveness within schools for different groups of students – a key issue related to equity. Other findings include the

considerable influence of school input, process and context factors on student's attainment and progress at senior secondary school. The implications of the findings are discussed in terms of educational policy and practice in mainland China and internationally.

Introduction

This paper presents key findings from a UK Department for International Development [DFID]/Economic and Social Science Research Council [ESRC] funded study: Improving Educational Evaluation and Quality in China (IEEQC, 2010). Overall the study aims to provide quality in-depth data to enhance understanding of the complex nature of school effectiveness in China and how local context may play a key role in determining definitions of educational effectiveness & quality. Understanding education quality, learning and evaluation processes also assists in achieving wider goals including social justice and cohesion and equal opportunities, especially for girls and disadvantaged students.

The study objectives include:

1. To identify and define the dimensions of secondary school effectiveness in China, using innovative quantitative (multilevel) techniques to create "value added" measures for different student outcomes and student groups, across three regional (west & east) LEAs, and to compare and contrast these findings to equivalent results from the UK and elsewhere.
2. To develop new theoretical insights and models of educational and school effectiveness in China that highlights the potential role and impact of different educational priorities and contexts.
3. To contribute to educational policy development (and capacity building) by providing robust and relevant new evidence, in an area where empirical data is lacking.

Theoretical framework and methods

In mainland China, raw measures of pupils' academic outcomes and entrance levels to higher education are frequently viewed as the key indicators of school quality. As a result schools with disadvantaged intakes tend to be judged unfairly, while complacency is possible amongst schools with more able pupils, and it is difficult to identify best practice. An alternative 'value added' approach aims to provide a fairer approach to accountability and evaluating school performance than the 'raw' examination results (Thomas et al, 2007). Essentially this is achieved by adjusting for students' previous attainment and other relevant factors outside the control of the school to estimate their progress, in comparison to students in other schools. The concept of value added is, therefore, both an indicator of a school's effectiveness and a tool for head teachers and their staff to use to analyse the extent to which they have effectively raised pupil achievement. Value added evaluation methods emerged from empirical studies of effective schooling that can be traced back more than 40 years and subsequently to improved statistical methodology. The latter developments involved the establishment of comprehensive and longitudinal datasets and sophisticated analysis techniques (multilevel modelling) used to create 'value added' measures of school effectiveness outlined above. The findings of school effectiveness research, largely conducted in western countries, demonstrate that schools do have a significant impact on children's attainment and progress and also that there are substantial differences between the effects of some schools (Teddlie & Reynolds, 2000). However, empirical studies of school effectiveness have only rarely been reported in mainland China, which is also notably missing from international comparative studies of school effects. Of the few limited and small-scale studies conducted to date the findings are intriguing, suggesting that senior school effects may account for up to 40 percent of the total variance in students' academic achievement and that in rural areas the equivalent figure may be higher (Peng et al, 2006, Ding & Xue 2009). Across a landscape as huge as mainland China, more large-scale and representative studies are clearly needed to provide robust quantitative evidence about the range and extent of school effectiveness in order to inform local and national policy development.

Data sources

IEEQC study 2 uses innovative quantitative methodology (multilevel modeling) to analyze the 2009 Entrance Examination to Higher Education (EEHE) examination scores, 2006 prior attainment scores and other pupil, class and school background data, collected from 97,532 students in 120+ senior secondary schools across three western and eastern LEAs in China.

Findings and Discussion

The findings from the application of a variety of different MLwin models indicate that in mainland China there are substantial and statistically significant differences between the estimates of senior secondary schools' value added effectiveness and that these differences vary across regions. Not surprisingly, across three LEAs and different subject outcomes, the percentage of total variance in student's unadjusted EEHE scores attributable to differences between schools is considerable, ranging from 20% to 40%. However, after controlling for students previous attainment on

entry to senior secondary school the equivalent figures are somewhat reduced (13% to 28%). Estimates of differential school effects in terms of different academic subjects and for different student groups (eg by gender) are also reported as well as the impact of a variety of student intake, classroom, school process and contextual factors on student and school performance are examined in detail. The findings are discussed in relation to how school effectiveness, educational quality and equity may be better understood and evaluated in the Chinese context and the implications of the findings for educational quality in other international contexts.

Educational Importance of the Study Improving the quality of education and student learning is a major goal in both developed and developing countries, given the clear links drawn between better student access and outcomes and poverty reduction and stronger economic growth (EFA, 2004). In this context, school effectiveness research has stimulated and focused educational policy makers' attention on the potential to raise overall levels of educational standards and student achievement. For example, western governments such as the UK have placed a strong focus on encouraging schools and teachers to use innovative evaluation methods and data to inform their own evaluations of the education they provide as well as to feed into accountability and inspection frameworks, and these approaches have been linked to improved student outcomes. However, there is very little comparable empirical research evidence on the range and extent of school effectiveness in mainland China and this paper aims to address this crucial gap. This evidence will inform new policy developments in mainland China; especially given the far-reaching educational reforms currently in progress (MOE, 2009). Moreover, the findings regarding school effects in China across different regions critically develops and extends the international and comparative educational effectiveness research.

PAPER PRESENTATION

Teaching for understanding: A perspective on university-students' learning for a globalized world?

Deep learning, Higher education, New Modes of Assessment

Antonia Scholkmann, Technische Universitat Dortmund, Germany; Bianca Roters, Technische Universitat Dortmund, Germany

When it comes to university learning, mere acquisition of declarative knowledge is no longer enough to meet the demands of a globalized world. Only if students develop skills and competencies to deal with what they have learned, teaching has reached the goals that universities stand for in Western societies. The levels of how well students are able to understand a complex scientific theory or the implications of a scientific argument might be a potent indicator for state-of-the-art university learning, as show results from an in-depth analysis of n=274 qualitative essays on the content of a scientific text. The essays were created by first-year students of Educational Psychology, taught in traditional or problem-based classes, and then classified in different levels of understanding according to a framework with references to the SOLO-taxonomy by Biggs and the taxonomy by Bloom. Results show significant variation amongst these answers, giving important hints for further discussion about the potential of the concept of understanding for teaching and testing academic success.

Introduction to Problem

The objective of student learning in higher education as a main teaching goal stands without doubt as most challenging alike: Universities and colleges are the most prominent locations for learning to take place in Western societies. But what is it that has to be learned in order to meet the demands of a globalized world, and which skills for the 'knowledge age' should universities and colleges aim to teach for?

Some evidence can be seen from research on 'state-of-the-art' teaching approaches such as problem based learning (PBL) and reflective teaching. Those approaches not only focus on fostering the acquisition of generic skills and competencies such as presenting, communication or reflecting – all of which are doubtless important domains of university learning. More importantly, these approaches claim to also enhance students' capabilities to deal with the knowledge they have acquired in a non-trivial, constructivist and even innovative way.

But what puts students in the place to apply what they have learned to new situations, problems, tasks? How can knowledge be operationalized in a cross-cultural and cross-curricular manner, so that it reflects not only declarative aspects? Which kind of testing knowledge-acquisition is appropriate and fair to students of various academic disciplines and taught by different teaching methods? And, with respect to the internalization of education: Are there certain indicators of knowledge that occur across cultural and national boundaries?

Theoretical Approaches

Our paper focuses on student learning being more than mere knowledge acquisition, but the acquisition of skills and competencies that allow dealing constructively with the specific content of a certain field or discipline. Dealing professionally with what one has learned becomes more and more superior to mere acquisition of declarative facts, as

shows research on expertise (Leinhardt & Greeno, 1986; Bereiter & Scardamalia, 1993), reflection (Schön, 1983; Moore, 2004) and satisfaction and success of students (NSSE, 2010).

A concept which might help bridge all the different approaches to knowledge-related student learning is the ability to understand the content of a concept or the implications of an academic argument. We hold this idea of 'understanding' (Marton & Booth, 1997; Dahlgren, 1997) to be a central domain of university teaching. Different levels of understanding can be seen with respect to university learning, as has shown significant prior research (Wahlström et al., 1997), with some inconsistencies concerning relation to a specific teaching method (Rahimi, 1995). Given these implications the research question for this study was: Can the concept of understanding be applied as a global indicator for university learning across different countries and different teaching approaches?

Empirical Evidence

As part of a greater research project which investigates learning through different teaching methods in different universities in Sweden, the Netherlands, Switzerland and Germany, we tested for students' understanding of a complex text. By bringing together qualitative and taxonomic approaches such as Biggs' Solo-taxonomy (Biggs 2003) or the domains of Bloom (see Anderson & Krathwohl, 2001), a framework was developed to classify qualitative answers with respect to different levels of complexity in understanding.

The texts to which we will refer to in our presentation were $n = 274$ answers by first to third year students in courses of developmental psychology from Switzerland and Germany. These students were taught in either 'traditional' form or enclosing an amount of problem-based elements during the academic term. All students gave written answers to the question "What is the text about?" after reading it. Stimulus was an essay on conditions and consequences of brain development (Høyther, 2006). Tests with further groups are under way in Germany, Sweden and the Netherlands. Results from the initial sample show significant differences between the levels of understanding displayed between students in both courses (PBL vs. non-PBL), thus differentiating them in at least five groups. Amongst the answers there can be seen a pattern going from only capturing the innermost fundamental message of the text via understanding one or more than one argumentative figures given by the author, and, at the higher levels, capturing also the implication of examples and differentiating aspects to foster these arguments and connect them to an overall academic discourse.

No statistic effect could be seen for age, gender, previous studies or any predictor of academic achievement on the performance in this test, thus indicating its diagnostic uniqueness. "Missing-the-point"-answers give important hints for further theoretical refinement of the concept 'understanding'.

Implications and Relevance

The implications of this study follow a twofold way: firstly, new contributions might be inferred from the idea of 'understanding' as core concept for university learning in bringing together related concepts such as reflection, comprehension and expertise. Secondly, conceptualizing university learning from the angle of how well students are able to understand complex scientific arguments rather than simply reproducing facts allows for new ways of testing academic success, and at the same time fosters ideas of combining more alternative teaching approaches like PBL with competence-oriented testing.

PAPER PRESENTATION

Research synthesis on the effectiveness of early education programs focused on social development

Franziska Egert, German Youth Institute, Germany; Andrea G. Eckhardt, German Youth Institute, Germany

A growing body of evidence reinforces the assumption of the positive impact of early childhood education programs on the individual development of young children. While (quasi)experimental research findings clearly indicate positive effects on cognitive and academic achievement, the effects of early education programs on the social development are inconsistent, ranging from positive to negative. Therefore, the research synthesis examines to what extent center based childhood education or specialized trainings in early education programs affect the social emotional development of children birth to six years of age. To obtain eligible studies published between 1960 and 2010, electronic search in international databases and hand search in reviews and renowned journals was conducted. An extensive coding scheme was developed a) to retrieve relevant information on study design, program characteristics, structural features of center based care settings as well as child characteristics and, further, b) to cluster and characterize the studies included in the research synthesis.

The research synthesis presents eligible studies that provide sufficient findings on the impact of early childhood programs. The synthesis contributes to existing knowledge and organizes the current state of the art with an emphasis on type and quality of studies. Furthermore, it provides lineages of research from 1960 to 2010. The findings

summarize the evidence of effectiveness of education programs and deduce principal contributions on structural program features for policy makers and child care providers.

Aims

Over the last decade, a number of studies had been conducted that investigate the impact of early childhood programs on child development. In general, findings indicate positive effects on cognitive and academic development. The impact of early educational programs on social development are, however, less conclusive. Results from (quasi-)experimental studies rang from positive effects to negative effects.

In order to provide a better understanding of the inconsistency, a research synthesis was conducted. The synthesis targets on (quasi-)experimental studies that assess the effects of various early childhood programs on the social development of children birth to six years of age. It aggregates the evidence of program effectiveness of research conducted between 1960 and 2010. Focused categorization of eligible studies were used to gain a systematic overview of relevant research and to explain differential effects due to study design, program features, child care setting and child characteristics. The purpose of this presentation is a) to depict the search process and b) to present the findings of the research synthesis by characterizing eligible studies.

Methodology

The research synthesis was conducted to provide detailed information on the state of the art in the field of early childhood education program effectiveness. The methodological framework of the research synthesis consists of five major steps.

First, an electronic search in the databases ERIC, PsycINFO, Francis, BEI, AEI, ProQuest Dissertations and Theses, WISO and FIS and, in addition, a hand search of publications was conducted and approximately 3.000 citations found. Secondly, titles and abstracts of the citations found were reviewed in terms of a) having an (quasi-) experimental design, b) evaluating early education programs that target at the social development of children under 7 years, and c) using quantitative assessment instruments. In a third step, full papers of the citations were screened with a short form using 21 selective criteria. Studies had to fulfil scientific inquiries with regards to study design, assignment and matching procedure, outcome measurements, sample characteristics and program features to be included in the synthesis. Approximately 70 studies met the selective criteria Fourth, the relevant literature was reviewed with an extensive coding scheme with 79 questions that extract more detailed information on the studies. The whole reviewing and screening process was conducted by two independent reviewers; disagreements were solved through discussion. In a fifth step, the relevant studies were analyzed and categorized with regards to information gathered in the extensive coding scheme.

Findings

The electronic search and hand search of publications resulted in 3.087 findings of relevant publication. After titles and abstracts were screened from all citations 724 publications were identified. From these approximately 70 studies met the selection criteria to be included in the research synthesis.

It has to be noticed, that quite a number of studies had to be excluded during the coding process because of missing comparison groups or insufficient information on statistical analysis. The following synthesis of study characteristics is based on the 19 results. Findings from the complete sample will be presented at the conference.

Publication characteristic: Publication years of studies relevant for the synthesis range from 1982 to 2008. However, most of the studies (70%) are published in the last 15 years. The majority of studies (80%) of the studies were conducted in North America (13 in the United States and 2 in Canada) while 20% were accomplished in Europe (3 in Germany and 1 in Sweden). About one third of the studies are characterized as unpublished (e.g., governmental reports, dissertations and thesis). The inclusion of unpublished papers is important to prevent and reduce publication bias. Because of the high ratio of unpublished papers included, screwed results caused by a lack of unpublished findings are not expected.

Study design: Most accurate estimations of the program effectiveness can be derived from random-assigned controlled experiments. Nevertheless, the current state demonstrates a lack of accurate experimental designs, because only 3 out of 19 studies used an experimental design with random assignment. All of them were conducted in the United States. Focusing on the participants, the sample size of studies included in the synthesis reach from 40 children to 3.376 children. Aggregating the data of all relevant studies, the overall sample consists of N = 9.496 children. Nevertheless, most of the studies (17) had child outcomes measurements at age 3 to 6, whereas only two

studies offered outcome data below the age of three. Due to the lack of studies aiming at children below three years, it is not possible to synthesize general program effectiveness based on the findings of this age group.

Early education program and the child care setting: About one third of the child care programs evaluations (N = 7) included in the syntheses aim at children at risk, all of the programs were conducted in the United States of America. Children at risk can either be disadvantaged due to socioeconomic status of the family, migration background or due to developmental risks of the children or a combination thereof (not including children with physical or mental impairment). The other two thirds of the studies do not aim at a specific group of children. About half of the study participants are cared for in mixed age groups (N = 9), ranging from 0-6 years (child care centers ranging from 0-6 years or German Kindergarten ranging from 3-6 years) or homogenous groups (preschool or Pre-k serving 4 year olds and kindergarten serving 5 year old children; N = 10).

Theoretical and empirical significant evidence based conclusions are necessary for policy decision makers and child care providers to offer appropriate and effective services for young children. The research synthesis summarizes the evidence of effectiveness of early childhood programs by reviewing the state of the art across-the-board. Furthermore, it provides particular knowledge of structural program features that impact the level of effectiveness which lead to improved child outcomes.

PAPER PRESENTATION

Who Benefits from Meta-cognitive Instruction and Under What Conditions?

Tova Michalsky, Bar-Ilan university, Israel; Zemira Mevarech, Bar-ilan University, Israel

The purpose of the present study is twofold: (a) to examine who benefits from meta-cognitive instruction and under what conditions; and (b) to analyze the meta-cognitive processes that higher and lower achieving, activate under the different conditions. The present study is a continuation of a previous study (Author, 2007) in which we examined the differential effects of meta-cognitive support provided at different phases of elementary school students reading scientific texts: before (beMETA), during (duMETA), after (afMEA), or without meta-cognitive support (noMeta). In the present study, we focused on the differential effects of these methods on higher and lower achievers' scientific literacy, and we analyzed the meta-cognitive processes that the pupils indeed activated under the different conditions.

Theoretical Framework

The main goal of the current science education reform is the enhancement of science literacy for all students. Science literacy (SL) involves the abilities to comprehend scientific phenomena (the big ideas) and to communicate these ideas to others (PISA, 2006.). Clearly, reading scientific texts plays an essential role in enhancing science literacy, because in reading students must learn how to access, evaluate, and interpret scientific information from books, periodicals, databases, electronic communication systems, and other resources (National Research Council [NRC], 1996). It is widely believed that reading comprehension and reading strategies could be enhanced by explicit meta-cognitive instruction implemented by the regular classroom teacher (Author et al, 2005, 2007; Simonsen & Singer, 1992). Although the effects of metacognitive instruction has been documented (Author et al, 2005, 2007) many research questions are still open. In particular, who benefits from meta-cognitive instruction and under what conditions? The specific format of the meta-cognitive instruction and its potential transferability are not fully known. The purpose of the present study is threefold: (a) to examine the different conditions under which metacognitive instruction is most efficient in enhancing SL (b) to compare the effects of this conditions on higher and lower achieving students' SL; and (c) to analyze the meta-cognitive processes that higher and lower achieving students activate under the different conditions.

Research Design

Four research condition were employed: metacognitive instruction – before reading (beMETA), during reading (duMETA), or after reading (afMETA) – and a control group received none (noMETA). The metacognitive instruction was based on Mevarech and Kramarski's (1997) IMPROVE method.

Participants - Participants were 108 fourth grade pupils (mean age: 9.5 years, SD = 0.77) who studied in four heterogeneous classes, randomly selected from four Israeli elementary schools.

Data collection – All students were pre- and post-tested on Israel national, standardized test based on PISA (Organization for Economic Co-operation and Development, 2002) science literacy tests (SLT). The students were asked to 'think aloud' continuously while they were answering the pre and post tests. All 'thinking aloud' protocols were audio-taped and transcribed verbatim.

Data analysis –quantitative analyses: The SLT included 15 items: 9 open-ended questions and 6 multiple-choice items such as "What did the pupils want to research in this experiment? (a - The effects of light on the beans' seeds, b - The effects of the number of seeds on the beans' growth, c - The effects of the amount of water on the beans' growth, or d - The effects of the ground on the beans' growth). Each item was scored as either 1 (correct) or 0 (incorrect), with the total score ranging from 0-15. Inter-judge reliability, was assessed by two experts in science education, the reliability coefficients ranging from $r = .82$ to $.95$ for all skill dimensions.

Qualitative analyses- the analysis of "thinking aloud" data followed Marshall and Rossman's (1999) four stages, namely, organizing the data, generating tentative themes, testing the emergent themes, and searching for alternative explanations. In doing so, data analysis crystallized participants' metacognitive process during reading scientific text.

Results

The quantitative analysis indicates significant main effects of science literacy for both the learning conditions ($F(3,100)=6.38$, p Also the interaction between learning conditions and achieving groups was significant ($F(3,100)=15.24$, p The analyses show no significant differences between conditions for the higher achievers, whereas the lower achievers in the afMeta significantly outperformed their counterparts in the beMeta, who in turn significantly outperformed their counterparts in the duMeta, whereas the noMeta students achieved the lowest mean scores. For the lower achievers the main effect for time and the time*treatment interaction were statistically significant for all five components, $MSe = 16.21$, $F(1, 41)$, p $\eta^2 = 0.46$ and 31.25 , respectively; formulating hypotheses, 92.36 , $\eta^2 = 0.43$ and 37.12 , $\eta^2 = 0.31$, respectively; identifying dependent variables, 122.32 , $\eta^2 = 0.51$ and 43.25 , $\eta^2 = 0.35$, respectively; identifying independent variables, 146.14 , $\eta^2 = 0.57$ and 48.34 , $\eta^2 = 0.37$, respectively; and describing results and drawing conclusions, 101.21 , $\eta^2 = 0.48$ and 37.68 , $\eta^2 = 0.32$, respectively. Post hoc analyses of the lower achievers adjusted mean scores based on the pair-wise comparison t-test indicated that on the SLT all five components (describing phenomena, formulating hypotheses, identifying dependent variables, describing results and drawing conclusions), the afMETA group statistically significantly outperformed all other groups; the beMETA research group statistically significantly outperformed the duMETA group; and the noMETA group attained the lowest mean scores (all p values)

The qualitative analysis provides deeper understanding of these findings. It focuses on the meta-cognitive processes that higher and lower achievers indeed activated in the different conditions. The qualitative analyses revealed two interesting phenomena: (a) higher and lower achievers activate different kinds of meta-cognitive processes; and (b) the exposure to the different kinds of meta-cognitive support indeed resulted in the activation of different kinds of meta-cognitive processes (see table 1).

Educational Significance

The study has both theoretical and practical implications. Theoretically, the study shows how young children at the age of fourth grade pupils employ metacognitive strategies under different conditions. In addition the study indicates in what way higher achievers differ from lower achievers. Practically, the study provide evidence on efficient condition in developing SL in elementary schools.

References

Mevarech, Z. R., & Kramarski, B. (1997). IMPROVE: A multidimensional method for teaching mathematics in heterogeneous classrooms. *American Educational Research Journal*, 34, 365-394.
Marshall, C., & Rossman, G. B. (1999). *Designing qualitative research* (3rd ed.). Thousand Oaks, CA: Sage.
Simonsen, S., & Singer, H. (1992). Improving reading instruction in the content area. In S.J. Samuels & A.E. Farstrup (Eds.), *What research has to say about reading instruction* (2nd ed., pp. 200-219). Newark, DE: International Reading Association.

PAPER PRESENTATION

Accuracy of Immediate and Delayed Judgments of Learning in Worked Examples and Problem Solving Tasks

Martine Baars, Erasmus University Rotterdam, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Fred Paas, Erasmus University Rotterdam, Netherlands; Anique de Bruin, Maastricht University, Netherlands

The assessment by a student of how well information is learned is called a judgment of learning (JOL). Only with an accurate JOL can a learner judge accurately what information needs to be restudied and how study time can be allocated efficiently. In Experiment 1, primary school children in grade 3 engaged in solving arithmetic problems, gave immediate or delayed JOLs and rated their invested mental effort. It was found that immediate JOLs were more accurate than delayed JOLs. Moreover, participants in the immediate JOL condition more often chose to restudy

problems they did not manage to solve during the first test, suggesting more efficient study time allocation. Whether this also positively affected learning could not be established due to lack of learning gains in both conditions. In Experiment 2 it is investigated whether these findings can be replicated with secondary education students and worked examples are included to investigate effects on learning.

Research has shown that students' judgments of what information they have or have not yet learned play an important role in self-regulated learning: these judgments guide study time allocation and subsequent restudy choices (Metcalfe, 2009), and as a consequence, need to be accurate to result in optimal study choices. Research on Judgments of Learning (JOLs) has mainly focused on language learning tasks (e.g., word pairs or texts; see Thiede et al., 2009). Immediate JOLs are given immediately after studying an item (e.g., text or word pair), whereas delayed JOLs are provided after studying several items. By comparing the JOLs to the performance on those items on a subsequent test, their accuracy can be measured. Research on word pairs has shown higher accuracy of delayed JOLs prompted by the first word of the word pair (Nelson & Dunlosky, 1991). This "delayed-JOL effect" was not found, however, for learning texts with JOLs prompted by the title of the text (Maki, 1998). When providing learners with additional instructions such as to generate keywords (Thiede et al., 2005) or summarize the texts (Thiede et al., 2003), they are able to establish the accessibility of information from the text at a delay, and delayed JOLs become more accurate than immediate ones. Little is known about JOLs in the kind of procedural problem solving tasks typically seen in math and science curricula. Because self-regulated learning is also considered important in those domains, we aim to investigate JOLs in problem solving tasks. Problem solving differs from texts and word pairs in important ways. A JOL about problem solving concerns knowledge of a procedure. Learners are not supposed to judge whether they have learned the answer to this particular problem, but rather, should judge whether they know the solution procedure required for solving this type of problem.

Consequently, as with texts, only a "title", that is, a description of the problem type, is available when making a JOL. Therefore, we hypothesized that as in texts without any additional instructions, immediate JOLs would be more accurate than delayed JOLs with problem solving tasks. Experiment 1. Participants were 76 Dutch third graders who were randomly assigned to either the Immediate ($N = 35$) or Delayed ($N = 41$) JOL condition. The study was run in group sessions in classrooms (both conditions present in each session). It consisted of five phases: pretest, learning phase, first test, restudy, and second test. In the learning and test phases, the children were asked to solve four arithmetic problems, one of each of the following types: addition without carrying, addition with carrying, subtraction with borrowing tens and subtraction with borrowing tens and hundreds. During the learning phase, the children provided JOLs on a 5-point rating scale (Dunlosky & Lipko, 2007; Thiede, et al., 2003) immediately after each problem or after all four problems, depending on their assigned condition. At the end of the learning phase children could indicate which problems they would like to solve again (cf. restudy in research with texts or word pairs). Subsequently, they completed the first test, were allowed to 'restudy' problems, and completed the second test. JOL accuracy was measured by means of gamma correlations between JOLs and first test performance.

Accuracy of restudy choices was measured by comparing whether a problem was chosen for restudy or not, to performance on the first test (i.e., if a problem was not chosen for restudy, 1 point was given when it was performed correctly and 0 points when it was performed incorrectly; vice versa if a problem was chosen). A t test performed on the JOL accuracy data revealed higher accuracy in the immediate JOL condition than in the delayed JOL condition ($t(74) = 2.05$, $p = .04$, $r = .23$), which confirmed our hypothesis. For the analysis of restudy choice accuracy, data from half of the participants had to be excluded because they did not restudy only those problems they had indicated. There was a significant difference between the conditions in restudy choice accuracy, $t(36) = 2.29$, $p = .03$, $r = .36$: Children in the immediate JOL condition made more accurate choices than children in the delayed JOL condition. This higher accuracy of study choices did not lead to better learning outcomes, because no learning gains were found in either condition. Since the children in Experiment 1 were quite young (i.e. 8-10 years), the procedure of giving delayed JOLs based only on the titles of problems might have been too difficult.

To establish whether age affects the accuracy of JOLs prompted with the title of a problem, secondary school students will be involved in a second experiment on JOLs and problem solving tasks. Furthermore, to be able to investigate the effect of restudy choices on learning gains, a worked-examples condition will be added: Research on the worked-example effect has shown higher learning gains of instruction consisting of examples compared to problem solving for novices (Sweller, 2006; Paas & Van Gog, 2006). Experiment 2. Approximately 120 Dutch secondary education students will participate in this experiment. A 2x2 factorial design with factors JOL (Immediate vs. Delayed) and Problem Format (Worked Examples vs. Problems) will be used. Students will be randomly assigned to one of the four conditions. The study will be run in group sessions in classrooms (all conditions present in each session). Consistent with Experiment 1, there will be five phases: pretest, learning phase, first test, restudy, and second test. In the learning and test phases, the students will solve/study problems about electrical circuits and during the learning phase

they will provide JOLs immediately after each problem or once after all problems, depending on their assigned condition. It is hypothesized that immediate JOLs will be more accurate than delayed JOLs, that students in the worked examples condition show greater learning gains, and that accuracy of restudy choices positively affects learning gains—at least in the worked examples condition. Data collection is finished in 2010 and results will be available well before the conference.

PAPER PRESENTATION

Promoting Metacognition in Industry Courses for Trainees in Lower Level VET programmes

Nadine Kipfer, IFFP, Switzerland; Ursula Scharnhorst, IFFP, Switzerland; Nicole Grolimund, Eidgenössisches Hochschulinstitut für Berufsbildung, Switzerland

Observations in industry courses with trainees in lower level vocational education and training (VET) programmes showed that they are rather passive learners. Previous research in vocational schools showed that a metacognitive training helped these trainees to become more strategic and to perform better in school tasks. The present research involves the development of a metacognitive training embedded in industry courses to support the acquisition of occupational knowledge and skills of car mechanic assistants. We expect the training to foster the apprentices' use of cognitive and metacognitive strategies in learning and problem solving. It should further enhance the trainers' efficacy in offering differentiated forms of support and guidance. Multiple research steps were conducted: (1) Field observations helped to understand the particular learning and teaching context of industry courses and to identify the occurrence of difficulties. (2) An online questionnaire was administered to assess the perception of trainers concerning trainees' cognitive and motivational learning difficulties. Trainers were also asked to describe their usual instructional approach. These first two steps allowed to identify which strategies should be trained and how their use may be fostered. (3) In collaboration with the trainers, different training components were developed, which they can integrate in their occupational-specific goals. Finally, the trainers implemented the training in their industry courses. (4) First effects have been analysed. In the paper we will present and discuss the developed metacognitive training components and first qualitative results regarding their use by the trainers.

Swiss VET programmes comprise theoretical courses at vocational school, work-based training in a host company and industry courses. The latter combine theoretical and practical aspects of VET and are also a part of the final certification. The purpose of industry courses is to instruct the competent use of machines and tools of the specific trade by teaching the trainees the corresponding knowledge and skills. Besides, soft skills (methodological, personal and social competencies) should be fostered.

Our research focuses on competencies taught in industry courses for car mechanic assistants. 'Car mechanic assistant' is one of the newly created occupational profiles in Switzerland which is trained in a two-year, lower level, VET programme.

Trainees in industry courses are often expected to solve tasks, which are organized in work stations, in an autonomous way. First observations showed that they often have difficulties to self-regulate the corresponding learning and working processes by using effective strategies to plan, monitor and control their problem solving and memorize it. In other words, they are often too passive learners.

Concerning the trainers, our observations revealed that they do not sufficiently encourage the trainees to use strategies and to develop their metacognitive awareness. Their support often focuses on the product of the tasks and not enough on the learning and problem solving processes.

A previous quasi-experimental research (Berger, Kipfer, & Býchel, 2009) showed that a metacognitive training in the vocational school setting helped the trainees to become more strategic learners and to be more aware of their own cognitive functioning in classical school tasks (e.g. mathematical and text comprehension tasks). However, it was pointed out that these positive effects may be limited and their transfer on practical problem solving contexts (e.g. at the workplace or in industry courses) was not assessed.

Considering these limitations, we adopted a design-based research approach to develop a metacognitive training in collaboration with industry course trainers so that the training components can be embedded or blended into their occupation-specific and practice-oriented training programme. The embedded metacognitive training should improve teaching and learning in industry courses: The trainees should become more strategic learners if they follow

such a training. And trainers should become more competent in fostering cognitive and metacognitive strategies of their trainees besides teaching specific course contents.

Different research steps were conducted: (1) Detailed exploratory observations of teaching and learning in industry courses were undertaken. These observations were discussed with trainers to identify strengths and also major weaknesses of trainees. (2) Further, 32 trainers, who are currently teaching car mechanic assistants in industry courses, completed a questionnaire about their perceptions of the trainees' cognitive and motivational learning difficulties as well as about their own instructional approach. The results indicated which strategies should be trained and how their use may be encouraged. (3) Two working groups composed of researchers (experts of metacognitive theory and intervention) and vocational trainers (experts of occupational practice) were established. They regularly met to discuss useful and possible changes in the teaching and learning arrangement of industry courses, thus trying to adapt and enrich the trainers' instructional approach. They also developed a script for incorporating metacognitive training components directly into the content-based, practical learning goals of the industry courses. (4) Finally, the trainers implemented these new components in their courses and the effects on teaching and learning were assessed. Multiple instruments were used to assess the effects and the practicability of this training: (A) Each trainer followed a group of trainees (approximately 10) during 8 days. (B) Each day, researchers interviewed trainers about the experiences done of the current day. (C) At the end of the 8 days, they were interviewed about their experiences in implementing the metacognitive training. (D) The trainees answered a metacognitive questionnaire before and after the 8 days of intervention. (E) The trainees were also interviewed after the solution of a specific practical task. (F) The training sessions were videotaped and coded according to an observation grid. A total of 40 apprentices from four different industry course centers participated in the study.

The paper will focus on the developed metacognitive training components and on first qualitative data concerning trainers' efficacy to implement and promote the use of metacognitive training components.

PAPER PRESENTATION

Is it helpful to force readers to search an available text? Effects of comprehension skills and JOLs

Amelia Mana, University of Valencia, Spain; Eduardo Vidal-Abarca, Universidad de Valencia, Spain

This paper examines whether forcing readers to search information in the text enhances their performance on comprehension questions. Furthermore, we are interested in study if comprehensions skills and the reader's judgments of learning (JOL) moderate that effect. To do this, we conducted an experiment in which 18 skilled and 17 less-skilled readers from 8th grade read two texts and answered eight questions per text on a computer using Read&Answer, a software tool that records the whole text-reader interaction (i.e. reading sequence). After reading each question, students rated their confidence about giving the right answer using a scale from 0 (I'm completely unsure to be able to give the right answer) to 100 (I'm completely sure to give the right answer). Students were randomly assigned to be in either the Non-Forced condition (n=18), where they were told that they were free to refer back to the text whenever they wanted, or the Forced condition (n=17), where students were required to refer back to the text in all questions. Results showed that both high and less-skilled readers in Forced condition outperformed readers in Non-Forced condition, showing a facilitative effect of forcing readers to search in both skills levels. However, this effect was different depending on the JOLs, being especially helpful for medium-level JOLs (40%-60%). On-line data of search process allows us to explain the reasons of to force to search effect

Answering questions from an available text has specific metacognitive demands due to the high level of interaction between the reader, the text and the questions, which involves monitoring and self-regulation processes (i.e. whether to search in the text or not, or what information to search). In a recent study, Vidal-Abarca, Mana, Gil & Martínez, (2009) found that readers seem to have self-regulation problems. Readers often decided not to search the text even though they were not certain to give the right answer, which seems a risky decision. The current work sought to test whether forcing readers to search the text after every question would facilitate their comprehension, and whether reading skill and their certainty of giving the right answer without re-reading the text moderates this benefit.

Comprehension monitoring has been investigated within the framework of the Judgments Of Learning (JOL) paradigm (Maki, 1998), in which students assess their level of learning or comprehension after studying some information and then they perform a learning task. JOLs predict the students' decisions to search the text, which may also explain performance (Thiede, Anderson & Theriault, 2003). In a previous study Vidal-Abarca, et al. (2009) found that high-skilled and especially less-skilled readers often decided not to search (around 50% and 70% of the time respectively) when they were not totally sure about providing the correct answer (JOLs 40-60).

Our specific interest in this study was to examine in detail the effect of forcing readers to search the text on final performance and to analyze whether comprehension skills and JOLs modulate this effect. We expected that forcing readers to search would be helpful for both less and high-skilled readers and we also expected different benefits from different JOLs.

Method

Eighteen high-skilled and seventeen less-skilled readers from 8th grade read two texts and answered eight questions per text. After reading each question, they made a JOL by responding to the following question: "How sure do you feel to give the right answer to this question without rereading the text?", though students knew they would have the text available. Students had six options from 0 (I am completely unsure to be able to give the right answer) to 100 (I am completely sure to give the right answer), using intervals of 20 units. Then, students in Forced condition had to search the text in all questions whereas students in Non-Forced condition were free to search the text at their will. Students performed the task on a computer using software Read&Answer (Vidal-Abarca et. al, in press) which recorded readers' actions (i.e. search decisions, what information were read and the final response)

Results and discussion

As we had predicted, readers in Forced condition ($M=10.35$; $SD=2.51$) marginally outperformed readers in Non-Forced condition ($M=8.66$; $SD=2.65$), $F(1, 31)=3.923$, $p=.057$, $\eta^2p^3=.11$. High-skilled readers ($M=10.55$; $SD=2.5$) also outperformed less-skilled readers ($M=8.35$; $SD=2.45$), $F(1, 31)=7.095$, $p^3=.19$, with no effect of interaction. Thus, we can conclude that forcing readers to search in the texts is beneficial for both less and high-skilled, because both groups improve their performance in forced condition. Our results also showed that the benefit of forcing students to search depends on the level of JOL (see fig. 1). For low-level JOLs (0-20), forcing readers to search was not helpful since the scores distribution (scores 0, 0.5 and 1) was the same in Forced condition than in Non-Forced condition for both groups ($X^2(2, 81)=.903$, $p=.637$; $X^2(2, 72)=.301$, $p=.860$, less and high-skilled respectively). For intermediate-level JOLs (40-60), forcing readers to search was helpful for both groups because they obtained significantly better scores (more scores 1 and less 0) in Forced condition than in Non-Forced condition ($X^2(2, 111)=9.254$, p $X^2(2, 85)=6.106$, p $X^2(2, 131)=10.691$, p Force condition are explained by the increase of searching opportunities, since in Non-Forced condition readers decided not to search less than 50% of the times in medium JOLs and high-skilled only 8.5% in high JOLs. Thus, forcing high-skilled readers to search is always helpful, while forcing less-skilled readers to search is only helpful in medium JOLs.

Detailed analyses of readers' behaviour when they search the text, more specifically the strategy of "using relevant information" (going directly to answer the question after reading a relevant piece of information) may explain the benefit of forcing readers to search. Forcing readers to search did not affect the frequency for readers to visit relevant information (high-skilled 74% and less-skilled 62%). However it affects the usefulness of using that information; only in Forced condition high-skilled readers, when used relevant information, obtained significantly better scores than less-skilled ($X^2(2, 203)=15.546$, p

In conclusion, forcing readers to search information in the text helps them to get better comprehension scores; however comprehension skills and JOLs modulate this effect. Forcing readers to search is helpful almost always for high-skilled readers and only helpful in intermediate-level JOLs for less-skilled readers. Furthermore, forcing high-skilled readers to search helps them to better interpret relevant information.

Maki, R.H. (1998). Test Predictions over Text Material. In Hacker, D.J.; Graesser, A.C. and Dunlosky, J. (Eds.). *Metacognition in Educational Theory and Practice*. (pp.117-144) Mahwah, N.J.: Lawrence Erlbaum Associates
Thiede, K. W., Anderson, M. C. M. & Theriault, D. (2003). Accuracy of metacognitive monitoring affects learning from texts. *Journal of Educational Psychology*, 95 (1), 66-73.

Vidal-Abarca, E., Maóá, A., Gil, L. and Martínez, T. (2009) Monitoring the decisions to search in the text in question-answering activities: Differences between good and poor comprehenders. 13th Biennial EARLI Conference. Amsterdam. August

Vidal-Abarca, E., Martinez,T., Salmerón,L., Cerdán, R., Gilabert,R., Gil, L. Maóá, A. Llorens, A. & Ferris, R. (in press) Recording online processes in task-oriented reading with Read&Answer. *Behavior Research Methods*

PAPER PRESENTATION

Enhancement of students' reading motivation and reading activity

Katrin Arens, University of Gottingen, Germany; Rainer Watermann, University of Goettingen, Germany;
Marcus Hasselhorn, DIPF, Germany

This study deals with the issue how to promote students' reading motivation after the transition from primary to secondary school with a school-based intervention. Respective interventions might have to facilitate students' needs for competence, autonomy, and relatedness as preconditions of intrinsic motivation stated by self-determination theory. However, reading motivation is shown to be primarily predicted by reading achievement. Thus, the implementation of skill development techniques fostering students' need for competence might be sufficient to promote students' reading motivation. In a pretest-posttest-follow-up design, three literacy training conditions were realized in a German secondary school attend by girls only. In order to promote students' need for competence, the teacher of one class directly taught several reading strategies. In a second class this literacy training was combined with an extended form of jigsaw, which was expected to facilitate all three needs described in the self-determination theory. A third class served as a control group. Both forms of literacy instruction were capable of increasing students' reading motivation in the short term. However, only the teacher-directed condition also showed a significant effect on reading activity. At follow-up the groups did not differ with respect to students' reading motivation and reading activity. The results hint again at the unjustified liability to overestimate the potency of cooperative learning methods in order to foster students' motivation. In fact, the effectiveness of cooperative learning seems to depend on the concomitant learning conditions.

Due to the decrease of students' reading motivation and reading activity after the transition from primary to secondary school (e.g. Jacobs, Lanza, Osgood, Eccles & Wigfield, 2002), school-based interventions are requested to counteract this unfavourable development. However, there is still a debate on the classroom practices and instructional methods suited to foster students' reading motivation after the transition to secondary school. According to self-determination theory (Deci & Ryan, 2000) intrinsic motivation depends on the satisfaction of needs for competence, autonomy and relatedness. Consequently, learning environments facilitating these needs might enhance students' reading motivation. However, it has been shown that students' reading motivation is primarily influenced by reading achievement (McElvany, Kortenbruck & Becker, 2008). Accordingly, skill development techniques emphasising students' need for competence might be sufficient to promote students' reading motivation.

The purpose of this study was to conduct initial steps for testing which of these both approaches might be adequate to enhance students' reading motivation during the first months after the secondary school transition. As in Germany the transition to secondary school takes place after the 4th grade, 5th grade students of a girls-only school were randomly allocated to one of three literacy training conditions. These different forms of literacy training were realised by the teachers over about six weeks immediately after students' transition to secondary school. In one class the teacher directly taught five reading strategies in order to develop students' literacy skills facilitating students' need for competence in turn. In the second class ($N = 27$), this skill development technique was embedded in a learning environment prone to satisfy all three basic needs stated by self-determination theory. For this purpose the literacy training was combined with an expanded form of the cooperative learning method of jigsaw. The classical form of jigsaw was used first, since it has been empirically shown that it is suited to foster students' intrinsic motivation through its positive impact on the three basic needs described in self-determination theory (Hänze & Berger, 2007).

The classical way of jigsaw was extended twofold: To augment the probability to satisfy students' need for competence, teacher-directed lessons were included. Secondly, a practical phase was supplemented, during which students were asked to exercise the instructed reading strategies in teams. This practical phase was assumed to facilitate students' need for autonomy, competence and relatedness simultaneously. A third class served as a control group ($N = 28$), for which the reading instruction method and contents of literacy lessons were not predetermined. The students' level of intrinsic reading motivation and reading activities were assessed in a pretest-posttest-follow-up design using psychometrically sound measures of PISA 2000.

Analyses of covariance with teaching condition as between-subject factor were conducted. In order to differentiate between short-term and long-term effects two steps of analyses were conducted. First, posttest scores of reading motivation or reading activity were taken as dependent variables with pretest scores as a covariate. In the second step follow-up scores were examined controlling for pretest and posttest data. In view of the small sample size the level of significance was set at $\alpha = .10$. With posttest reading motivation as dependent variable the effect of teaching condition marginally failed to gain statistical significance ($F [2,68] = 2.24, p = .12$). Nevertheless, pairwise post-hoc analyses revealed that both forms of literacy instruction were capable of enhancing students' reading motivation in the short term with no significant difference between the two experimental conditions themselves. In the second analysis of covariance based on follow-up data there was no significant effect of teaching condition on reading motivation ($F [2, 63] = 0.25, p = .78; n.s.$). With respect to reading activity a slight superiority of the teacher-directed condition compared to the combined instruction and the control group could be shown for the short-term ($F [2, 68] = 2.41, p = .10$, partial $\eta^2 = .07$). Inspection of group mean levels indicated a decline of students' reading activity in the combined instruction and control group between pretest and posttest while it maintained in the teacher-directed

condition. In the analysis of covariance integrating follow-up assessment no group differences in students' reading activity could be shown ($F [2, 63] = 0.71, p = .47; n.s.$).

These results indicate that at least in the short term a skill-based intervention approach facilitating students' need for competence is equally capable of promoting students' reading motivation as is an extended form of jigsaw addressing all three basic needs. Consequently, methods of cooperative learning should not be one-sidedly approved as the best way of enhancing students' motivation and these results hint again at the potency of teacher-guided learning. However, this implication must not be overgeneralized, as other cooperative learning methods than jigsaw might yield superior effects on students' intrinsic motivation and the sample of this study was restricted to German 5th grade girls. Thus, further research is still necessary in order to better understand whether there are instructional tools capable of alleviating or even stopping the decline of students' reading motivation and reading activity in the first months after the transition to secondary school.

References:

- Deci, E. L. & Ryan, R. M. (2000). The "what" and "why" of goals pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268.
- Hänze, M. & Berger, R. (2007). Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning and direct instruction in 12th grade physic classes. *Learning and Instruction*, 17, 29-41.
- Jacobs, J. E.; Lanza, S.; Osgood, D. W.; Eccles, J. S. & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grade one through twelve. *Child Development*, 73, 509-527.
- McElvany, N., Kortenbruck, M. & Becker, M. (2008). Lesekompetenz und Lesemotivation. Entwicklung und Mediation des Zusammenhangs durch Leseverhalten [Reading literacy and reading motivation: Their development and the mediation of the relationship by reading behavior]. *Zeitschrift für Pädagogische Psychologie*, 22, 207-219.

PAPER PRESENTATION

Effects of motivation on transfer: A meta-analysis

Andreas Gegenfurtner, University of Turku, Germany

This meta-analysis (148 studies, $k = 197, N = 31,718$) examined effects of motivation on transfer in professional training. Based on prevailing theories in research on training motivation, the analysis included relations of transfer with motivation to learn, motivation to transfer, pre- and post-training self-efficacy, goal orientations, expectancy, and instrumentality. Results of the primary meta-analyses indicated the presence of moderator effects. Four alternative theory-driven moderator analyses tested study design artifacts with regard to instruction and knowledge type; the transfer context; time; and assessment conditions. New directions for future theory development and research are suggested, and practical implications of the findings are discussed.

1. Aims and Hypotheses

The study aimed to examine the relationship between motivation and transfer in professional training. Based on prevailing theories in training motivation research, analysis included motivation to learn, motivation to transfer, self-efficacy, goal orientations, expectancy, and instrumentality (Bandura, 1977; Dweck, 1986; Noe, 1986; Vroom, 1964). Although motivation is widely believed to be important for knowledge application and transfer (Noe, 1986; Pugh & Bergin, 2006; Renkl et al., 1996), little systematic investigations exist on the size, direction, and boundary conditions of motivation-transfer relationships. Specifically, an analysis of the boundary conditions of existing theories could contribute to future theory development. Therefore, this study also sought to identify potential moderating effects of study design artifacts. Four moderator effects were hypothesized. First, we assumed that instruction (lecture-based instruction vs. active learning; Iran-Nejad, 1990; Schwartz & Bransford, 1998) X knowledge type (declarative, procedural, self-regulatory; Schraw, 2006) would moderate motivation-transfer relationships. Second, we hypothesized that near transfer contexts would be more motivating than far transfer contexts for both social, physical, and modal dimensions (Barnett & Ceci, 2002). Third, we hypothesized that training length X measurement time would function as boundary conditions (Beier & Kanfer, 2010; Cole, 2008), with higher correlations for longer trainings and shorter time lags between the end of training and the transfer measure. Finally, we assumed that assessment criterion (transfer assessed as subsequent use, frequency of use, increased effectiveness, or correct performance) X source (self, peer, supervisor, external) would influence the size of motivation-transfer correlations, being highest for self-ratings of increased effectiveness due to the presence of self-serving bias (Mullen & Riordan, 1988).

2. Method

2.1. Database

Moderator estimation techniques available in psychometric meta-analysis seemed appropriate to address the study goal. To be included in the database, a study had to report an effect size r or other effect sizes that could be converted to r (b coefficient, t statistics, F , Z , Cohen's d). We searched the PsycINFO and Web of Science databases for the period of 1986 through 2010. We also cross-referenced previous literature reviews, and contacted researchers to send unpublished manuscripts, conference papers, or dissertations. A total of 148 articles were located and coded.

2.2. Meta-analytic procedure

We used the meta-analysis methods by Hunter and Schmidt (2004). Using full artifact distribution analysis, correlations were corrected first for sampling error and then for error of measurement. We computed population correlations, 80% credibility intervals around population correlations, and the percentage of variance explained.

2.3. Moderator analysis

Spans of the 80% credibility interval (Whitener, 1990) and the percentage of variance explained (Hunter & Schmidt, 2004) were used to detect moderator biases. Theory-driven hierarchical sub-group analyses were used to estimate confounding moderator effects.

3. Results

3.1. Study characteristics

The 148 articles reported 197 independent data sources with 376 effect sizes. Total sample size was 31,718 participants, with a mean age of 30.72 years ($SD=9.42$) and 6.88 years of work experience ($SD=6.47$). 43.62% of the participants were female ($SD=25.26$).

3.2. Estimating population correlations

Complete results of the primary meta-analyses are shown in Table 1 (appendix 1). In all motivational dimensions, the span of the 80% credibility interval and the percentage of variance explained indicated the presence of moderator effects.

3.3. Estimating moderator effects

To account for effect size heterogeneity, we conducted four theory-driven analyses of possible moderator effects.

3.3.1. Effects of instruction and knowledge type. Results indicated that, for declarative and self-regulatory knowledge, correlations between motivation and transfer tended to be higher for active learning than for lecture-based instruction. For procedural knowledge, the pattern was reversed.

3.3.2. Effects of transfer context. Results indicated higher correlations for near transfer contexts at social and modal dimensions. Contrary to our expectations, however, the pattern was reversed for the physical dimension.

3.3.3. Effects of training length and measurement time. For short trainings, correlations tended to be highest for transfer measures at immediate training end. For longer trainings, correlations were highest for measures 1 to 8 weeks post-training.

3.3.4. Effects of assessment criterion and source. Irrespective of the assessment criterion, self assessments tended to show highest motivation-transfer correlations.

4. Discussion

This meta-analysis examined the relationship between motivation and transfer in professional training. Overall, it can be concluded that motivation is an important prerequisite for knowledge application and training effectiveness (Noe, 1986; Pugh & Bergin, 2006; Renkl et al., 1996). However, the size and direction of motivation-transfer relationships was found to be moderated by study artifacts. Identification of these boundary conditions added to the understanding of motivation in professional training.

4.1. Implications for theory development

Implications for theory development are on global and local levels. On a global level, it seems that research on transfer efficiency needs to consider the profound impact of motivation that has been reiterated in this meta-analysis. Without denying the relevance of cognitive factors for transfer (Paas & Van Gog, 2008; Van Merriënboer & Sweller, 2005), motivational and affective dimensions can refine existing theory models (Schnitz et al., 2009).

On a local level, moderator analyses illustrated temporal dynamics of goal orientation. This finding is unexpected, since Dweck (1986) and others (Brett & VandeWalle, 2001) conceptualized goal orientations as stable motivational traits. This would imply a certain stability over time. Future research may further explore our meta-analytic finding of goal orientation's variance as a function of increased time lag in professional training.

4.2. Practical implications

Practical implications are significant for organizational training and for research practice. First, concerning organizational training, results indicated that traditional lecture-based trainings had high motivation-transfer relationships for procedural knowledge only; when training programs focus on declarative or self-regulatory knowledge, active learning may be more effective.

Second, concerning implications for research practice, the study identified biasing effects of study design artifacts. Decisions on assessment criteria, rating sources, and measurement times influence size and direction of motivation-transfer relationships, as does the similarity between the training and the transfer situation. Ideally, the use of longitudinal multitrait-multimethod designs may seem to help minimize the biasing effects of study artifacts, making individual research outcomes more rigorous and robust.

PAPER PRESENTATION

Relation between personal computer uses at home and achievement motivation in science

Normand Roy, University of Montreal, Canada; Roch Chouinard, University of Montreal, Canada

The aim of this study is to validate a motivational model including information and communication technology (ICT) personal uses as a predictor. Technology is now part of everyday students' life. OCDE (2006) study had shown that 90% of the students frequently use computers at home. Moreover, recent studies showed that students who use ICT at home have better grade in key subject matter (Beltran, Das et Fairlie, 2008; OCDE, 2006). To achieve the aim of this study, several auto-reported attitude scales in science and socio-demographic questions were administered to a sample of about 332 French-Canadian students (boys and girls) from five junior high-schools in grade 8th at the beginning of the school year. Cluster analyses were first conducted to create three ICT user profiles. From those profiles, achievement motivation models based on an Expectancies-values model (Chouinard, Karsenti and Roy, 2007) were tested with a multi-group structural equation. Our results showed difference between profiles. Users with various usages have higher motivation whatever uses they make of ICT. However, social-gamer users, who use ICT mostly to communicate and play games, have lower scores on motivational scales, akin to casual users. Moreover, the only negative indicator of the model is communication uses. Students in casual or social-gamer profiles who passed more time in front of a computer to communicate (chatting and emailing) also show less commitment in science. Nonetheless, teachers and parents should not think computers as a negative factor on general commitment in science, but should favour positive uses of computer at home.

Aims

Studies showed great incomes of using ICT for student in many contexts (BECTA, 2003); many variables must be studied to be able to define models and effective pedagogy with ICT. One of the key elements is to determine which factors could prevent or enable the effectiveness of the use of ICT in school. Some research groups think that the use of computers at home could greatly impact school achievement (Beltran et al., 2005; Locke and Andrews, 2004; OECD, 2003; Piette, Pons and Giroux, 2006). Studies by these groups showed emphasis on the relation between computers and grades. However, motivation could give a more global picture of the learning process and the school achievement. Researchers have showed that motivation could be linked to achievement-related behaviours, such as effort and achievement (Bandura, 1997; Pintrich & Schunk, 1996; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

Therefore, in the present study, we examine the relationship between the frequencies of use of computers at home and motivational attitudes in science.

Methodology

Participants

Data were collected in October 2005 from students who were attending five French-speaking public high schools in the Montreal area (Canada). The seven classes selected for recruitment were all regular science classes enrolled in 7th and 8th grade; all students in each classroom were asked to participate. The sample consists of 332 French-Canadian students (179 boys and 153 girls).

Procedures

The questionnaire was completed during students' science classes at the beginning of the school years. Several self-reported attitude scales from different sources were compiled into one. This questionnaire took approximately 25 minutes

Measures

Motivational scales

Six scales were used to test our achievement motivation model: Self-Efficacies in science, Mastery-Approach Goals, Performance-Approach Goals, Work-Avoidance Goals, Interest for studies in science, Commitment in science.

Self-Efficacies in science has been taken from the SMTSL Attitude Scales (Hsiao-Lin, 2005), was used to measure participants' competence beliefs ($\alpha = .72$).

Three types of goals have been measured with an instrument produced and validated by Bouffard et al. (1998). The Mastery Goals Subscale ($\alpha = .83$) entailed seven statements assessing the extent to which participants wished to master the content of their science courses. The Performance Goals Subscale ($\alpha = .68$) consisted of six statements measuring the degree to which participants set personal goals to be amongst the best in their class and to obtain high marks in science. The Avoidance Goals Subscale ($\alpha = .65$) was comprised of six statements measuring the degree to which participants set their goals to do the least possible work to pass.

To measure interest for studies in science, a new scale of six items was created ($\alpha = .88$) by the researchers.

General commitment in science represents the challenge given by a task in science. The subscale General Commitment ($\alpha = .71$) was adapted from a French version of Fennema and Sherman's (1976) Mathematics Attitudes Scales, translated and validated by Vezeau, Chouinard, Bouffard and Couture (1998), combined with items from Hsiao-Lin and his collaborators (2005).

Items from all of these scales were rated on a six point Likert-type scale, ranging from 1 ("Strongly disagree") to 6 ("Strongly agree") for motivational scales

ICT Usages

ICT usages were measured with seven different questions about how many times students use ICT for : email, chatting, word, play games, learning programs, research for personal and research for school works. Their usage was measured with a scale ranging from 1 (Never) to 4 (Almost every days).

Data Analysis

Multi-group structural equation modeling with latent variables was performed with Amos 17.0. Profiles were composed with a two-steps cluster analysis based on ICT usages (email, chatting, word, play games, learning programs, research for personal and research for school works) performed with SPSS 18.

Findings

Clusters analysis showed three profiles. The first cluster, or multi-users, reported using all types of uses more often than other students. The second cluster, or social-gamer users, was using ICT especially to communicate and play games. The last cluster, or casual users, used ICT less often than the other two profiles. Results showed some distinctions between clusters in the multi-group SEM models (multi-users/social-gamer users/casual users respectively).

Use of ICT for pedagogical applications has a positive relation with self-efficacies in science ($\beta = .24^*/.32^*/.31^*$) for all profile. Communication usage has a negative relation with interest ($\beta = -.03/-.23^*/-.09$) and commitment in science ($\beta = -.06/-.20^*/.06$), only for those of the social-gamer profile. Entertainment has positive relation with self-efficacies in science ($\beta = .16/.19^*/.25^*$).

Motivation part of the model has some similarities between profiles. Self-efficacies have high positive relation ($\beta = .66^*/.62^*/.59^*$) with mastery-approach goals. Mastery and performance-approach goals have positive relation with general commitment in science ($\beta = .06/.19^*/.25^*$) and $.86^*/.86^*/.98^*$ respectively).

Two surprising results are observed. The work-avoidance goals have no direct relation with commitment in our achievement motivation model, and therefore were removed from the final model. Moreover, interest in science has little relation on both achievement goals. We observe a negative relation between interest and performance goals only for multi-users ($\beta = -.71^*$), and a relation between interest and mastery-approach goals only for social-gamer users ($\beta = .34^*$).

Significance of the research

Our research sheds new light on personal uses for computers. It seems that the type of usage, combined with the amount of time passed in front of a computer, is related to your motivation in science. Teachers and parents should not see computers as a negative influence on school performance, but should instead think to promote pedagogical use of the computer. Negative impact of computers is mostly observed in students with a limited usage of computers: social-gamer and casual users, limited to communication uses. Our hypothesis is that good and diverse use of technology allows student to develop computer skills and facilitate learning of science. However, relation between personal use and motivation is not causal. It is difficult to determine if motivation in sciences increase ICT usage or good ICT uses increase motivation. To further investigate the subject, studies designed for more in-depth exploration

of computer usage at home would be required. Moreover, we should delve into the relation between computer uses, computer competencies and motivation at school.

PAPER PRESENTATION

Engineering Undergraduates' Goal Setting for Their Future and Its Motivational Implications

Wen-Ting Chung, Arizona State University, United States; Jenefer Husman, Arizona State University, United States; Jonathan Hilpert, Indiana University Purdue University Fort Wayne, United States

Undergraduate students are engaged in a learning process in which they are expected to explore, evaluate, and determine their majors, and invest time and efforts in the chosen profession in order to achieve anticipated future careers and lives. In the US, engineering, compared with other majors, has been identified as a field that students are most likely to switch to other majors or drop out. This study investigated engineering undergraduates' goal setting for their future, and its relationships with their future time perspective, perceived instrumentality of their coursework, self-efficacy, and perceived active learning strategy use. Our results suggested that (1) engineering students set goals in many domains their future; however, only engineering-relevant professional goals (e.g., get accepted into civil engineer's corps) rather than academic goals were associated with their reported use of deep learning strategies in engineering courses; (2) engineering students who perceived more connectedness between their current course learning and their future as engineers set more professional goals relevant to engineering. Our results imply that engineering instructors might need to consider fostering students to develop their future goals beyond academic level because it is the long-term professional goals which are mostly likely to motivate students' to actively seek meanings and gain deep understanding about their course materials. In our final paper, we will also discuss the theoretical contribution regarding the relationships between Goal setting and other critical motivational variables.

Theoretical Framework

Undergraduate students are engaged in a learning process in which they are expected to explore, evaluate, and determine their majors, and invest time and efforts in the chosen profession for achieving anticipated future careers and lives. In the US, engineering has been identified as a field that students are most likely to switch to other majors or drop out. Our research team has been interested in examining how engineering students' future time perspective (FTP) could impact their classroom behaviors as well as academic and professional trajectories.

FTP theory has been growing in popularity among educational psychology researchers (Seginer, 2009). The theory suggests that individuals mentally construct episodic future paths which guide and dictate present behaviors and decision making (Husman & Shell, 2008; Nurmi, 2005; Zimbardo & Boyd, 1999). However, there is little research designed to examine what the content of students' mental representations of the future looks like and its impacts on students' academic and professional paths. This study primarily investigated engineering undergraduates' goal setting, and its relationships with other critical motivational variables.

Research hypotheses: (1) Students who perceived more connectedness between their current learning and engineering future would report more academic and professional goals relevant to engineering. (2) Students who reported more academic or professional goals relevant to engineering would also reported that they (a) engaged more in using deep leaning strategy, (b) had higher confidence to succeed in engineering courses, and (c) perceived their current learning in engineering courses was more useful for their future; (3) Students' goal setting partially mediated the relationships between connectedness to engineering and deep learning strategy use as well as perceived instrumentality.

Methods

Participants

Participants (N=366) were recruited in a large sample of post-secondary mechanical and aerospace engineering students from a variety of undergraduate courses.

Open Ended Measures

Future Goals – Participants were asked to describe ten important future goals and list the age at which they would like to achieve those goals. We coded their personal goals using an emergent approach; six categories emerged: Academic, Professional, Monetary, Domestic, Community Building, and Personal. For the purposes of this study, we focused on professional and academic goals relevant to engineering. An Academic goal would be “to graduate”; an Engineering Academic goal would be “to graduate as an engineer.”

Survey Measures

Connectedness to Engineering– measured using an adapted version of the connectedness subscale of the FTPS (Husman & Shell, 2008). Example items: “One should be taking steps today to help realize future engineering goals.”

Perceived Instrumentality (PI) – measured using the endogenous subscale of the Perceived Instrumentality Scale (Husman et al, 2004). Example items: “I will use the information I learn in [Engineering Course] in other classes I will take in the future,”

Deep learning strategy use – measured using the knowledge building subscale of the Student Perceptions of Classroom Knowledge Building Scale (SPOCK) (Shell, et al., 2005). Example items: “In [Engineering Course], I focus on developing my own understanding of the important ideas in what I am studying or reading.”

Self-efficacy – measured using Motivational Strategies for Learning Questionnaire (MSLQ) (Pintrich et al, 1993). Example items: “I am confident I can do an excellent job on the assignments and tests in this course.”

Analysis and Results

Hypothesis 1

Bivariate correlations were conducted between Connectedness-to-Engineering and the number of Goals, either Academic (not significantly correlated, $r < .01$) or Professional (weakly significantly positively correlated, $r = .14$). To further examine whether engineering-relevant goals were correlated with Connectedness-to-Engineering, engineering relevant and non-engineering goals were separated within either professional or academic goals.

Non-engineering goals (either academic or professional) are normally distributed, but engineering relevant goals (either academic or professional) were positively skewed. Approximately half of the student did not report explicit engineering goals. For both Academic and Professional goals, students’ were split into two groups: Students who reported ANY or NO engineering related goals.

Bivariate correlations were first conducted between Connectedness-to-Engineering and non-engineering goals. As expected, the results were not significantly (non-engineering academic: $r = -.05$; non-engineering professional, $r = .04$). To determine if students who reported engineering goals also reported significantly higher Connectedness- to-Engineering, two t-tests were conducted. Students who reported engineering academic goals were not significantly different from those that did not. Students who had Engineering Professional Goals reported significantly higher Connectedness-to-Engineering, $t(364) = -3.02$, $p < .01$.

Hypothesis 2

To determine if there is a relationship between students reporting of an engineering Academic or Professional goal and the variables of interests, a series of t-tests were conducted: (1) Engineering Academic Goal: the results were significant for Self-efficacy, $t(364) = -2.06$, $p < .05$, and PI, $t(364) = -3.29$, $p < .01$; (2) Engineering Professional Goal: the results were significant for deep learning strategy use, $t(364) = -2.69$, $p < .01$, and PI, $t(364) = -2.17$, $p < .05$.

Hypothesis 3

Bivariate correlational analysis between Connectedness-to-Engineering and students’ reported strategy use and their motivational beliefs replicated previous research. Reported learning strategy use ($r = .24$), and PI ($r = .30$) are significantly related to Connectedness-to-Engineering.

These findings indicate that students who are Connected to their future as engineers are more likely to have professional engineering goals as well as to use deep learning strategies and perceive engineering courses as instrumental. We further examine the potential of students’ future professional goals to partially mediate the relationship between students Connectedness- to-Engineering and their motivational beliefs and approaches to learning.

When split into two groups, the relationship of PI to their Connectedness-to-Engineering is lower for students who reported engineering professional goals ($r = .15$, $p = .06$); who do not report ($r = .29$, $p < .01$). The relationship of deep learning strategy use and their Connectedness-to-Engineering is lower for students who reported engineering professional goals ($r = .17$, $p < .05$); who do not report ($r = .38$, $p < .01$).

Significance

Our results imply that engineering instructors might need to consider helping develop students’ future goals beyond academic level because it is the long-term professional goals which motivate students to actively seek meanings and gain deep understanding about their course materials. Our final paper will also discuss the theoretical contribution regarding the role of Goal setting and its relationships to other motivational constructs.

References

Please find the references in the uploaded appendix image.

PAPER PRESENTATION

Research Ethics Education: a descriptive map

When we have decided to realize a study on Ethic education we developed a literature review, in order to know the different perspectives using by the researchers in this field. Because of the great number of empirical approaches developed in the research practices and the different themes faced by the researchers in any topic we have decided to conduct a systematic review.

Systematic Review is used in order to determinate what is know and what is not know about a topic of interest, reflect on the processes and perspectives of the relevant body of research, explore the underlying methodological decisions and theoretical influences and suggest future directions for researchers (Paterson & Thorne, 2003).

The aim our systematic review is to know the current research landscape about ethic education. What kinds of researches are realized? Which are the theoretical frameworks the researchers take into account in developing their works? What are the predominant methods used?

The objective of the inquiry is to delineate a descriptive map of the studies in order to define ethic education from the ground-up that is describing ethic education as it is developed in the research practice.

The finding of the systematic review will be a descriptive map, which give to researchers a tool to clarify the "state of the art" on researches in ethic education and to discuss where placing ourselves as researchers in this field.

The research

This study is part of a complex theoretical and empirical research on ethic education with primary school's children. Two main focuses compose the research: a theoretical focus and an empirical one.

The theoretical focus aims to develop a theory of Ethics education grounded in the ancient Greek philosophy, with particular attention to the Aristotle's idea of Ethics and in the current Gilligan's perspective on the ethic of care. The empirical study is oriented to realize a research with children on virtues, in order to outline which kind of education enables children to develop an ethical disposition to virtues.

In order to develop this research project, from both the theoretical and the empirical side, one of the main aspects is to place our work in the current paramount of researches on this topic. From the theoretical perspective, we choose to place the project in the Virtue Ethics approach. From the empirical perspective the choice was more difficult, because of the great number of empirical approaches used in the research practices and the different topics faced by the researchers.

In order to place our study in the present research's landscape we decided to develop a literature review to know the different perspectives using in ethic education's research projects. The recent increase of sources in delivering primary studies changes the way in which researchers realize literature review on a particular topic and systematic reviews (both meta-analysis and meta-synthesis) become the new methods to reviewing the studies (evaluating and interpreting them) in order to synthesize the scientific literature.

Aim

Systematic Review (Meta-Synthesis) is used in order to determinate what is know and what is not know about a topic of interest, reflect on the processes and perspectives of the relevant body of research, explore the underlying methodological decisions and theoretical influences and suggest future directions for researchers (Paterson & Thorne, 2003).

The aim of the systematic review we have conducted is to know the current research landscape about ethic education. What kinds of researches are realized? Which are the theoretical frameworks the researchers take into account in developing their works? What are the predominant methods used?

The objective of the inquiry is to delineate a descriptive map of the studies in order to define ethic education from the ground-up that is describing ethic education as it is developed in the research practice.

Methodology

The review is conducted on primary studies, which were collected searching through Electronic databases - three databases were included in the study: ERIC, A+Education and ERC – and the research was conducted combining thesaurus's criteria - the different –subjects» that concern the moral education's category – and time's criteria – the last 5 years. The discussion of the criteria adopted is part of the presentation.

The analysis process of the articles aims to interpret and synthesize the findings in order to realized a theoretical description (comprehensive and thickly), which is useful to explain theories, methods and models used in ethic education's studies.

Findings

The result of this systematic review on the research in ethic education is a descriptive map, which outlines:

- the different perspectives in ethic education;
- a list of key words, which give an idea about what are the concepts that perform ethic education in the researches practice;
- a list of topics that concern the ethic education today.

Significance

The great number of projects in ethic education gives new efforts to the researchers in this field as well as increases the complexity of the research landscape. Which is the –quality» of these studies?

In order to answer this prime question it's firstly necessary to design a descriptive map, which gives to the researchers a paramount of what is the idea of ethic education in the research practice (i.e. approaches, methodologies and methods). The finding of the systematic review will be a descriptive map, which give to researchers a tool to clarify the "state of the art" on researches in ethic education and to discuss where placing ourselves as researchers in this field.

PAPER PRESENTATION

Figures' value and place - a learning study on arithmetic in grade seven

Mona Holmqvist, University of Gothenborg, Sweden

This study aims to describe in what way pupils in grade seven experience the base 10 positional numeration system (place-value system) before and after three different designed lessons in a learning study, each one given to one group of students (A, B and C). By analyzing the three video-recorded research lessons differences in the students' ways of developing knowledge can be answered by what actually happened in the class room. The model used in this study is learning study with three different designed research lessons, one per students group, where the results of the former is due to the developed design of the later. The design of the research lessons are based on variation theory. In total 52 students participated in three different groups (A=13, B=19, C=20) together with their five teachers and one researcher. A test was taken by the students before and after the research lesson, which included 8 questions and 5 of those have sub queries, which resulted in 23 as a total score. A delayed post-test was given the students four weeks after the research lessons. The results from the pre- and post-test show a change in learning outcome which varies in the different groups of students (A +4, B +1, C +14).. In lesson C at least one critical aspect, namely the difference between ten and tenth, hundred and hundredth, and so on this was offered the students to discern which was not offered in the other two lessons in the same distinct way.

Aim

This study aims to describe in what way pupils in grade seven experience the base 10 positional numeration system (place-value system) before and after three different designed lessons in a learning study, each one given to one group of students (A, B and C). By analyzing the three video-recorded research lessons differences in the students' ways of developing knowledge can be answered by what actually happened in the class room. When the students solve two different kinds of arithmetical tasks; how to use decimal terms in addition and decimal factors in multiplication, their knowledge on the base 10 positional system are crucial. One hypothesis is that the different ways of solving the two tasks, in which one requires knowledge about place-value, affect their possibilities in different ways. The multiplication $0.5 * 0.5$ does not require knowledge about the base 10 positional numeration system as it is possible to count the amount of decimals in the factors (two) and by that put the dot two steps to the left (0.25). But the addition of the terms 0.2 and 0.22 is difficult to solve without knowledge about the base 10 positional numeration system. Otherwise it is easy to get the sum 0.24 instead of 0.42.

Methodology

The model used in this study is learning study (Marton & Tsui, 2004) with three different designed research lessons, one per students group, where the results of the former is due to the developed design of the later. The design of the research lessons are based on variation theory (Marton & Booth, 1997), which means critical aspects of the object of learning are offered the students in different ways. This variation of in what way the features are offered gives the students different ways to experience and by that learn. In total 52 students participated in three different groups (A=13, B=19, C=20) together with their five teachers and one researcher. The learning study started with two meetings with the teachers to present the theory which the study is based, variation theory, and to plan tests and lessons. The test was given to another class to see if the questions where suitable and the time it takes to answer the questions were reasonable (10-15 minutes). The test included 8 questions and 5 of those have sub queries, which resulted in 23 as a total score. The test was taken before and after the research lesson in each group, and a delayed post-test was given the students four weeks after the research lessons.

Findings

The results from the pre- and post-test show a change in learning outcome which varies in the different groups of students. In group A, 27% of the answers were correct in the pre-test and 31% in the post-test (+4). Group B showed the less improvement – from 51% in the pre-test to 52% in the post-test (+1). Finally, in group C the results increased from 50% to 64% (+14). This was due to the finding of at least one critical aspect, namely the difference between ten and one tenth, hundred and hundredth, and so on. In lesson C this was offered the students to discern which was not offered in the other two lessons in the same distinct way. The results also show in what way the students' abilities to solve the addition and multiplication tasks develop.

Theoretical and Educational significance of the research

In previous studies, children's difficulties with base ten numeration was studied in a teacher training course (Sawada & Atkinson, 1981). The results in a study of 106 students shows that work with a nondecimal numeration system including new number symbols and names can lead to heightened awareness and appreciation of difficulties that children might have in understanding base ten numeration. In another study, preservice teachers' knowledge of decimal numeration was tested (Stacey, Steinle, Baturo, Irwin & Bana, 2001). The results showed that pre-service teachers had inadequate content knowledge of decimals and were confused about the size of decimals in relation to zero. The results of the study described in this abstract shows both how the aspects critical for learning are possible to find by examining the students' learning outcome in relation to what happens in the research lessons. It seems as the knowledge on the base 10 positional numeration system, or lack of such knowledge, are important not only to solve additions and multiplications correct, but also to understand why a multiplication with decimals ends up in a product smaller than the factors; $0.5 * 0.5 = 0.25$. If the students understand the base 10 positional numeration system and the difference between the left and right side (ten and one tenth), they might understand multiplication of decimals as a division as the term is divided several times in smaller parts. The lack of an overall comprehension seems to make it difficult even for students at later levels of the educational system, and as pre-service teachers also seem to lack this kind of knowledge it is an area important to study.

PAPER PRESENTATION

Conjoint analysis as an instrument to measure student perceptions of education quality

Margriet van der Sluis, Maastricht University, Netherlands

In this paper we apply conjoint analysis to measure students perceptions. Conjoint requires respondents to simultaneously evaluate aspects following trade offs and is therefore seen as more realistic than traditional survey methods. Our students repeatedly ranked descriptions of 4 courses, existing of 9 quality aspects with varying scores. Subsequently, the students completed a traditional survey with statements on several aspects of educational quality, including the 9 aspects used in the conjoint task. 334 students of administrative, social pedagogical and building studies, aged 17-19, participated in the study. The scores of the conjoint task, indicating the relative importance of aspects, appear to yield a different insight in the ideas of students towards aspects of education quality than the survey questions. Some aspects with high average scores in the survey, lost significance in the conjoint task, whereas other aspects gained significance. By systematically comparing both methods on subgroups we further explore the differences and argue that conjoint is a valuable addition to traditional surveys in educational research.

Conjoint analysis as an instrument to measure student perceptions of education quality AimsFor school administrators, teachers, policy analysts and educational researchers, it is important to know how students value different aspects of educational quality and what they find important. Especially in secondary and higher (vocational) education, student evaluations are used more and more to shape or improve the educational practice. Often, however, students' opinions are measured with traditional surveys, in which aspects of quality are assessed independent of each other. Shaping the educational practice though, is in fact full of trade-offs. There is a limited budget, and there are choices to be made in which part of the educational process the investment is most worthwhile. Conjoint analysis uses the principle of trade-off and might therefore do more justice to reality. This article explores the use of conjoint analysis in the field of educational quality. The aim is to find out what students find important when being forced to make choices, and to compare this with how they evaluate the same aspects in a traditional survey. MethodologyOur study uses conjoint analysis (Batsell & Louviere, 1991; Leslie & Ettenson, 2000; Neil, 1992; Jeffries & Maeder, 2005; de Wolf, 2000). In a conjoint study, a hypothetical product or service is defined in terms of a few important characteristics. Instead of valuing the characteristics separately, the respondent simultaneously evaluates and combines the information on multiple product-service characteristics.

The objective of conjoint analysis is to determine what combination of a limited number of indicators is most influential on respondent choice or decision-making. We chose to include 9 characteristics in the study. In a pre-study among students this number turned out to be manageable. We wanted the 9 characteristics to fulfill three requirements. Firstly, three in a pre-study described perspectives are reflected in the characteristics: the labor market

perspective, the educational effectiveness perspective and the social economic perspective. Secondly, the set of characteristics encompasses both process and product aspects of education. And finally, each characteristic plays a significant role in the present-day Dutch Vocational Education and Training (VET) sector. We assigned two or three possible values to each character. Participants were shown four sets of four profiles on the computer. The values were assigned to the profiles according to pre-set rules, which maximized variation in each set. Figure 1 shows an example of the profiles the participants saw on their computer screen. The question above is "Which course matches most with your idea of quality? Rank the courses according to your preferences". On the left the nine characteristics are shown. The respondents had to rank the vocational courses using the bottom four blocks with the options from 1 (the best) to 4 (the worst). Figure 1. Example of 4 profiles the participants faced on the screen.[In appendix]

To identify the impact the course characteristics on the choices of students in the conjoint task we used rank ordered logistic regression. This model interprets the 4x4 rankings assigned to the courses by our respondents as a rank ordering of choices out of a given choice set. After the conjoint task, students had to value quality aspects on a 10 point scale, in which 5 indicated 'I find this very important', 0 'neutral', and -5 'I'd rather not have this'. In the survey 37 aspects were valued, including the nine aspects that were selected for the conjoint task. Findings In the study 334 students from administrative studies, building and construction studies, and social pedagogic studies were surveyed. They completed the survey in the classroom. 56% of the students were male. The results of the both the survey and the conjoint task are seen in table 1. In the survey, teacher quality and diploma result scored highest, with a mean score of 4,05 and 3,89. The second column represents the outcomes of the conjoint task. The coefficients indicate the weight that the four participants groups placed on each of the nine quality aspects when ranking the courses.

In the conjoint task diploma result was the most important characteristic (.25) directly followed by structure (.24). Schooling hours and guiding hours in workplace learning were of minor importance for the students. The three aspects with the highest scores in the survey, teacher quality, diploma result and employers' satisfaction, are also highly valued (over .20) in the conjoint task. Furthermore, schooling hours appeared to be the least important aspect for the students in both the survey and the conjoint task. There are, however, some striking differences between both outcomes. Civic education, that scored only 0,43 in the survey, appeared to have substantial influence on the choices made in the conjoint task (.19). For the aspect guidance in workplace learning it is the other way around; it had a high average score in the survey (3,73), whereas in the conjoint task it is completely overruled by the other aspects (.03). Figure 1 shows the differences between both methods in a bar chart. Figure 2. Bar Chart. The importance of nine course characteristics according to the students in a survey compared to a conjoint task.[In Appendix] In the final paper we will further explore the differences between both methods. We will compare the results of subgroups (divided according to gender, age, study field, personality traits) on both methods.

Theoretical & educational significance 1.

This study shows how conjoint can be applied to the subject of educational quality. It explains the different steps of the conjoint study: the selection of aspects, the number of aspects and vignettes, the (digital) programming of the study and the analyzing of the outcomes. 2. Conjoint analysis is a relatively new way to examine perceptions of education quality. This study shows the differences of the conjoint analyses with the more traditional survey.

References

- Batsell, R., Louviere, J. (1991). Experimental Analysis of Choice. *Marketing letters* 2(3), 199-214.
- Lesley, L., Ettenson, R., Cumsille, P. (2000). Selecting a Child Care Center: What Really Matters to Parents? *Child & Youth Care forum*, 29 (5), 299-322.
- Neil, A. (1992), *Conjoint Analysis: A Guide for Designing and Interpreting Conjoint Studies*, Chicago, American Marketing Association, Market Research Division.
- Jeffries, C. & Maeder, D.W. (2005) Using vignettes to build and assess teacher understanding of instructional strategies. *The professional educator*. 27 (1&2), 17-28
- de Wolf, I. (2000). *Opleidingsspecialisatie en arbeidsmarktsucces van sociale wetenschappen*. Doctoral thesis, Utrecht University.

PAPER PRESENTATION

A new approach to 'text quality'

Victoria Johansson, Lund University, Sweden; Asa Wengelin, Lund University, Sweden; Roger Johansson, Lund University, Sweden

This paper is an approach to discuss the complicated measure of text quality – what do we mean by it, and what to we measure? We present a method for training reviewers to evaluate texts, and we investigate the text quality in a data

set consisting of 84 expository texts, produced in ScriptLog, by four groups: 1. University students without reading and writing difficulties (RWD), 2. University students with RWD, 3. 15-year-olds without RWD, 4. 15-year-olds with RWD.

After a training process involving both holistic and analytic methods, the reviewers evaluated the data set with unusually high interreliability (Cronbach's $\alpha = .917$). Not surprisingly, the texts by the adults without RWD were ranked the highest, followed by adults with RWD, 15-year-olds without RWD and 15-year-olds with RWD.

Further, we compared the text quality between adults and 15-year-olds without RWD, using writing speed and text length as co-variables. The results show that the quality evaluations are not dependent on either. This opens up for some new interpretations, since text quality has usually correlated with text length.

It is important that teachers or researchers, using increased text quality as evidence for development of any kind define what is meant by this notion.

In writing research, the importance of various writing process, as well as the written product is often related to text quality. Typically, text quality is related to various sets of text characteristics, e.g. text length, production rate, lexical measures, or the writer's age or schooling, and often increased text quality is seen as an important outcome of e.g. an intervention (cf. e.g. Rijlaarsdam et al, 2008). However, it is not always discussed what is meant by text quality, or how it is measured.

This paper is an approach a) to discuss the complicated measure of text quality, b) to present a method for training reviewers to evaluate texts, and c) to investigate the text quality in a data set consisting of 84 expository texts, produced using a keystroke-logging program (ScriptLog) by four different groups: 1. University students without any reading and writing difficulties (RWD), 2. University students with RWD, 3. 15-year-olds without any RWD, 4. 15-year-olds with RWD.

We engaged three reviewers (with a background including at least a master exam with linguistics; only one of them had worked as a teacher). Their task was to agree on a scale to use for judging text quality, and thereafter to identify properties, characteristic for each grade in the scale. Prior to the evaluation of the data set in our investigation, the three reviewers were trained on several sets of texts of the same type (e.g. expositorys) written by different age-groups (ranging from age 13 to adult university students; however no texts in the training data were produced by persons with RWD). In the first stage, their task was to evaluate texts on holistic grounds. The second stage was to group the rated texts, and agree on a scale to use, based on the grouping of the text. This led to a four-grade scale. The third stage was then to agree on text properties typical for each grade, and to select one or two model texts from each grade. The fourth stage was to train on a set of texts grading them using the model texts and the criteria for each text. In the fifth, and final stage, they graded the data set that we investigate in this study. The reliability between the reviewers proved to be high (Cronbach's $\alpha = .917$). This is notable, since e.g. Lofqvist (1990) report that a correlation around .70 will be considered a high agreement between teachers' judgements of student papers. The high interreliability in our study is thus a sign of that the method of working with both holistic and analytic methods to rate text quality can increase the certainty of how texts are evaluated.

When we relate the quality ratings to the four groups of writers in the data set we were interested in, we find that the texts written by the adults without RWD have the highest quality, followed by the adults with RWD. Thereafter follow the 15-year-olds without RWD and the group with the lowest quality is the 15-year-olds with RWD. This is not an unexpected result, considering the age differences between the groups, and the difficulties with text production that are typical for the groups with reading and writing difficulties. The question is whether this approach to measure text quality would have been the same if we e.g. had compared groups that were more similar in age, education or writing ability. Another question is whether the use of a more fine-graded scale would have led to a different grading.

Further, we compared the text quality between adults and 15-year-olds without RWD, using writing speed (e.g. median transitions between keystrokes within a word) and text length (e.g. number of keystrokes in the final texts) as co-variables. The results show that the quality evaluations are not dependent on text length or writing speed. This opens up for some new interpretations, since we know from other studies (e.g. Grandin & Lindskog) that text length (and thus also the ability to produce much text fast) is usually strongly correlated with text quality.

It is important to continue to discuss the notion of text quality, what is meant by it, and what contributes to an increased quality, in the light of recent changes in the educational system. For instance, in Swedish schools, a new set of additional national testing is proposed. How could children's writing development be discussed and judged if there are no reliable methods of measuring text quality? If 'text quality' is used for proving the developmental

outcome in any way, it is finally of equal importance for every researcher who uses the notion of text quality to clarify exactly what is meant by it.

References:

Rijlaarsdam, G., Braaksma, M., Couzijn, M. Janssen, T. Raedts, M, van Steendam, E. Toorenaar, A., van den Bergh, H. (2008) "Observation of peers in learning to write. Practise and research." in Journal of Writing Research
Grandin, S. & Lindskog, M. (2007) Logopeders bedomning av textkvalitet. Masterthesis in logopedics, Lund University
Lofqvist, G. (1990) The IEA Study of Written Composition in Sweden. Lund: Studia psychologica et paedagogica – series altera, nr 93.

PAPER PRESENTATION

Predicting Adolescent Truancy – Individual Judgments and Classroom Factors

Christine Saelzer, Education (IfE), Germany

Only little is known about the association of classroom characteristics with adolescent truancy. An unresolved critical question is whether high achievement standards, high workload, and high pace do protect against or increase adolescent truancy. In this study, self-reports from 3,500 Swiss middle and high school students in 202 classes (in 28 schools) were used to predict truancy. The multilevel latent covariate approach (MLC) implemented in Mplus was implemented to specify hierarchical models. These models served to differentiate between the student and the classroom level. It was found that high achievement standards were associated with a lower truancy rate at both the student and the classroom level, whereas a high pace during lessons was associated with more truancy. At the student level, the perception of low workload was an additional predictor of high truancy.

Predicting Adolescent Truancy –

Individual Judgments and Classroom Factors Research Topics and Objectives

Truancy is known to be an important predictor of premature school dropout (Rumberger, 2000). Skipping lessons is seen mainly as an individual student's behavior within an institutional context (Claes, Hooghe & Reeskens, 2009; Rothman, 2001). Focusing at the individual level, students who truant are often thought of as being academically weak and over-challenged at school (Fogelman, Tibbenham & Lambert, 1980; Tyerman, 1986). On the other hand, there is a reasonable argument that truancy may also be linked to high academic potential (Rumberger, 1987; Voss, 1966).

According to Walberg and Ahlgren (1970), learning outcomes represent a function of three distinct construct domains including aptitudinal variables, instructional variables, and environmental variables. Key to this claim is that environmental variables explain variance in learning outcomes over and above the amount of variance explained by instructional and ability variables. This paper applies Walberg and Ahlgren's theory to truancy and thus bridges a gap in truancy research by taking into account two aspects: (a) classrooms as learning contexts and (b) predictors of truancy. The focus is given to students' workload, pressure to perform, and pace during lessons. Two research questions are focused on: How can individual characteristics explain truant behavior? And how are classroom characteristics related to truancy?

Data and MethodsSample

Participants consisted of a total of 3491 Swiss seventh to ninth graders (n = 1142 grade 7, n = 1314 grade 8, n = 1089 grade 9) in 202 classes in 28 schools and their teachers and principals.

Instruments

Truancy was measured by a weighted frequency index consisting of seven items which focus on skipping single lessons, half and whole school days as well as several days in a row. Students' background factors were collected including gender, grade level, grades, class repetition, nationality, school level, and SES ([HISEI]) as well as individual and family-related scales. School characteristics were measured using structural criteria (e.g. school size, geographic situation) and students' and teachers' opinions concerning processes and classroom climate issues. Most of the scales were adapted from Eder's (1998) school study.

Analyses

For this analysis, the multilevel latent covariate approach (MLC) implemented in Mplus was adopted, which takes the unreliability of the group mean into account when estimating the contextual effect. The group average is thus treated as a latent variable. A nested multilevel model was specified using Mplus 5.2 (Muthén & Muthén, 1998-2007) in order to predict truancy from individual covariates, individual student judgments and aggregated class level (latent) covariates.

Results and Conclusions

Table 1

Most strikingly, in model 3, both pressure to perform and pace during lessons were significant predictors of truancy ($b = -.09$; $b = .12$) at the individual level and were associated with truant behavior when used as latent covariates at the class level (pressure to perform: $b = -.28$; pace during lessons: $b = .25$). Explained variance was low at the individual level (6%) and intermediate at the class level (35%). It was thus verified that shared classroom perceptions mattered for a student's decision to play truant.

Educational and Scientific Importance of the Study

Truancy is still seen as a minor problem by teachers and principals, but it is likely to become a major social problem during the next few years. The importance of truancy as a step towards school dropout is of immense social importance given the costs of students disconnecting themselves from the educational process. Understanding how truancy is related to classroom characteristics and how individuals respond to these features is useful in finding effective levers to prevent and deal with truancy as an unwanted student behavioral pattern. The level of perceived challenge is, both at the individual and the contextual level, a possible lever to prevent truancy.

References

- Claes, E., Hooghe, M., & Reeskens, T. (2009). Truancy as a contextual and school-related problem: A comparative multilevel analysis of country and school characteristics on civic knowledge among 14 year olds. *Educational Studies*, 35, 123–142. doi:10.1080/03055690802470258.
- Fogelman, K., Tibbenham, A., & Lambert, C. (1980). Absence from School: Findings from the National Child Development Study. In L. Hersov & I. Berg (Eds.), *Out of School* (pp. 25–48). Chichester: Wiley.
- Rumberger, R. W. (1987). High school dropouts: A review of issues and evidence. *Review of Educational Research*, 57, 101–121.
- Tyerman, M. J. (1968). *Truancy*. London, England: ULP.
- Voss, H. L., Wendling, A., & Elliot, D. S. (1966). Some types of high school dropouts. *Journal of Educational Research*, 59, 363–368.
- Walberg, H. J., & Ahlgren, A. (1970). Predictors of the Social Environment of Learning. *American Educational Research Journal*, 7, 153–167. Retrieved from <http://www.jstor.org/stable/1162157>.

PAPER PRESENTATION

Schooling and students' well being: a review of qualitative studies

Mara Westling Allodi, Stockholm University, Sweden

A systematic literature review of qualitative studies on the experiences and perceptions of school of Swedish children and adolescents was performed after literature searches in international and national databases. A narrative synthesis of 38 studies is presented focusing on the relationship between schooling and students' well being and mental health. Four themes were identified: general experiences (emotions, self-concept, choices); protective experiences (activities, participation, supportive relationships); risk experiences (tests, stress, school failure, negative evaluations, learning difficulties, lack of interest, negative relationships with teachers and peers); specific individual risks (disability, stigma, family problems, abuse, addiction, body image). The results are discussed in relation to developmental theories, special educational practices and current evaluation practices. The methodology of systematic review of qualitative studies applied in the field of educational research is discussed.

People's experiences and perceptions that are collected with non-experimental and qualitative studies can make a valuable contribution to an understanding of the meanings of processes and of relationships between phenomena. The object of this study was the relationships between educational experiences and students' well being and mental health. The methodologies of systematic review of qualitative research have been applied to a review of qualitative studies on Swedish children and adolescent's experiences of mental health and well being at school. The review was conducted as a part of a systematic review of research on "School, learning and mental health" performed by appointment of the Swedish Royal Academy of Sciences. The motives for doing a review of studies reporting children's and adolescents views on these matters was the ethical consideration to consider children and adolescents as subjects, having a right to express their views in matters that affect them; and the need to take account of the specific Swedish social and educational context through the experiences of the students that actively take part of it.

The aim of the review was to gather testimonies that can give indications of the experiences of mental health and well being of students in the Swedish educational system. Literature searches in several research databases with international and national publications were performed during spring 2009. A systematic screening of titles and abstracts was done on 527 references; 107 references were then screened in full text and 38 reports were judged to meet the inclusion criteria, requiring the presence of reports of children or adolescents' views, and that both aspects

of mental health and of educational factors were treated in the study. The studies included were written by authors from fifteen Universities; they consisted of doctoral dissertations, academic papers, peer-reviewed articles and reports from agencies and organisation, representing the disciplines of science of education, disability studies, psychology, public health, youth studies, social work and interdisciplinary. The studies included in the review collected the students' views by mean of individual interviews, focus group interviews, observations, texts, phone conversations, internet messages, surveys and drawings. The results from the studies that were relevant for the aims of the review are structured in four themes: general views (well being, emotions, self-concept, stress, choices); protective experiences (activities, achievement, enjoyment, mastery, relationships, participation); risk situations (tests, school failure, academic expectations, lack of meaning, lack of adaptation, conformism, alienation, relationships, victimization, exclusion); individual risk (disability, special educational settings, stigma, family problems, abuse, addiction, mental illness, body image).

The results are presented in a narrative synthesis, giving a particular weight to the direct and indirect report of children's and adolescents' own views. The theme general views is represented by sex studies. The adolescents defined mental health as emotional experiences, seen both as internal feelings and as relational feelings. Family, friends and educational environments as social and physical environments were perceived as determinants of mental health. A great number of feelings were related to school. The students expressed what characterize a healthy school environment and also that harassment and rejection at school, performance stress, worries about grades and future prospects could be threats against self-worth and self-esteem, while teachers that do not care could generate negative experiences. Various kind of stress could be described and various strategies to resist stressful situations: for instance emotional support, safety and involvement.

The educational environments can be an arena for social, cognitive and emotional experiences, relationships and accomplishments that are enriching the individuals and increase their well being. General structural characteristics of the educational environments may also affect well being in different directions: performance, evaluation and feedback, freedom of choice and responsibility for the future may be perceived as a burden. The protective experiences were described in nine studies that emphasised the protective role of supporting relationships with teachers and friends. Caring relationships with the teacher involve their instructional skills, their beliefs in the students' potentials, and their firmness in keeping helping the students, never giving up their efforts.

The relationships with peers are important for the students' well being and even for their commitment to school work. A relationship with caring staff at school could be a decisive turning point for students with family troubles. Success and mastery experienced at school can make the students feel empowered and more competent. The learning environment could be also experienced as a healthy heaven, a safe place filled with activities, that make you feel purposeful and engaged. Risk experiences in school was the fourth theme, represented by 25 studies. School difficulties and special educational interventions could be perceived as stigmatizing and contributing to embarrassment, lowered status or simply to an undesired separation from the company of peers, and sometimes also to harassments.

The competition, the pressure to get good grades experienced in certain groups could cause performance anxiety, concentration difficulties and psychosomatic symptoms. The social life of the group can be very deprived and unhappy for isolated and rejected students. Conflicts with the teachers are identified as contributing to lowered interest and motivation in school work, but also detached and indifferent behaviours may affect motivation and self-confidence negatively. The theme of specific and individual risks emerged in nine studies. Among students that experienced learning disability (dyslexia) secondary emotional problems had been common. Having a disability that influences the social behaviour may increase the risk to be victimized by peers. The students reported that the victimizations caused school difficulties, sickness, absenteeism and depression. Other social problems (family conflicts, abuse, addiction, refugee status) could also make the students more easily exposed to negative experiences at school.

Some reflections: The studies reporting views of younger children on the matters of this review were less well represented. The negative experiences may be expressed in rather cautious terms by younger children. The experiences of the students change when they grow older, go through developmental processes and encounter different educational situations. Several developmental trajectories can be identified. The systematic review of qualitative studies is a valuable methodological approach that can be applied in the field of special educational needs.

PAPER PRESENTATION

Success at adult education: The situation of 16 to 18 year-old students with special needs

Nadia Rousseau, Université du Québec à Trois-Rivières, Canada; Karen Tetreault, Université du Québec à Trois-Rivières, Canada; Ghislain Samson, Université du Québec à Trois-Rivières, Canada; Sylvie Frechette, Université du Québec à Trois-Rivières, Canada

Many students with special needs leave high school before getting a diploma but reconnect with school through adult education. However, very few studies examine the situations experienced by these students. Therefore, this study aims to document the factors explaining why youths with special needs register in adult education programs at the age of 16, and to describe and analyse the school experiences of these students until they leave adult education with or without diploma. A sample of 165 youths with special needs, registered in an adult education program, answered a questionnaire outlining their past, present and expected situation as students. Also 45 of them accepted to participate in focus groups. 59 youths who left the adult education participated in phone interviews discussing their adult student experience and their expectations about the future. Factors explaining the shift from youth to adult education are presented in order of significance. Students report a very positive perception of their school experience at the adult education. Recommendations are made to maintain this positive perception of adult education.

Introduction

Many teenagers abandon school before getting a high school diploma. In 2007-2008, 25.7% of Quebec teenagers were not enrolled in school and had not completed high school (MELS, 2009). They are unlikely to find a job in this complex society without the minimum credentials required in the job market. An important decrease in available jobs for youths without a high school diploma has been observed in the past years (Vultur, 2003).

Many youths reconnect with school through adult education. A significant increase of registration has been observed. Indeed, the number of students enrolled in adult education has increased from 128,200 in 1999-2000 to 158,793 in 2005-2006 (CSE, 2008). Many of them are students with special needs. Unfortunately, very few Canadian or Quebec studies examine the situations experienced by youths with special needs enrolled in adult programs. Therefore, it is advisable to examine the matter.

Objectives:

1. Document the factors explaining why youths with special needs register in adult education programs at the age of 16
2. Describe and analyse the school experiences of these students until they leave adult education with or without diploma.

Theoretical framework

Students that drop out of general education give the following reasons: lack of motivation, academic reasons, personal or family related issues, hoping to earn a living or have a job, their training perceived as completed, wanting to continue their schooling elsewhere, and repeated academic failures. (Potvin et al 2004). These reasons are associated with a number of challenging characteristics listed in several studies relating to dropouts : male gender, unproductive coping strategies, low self-esteem, poor social skills, negative perception of school, academic difficulties (especially in writing and reading), lack of motivation, behaviour problems (Fortin, Potvin & Royer, 2000), and negative school experiences (Rousseau, 2005). Finally, negative class atmosphere, negative teacher-students relationship and negative teachers' attitudes towards students with special needs (Potvin, 2005) are also associated with dropping-out. Many dropouts will register to the adult education in order to get a first diploma.

Methodology

A microethnographic analysis of case studies is conducted.

a) Participants and procedure

First objective

The sample is composed of 165 youths with special needs in high school and registered in an adult education program in autumn 2007. They answer a questionnaire containing mainly metaphors (see Steinhoff and Owens, 1989) outlining their past, present and expected situation as students. Also 45 of them participate in focus groups.

Second objective

59 youths of the above sample that left the adult program with or without a diploma also participate in a twenty-minute phone interview on their adult student experience and their expectations about their future.

b) Data source

Two independent coders conduct a qualitative network approach of analysis that implies an inductive coding. The Cohen's Kappa coefficient of inter-rater agreement is 0.82. Frequencies are calculated in terms of proportion of meaning units in interviews.

Findings and discussion

According to frequency accounts, factors explaining the shift from youth to adult education are presented in order of significance in three broad themes: negative high school experiences, possibility of getting credits or a diploma, individual students' characteristics. Factors associated specifically with adult education are fulfillment of distal (getting a job) and proximal (getting a diploma) objectives. Factors associated with school are individual support, respect of individual learning pace, less stress and anxiety, and hope of success. Factors that explain leaving adult education without certification are the following: employment and persistence of school problems.

The participating youths with special needs left high school for adult education because they do not like school. The negative feelings are stronger with those in special education classes. When leaving adult education, they all have, without exception, a very positive perception of their school experience, which represents a complete turnover. Students report working at their own pace in their books. Individual progress is monitored without references to the group. Moreover, positive feedback is given frequently and without prejudice. Unlike common belief, these students are persevering.

Conclusion and educational significance of the study

An increasing number of high school students who experience academic difficulties switch to adult education to get a high school diploma or the credits required for professional training. Throughout their schooling, they persist to overcome obstacles and progress at their own pace. Recommendations are made to maintain this positive perception of adult education.

References

- Conseil sup rieur de l' ducation (2008). De la flexibilit  pour un dipl me d' tudes secondaires de qualit  au secteur des adultes. Qu bec : Gouvernement du Qu bec.
- Dumont, M., Leclerc, D. & McKinnon, S. (2009).  volution temporelle du stress, du rendement scolaire et des ressources psychosociales selon cinq profils de d tresse psychologique d'adolescents. In R. Rousseau (ed.), *Enjeux et d fis associ s   la qualification. La qu te d'un premier dipl me d' tudes secondaires* (p. 121-160). Quebec : PUQ.
- Minist re de l' ducation, du Loisir & du Sport, (2009). Indicateurs de l' ducation –  ditions 2009. Quebec : Quebec Gouvernement.
- Potvin, P. (2005). La relation m tre/ l ves et  l ve en difficult  scolaire. In L. DeBlois (ed.), *La r ussite scolaire. Comprendre pour mieux intervenir* (p.149-159). Quebec : PUQ.
- Potvin, P. Fortin, L., Marcotte, D., Royer,  . & Deslandes, R. (2004). Guide de pr vention du d crochage scolaire. Loretteville: Centre de transfert pour la r ussite  ducative du Qu bec.
- Rousseau, N. (2005). L'expression du sentiment de r ussite ou d' chec scolaire : qu'en disent les principaux int ress s? In L. DeBlois (ed.), *La r ussite scolaire. Comprendre pour mieux intervenir* (p.149-159). Quebec : PUQ.
- Steinboff, C.R. & Owens, R.G. (1989). The organisational culture assessment inventory: A metaphorical analysis in educational settings. *Journal of Educational Administration*, 27(3), 17-23.
- Vultur, M. (2003). L'insertion sociale et professionnelle des jeunes "d sengag s": analyse du programme d'intervention de La R  plique. Sainte-Foy : INRS.

PAPER PRESENTATION

Can preschool education prevent the incidence of later emotional and behavioural difficulties?

Pamela Sammons, University of Oxford, United Kingdom; Yvonne Anders , University of Bamberg, Germany; Kathy Sylva, University of Oxford, United Kingdom; Edward Melhuish, University of London , United Kingdom; Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Brenda Taggart, University of London, United Kingdom

Drawing on a large data set collected as part of the Effective Provision of Preschool and Primary Education 3-11 Project (EPPE 3-11) this paper looks at children identified as showing special educational needs in England at age 10. The present study investigates which child, family and home predict primary teachers' identification of children's SEN status in relation to emotional and behavioural difficulties at age 10 using logistic regression models. Further, the analyses explore whether children's earlier preschool experience is related to later incidence of SEN. The sample consists of 2509 EPPE3-11 children. 8.3 % of the children were identified by their teachers as showing SEN related to emotional or behavioural problems. Early health problems or behavioural problems, having been a premature child, low maternal education, self employment of the mother, low socioeconomic status and eligibility for free school meals show to be risk factors for the identification of SEN at age 10. Also, boys have a higher risk than girls whereas child age has a protective impact. Analyses further showed that the quality of preschool attended still was significantly

associated with SEN identification, even when other background factors were controlled. The results of the present study underline the continuing effect of preschool quality as a factor that has a specific role in reducing the likelihood of later emotional and behavioural problems. High quality preschool may be viewed as an effective intervention for enhancing resilience in young children.

Aims

More than 30 years ago the Warnock Report (Department of Education and Science, 1978) suggested that about 20% of children would at some stage in their school career experience special needs of some kind. There has been much debate about this figure, which was largely based on teachers' estimates, but it still reflects current levels of SEN identification in England (e.g. Croll and Moses, 2003). The early identification of SEN in primary school is considered one important prerequisite for children to reach their full potential (Davie, 1996). But rather than relying solely on strategies implemented in primary school, it may be more effective to investigate what influences children's development at an earlier age (in preschool). Preschool education programs which may promote better adjustment to school and school readiness (e.g. Magnuson et al., 2004; Sammons et al., 2008; Sylva et al., 2010) might therefore be hypothesised to be a means to help protect children from later being identified as having some form of SEN while they move through primary and secondary school. Only a few studies have investigated longer-term benefits of preschool education so far and very little attention has been paid to the question of whether preschool has particular benefits with respect to children with SEN or at risk of developing SEN (Anders et al., 2010; Taggart et al., 2006).

Drawing on a large data set collected as part of the Effective Provision of Preschool and Primary Education 3-11 Project (EPPE 3-11), - a major longitudinal study of preschool and primary school influences on children's developmental outcomes - this paper investigates children identified as showing special educational needs in England and explores the factors that help predict SEN status at age 10. The present study investigates which child, family and home factors predict primary teachers' identification of children's SEN status in relation to emotional and behavioural difficulties at age 10. Further, the analyses explore whether children's earlier preschool experience is still related to later incidence of SEN.

Methodology

Sample

All data are drawn from EPPE3-11, which followed children's cognitive and social/behavioural development between the ages of 3 and 11 in England and was funded by the Department of Children, Schools and Families (DCSF). The project collected a wide range of data on over 3000 children, their background and the preschool settings they attended. At each assessment of the longitudinal investigation, primary teachers completed a child social behavioural profile for each EPPE child and reported details of any SEN. This investigation uses the child profiles completed at the end of Year 5 (age 10). The sample for this study consists of 2509 EPPE3-11 children with a valid profile.

Measures

Outcome measure

Teacher reported on present SEN in the child profiles. The current analyses focus on special needs related to emotional and behavioural difficulties.

Predictors

Child factors included gender, English as additional language (EAL), age in months, ethnic group, birth weight, early behavioural problems, number of early health problems and number of early developmental problems as reported by the parents in preschool interviews, premature child and number of siblings.

Family factors included family structure, parents' employment status, parental education, family salary at time of preschool education, family SES and child eligibility for FSM (a proxy measure for low income).

Parent-child activities and routines during the preschool years which provide an indication of aspects of the early years home learning environment (HLE), such as reading to the child, listening to the child read, teaching songs and nursery rhymes etc, were aggregated to a scale measure of the quality of HLE (Melhuish et al., 2008).

Preschool measures: The duration of preschool attendance and the quality (based on environment ratings using ECERS-R and ECERS-E) and effectiveness of the preschool centre were regarded as potentially protective factors and tested as potential protective factors.

Statistical analysis

First, all child, family and home characteristics were tested as potential risk or protective factors for SEN. Stepwise analyses were conducted and only significant variables were retained in the models. Subsequently, the impact of indicators of preschool education was tested individually in logistic regression models controlling for all statistically significant variables retained in the background model. Standard errors adjusted for the multilevel structure of the data were estimated.

Findings

8.3 % of the children were identified by their teachers as showing SEN related to emotional or behavioural problems. Early health problems, behavioural problems in the early years, having been a premature child, low maternal education, self employment of the mother, low socioeconomic status and eligibility for free school meals show to be risk factors for the identification of SEN at age 10. Also, boys have a higher risk than girls whereas child age has a protective impact with older children in the sample being less likely identified as SEN. The quality of HLE is not significantly related to SEN identification. With respect to the influence of preschool experience, analyses revealed that the most basic indicator – preschool attendance versus no preschool – was not found to be significantly related to SEN identification when other background variables were controlled. The same holds for duration of preschool attendance and preschool centre effectiveness. In contrast the quality of preschool attended still was significantly associated with SEN identification, even when other background factors were controlled.

Theoretical and educational significance of the research

The results of the present study suggest that a range of preventive strategies that support children's development in the early years may improve 'school readiness' and therefore reduce the number of children who may be at risk of developing SEN in later years. An important point concerns the continuing effect of preschool quality as a factor that has a specific role in reducing the likelihood of later emotional and behavioural problems. High quality preschool may be viewed as an effective intervention for enhancing resilience in young children. The findings of the study are highly relevant to educational policy-making and the politics of change and improvement.

PAPER PRESENTATION

PowerPoint Does Not Make Us Stupid – But Extensive Slides Impair Recall of Oral Information!

Christof Wecker, University of Munich, Germany

This study investigated whether information presented on slides is more easily recalled than information presented orally, whether information presented orally is recalled more easily if concise slides are presented than if extensive slides are presented, whether concise and extensive slides are superior to purely oral presentation overall and whether any such effect of the presentation mode can be explained by differences in cognitive load. A field study with a one-factorial design with the conditions no slides, concise slides and excessive slides was conducted in tutorials about literature search and supply. Cognitive load as well as recall of information presented orally and information presented on slides were measured separately in all three conditions. The results show no general negative effect of slides with respect to the recall of orally presented information, but a superiority of concise slides compared to extensive slides with respect to orally presented information and compared to no slides with respect to overall recall of information. Information presented on slides is recalled more easily than orally presented information. Differences in cognitive load can be ruled out as explanations for any of these effects. Given these findings it seems advisable to keep presentations concise, but more research is needed in order to delineate the optimal amount and kinds of content on slides.

Presentation software has become ubiquitous in educational institutions. However a fear that "PowerPoint makes us stupid" (Gralla, 2010) has been voiced. Research evidence about the effects of the use and of design features of slides on cognitive learning outcomes is sparse. In one study a negative effect of a PowerPoint lecture compared to a traditional lecture was found with respect to the recall of information that was presented exclusively orally, with recall for oral information being as low in the condition with electronic slides as in a condition that did not receive any instruction on the topic (Savoy, Proctor & Salvendy, 2009). One potential explanation for this finding would be that the extensive use of slides might place to excessive demands on learners' cognitive resources. Another explanation could be that an extensive use of slides might induce the impression that only information presented on slides is important.

The present study aims to contribute to a broader research base about these issues and to provide some constraints for potential explanations for effects on recall of orally presented information. In particular, it addresses the following research questions: (1) How does the presentation of information on slides vs. purely oral presentation affect the recall of information? (2) How do concise vs. extensive slides affect the recall of information presented only orally and information presented on slides? (3) How does the presentation of information without slides, with concise slides and with extensive slides affect the overall recall of information? (4) Can differences in recall of information between presentation modes be due to differences in cognitive load?

Method Instructional setting.

The study was conducted in tutorials in which skills in searching and obtaining literature were taught. These started with a presentation about the scientific publication system and basics of literature research and supply, which was followed by a quiz that served as a posttest.Design. Three conditions were compared in a one-factorial design: No slides, concise slides and extensive slides. Four tutorial groups were nested within each condition.Independent variables. Content was constant across conditions. In the condition without slides all information in the presentation was given orally. In the conditions with slides the same information was presented orally, but in the condition with concise slides key points were listed on projected slides during some parts of the presentation, whereas in the condition with extensive slides also detailed information and key statements were projected on slides throughout the presentation. All slides contained a maximum of eight lines or six bullet points.

Dependent variables.

Recall of information was measured by 18 multiple choice items. One third of them covered information that was presented orally in all three conditions, information that was presented on slides in the condition with extensive slides, and information that was presented on slides in both conditions with slides, respectively. To equate these subtests, scores were z-standardized using the means and standard deviations from the condition in which all three kinds of information had been presented orally (no slides). Then two equally weighted scores were formed for recall of information presented only orally and for recall of information presented on slides separately for each condition.Cognitive load was measured by a single Likert type item with a nine-point answering scale.Participants. The sample comprised 294 freshers (86 % female, 14 % male) in a degree program in education from two subsequent years. Results (1) Recall of information presented on slides in the conditions with slides was higher than (i) recall of the same information in the condition without slides, $F(1; 282) = 14.48$; $p = .05$, and than (ii) recall of information presented only orally in the same conditions, $F(1; 181) = 43.78$; $p = .20$.(2) While there were no differences between concise and extensive slides with respect to the recall of information presented on slides, $F(1; 181) = 4.36$; $p = .02$. Although recall of orally presented information in the condition with concise slides was descriptively higher than in the condition without slides, these conditions did not differ significantly.(3) When recall for information presented only orally and for information presented on slides were weighted equally and combined to an overall indicator of recall of information, the three conditions differed in this respect, $F(2; 282) = 3.24$; $p = .02$. While concise slides were superior to no slides with respect to overall recall of information, $F(1; 191) = 5.53$; $p = .03$, the corresponding difference between extensive slides and no slides could not be secured against chance, $F(1; 192) = 1.47$; $n. s.$ (4) Cognitive load was generally moderate and did not differ between the three conditions, $F(2; 275) = 1.58$; $n. s.$

Discussion

A general negative effect of slides on recall of orally presented information as suggested by Savoy et al. (2009) could not be found. Instead, a positive effect of concise vs. extensive slides with respect to orally presented information was demonstrated. This effect cannot be explained by excessive demands on learners' cognitive resources.Presenting information on slides has an advantage with respect to the recall of these particular pieces of information. However, in many cases it seems unfeasible to put all the information one wants to convey on slides. Some information will almost certainly need to be presented orally. When equal value is attached to information irrespective of its presentation mode, concise slides appear superior to purely oral presentation whereas extensive slides do not. Therefore it seems advisable to keep slides concise. Future research has to delineate the boundaries of "conciseness".

References

- Gralla, P. (2010). U.S. Army discovers PowerPoint makes you stupid. Retrieved from http://blogs.computerworld.com/16006/powerpoint_makes_you_stupid, 28th October 2010.
- Savoy, A., Proctor, R. W. & Salvendy, G. (2009). Information Retention from PowerPoint and Traditional Lectures. *Computers & Education*, 52(4), 858-867.

PAPER PRESENTATION

Demonstration of Procedures in Face-to-Face Instruction: Effect of Animated Steps in Worked Examples

Christof Wecker, University of Munich, Germany

This paper deals with the question how worked examples for procedures should be demonstrated in face-to-face instructional situations. A plausible way of transferring the findings from research on worked examples to face-to-face instruction would be the use of presentation software. In particular, the requirement of making intermediary results transparent could be achieved by using animation functionalities for the stepwise presentation of intermediary results. The present study investigates whether such an animated stepwise presentation has a positive effect on procedure acquisition compared to a static presentation of the whole solution path.

A within-subjects design was implemented in a one-year university course about empirical research methods in two subsequent years: One of two procedures was demonstrated with animated stepwise presentation of intermediary results, whereas the other was demonstrated with a static presentation of the whole solution path. The order of the manipulation was counterbalanced. Procedure acquisition was measured in the regular examinations at the end of each term. The scores were z-standardized topic-wise in order to allow for within-subject comparisons of the two presentation modes. A significant positive effect of animated stepwise presentation of intermediary results compared to static presentation of the whole solution path was found, which was specific for the procedures in focus. This effect is remarkable given that it was obtained in a field study within a regular course where outcomes were measured several weeks after manipulation. In practice, intermediate steps should be presented stepwise using animation functionalities, which once was common in the age of the blackboard.

In many learning settings the acquisition of procedures such as performing statistical tests is a main goal of instruction. A central source for the acquisition of a procedure is the study of worked examples, i. e. the induction of the procedure based on the trace of intermediary results of the solution steps performed during its application (VanLehn, 1990): During the study of worked examples, the current knowledge of the procedure is applied to each intermediary result. Thereby, the subsequent intermediary result is either predicted or explained (anticipatory reasoning and principle-based explanation, cf. Renkl, 1997). An important prerequisite for this mechanism of procedure acquisition is specified by the so-called "show-work principle" (VanLehn, 1990): All intermediary results need to be transparent. Furthermore, step-wise presentation of intermediary results has been found to foster learning (Renkl & Atkinson, 2002). In face-to-face instructional settings, presenting the types of worked examples used in laboratory research often would appear somewhat strange. Instead, the more natural and common way of presenting worked examples is an instructor providing a demonstration of the procedure (cognitive modeling).

In fact, [o]ne could argue that studying worked examples is a type of observational learning" (van Gog & Rummel, 2010, p. 156). Therefore, the research literature on worked examples can be regarded as basic research that needs to be transferred to face-to-face demonstrations in practical application settings (Atkinson, Derry, Renkl, Wortham, 2000). A plausible way of transferring the findings from research on worked examples to face-to-face instruction would be the use of presentation software (e. g. PowerPoint) that has become ubiquitous anyway. In particular, the requirement of making intermediary results transparent could be achieved by using the animation functionalities of this kind of software for stepwise presentation.

The present study investigates whether such an animated stepwise presentation has a positive effect on procedure acquisition compared to a static presentation of the whole solution path. Method Instructional setting and content. The study was conducted as a field study in the context of a one-year university course about empirical research methods in two subsequent years during the winter and summer terms. Design and manipulation of the independent variable. A within-subjects design was implemented: Of two procedures (winter term: Cohen's kappa, summer term: t-test for independent samples), in each year one was demonstrated with animated stepwise presentation of intermediary results, whereas the other was demonstrated with a static presentation of the whole solution path. The order of the manipulation was counterbalanced across the two topics in the two years without changes in content or amount of accompanying verbal explanations.

Dependent variables.

Procedure acquisition was measured by calculation tasks in the regular examinations at the end of each term. In both cases, the occurrence of the steps of the procedure in the solutions was coded and counted (winter: Cronbach's $\alpha = .85$, summer: Cronbach's $\alpha = .90$). Furthermore, the unspecific learning outcomes (for the other topics of the course) were measured in these examination by means of 21 and 16 multiple choice items, respectively (winter: Cronbach's $\alpha = .63$, summer: Cronbach's $\alpha = .65$). Both measures were z-standardized using the means and standard deviations for the respective topic to allow for within-subjects comparison between the two manipulated conditions. Participants. The sample comprised 324 students from the lecture who participated in it for the first time and took both examinations in the same year. They were on average 21.4 years old ($SD = 3.2$); of them 88 % were female and 12 % were male.

Results

The z-standardized scores for procedure acquisition were higher for the topic covered with animated stepwise presentation of intermediary results than for the topic introduced with static presentation of the whole solution path was implemented, $t(323) = 2.25$, $p = .01$, $d = 0.12$. To rule out the possibility that this difference might be due to variations between terms confounded with the manipulation, the unspecific learning outcomes were compared in the same way. The z-standardized scores for this variable from the terms in which animated stepwise presentation of

intermediary results with respect to the particular topics chosen was implemented were not higher than the z-standardized scores from the terms in which static presentation of the whole solution path was implemented, $t(323) = -1.83$, n. s. Rather, the descriptive results tended in the opposite direction.

Discussion

In line with research on worked examples (Renkl & Atkinson, 2002), these findings indicate that animated stepwise presentation of intermediary results is more effective for procedure acquisition than static presentation of the whole solution path when demonstrating a procedure. In particular, potential confounding that might occur in a field setting using intact courses could be ruled out by means of the within-subjects design and the test for the specificity of the effect for the topics selected for manipulation. The effect on procedure acquisition is remarkable in spite of its low magnitude given that it was obtained in the context of a field study within a regular university course where the learning outcomes were measured several weeks after a rather small-scale manipulation. For instructional practice it might be concluded that when using presentation software for the demonstration of procedures, intermediate steps should be presented stepwise using the animation functionalities of the software. This was actually the typical way of presentation in the age of the blackboard, but in the age of slides it requires additional effort during preparation.

References

- Atkinson, R. K., Derry, S. J., Renkl, A. & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, 70, 181-214.
- Renkl, A. (1997). Learning from worked-out examples: A study on individual differences. *Cognitive Science*, 21(1), 1-29.
- Renkl, A. & Atkinson, R. K. (2002). Learning From Examples: Fostering Self-Explanations in Computer-Based Learning Environments. *Interactive Learning Environments*, 10(2), 105-119.
- van Gog, T. & Rummel, N. (2010). Example-Based Learning: Integrating Cognitive and Social-Cognitive Research Perspectives. *Educational Psychology Review*, 22, 155-174.
- VanLehn, K. (1990). *Mind bugs: The origins of procedural misconceptions*. Cambridge, MA: MIT Press.

PAPER PRESENTATION

The Mere Exposure to a Problem Prepares Teacher Students for Learning

Inga Glogger, Institute of Psychology, Germany; Lars Holzapfel, Educational University of Freiburg, Germany;
Elmar Offenwanger, University of Freiburg, Germany; Rolf Schwonke, University of Freiburg, Germany; Matthias Nuckles, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany

There are approaches that try to optimize receptive forms of learning and direct forms of instruction by problem-oriented activities (e.g., Schmidt et al., 1989; Schwartz & Bransford, 1998). Such approaches typically use generative group activities that are quite time consuming. These activities are thought to generate useful forms of prior knowledge. Simply knowing about target problems might, however, already sufficiently prepare for learning from direct instruction, as the goal of learning and the application context becomes salient. In an experimental pretest-posttest design, 89 student teachers learned about assessing learning strategies in students' learning journals by a computer-based learning environment. The problem-first group were shown an authentic problem (evaluating learning journals and giving feedback) prior to a "receptive" learning phase and they worked on the problem after the learning phase. The problem-after group received the problem subsequent to the learning phase and then worked on it. The open-ended questions of the posttest were coded for identification of learning strategies and their quality and for suggestions to students for improving strategies (i.e., feedback). Providing the problem first enhanced learning in terms of identifying learning strategies and their quality. Surprisingly, suggestions for improving learning strategies were made more often by the problem-after group, even though they did not identify strategies and their quality as well as the problem-first group. Hence, receiving an authentic problem prior to learning prepared teacher students to providing feedback that was based on specific observation rather than sparsely founded suggestions.

Aims of the study.

There are approaches that try to optimize receptive forms of learning and direct forms of instruction by problem-oriented activities (e.g., Schmidt, De Volder, DeGrave, Moust, & Patel, 1989; Schwartz & Bransford, 1998). These approaches typically use generative group activities that should lead to forms of prior knowledge that allows for subsequent elaborative processes. For example, Schmidt et al. activated prior knowledge by letting students discuss explanations for a problem central to the learning domain. There are little attempts to systematically study which features of the work on the problems are crucial. Does it actually require solving the problem? Attempts to solve the problem let learners encounter lacks of understanding or knowledge which is thought to be productive (Kapur, 2008, "productive failure"). Simply knowing about an authentic problem might, however, also hint to knowledge deficits. Knowing an authentic problem makes the goal for learning and the application context more salient. If knowing about a problem already suffices to prepare for learning from direct instruction, this option would be more time efficient.

In a previous study, teacher students learned about learning journals and how to diagnose learning strategies in such journals. By writing learning journals, students are encouraged to use learning strategies such as elaboration, organisation, and metacognitive strategies. For example, they could explain how a new concept relates to something they already knew (elaboration strategy). In order to apply learning journals as a method to foster learning strategies in students, teachers have to be able to identify learning strategies, their quality, and formulate useful feedback. Therefore, as an authentic starting problem, student teachers received learning journals of students. They were asked to find learning strategies and criteria for evaluating them. They showed more transfer than a control group that received explanations instead. In the present study, which was part of the research program "Bildungsforschung" ("Educational Research") of the Baden-Württemberg Stiftung, student teachers only knew about the authentic problem (i.e., evaluating and providing feedback on students' learning journal), but they worked on it after learning. We expected that getting to know an authentic problem prior to learning enhances teacher students' diagnosis and feedback skills with respect to learning strategies.

Methods.

Eighty-nine student teachers (71 female, 18 male) from two equivalent seminars at a German University of Education participated in the study (title of the seminars: "Selected topics of mathematics instruction"). Two weeks prior to the intervention, they all worked on a pretest during their seminar. The pretest assessed diagnosis skills regarding learning strategies by three open questions. At the intervention, participants were randomly assigned to two conditions: (a) they received an authentic problem prior to learning with a computer-based learning environment and had 5 minutes to familiarize themselves with the problem (problem-first group, $n = 42$); (b) they received the same problem after learning (problem-after group, $n = 47$). The problem consisted of learning journal entries and a description of a situation ("Here you see two learning journal entries of two students. Your challenge is the identification of learning strategies and the formulation of a feedback to the students. Use the information from the learning environment. Before you start the learning environment, we would like to ask you to read the learning journal entries in detail (5 minutes)."). All participants learned in the computer-based learning environment for 30 minutes. In the learning environment, the diagnosis of elaboration strategies in learning journals was taught. Providing feedback was not specifically taught. After learning, the problem-first group had 10 minutes to solve the problem, that is, to identify learning strategies in the learning journals and to write feedback to the students. The problem-after group now received the problem, read it carefully (5 minutes) and worked on it for 10 minutes, that is, time-on-task was equal across groups. The open-ended questions of the posttest were coded by two independent raters ($ICCs > .80$). Learning outcome scores were (1) the number of sections coded as "identify and feedback learning strategies and their quality" and (2) the number of sections coded as "suggestions for improving learning strategies".

Results.

Teacher students who first familiarized themselves to the authentic problem achieved higher scores in identify ($F(1, 87) = 4.91, p = .029, \eta^2 = .05$). Suggestions, however, were made more often by the problem-after group ($F(1, 87) = 14.24, p = .001, \eta^2 = .14$). Prior knowledge was not significantly related to the learning outcome scores.

Theoretical and educational significance. Research on preparation to learn from direct forms of instruction used time-consuming instructional methods. Results of this study suggest that adult learners such as student teachers, however, can be prepared by the mere exposure to a problem taken from their professional context. The phase of (un)productive failure while struggling with a problem might not be necessary for all kinds of learners.

Unexpectedly, the problem-after group gave more suggestions to students how to improve their learning strategies even though they were less successful than the problem-first group in identifying learning strategies and explaining why the learning strategies were suboptimal. However, well-grounded specific and, thereby, helpful (Shute, 2008) suggestions can scarcely be made without detailed identification of learning strategies and their quality. We will reanalyse the suggestions in order to test if the problem-after group's suggestions were of lower quality than the suggestions of the problem-first group. In summary, receiving an authentic problem prior to learning prepared teacher students to learn and transfer their knowledge to giving feedback that was based on specific observation.

References

- Kapur, M. (2008). Productive Failure. *Cognition and Instruction*, 26, 379-424.
- Schmidt, H. G., DeVolder, M. L., De Grave, W.S., Moust, J. H. C., & Patel, V.L. (1989). Explanatory models in the processing of science text: The role of prior knowledge activation through small-group discussion. *Journal of Educational Psychology*, 81, 610-619.
- Schwartz, D. L., & Bransford, J. D. (1998). A time for telling. *Cognition and Instruction*, 16, 475-522.
- Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, 78(1), 153-189.

PAPER PRESENTATION

Expository Instruction before Inquiry Learning: Fostering Understanding of “Undiscoverable” Theories

Alexander Rachel, University of Munich, Germany; Christof Wecker, University of Munich, Germany; Eva Heran-Dorr, University of Bamberg, Germany; Christine Waltner, University of Munich, Germany; Hartmut Wiesner, University of Munich, Germany; Frank Fischer, Universität München, Germany

Some scientific theories that students are supposed to learn through inquiry learning involve assumptions about unobservable theoretical entities and relations among them. This study investigated whether prior expository instruction and summary expository instruction can foster the understanding of these theories. In an experimental study with a 2x2-factorial design 604 high school students from 23 classes participated in an inquiry unit about magnetism. Prior expository instruction fostered the understanding of the explanatory theory both in an immediate and a delayed posttest. Summaries produced an effect on understanding of the explanatory theory only in an immediate, but not in a delayed posttest. The findings suggest that prior expository instruction can provide learners with explanatory theories they can apply to phenomena observed during their inquiry activities and thereby foster the understanding of such explanatory theories.

One of the main goals of science education is to foster the understanding of scientific theories that can explain observable phenomena. Inquiry learning is regarded as functional for accomplishing this goal (de Jong, 2006). However, explanatory theories in science that students are supposed to learn often go beyond functional relationships among observable variables that can be discovered by observation in a straightforward way. For example, in phenomena related to magnetism, (theoretical) molecular magnets cannot be observed directly. Accordingly, the learners' hypothesis space (Klahr & Dunbar, 1988) will hardly contain assumptions about them, and they have little chance to discover them on their own. This suggests expository instruction about possible explanatory theories as an approach to foster theoretical understanding during inquiry learning. In principle, expository instruction can be provided prior to inquiry activities, but the same content can also be presented in a summary afterwards.

In the former case, learners could use these theories to explain the phenomena they encounter during inquiry activities, which could help them develop a robust understanding of them. In the latter case, however, this use of the theories is not possible: Without the opportunity to use them to make sense of the phenomena observed, learners may be less likely to build up a robust understanding of them. To test these assumptions, we conducted an empirical study to investigate the effects of prior expository instruction and summary expository instruction on the acquisition of understanding of scientific theories. We hypothesized that prior expository instruction improves understanding of scientific theories compared to no prior expository instruction in a test immediately after the learning phase as well as several weeks later. We further expected that summary expository instruction improves understanding of scientific theories compared to no summary expository instruction only in a test immediately after the learning phase, but not several weeks later.

Methods and data sources

Participants. The participants in this study were 604 German high school students from 23 7th grade classes (60 % female, 40 % male; age: $M = 12.66$, $SD = 0.59$). **Design.** Five to six intact classes were randomly assigned to each condition of a 2x2-factorial design with prior expository instruction (without/with) and summary expository instruction (without/with) as independent variables. **Procedure and learning environment.** Whole classes of students first completed a 10 minute pretest. Then they worked on an inquiry unit about magnetism for 100 minutes. In all conditions the students conducted hands-on experiments in dyads at up to eleven learning stations. They completed an immediate 20 minute posttest and about two months later a 20 minute delayed posttest in their classrooms.

Independent variables.

In the conditions with prior expository instruction, first a 25-minute introduction to the theoretical background of magnetism was provided by a teacher. No such introduction was given in the conditions without prior expository instruction. In the conditions with summary expository instruction a 25-minute teacher-led wrap-up phase about the same topics as in prior expository instruction took place afterwards, while there was no such phase in the conditions without summary expository instruction. **Dependent variable.** Understanding of the scientific theory of magnetism was measured by means of 16 multiple-choice and true-false items (immediate posttest $\alpha = .71$; delayed posttest $\alpha = .74$). A test for knowledge about functional relations among observable variables associated with magnetism was used as the pretest (13 items, $\alpha = .62$).

Statistical analysis.

Data were analyzed by means of single ANCOVAs with the respective posttest measure as the dependent variable, prior expository instruction and summary expository instruction as independent variables, class as a random factor nested within the cells of the design and the pretest measure for knowledge about functional relations among observable variables as a covariate. The significance level was set to 5 %. Results A main effect of prior expository instruction in favour of the conditions with prior expository instruction compared to the ones without prior expository instruction could be detected in the immediate posttest, $F(1; 19.14) = 12.39$; $p = .002$; partial $\eta^2 = .05$. An analogous main effect of prior expository instruction was found in the delayed posttest, $F(1; 19.37) = 10.87$; $p = .004$; partial $\eta^2 = .03$. Furthermore, a main effect of summary expository instruction in favour of the conditions with summary expository instruction compared to the ones without summary expository instruction was found in the immediate posttest, $F(1; 19.12) = ; p = .001$; partial $\eta^2 = .06$. However, this effect disappeared at the delayed posttest, $F(1; 19.38) = n. s.$ In both posttests, no significant interactions were found.

Discussion

These findings provide evidence for our argument that understanding of scientific theories that involve unobservable variables is less likely to be attained by inquiry activities without further support. Rather, learners benefit substantially by being introduced to the theories developed by scientists. The finding that a summary of the same content as provided by prior expository instruction did not produce a lasting effect on the understanding of scientific theory suggests that the effect of prior expository instruction is not simply a matter of being told the right answers. An explanation could be that prior expository instruction about theories that cover phenomena observed during hands-on experimentation can lead to the application of these theories during inquiry activities, thereby yielding deeper theoretical understanding. Overall, the study supports the argument that elements of direct instruction might play an important role in inquiry learning (cf. Klahr & Nigam, 2004), while still highlighting the importance of phases of inquiry in which learners can apply the theories to be learned. Teachers implementing inquiry learning would be well advised to reflect about the chances their students actually have to find out by inquiry what they are supposed to learn, and provide targeted support.

References

- de Jong, T. (2006). Technological advances in inquiry learning. *Science*, 312, 532
- f. Klahr, D. & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science*, 12(1), 1-48.
- Klahr, D. & Nigam, M. (2004). The equivalence of learning paths in early science instruction: Effects of direct instruction and discovery learning. *Psychological Science*, 15(10), 661-667.

PAPER PRESENTATION

Interpersonal teacher behaviour: lesson associations with classroom social climate

Tim Mainhard, Utrecht University, Netherlands; Mieke Brekelmans, Utrecht University, Netherlands; Theo Wubbels, Utrecht University, Netherlands

The present study investigated whether the classroom social climate varies between lessons. Specifically, the within- and across-lesson associations of coercive and supportive teacher behaviour incidents with the classroom social climate were studied. Participants in the study were 48 Dutch secondary school teachers and their classes, that is, 1208 students. Multilevel process analyses showed that supportive behaviour incidents correlated with a positive social climate during the current lesson and the lesson a week later in terms of teacher interpersonal Affiliation. Supportive behaviour incidents did not, however, correlate with social climate in terms of teacher interpersonal Control. Coercive behaviour incidents correlated with disrupted teacher Affiliation during the current lesson and the lesson a week later, but did not virtually correlate to increased levels of a teacher's Control in the classroom.

How students perceive the classroom social climate, and especially the way students perceive their teachers interpersonally, is strongly related to student achievement and well-being (Davis, 2003; Wentzel 2002; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006). The more warm and supportive a teacher is, the more students report a sense of belonging and being engaged (Freeman, Anderman, & Jensen, 2007). On the other hand, if teachers are acting offensive and coercive learning is negatively affected, and students report more psychological and somatic complaints (Sava, 2002).

The aim of the present study is to examine how incidents of coercive and supportive teacher behaviour are associated with the variability of the classroom social climate teachers create. Studies which have investigated changes of the classroom climate (Mainhard, Brekelmans, Wubbels, & den Brok, 2010; Patrick, Anderman, Ryan, Edelin, & Midgley, 2001) have largely done so over rather extended periods of time (e.g., several months), thereby ignoring lesson-to-lesson variability. The present adds to the existing body of knowledge on classroom social climates by investigating these associations within (i.e., during a lesson) and across lessons; specifically, what is the association of coercive and

supportive behaviour of a teacher with the classroom social climate one or two weeks later? Incidents of teacher coercion and supportive teacher behaviour may change classroom social climate temporarily or permanently.

Classroom Climate and teacher behaviour

In the present study, the social climate is conceived as the quality of social relations in classrooms. Collective students' perceptions of the teacher Control and Affiliation are utilized as an indicator of the climate. Building on a phenomenological point of view, students are considered as the most appropriate informants of their learning environment (c.f., Lýdtke, Robitzsch, Trautwein, & Kunter, 2009). Teachers with relative more Control and Affiliation provide, in terms of students motivation and learning outcomes, more effective classrooms (Brekelmans, Sleegers, & Fraser, 2000). The student Questionnaire on Teacher Interaction (QTI, Wubbels et al., 2006) was used to tap students' perceptions teacher Control and Affiliation (respectively: $\alpha = .80$ and $.93$; ICC1 = $.44$ and $.52$, ICC2 = $.93$ and $.95$).

Actions to gain control that students perceive as coercive negatively affect the social climate and student learning (Lewis (2001). Coercive discipline includes sarcasm, yelling in anger, embarrassing students, and punishment. On the other hand, using appropriate humour, providing clear and structured instruction, or undertaking activities students think are fun are factors that support a positive classroom social climate. A Teacher Behaviour Observation Checklist (TBOC) was developed, to collect student observations of teacher behaviour incidents (coercive: $\alpha = .81$, ICC1 = $.58$, ICC2 = $.92$; supportive: $\alpha = .71$, ICC1 = $.53$, ICC2 = $.91$).

Hypotheses

In classrooms with more incidents of coercive teacher behaviour students perceive less Affiliation; teachers might gain Control because students comply with the teacher's display of power (Hypothesis 1).

Incidents of supportive behaviour positively correlate with students' perceptions of a teacher's Affiliation, but are also beneficial to the teacher's Control (Hypothesis 2).

Method

Participants and Procedure

48 Dutch secondary school teachers (26 females) and one of their classroom groups (1208 students, age $M = 14.09$, $SD = 1.47$). Teachers were asked to administered questionnaires on 9.31 ($SD = 2.35$) occasions during 4 month (i.e., 447 individual classroom lessons in total). Half of the students completed the QTI and the other students the TBOC. Thus, each time, a student focused on either teacher behaviour incidents or teacher Control and Affiliation to yield some independency in the applied measures.

Results

Multilevel process analysis was employed (van Doorn et al., 2008), which relates two or more simultaneously assessed concepts across time. This analysis is similar to multilevel modelling employing time varying covariates but without including a designated time variable as a predictor. Results are summarized in Table 1.

Discussion

Hypothesis 1

Frequently using coercive behaviour was associated with significantly lower teacher Affiliation. It immediately disrupted the social climate, and was associated with less Affiliation a week later. The use of coercive behaviour was associated with somewhat more Control in class, but acting coercively in two lessons in consecutive weeks occurred to counterbalance these associations.

Hypothesis 2

Frequent supportive behaviour was associated with more teacher Affiliation during the current lesson as was supportive behaviour one week earlier, but to a lesser extent. More frequent supportive behaviour however was hardly associated with teacher Control.

There were no differences found between classrooms in the associations between teacher behaviour and the social climate (i.e., random slopes). This suggests that the processes described here are comparable across classrooms.

Practical implications

Coercive teacher behaviour is very unlikely to go together with greater Control in the classroom. Teachers who engage in coercive behaviour may deliberately sacrifice Affiliation because they believe they will re-establish or consolidate their Control in the classroom. The present study shows that this assumption is not justified. Teachers should use small rather than intense corrections, behave as unaggressive as possible (Evertson & Weinstein, 2006), and should apply increased intensity of disciplinary actions only for intensified disruptive student behaviour (Cr   ton et al., 1989).

Regarding supportive behaviour, although the effects we found were not substantial, we have shown that supportive behaviour pays off immediately and is an investment for the near future as well.

PAPER PRESENTATION

Dialogic interaction among primary pupils in a wiki-environment in science

Judith Kleine Staarman, University of Exeter, United Kingdom; Manoli Pifarre Turmo, University of Lleida, Spain

This paper describes the analysis of the collaborative process of a primary pupils' writing task with the aid of a Wiki environment. Students worked and contributed to the wiki in pairs. The aim of the project was to explore how a wiki may be used to support primary school pupils' collaborative interaction and to shed light on the complex process of collaboration and interaction, both in and around the Wiki environment.

Our study illustrates some of the challenges and the difficulties that students had to face in order to write a text collaboratively with a Wiki. We argue that students need to develop an intersubjective orientation towards others participants' perspectives, to be able to co-construct knowledge about a topic. For this purpose, the project utilised a "Thinking Together" – type approach to help students to develop an intersubjective orientation towards one another and to support the creation of a 'dialogic space' to co-construct new understanding.

We present our focus for the analysis of face-to-face students' interaction in order to contribute in the Wiki environment, which is based on a dialogic approach to collaboration. Our results illustrate how the thinking together approach became embedded in the Wiki environment and how in the context of a science project, it enabled the collaborative writing of a joint informative text about the science topic under investigation.

Our aim for this paper was to find out how, in a Wiki environment, students develop and maintain shared understanding of a science topic, and how students are taking each other's perspective into account. We also aimed to examine how the wiki environment itself may or may not support students in this process. To this end, we designed, implemented and evaluated a science project in which primary students used a Wiki environment, with the specific aim of establishing and supporting collaborative interaction, while engaging in a collaborative writing task. Students worked in pairs and also made their wiki contributions as pairs.

Our theoretical background is grounded in socio-cultural theory, which states that social interaction lies at the heart of all learning processes. From our perspective, participation in a collaborative activity requires that participants establish and maintain what Rogoff (1990) and Wertsch (1991) have termed intersubjectivity.

To enable and support collaborative learning, there are a number of particular relevant characteristics of wikis. First, wiki software enables the collaborative editing of texts and these texts are then available to the whole community of users. This means that the joint collaborative process and product is visible to all participants. Secondly, the wiki software allows two separate but related collaborative processes to happen simultaneously. The actual wiki content is written collaboratively on one page, while a tab leads to another page, in which participants may negotiate the actual content of the wiki. Thirdly, the collaborative writing process in a wiki environment is asynchronous, mediated and indirect, which gives participants the opportunity to reflect on what they read and write to respond/reply to their partners. And fourthly, all revisions to the wiki page are kept in the wiki history, enabling users to trace the development of the wiki and reflect on the changes in the collaborative work.

Although these features are characteristics of wiki design that may enhance the collaborative processes, it remains unclear which pedagogical approach could contribute most to successful collaborative learning processes using wikis and what difficulties and needs primary students would require in order to participate in the Web 2.0 global knowledge era.

The study took place in Lleida, Spain, in an urban primary school. Twenty-five 9-10 year old pupils participated in the study. Students worked together in pairs in the wiki environment to create a joint informative text about a science topic, together with 2 other pairs. We analyzed in depth the data collected during the seven wiki sessions. We video-taped, transcribed and analyzed face-to-face pairs' interaction while working in the wiki environment.

In this paper, we aim to answer the following research questions:

1. What type of peer's interaction occurs when they are working in a wiki environment? What features of dialogue are they using?
2. How does the face-to-face interaction of pupils support the interaction in the wiki-environment and the creation of a joint collaborative text.

3. What is the relationship between the pairs' collaborative communication and thinking as evidenced in their talk and their contributions in the wiki environment?

Our analysis approach has strong links with a methodological framework called Sociocultural Discourse Analysis (Mercer, 2005). The first stage of the analysis involved characterizing the type of interaction of students in and around the Wiki. The second stage of the analysis process consisted of searching for the presence of key words that may indicate reasoning and collaboration. For this reason, we used a computer-based concordance analysis programme (Wordsmith Tools).

For our analysis approach, we adopted a dialogic approach to studying the interaction of the students, and aimed to characterise the interaction process in terms of the students' intersubjective orientation. We based our analysis on the characterisation of talk in terms of Disputational, Cumulative and Exploratory, as proposed by Mercer and colleagues (Mercer, Littleton and Wegerif, 2004). We argue that a dialogic approach such as this is needed to analyse interaction in a complex environment such as the one utilised in the current study, to be able to take into account the collaborative dimension of computer-supported collaborative learning.

Our data showed many episodes in which students presented a Disputational or more Cumulative orientation. The presence of these kinds of students' orientations could partially be explained in relation to the purposes of the task, it also indicates that the technology itself does not guarantee effective collaborative processes. It is therefore necessary to design an instructional approach that prepares students to use the wiki effectively and to develop students' awareness about thinking and working together in web 2.0 technologies. This result is in line with many voices that highlight students need a shift to a more participatory and collaborative culture of literacy practices (Wei-Ying, Hyo-Jeong & Seng-Chee, 2010). This shift needs also deep changes in the pedagogical practices that design the conditions to develop students' competences that eLearning 2.0 technologies require.

In contrast, our study also found episodes in which students presented a more Exploratory orientation. In the paper we will discuss what characteristics of the pedagogic design of the wiki environment used in our study might support students' joint interaction processes. Briefly, we stand out the next four. Firstly, the students' preparation to collaborate in a wiki environment using the "Thinking Together" approach was fruitful. Students used explicitly many of the features of the program in their collaborative talk. Secondly, every pair presented their own ideas in an initial text in the wiki environment, which was helpful in giving a 'voice' to all members of the group from the beginning of the collaborative work as it enabled all the pairs to be orientated to each other's ideas from the start. Thirdly, the students were all the time working with an artefact that was created as the product of their active participation. This may have encouraged users to examine others' opinions more closely, take them into consideration and increase their knowledge more deeply. Fourthly, the asynchronous nature of the collaborative processes in the wiki seems to have supported co-reflective processes about others' ideas, thoughts, arguments and information, which, in turn, lead to reconstruction and reorganization of experience.

PAPER PRESENTATION

Doing instructions. Exploring instructions in multilingual classroom interaction

Oliver St John, Orebro university, Sweden, Sweden, Sangeeta Bagga-Gupta, University of Orebro, Sweden

Doing instructions. Exploring instructions in multilingual classroom interaction

The aim of this study is to explore what might distinguish instructions from other kinds of classroom interaction in different classroom settings. Data is taken from video recordings of entire lessons in English, Home Economics, French and Maths as part of ethnographic fieldwork at an international secondary school in Sweden. CA analytic procedures have been adopted and developed. A complementary source of data is ethnographic field notes.

Preliminary findings suggest that instructions exhibit distinct features which participants orient to as instructions while relating them structurally to lessons as a whole. In doing instructions, teachers routinely mark their beginnings with 'openings' (e.g. calling the class to attention), sequence a variety of components (e.g. invoking past lesson activity) and conduct recurrent ways of bringing them to a close (e.g. giving a summary). Data makes evident certain kinds of boundary markers framing instructions as well as reinforced discourse, measured pace and the prominence of kinetic and gestural synchronized signals during such activity. A comparison of doing instructions across subjects suggests that the learning of any subject is, to a significant degree, language learning.

The pedagogic significance of such studies is to encourage investment in instructions as not simply communication for cueing other learning tasks, but as platforms for supporting task-related language learning, student engagement, the

negotiation of common purpose, cohesion between different (parts of) lessons, the creation of meaningful entry points, etc. In short, an environment for co-constructing meaning and understanding for tasks.

Doing instructions. Exploring instructions in multilingual classroom interaction

The 's' on the end of 'instruction' indicates the distinction made in teaching methodology arenas between explaining subject content (instruction) and explaining what to do (giving instructions) (e.g. Kerry and Wilding, 2004). 'Instruction' has often been equated with learning (Säljö, 2005:13) while 'giving instructions' has been viewed as prior or incidental to learning per se, as an activity whose value is attached to the greater cause it serves. While the view that the main purpose of instructions is to prepare the way for forthcoming learning activity has some validity, it masks the complexity of the relationship between giving instructions and other teaching routines and activities that structure classroom lessons (see Richards & Lockhart, 1996). Views of learning as integral to social practice (Lave & Wenger, 1991), as participation and acquisition (Sfard, 1998) and as interaction (Firth & Wagner, 1997; 2007) challenge an assumed distinction between a non-learning preliminary and learning proper as untenable.

The aim of this study is to explore what might distinguish instructions from other kinds of classroom interaction, such as transitions or teacher-presented instruction, in different classroom settings. Aspects which observations in this study have suggested may be relevant to the distinctive identity of 'giving instructions' include discursive composition, boundary markers, techniques used by participants to make meanings clear and constraints on or opportunities for interaction.

This study is part of a larger analysis of lesson phases using video documentation of eighth-grade lessons recorded during ethnographic fieldwork at an international secondary school in Sweden. Video data for the study has been selected from sixteen English, Home Economics, French and Maths lessons. In pursuit of an emic perspective, CA analytic procedures have been adopted and developed by amplifying CA transcript conventions in order to widen the aperture on some of the finely-tuned visually-mediated communicative moves configuring classroom interaction. This multi-track transcription system aims to make available for analysis not only speech, but the printed, written language, bodily conduct and positions in relation to artefacts and other environmental resources in the classroom (see Bagga-Gupta & St John, 2010, in preparation). As a complement to this fine-grained micro view, ethnographic field notes serve as a bridge to possible broader significations in the analysis.

Preliminary findings suggest that instructions exhibit distinct features which participants orient to as instructions while relating them structurally to lessons as a whole. In doing instructions, teachers routinely mark their beginnings with 'openings' when they call the class to attention, announce an imminent task or preview what the 'instructions' are intended to explain or achieve. After beginning, teachers sequence a variety of components including invoking past lesson activity, use of artefacts such as books and whiteboards, categorizing or labelling tasks, directives in steps or stages, prospectively projected sample utterances to illustrate specific activity, examples of task-related choices the students are to make and task assessment criteria. The data also indicates that teachers conduct recurrent ways of bringing instructions to a close, such as giving a summary, managing role distribution or delivering a directive to begin the task.

Data makes evident teacher use of oral expressions (e.g. ok) body movements (e.g. claps) and orientations to classroom artefacts (e.g. books) as boundary markers between instructions and other activities. Talk tends to be well reinforced by paraphrases, double-layered in some cases, while the pace tends to be more measured and the use of synchronized kinetic and gestural signals is a prominent part of the concerted communicative action.

Indeed it is evident that the internal structure of instructions bears many of the features related to the organization of a whole lesson. A picture of task instructions as a miniature model of a lesson suggests that learning has just as much chance to thrive during the doing of instructions as it might in any other component part of a lesson. Cross-subject comparisons of doing instructions showcase that the way language is used in classrooms provides a basis for relating lessons along language continua rather than separating some as 'language' lessons and others in terms of non-language learning lessons. Since the different subjects and disciplines of school are constituted by and generate their own vocabularies and conceptual lexical labels, the learning of any subject is, to a significant degree, language learning.

The pedagogic significance of such studies is to encourage investment in doing instructions as not simply communication for cueing other learning tasks, but as a platform for supporting task-related language learning, student engagement, the negotiation of common purpose, cohesion between different (parts of) lessons, the creation of meaningful entry points, etc. In short, an environment for co-constructing meaning and understanding for tasks. Such an investment will make better sense if giving instructions is viewed not as a set of directions or step-by-step

guide, for example, on how to assemble a piece of furniture or operate an appliance, but as one of the steps integral to and inseparable from the process of realizing all the steps.

References

- Bagga-Gupta, S. & St John, O (2010). Making complexity invisible. (Article in preparation)
- Firth, A. & Wagner, J. (1997). On Discourse, Communication, and (Some) Fundamental Concepts in SLA Research. *The Modern Language Journal*, 81,285-300.
- Kerry, T. & Wilding, M. (2004). *Effective Classroom Teacher*. London: Pearson.
- Lave, J. & Wenger, E. (1991). *Situated Learning*. Cambridge University Press.
- Macaro, E. (1996). Teacher use of the target language. Part 1. In Roberts, T. (ed.) *Languages Forum* (5), 2-7, London: Institute of Education.
- Richards, J. & Lockhart, C. (1996). *Reflective Teaching in Second Language Classrooms*. Cambridge University Press.
- Sfard, A. (1998). On Two Metaphors for Learning and the Dangers of Choosing Just One. *Educational Researcher* 27 (2), 4-13.
- Säljö, R. (2005). *Lärande & Kulturella Redskap*. Norstedts Akademiska Förlag.
- Wong-Fillmore, L. (1985). When does teacher talk work as input? In S. Gass & C. Madden (eds.) *Input in Second Language Acquisition* (pp. 17-50). Rowley, Mass.: Newbury House.

PAPER PRESENTATION

Instructional Explanations When Introducing the Pythagorean Theorem: A Case Study

Daniela Jimenez, German Institute for International Educational Research, Germany; Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

Instructional Explanations in mathematics lessons remain a common practise and a typical discourse form though mathematics education has gone through dramatic changes in the last decades. The role of explanations seems to be particularly important when students are learning a new content, because explanations are a mean of conveying mathematical knowledge (Perry, 2000).

The aim of the present study is to characterize effective instructional explanations in videotaped mathematics lessons when introducing the Pythagorean Theorem. The case study was carried out in the context of a broader study including tests of mathematical understanding taken to the students immediately before and after the videotaped lesson unit. The 3 classes examined here were selected according to their learning outcomes under control of their previous knowledge. The results suggest that effective instructional explanations are based on concrete graphic support, showing flexibility in rewording and linking with previous knowledge. Besides, they include concrete applications of the Theorem and examples of its usefulness in everyday life. Even though these findings don't allow generalization, they could suggest that effective instructional explanations contribute to instructional quality.

Background and Aim of the Study One of the most important shifts in mathematics learning and instruction in the last decades has taken place in the conception of the subject matter, changing from a perspective of mathematics as composed of concepts and skills to be learned, to a new one emphasising the mathematical modelling of the reality (De Corte, 2004). This shift has had natural implications on classroom processes, and changed instructional settings and practises. In that landscape instructional explanations are an interesting topic, since they remain being a typical form of classroom discourse, especially when new contents are introduced to the students (Perry, 2000). Instructional explanations can be defined as pedagogical actions in response to implicit or explicit questions provided by teachers or students (Leinhardt, 2001). Their main purpose is the understanding of a portion of subject matter and can be accomplished in different ways, including diverse degrees and sorts of interaction between teacher and one or more students (Kiel, 1999). This means that instructional explanations can appear in several contexts and also take different shapes according with the instructional setting in which they occur.

On one hand instructional explanations have been conceived as a critical issue in understanding mathematical concepts since they are an important communication form of mathematical knowledge (e.g., Perry, 2000). Additionally, it has been argued, that since explanations are a form of oral communication, they offer the teacher the possibility to monitor the students' understanding and provide, if necessary, additional information or discuss possible misunderstandings immediately (Duffy et al., 1986). In contrast to that, Wittwer & Renkl (2008) indicate that explanations are often unnecessary, since they don't really promote understanding. A possible underlying reason is that while explanations occur, the learner assumes a passive role only listening to the teacher, instead of engaging actively in his own learning process. To sum up, there is agreement about considering instructional explanations as a frequent issue within lessons, but there are contradictory positions about whether and how they contribute to promote understanding. We would like to argue that whether instructional explanations promote understanding or

not depends rather on elements of the way how explanations take place than to their frequency or duration. Consequently, the only possibility to assess whether instructional explanations are effective or not is regarding carefully the context in which they occur.

The present paper aims to shed light in aspects related to success and failure of instructional explanations in mathematics lessons when introducing the Pythagorean Theorem. More specifically following research questions will be examined, namely, what characterizes instructional explanations in lessons in which a high promotion of mathematical understanding takes places compared to lessons in which a low promotion of mathematical understanding occurs? Method The data source is the Chilean implementation of the core-design of the study "Quality of instruction, learning and mathematical understanding" designed and carried out originally in Switzerland and Germany (2000-2006) by the German Institute for International Educational Research and the University of Zurich. The complete Chilean sample consists of 21 mathematics teachers of 7th grade classes and their respective 784 students, which participated in the investigation along one school year. In every class 3 consecutive lessons about the introduction of the Pythagorean Theorem were videotaped. Tests of mathematical understanding were taken immediately before and after the videotaped lesson unit. 3 of those teachers were chosen in order to carry out the present case study, according with the results of the post-test (under control of the pre-test). The analyses for the case study were based on the theoretical phases of the videotaped lessons and their respective transcripts. They included following dimensions of the instructional explanations, (1) use of graphic support, (2) explanations are repeated/modified, (3) Pupils' participation and contribution to explanations, (4) check for understanding, (5) link with previous knowledge, (6) abstraction and usefulness of the Pythagorean Theorem. Results The findings show differences in most of the dimension analyzed. Effective explanations about the Pythagorean Theorem were supported by hands-on activities, not only performed by the pupils, but also by the teacher or shared with the whole class. Besides, explanations' repetitions include often new information and there's some evidence of flexibility by rewording and going in depth. The teacher continuously checks for understanding while explaining and links the new contents with previous knowledge, not only mentioning it when a step is missing, but also using it as context to embed the new contents. Finally, effective explanations about the Pythagorean Theorem include concrete applications and examples of its usefulness in everyday life. In contrast to that, less effective explanations include graphic support, but just as context and not as a concrete tool. Repetitions occur frequently, tend to be rigid and don't incorporate new information. The teacher checks for understanding only few times along the lesson and often implicitly. New contents were linked with previous knowledge strictly when needed, for example to solve an exercise, but not really clarifying which is the link and why it is necessary. Only few or none concrete applications of the Pythagorean Theorem were presented and its usefulness was limited to mathematical contexts. It's interesting to note, that there were no differences regarding the participation opportunities given to the pupils, mainly answering dichotomous questions or only with one word.

Discussion

It is possible to characterize effective instructional explanations and distinguish them from less effective ones, regarding to what extent they promote mathematical understanding. In other words, even if we don't aim to assume that the improvement in learning outcomes is only attributable to the explanations examined here, these findings could suggest that effective instructional explanations contribute to instructional quality. These finding were obtained in a case study and don't allow generalization, besides they refer to an introductory unit in one curricular content, facts that allow a thorough examination. However, it would be interesting to investigate to what extent such characteristics can be applied to other teaching contents or whether it is possible to define features that allow their valid and reliable measure in bigger samples..

PAPER PRESENTATION

Experienced and non-experienced e-tutors in Europe: Differences in supporting online collaboration
Birgitta Kopp, Ludwig-Maximilians-University, Germany; Maria Cristina Matteucci, University of Bologna, Italy;
Carlo Tomasetto, University of Bologna, Italy

In this study, we investigated differences between experienced and non-experienced European e-tutors in their support of online collaboration in practice. Therefore, we developed a questionnaire European e-tutors had to fill in to evaluate specific collaborative activities and to answer yes/no-questions regarding their intervention to support these collaborative activities. In respect of these collaborative activities, we distinguished between cognitive and social activities which are relevant for effective online collaboration.

Overall, we received answers of 78 e-learning experiences from 17 different European countries. Cluster analysis was conducted to determine groups of e-tutors who answered similar regarding the response type across the various categories of support activities. To validate the cluster solution, we compared the resulting two clusters on the basis

of the experience of e-tutors. The results indicate that e-tutors with experience evaluate relevant cognitive activities more important for collaboration than e-tutors without experience. Furthermore, e-tutors with experience intervene more often to foster cognitive and social activities. These findings show the importance of expertise in e-tutoring: It seems that e-tutors with experience consider the importance of specific cognitive activities for effective online collaboration and that they also are more familiar in detecting dysfunctional social phenomena and in adequately intervening to avoid such phenomena. Therefore, for daily practice it seems to be necessary to train e-tutors in sensitizing them to the problems and pitfalls of online collaboration.

Objectives

This study investigates how experienced and non-experienced e-tutors differ in supporting collaborative online learning in practice. E-tutors received a questionnaire evaluating specific online activities and answering yes/no-questions whether they practically gave online support for these specific activities in their e-learning experiences.

Theoretical framework

E-tutors are very important for the support of their learners, because virtual collaboration is often more demanding for learners as they mostly have no experience with this way of learning. E-tutors are defined according to their main function, which is to supervise and support learners.

When we look at the support of e-tutors, the question is which collaborative activities they specifically foster. There are especially cognitive and social activities important for collaboration. Cognitive activities are knowledge exchange, online discussion, argumentation, collaborative problem solving, and considering different perspectives. Regarding social activities, the focus is on the motivation of the group members, interpersonal interaction, social influence processes and information processing.

Regarding the daily practice of e-tutors, the question arises how e-tutors support collaborative online learning. As research on the topic of expertise shows that experts differ from individuals without expertise in their way how they deal with problems, the question remains whether such differences in problem-handling are true for e-tutorial support in collaborative online learning.

Research question

Do experienced and non-experienced e-tutors differ in supporting online collaboration? As experienced e-tutors already know how collaboration in virtual learning environments functions, the assumption is that experienced e-tutors differ in their support from non-experienced e-tutors in that way that experienced e-tutors support collaborative online learning to a greater extent than non-experienced e-tutors.

Method

Sample

The sample included seventy-eight e-learning experiences from 17 different European countries. All e-tutors completed an online questionnaire regarding their e-learning experiences with collaborative learning. Participants were instructed to complete one questionnaire for each e-learning course.

Design of the Study

The study was a survey for e-tutors regarding their experiences in providing and supporting virtual collaboration which took place in July 2007. All e-tutors received access to an online questionnaire in their language and were asked to answer this questionnaire for every e-learning experience they offered.

Data sources

The online questionnaire which was developed for this purpose included two main dimensions: cognitive activities and social activities. Regarding the cognitive aspects of collaboration, the questionnaire included five main activities: knowledge exchange, online discussion, argumentation, collaborative problem solving, and considering different perspectives. To gain deeper insights into these activities, the questionnaire asked e-tutors whether they intervened to foster the specific collaborative activity and if yes, how they intervened and if no, why they did not intervene.

Based on theoretical assumptions, social activities were evaluated mainly according to four processes: motivation of the group members, interpersonal interaction, social influencing factors and information processing. Regarding motivational aspects, two dimensions were considered, namely different group goals (2 items) and dysfunctional competition. Interpersonal interaction included phenomena such as dysfunctional interpersonal conflicts, balanced participation, and diffusion/lack of responsibility. Social influencing factors are ignoring minorities and putting pressure on group members. Information processing included the following: superficial discussion to avoid conflicts and addressing the e-tutor rather than group members (2 items). In the questionnaire again, e-tutors were first asked

whether they intervened to avoid a dysfunctional phenomenon. If they answered yes, they were asked how they intervened, and if no, why they did not intervene.

Data analyses

We used the TwoStep cluster methodology to explore the data. The algorithm selected the optimal number of clusters based on either the Schwarz Bayesian Information Criterion (BIC) or the Akaike Information Criterion (AIC). Once clusters were established, we used separate t-tests and chi-square tests on variable(s) not used to form the clusters to test the validity of the cluster solution. We compared the clusters based on their response type across the various categories of support activities in terms of past experience of e-tutors, feedback practices and intervention rate.

Results

The cluster analysis identified two clusters whose stability was ascertained until 75 % of the sample size. Using a theoretically meaningful distinction, we report the data on the cognitive and on the social activities. Cluster 1 (n= 51; 65.4%) comprised e-tutors who evaluated cognitive activities more important (mean between 4.90 and 5.47) than e-tutors included in cluster 2 (n =24; 30.8%) (mean between 4.08 and 4.83). Furthermore, e-tutors of cluster 1 intervened between 40 and 48 times to foster cognitive activities in online collaboration while e-tutors of cluster 2 intervened only 8 to 14 times. Regarding social activities, according to Chi-Square-Tests again e-tutors of cluster 1 intervened in 9 of 11 times significantly more often than e-tutors of cluster 2.

Validity of the two cluster solutions was evaluated by testing group differences on variables that were theoretically or empirically related to each cluster. In particular we used as cluster validation items concerning the past experience of e-tutors in designing and realizing online courses. We expected e-tutors with experience to be over-represented in cluster 1, which was confirmed by a chi-square analysis. The great majority of e-tutors with past experience in designing and realizing e-learning courses belonged to cluster 1, $\chi^2(1, n = 75) = 11.75, p$

Discussion

Cluster analysis has shown that our sample of e-tutors significantly differ in evaluating the importance ascribed and in intervention rate concerning specific cognitive activities which are relevant for online collaboration. Subsequent analyses confirm that e-tutors who intervened more frequently in respect of fostering cognitive and social activities in virtual collaboration are those with past experience. Even though, overall the intervention rate for social activities is much lower than for cognitive activities (overall less than 50 per cent), e-tutors with experience are more able to detect dysfunctional phenomena and thus support their learners in working effectively together.

Educational significance

This study shows that experience in supporting e-learning groups is an essential precondition for evaluating relevant collaborative activities higher and in adequately intervening for fostering the interaction between group members. As this study asked e-tutors concerning their daily practice, it seems essential to train e-tutors in considering and detecting specific dysfunctional phenomena which may otherwise inhibit effective group work.

PAPER PRESENTATION

Scaffolding self-regulated learning: implications for the design of CBLEs

Anneline Devolder, Ghent University, Belgium; Johan van Braak, Ghent University, Belgium; Jo Tondeur, Ugent, Belgium

Research has shown that in order to learn effectively in computer-based learning environments (CBLEs), students need to show sufficient self-regulated learning skills (SRL). Unfortunately, not many students possess these necessary skills, so support needs to be provided towards the students when learning in these environments. A specific type of support we focus upon in this study are scaffolds. Scaffolds are technology-mediated systems that support the learners when performing a task (Sharma & Hannafin, 2007). In the field of scaffolding, little conceptual clarity exists. Moreover, it was shown that some specific scaffolds are only effective for some specific processes of SRL (Schraw, 2007). The aim of this study was to create an overview that makes it possible to compare the effectiveness of the different scaffolding types in support of the different processes of SRL. Therefore, we extended a review study in search of which specific scaffolds are proven to be effective in supporting SRL processes when gaining scientific knowledge. In order to support educational practice in the decisional process of choosing the right scaffolds, the results of this study are presented in an integrated framework of SRL.

FrameworkComputer-based learning environments (CBLEs) are becoming ubiquitous and more extensively used in education [1]. CBLEs comprise systemic features (e.g. open-ended in structure, non-linear) that offer new possibilities for learning and instruction like direct visualization and manipulation of complex topics [6]. In order to learn effectively with CBLEs, learners will need to show skilful engagement which can be captured as self-regulated learning

(SRL) [15]. Students are self-regulated to the degree that they are metacognitively, motivationally, and behaviourally active participants in their own learning process [16]. Unfortunately, many students do not possess the necessary SRL-skills [3]. Therefore, students need to be supported when learning with CBLEs. Research has shown that scaffolds can give the necessary support to students lacking SRL-skills [1]. Recently, scaffolding is being described as "...the provision of technology-mediated support to learners as they engage in a specific learning task" [12, p.29]. Studies have shown that different types of scaffolds provide effective support for different processes of SRL [4]. This means that when CBLEs are being developed, the types of scaffolds will need to be selected with care. Purpose & Method In order to support educational practice in this decision making process, the aim of our study is to synthesize and schematize research results on the effects of scaffolding on the processes of SRL when learning in CBLEs. To fulfil this purpose, a systematic literature review was conducted [8]. Some general criteria were set to mark out our search (e.g. studies published since 2000). Second, inclusion and exclusion criteria were defined. According to these criteria, the database Web of Science was searched through using terms like scaffold*AND self-regulated learning/self-regulat*. This search resulted in 24 articles. To present these results clearly, they were placed in an integrated framework of SRL [5] that is designed based on some central models of SRL as well as more current research relating the specific context of CBLEs towards these central models [e.g. 9,2,14].

Results

The results of this are presented in Table 1. Table 1. An integrated framework for effective scaffolds in support of processes of self-regulated learning (p: primary education; s: secondary education, h: higher education) Cognition Motivation Behaviour Phase 1: Task definition & Planning Guiding questions (h) Concept-mapping task (s,h) Preset goal hierarchy & goal Description (s) 'Plan ahead' prompts (s) Searching features (p) High-order questions (h) Phase 2: Monitoring Diagrams (h) Hints & cognitive feedback (p) Self explanation prompts, reason-justification prompts, cues (s) Written question prompts (s) Guiding questions (h) Phase 3: Control Metacognitive feedback & Strategy prompt (h) Concept-map template (p) Spoken advice (prompts) (s,h) Generating prompts (s) Processing prompts (s) Worked-out examples (s) Organization feature (s) (headings and written) Question prompts (s) Organization feature (s), Collaboration features (p), Maintenance features (p) Self-explanation prompt & Worked-out example (u) Spoken advice (h) Worked-out examples (s) Saving/viewing features (p) Concept-map (h) Strategic prompts & Graphic advance organizers (h) Phase 4: Reaction & reflection 'Look back' prompts (h) From the 24 retrieved studies, 16 of them proved that the use of certain scaffolds were effective when gaining scientific knowledge. Most of the studies examined scaffolds that support processes of cognitive regulation.

Results indicate that especially prompts are effective scaffolds for this area. Little effective scaffolds were found in the area of motivation and behaviour. The area of context in this framework was deleted, because no effective scaffolds were found. Another remarkable finding is that a small amount of these studies focuses on primary education, although this is a category of students possessing the least SRL-skills. As it can be seen in the framework and is confirmed by the literature, some scaffolds provide effective support for multiple processes of self-regulated learning [10]. Conclusion On the basis of the discussed theoretical framework and method, we were able to list up the effective scaffolds influencing self-regulatory skills of students when learning in CBLEs. In the presentation, we will focus on the meaning of these scaffolds towards the design of future CBLEs while bringing personal characteristics (e.g. prior knowledge) and contextual characteristics (e.g. task, peers) into account.

References

- [1] Azevedo, R. (2005). Computer Environments as Metacognitive Tools for Enhancing Learning. *Educational Psychologist*, 40(4), 193 - 197.
- [2] Azevedo, R. (2008). The role of self-regulated learning about science with hypermedia. In D.H. Robinson and G. Schraw (Eds.), *Recent innovations in Educational Technology that facilitates Student Learning* (pp. 140). Charlotte, NC: Information Age Publishing, Inc.
- [3] Azevedo, R., & Cromley, J.G. (2004). Does Training on Self-Regulated Learning Facilitate Students' Learning With Hypermedia?. [Article]: *Journal of Educational Psychology* September 2004; 96(3):523-535.
- [4] Dabbagh, N., & Kitsantas, A. (2005). Using web-based pedagogical tools as scaffolds for self-regulated learning. *Instructional Science*, 33(5-6), 513-540.
- [5] Devolder, A., van Braak, J., & Tondeur, J. (2010). Supporting Self-Regulation in Computer-Based Learning Environments: A Systematic Review of the Impact of Scaffolding. Paper presented at the European Conference of Educational Research (ECER), Helsinki (Finland), 25-27 August.
- [6] Dignath, C., Buettner, G., & Langfeldt, H.-P. (2008). How can primary school students learn self-regulated learning strategies most effectively?: A meta-analysis on self-regulation training programmes. *Educational Research Review*, 3(2), 101-129.
- [6] Land, S., & Hannafin, M. (2000). Student-centered learning environments. In D. Jonassen & S. Land (Eds.). *Theoretical foundations of learning environments* (pp. 1-23). Mahwah, NY: Erlbaum.

- [7]Petticrew,M.& Roberts,H. (2005). Systematic reviews in the social sciences: a practical guide. Malden, MA: Blackwell Publications.
- [8]Pintrich,P.R. (2000). The role of goal orientation in Self-Regulated Learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic Press.
- [9]Schraw,G. (2007). The use of computer-based environments for understanding and improving self-regulation. *Metacognition and Learning*, 2, 169-176.
- [10]Shapiro,A.M. (2008). Hypermedia design as learner scaffolding. *Etr&D-Educational Technology Research and Development*, 56(1), 29-44.
- [11]Sharma,P.,&Hannafin,M.J. (2007). Scaffolding in technology-enhanced learning environments. *Interactive Learning Environments*, 15(1), 27-46.
- [12]Steffens,K. (2006). Self-Regulated Learning in Technology-Enhanced Learning Environments: Lessons of a European Peer Review. *European Journal of Education*, 41(3), 353-379.
- [13]Winne,P.H.,&Hadwin,A.F. (1998). Studying as Self-Regulated Learning. In D.J. Hacker, J. Dunlosky, & A. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277-304). Hillsdale, NJ: Erlbaum.
- [14]Winters,F.,Greene,J.,&Costich,C. (2008). Self-Regulation of Learning within Computer-based Learning Environments: A Critical Analysis. *Educational Psychology Review*, 20(4), 429-444.
- [15]Yelland,N.,&Masters,J. (2007). Rethinking scaffolding in the information age. *Computers & Education*, 48, 362-382.
- [16]Zimmerman,B.J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81(3), 329-339.

PAPER PRESENTATION

Understanding the online information seeking practices of young people

Rebecca Eynon, University of Oxford , United Kingdom

As the Internet and other new technologies become embedded within the lives of young people there is a growing interest in the extent to which new technologies can enhance informal and formal learning. Effective online information seeking forms a key part of many of these potential learning opportunities. Using nationally representative survey data of 1000 young people, this paper aims to add to existing research by providing empirical data on how and why young people in Britain use the Internet for information seeking outside formal educational settings for homework and everyday life. Using path analysis, this paper will provide an overview of the ways young people are using the Internet for information seeking and examine the individual (e.g. age and gender), skill and contextual factors (e.g. parent, school and friends use of technology) that help to explain this behaviour. It is hoped that these findings may assist in the development of policies and practice to support young people to make the most effective use of the Internet for information seeking as part of their learning in a global networked society.

As the Internet and other new technologies become increasingly embedded within the lives of young people there is a growing interest in the extent to which new technologies can enhance informal and formal learning opportunities (e.g. Becta, 2008). Effective online information seeking forms a key part of many of these potential opportunities both to support formal education (e.g. for homework) and to support informal learning through everyday life information seeking (ELIS) (Savolainen, 1995).

While relatively little is known about how and why young people access information online in their daily lives for these purposes, it is likely that there is significant diversity in what, how and why young people search for information online.

This paper aims to add to existing research by providing empirical data on how and why young people in Britain use the Internet for information seeking outside formal educational settings for homework and ELIS. The data is based on a nationally representative face to face survey of 1000 young people in Britain aged 8, 12, 14 and 17-19. The survey was conducted between December 2008 and January 2009 utilising a stratified sampling strategy. The survey formed part of the Learner and their Context study, commissioned by Becta, which explored young people's views and experiences of new technologies outside school and was designed to inform the UK's Harnessing Technology Strategy. Using path analysis, this paper will provide an overview of the ways young people are using the Internet for information seeking and examine the factors that help to explain this behaviour. Drawing upon the learning ecology approach (Barron, 2006) and in line with a range of theoretical frameworks that stress the importance of understanding both individual and environmental factors when exploring Internet use (e.g. LaRose et al., 2001; McHale et al., 2009) this paper will examine the importance of: 1) individual factors, specifically, age and gender (Livingstone and Helper, 2007), socio economic factors and quality of access (Facer, Furlong, Furlong, and Sutherland, 2003); 2) networks of support, specifically, peer use of technology (Ito et al., 2008), parental engagement / regulation (Livingstone and Bober, 2005) and the school environment; and 3) skills and confidence, that is, self concept in

learning new things and confidence in online information seeking skills (Broos and Roe, 2006). Each of these three areas are hypothesised to contribute (both directly and indirectly) to online information seeking. The overarching research question for this study is: what are the direct and indirect effects of individual and contextual factors on online information seeking for homework and everyday life?

The initial analysis demonstrates that parent's involvement in their child's uses of technology and school uses of the Internet have no direct effect on online information seeking either for homework or everyday life. However, they do have a direct effect on learner self-concept and / or online information seeking ability which are of key importance in understanding both kinds of online information seeking analysed here. Furthermore, individual characteristics which reflect basic factors of digital inclusion (such as home access to the Internet and / or socio economic status) continue to play an important role in understanding online information seeking for homework and / or everyday life. The findings indicate that there is a need for researchers to explore both offline factors (e.g. SES and learner self concept) as well as online factors in understanding Internet use; and highlights the opportunities open to educators to support young people more in using the Internet for information seeking. It is hoped that these findings may assist in the development of policies and practice to support young people to make the most effective use of the Internet for information seeking as part of their learning in a global networked society.

References

- Becta (2008). *Harnessing Technology: Learning Next Generation Learning 2008 - 2014*. Becta Report: Coventry.
- Barron, N. (2006). Interest and Self-Sustained Learning as Catalysts of Development: A Learning Ecology Perspective. *Human Development*, 49, 193–224.
- Broos, A and Roe, K (2006). The digital divide in the playstation generation: Self-efficacy, locus of control and ICT adoption among adolescents. *Poetics*. 43: 306-317.
- Facer, K, Furlong, J, Furlong, R, and Sutherland, R (2003). *Screenplay: Children and Computing in the Home*. London: RoutledgeFalmer.
- Ito, Mizuko, Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P., Pascoe, C.J. and Robinson, L. (2008). *Living and Learning with New Media: Summary of Findings from the Digital Youth Project*. The John D. and Catherine T. MacArthur Foundation Reports on Digital Media and Learning.
- LaRose, R, Mastro, D and Eastin, M (2001). Understanding Internet Usage: A Social-Cognitive Approach to Uses and Gratifications. *Social Science Computer Review*. 19(4): 395-413.
- Livingstone, S and Bober, M (2005). *UK Children Go Online. Surveying the Experiences of Young People and their Parents*. London: London School of Economics and Political Science.
- Livingstone, S and Helsper, E (2007). Gradations in Digital Inclusion: Children, Young People and the Digital Divide. *New Media and Society*. 9: 671-696.
- McHale, S, Dotterer, A and Kim, J (2009). An Ecological Perspective on the Media and Youth Development *American Behavioral Scientist*. 52(8): 1186 -1203.
- Savolainen, R. (1995). Everyday life information seeking: approaching information seeking in the context of 'way of life.' *Library & Information Science Research*, 17, 259-294.

PAPER PRESENTATION

Effects of constructivist teacher-led digital platform on learning achievement

Rosen Vigal, University of Haifa / Time To Know, Israel

This study explores the effects of a constructivist teacher-led one-to-one computing learning environment on elementary schools students' achievement in Mathematics and English Language Arts (ELA). The subjects were 59 4th grade students, who joined a Time To Know year-long program in Dallas, Texas and 68 4th grade students who learned in traditional settings. Findings indicated that learning with Time To Know program significantly enhanced students Mathematics and ELA achievements and contributed to development of Mathematics reasoning skills. In addition, the study showed that Time To Know program narrowed the gap between the low and high achievement students, as well as significantly promoted the academic outcomes of at-risk students, compared to the traditional settings. Overall, the findings indicated that intertwining digital content that is aligned with state standards and a constructivist-oriented teacher-led platform, enables a significant empowerment of teaching and learning processes.

Over past decade, there has been a growing interest in one-to-one laptop technology initiatives, whereby the teachers and the students have full access to a technology-rich learning environment (Bebbel, 2007; Gulek, & Demirtas, 2005; Jaillet, 2004; Lei & Zhao, 2008; O'Dwyer et al., 2008; Shapley et al., 2009; Silvernail & Gritter, 2005; Weston & Bain, 2010; Zucker & Light, 2009). The current study explores the effects of teaching and learning in the Time To Know program on Mathematics and ELA achievement of 4th grade students, compared to learning in more traditional setting.

Time To Know's teaching and learning environment is designed with a social-constructivist teacher-led approach to learning and teaching (Fosnot, 2005; Prawat & Folden, 1994; Roschelle, Pea, Hoadley, Gordin & Means, 2000; Von Glasersfeld, 1995). The program consists of five main components (Walters, Dede & Richard, 2009; Weiss & Bordelon, 2010): (a) Infrastructure: one-to-one laptop environment with a workstation for the teacher; (b) Interactive year-long core curriculum: Recommended sequences of interactive learning activities that are aligned with state standards. Teachers can modify these sequences by uploading their own "best practice" materials directly into the lesson flow; (c) Digital Teaching Platform (DTP): A platform that enables the teacher to conduct or plan a lesson, and to receive formative and summative assessment reports for data-driven instruction; (d) The platform also enables teachers to create their own content and adjust the recommended ready-made interactive learning activities to their teaching needs.; (e) Pedagogical support: Every teacher who joins the program takes part in comprehensive professional learning and ongoing guidance from an instructional coach.

The study addressed the following questions regarding the effects of the Time To Know program:

1. What is the impact of Time To Know program on reading, writing and Mathematics academic achievements, as measured by Texas Assessment of Knowledge Skills (TAKS) tests, compared to the traditional settings?
2. What is the impact of Time To Know program on academic achievements of at-risk students, compared to the traditional settings?
3. Do Time To Know students demonstrate greater Mathematics reasoning skills than control students?
4. Do lower performing Time To Know and control students (based on previous year TAKS scores) differ from higher performing students on Mathematics reasoning skills?

The study was based on the quantitative methodology using a quasi-experimental design (participation or non-participation in the Time To Know program). Pretest data were collected before the onset (April, 2009) of a Time To Know program, while post-test data were collected near the completion of the year-long school program (April, 2010). The study participants were 4th grade male and female students from four elementary schools from the Dallas-area district. Gender distribution was close to even. Two experimental schools were selected on the basis of two criteria: their participation in the Time To Know program and the same demographic background. Two control schools were purposively sampled to "match" the two Time To Know schools on the basis of known demographics (e.g., neighborhood characteristics, teacher characteristics, student characteristics). In all, there were 127 students who participated in the pre- and post-test data collection (59 experimental and 68 control students).

The instruments comprised on Mathematics, Reading and Writing and an adopted Mathematics reasoning test (HersHKovitz, in preparation). Mathematical reasoning refers to the ability to analyze mathematical situations and construct logical arguments (Francisco, & Maher, 2005; Stiff, & Curcio, 1999; Yackel, & Hanna, 2003). The Mathematics reasoning test was based on open-ended questions related to graphs and tables theme in 4th grade Texas curriculum that was taught in both the control and Time To Know classes.

The results indicated that participation in Time To Know (T2K) program contributed significantly to 4th grade students' academic outcomes in reading, writing and Mathematics, as measured by TAKS standardized tests. After controlling for gender, at-risk status, and 2009 reading TAKS scores (ANCOVA), the Time To Know students ($M=657.2$, $SD=88.3$) significantly outperformed the control students ($M=602.9$, $SD=104.4$) on the 2010 reading TAKS, $F(4, 95)=10.8$, p Time To Know students ($M=656.7$, $SD=83.0$) scored significantly higher than the control students ($M=625.1$, $SD=91.4$) on the Mathematics TAKS test, even after controlling for previous years TAKS scores (ANCOVA), gender, and at-risk status, $F(4,95)=6.5$, p

Although not significant, a trend was found in the context of at-risk students, showing that at-risk and non-at-risk students in the Time To Know classrooms score similarly. Whereas, in the control classrooms, the at-risk students Mathematics score much lower than the non at-risk population.

After controlling for students' third grade math TAKS scores, gender and at-risk status (ANCOVA), there was a statistically significant difference between the Time To Know and control students in the context of Mathematics reasoning (see Figure 9). Time To Know students ($M=35.7$, $SD=8.1$) far out-performed the control students ($M=24.3$, $SD=11.3$) on the Mathematics reasoning assessment overall ($F(4,95)=5.7$, p

Overall, the findings of the current study are showing the high potential of one-to-one computing learning environments, in which a comprehensive digital curriculum is combined with a constructivist-oriented teacher-led platform. Further research is recommended to examine qualitatively changes in teaching and learning practices underlie the effects of Time To Know program on academic outcomes, as well as the possible affective processes (i.e.

engagement, motivation, self-regulated learning). In addition, given the relatively small sample, it is essential to conduct large-scale studies to examine the effects of comprehensive one-to-one laptop learning environments.

PAPER PRESENTATION

Effects of computer-based interventions to enhance the development of mental number representations

Andreas Obersteiner, Technische Universität München, Germany; Stefan Ufer, University of Munich, Germany;

Kristina Reiss, Technische Universität München, Germany

Cognitive psychological and neuropsychological research suggests two core cognitive systems of number processing, namely an object-file system for the exact representation of discrete objects and an analogue magnitude system allowing an approximate representation of quantities. In an intervention study we explored whether an exact or an approximate approach for fostering students' development of mental number representations was more successful. N=46 second grade students were tested in basic number processing (e.g., number comparison) before and after seven computer-based intervention sessions. During the intervention students played one of two versions of a number game, requiring exact or approximate number processing. Results show that both the exact and the approximate condition led to improvements of basic number processing, without significant differences between these conditions. Process data revealed that both games were suitable for the students and did not differ in difficulty.

Theoretical background and aims

Cognitive psychological and neuropsychological research suggests that number processing relies on two "core systems" (Feigenson, Dehaene & Spelke, 2004), namely an object-file system for the exact representation of single objects and an analogue magnitude system for an approximate representation of quantities. Both systems seem to be innate and are responsible for early number learning. To enhance learning, mathematics education theories support the use of two kinds of manipulative materials representing exact numerosities using symmetric structures (e.g., a pegboard with two rows of ten pegs each) or analogue quantities (e.g., an empty number line). There is, however, no empirical evidence for the assumption that the use of such number representations has an effect on the development of students' mental representations. The aim of our study is to explore whether an intervention using specific external number representations leads to improvements in basic number processing tasks, whether differential effects can be found for specific tasks, and whether computer games are an appropriate method for such an intervention.

Methods

In an intervention study with N=46 second grade students (mean age: 7;2 years) we used two different computer games (see Obersteiner, Ufer & Reiss, 2010). Both games were based on the "Number Race" (Wilson, Dehaene, Pinel, Revkin, Cohen & Cohen, 2006), an adaptive software with the aim of enhancing "number sense". The two games were identical with respect to the overall conception. Depending on the level, the player had to solve number comparison tasks, calculation tasks, or number identification tasks with increasing task difficulty and time pressure. After each task, the player had to move his character on a game board by clicking on each square separately ("counting strategy") or by clicking on the end square directly. However, the games differed in the way tasks were presented to the player. In the exact version numerosities were presented in symmetric structures and the tasks required exact number processing (e.g., exact calculation), while in the approximate version numerosities were presented without structures and the tasks required approximate number processing (e.g., approximate calculation). During the game, process data such as successful runs and number of clicks were logged. Before and after seven intervention sessions (30 minutes each) the students took a computer-based test of basic number processing (dot enumeration of structured and unstructured sets, number comparison, magnitude comparison, magnitude estimation, approximate calculation). Response times and accuracy rates were measured. Data from 3 students were excluded from further analysis due to absence in more than one intervention session.

Preliminary results

Both versions of the intervention program were suitable for the students and did not differ in general difficulty, as indicated by an equal mean number of games won by the students (22.1 for the exact version, 23.2 for the approximate version; $t(41)=-1.04$; $p=0.30$). Overall, students improved their number processing skills as indicated by reduced response times in all tasks of the post-test as compared to the pre-test. An analysis of variance with repeated measures showed that neither the differences between the two intervention groups nor the interaction terms with group reached significance for any task ($p \geq 0.053$ for group differences, $p \geq 0.108$ for interactions). Process data such as the number of clicks used to move the character on the game board revealed that students in the exact condition were more successful in directly clicking on the correct square as compared to students in the approximate condition (79% vs. 46% successful direct clicks; $t(41)=8.08$; $p<0.001$). This may reflect the successful use of structures by students in the exact condition.

Discussion

The two computer games were comparable in overall difficulty. They were an appropriate method to be used in an intervention study with an experimental design. Both games had positive effects on second grade students' number processing abilities. However, as the present experiment was basically carried out to test the computer games, there was no control group, so that we do not know how specific these effects were. First results did not reveal group differences, indicating that both the exact and the approximate approach can be used to foster students' number processing abilities. In the present study, we have tested a relatively small sample. After further developing the computer games we will test intervention effects in a larger sample of first grade students. So far, we have analysed differential effects on the group level only. In further analysis we will explore how individual factors such as working memory or visuo-spatial abilities may have influenced students' test performances and their success during the intervention. A better understanding of such relations could help to develop individually tailored training for each individual student and is therefore of high relevance for mathematics education.

References

- Feigenson, L., Dehaene, S., & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences*, 87, 307-314.
- Obersteiner, A., Ufer, S., & Reiss, K. (2010). Fostering the development of mental number representations and arithmetic competencies in the first school year. Poster presented at the EARLI SIG22–Conference in Zurich, June 3-5. doi: 10.3389/conf.fnins.2010.11.00069.
- Wilson, A. J., Dehaene, S., Pinel, P., Revkin, S. K., Cohen, L. & Cohen, D. (2006). Principles underlying the design of "The Number Race", an adaptive computer game for remediation of dyscalculia. *Behavioral and Brain Functions*, 2, 19.

PAPER PRESENTATION

Students' use of tools in an undergraduate course: in search of tool-use patterns

Jan Elen, Katholieke Universiteit Leuven, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium; Griet Lust, Katholieke Universiteit Leuven, Belgium

Research in controlled settings has revealed that students' tool-use behavior is a complex self-regulated behavior that cannot be taken for granted (Azevedo, 2004). It remains however unclear if these results are replicated in an ecological setting characterized by learning tasks integrated into the natural flow of the study, enough time to learn to use the tools and with long-time retention measurements (Grabinger, 2008). This contribution focuses on students' tool-use in an ecological setting. An undergraduate course was selected as object of research because despite the popularity of blended courses, as an integration of course management systems into the traditional constellation, there is little insight in how students behave in those environments. More specifically, the study investigates how students use the whole toolset at their disposal, whether user-profiles can be found and what the effects of students' tool-use on performance are. Cluster analysis reveals three distinct tool-use patterns or user profiles: the no-users, the intensive users and the incoherent users. Results from multiple analyses of variance reveal that those tool-use patterns affect the performance significantly. The results indicate that despite the benefits of blended learning environments as illustrated in literature, not all students seem to profit from the opportunities that are provided. Similar as in controlled settings, the results seem to indicate that students' tool-use cannot be taken for granted. Hence, they call for more research into the influencing variables, student-and context related, and the performance effects.

Research in controlled settings (e.g. review Aleven et al, 2003) underlines the fact that adaptive tool-use, as using tools in accordance with perceived learning needs, is a self-regulated activity that cannot be taken for granted (Azevedo, 2005). However, most of the research is done in a controlled setting characterized by non-embedded learning tasks and a focus on short-time learning effects (Grabinger, 2008). It remains unclear whether these results are replicated in an ecological setting. The current study puts the tool-use research in an ecological setting and more specific in an undergraduate blended course where learning is supported by various combinations of classical face-to-face initiatives (e.g. lectures, learning sessions) and digital devices as provided through the CMS (e.g. exercises, practice quiz, discussion board). Despite the fact that students, in most cases, have control in using these tools, there is little insight in how students' deal with this learner control i.e. how they use the tools and how that affects their performance.

First evidence in the Elis, Marcus and Taylor (2003) study indicates that coherently using the total tool-set cannot be taken for granted. Students were unsure of how to approach the online tools in ways that are likely to maximize the learning benefits in blended experiences. With respect to students' use of CMS tools, different studies reveal that students differ in how they approach a specific CMS tool (e.g. Grabe & Christopherson, 2005) or multiple CMS tools (e.g. Hoskins & Van Hooff, 2005) and this affects their performance for the course. The studies are however focused on one or multiple CMS tools without investigating how students use the tools all together, i.e. tool-use patterns.

The current study investigates students' tool-use in a blended undergraduate course. Based on evidence regarding students' use of CMS tools, it is expected that tool-use differences will exist and similar with evidence in controlled settings (e.g. Jiang, Elen & Clarebout, 2009) they will reflect distinct tool-use patterns among students. At least three tool-use patterns are expected: the no-users, the incoherent users and the intensive users.

Method

The sample

The study runs in a first year undergraduate course at the department of 'Educational Sciences' at the Katholieke Universiteit Leuven. It contains 91% of the course-participants ($n=159$). There are 152 women and 8 men. Most of the students were 18 years (72.3%).

The undergraduate course: toolset

Additional to the lectures, a CMS was provided and a team of support staff was at students' disposal. The support staff organized three learning support sessions and a feedback session that students could use voluntarily. The CMS was designed using Blackboard. The access and the use of the learning environment were under control of the student.

The tool-use behavior was captured through log-files. Table 1 presents the tools and the log indicators that were used in this study.

Indicators of learning

Students' course performance was assessed by an exam (consisting of factual items, comprehension items and application items) and an assignment for which students had to argue about an educational proposition.

Results

Students' tool-use behavior: tool-use patterns

K-means cluster analysis in Matlab was performed. K-means cluster solutions with two to ten clusters were fitted using 1000 restarts (for a discussion of the use of K-means cluster analysis, see Steinley, 2003). On the basis of a scree-test, the three-cluster solution was selected as optimal solution since a clear demarcation point is visible after three clusters.

One-way analysis of variance reveals that all the tool-use variables have a significant impact in defining the three clusters, $p = .000$. Post-hoc comparisons are illustrated in figure 1. As the figure illustrates, those three clusters represent different tool-use behavior among students, characterized by different tool-choices and distinct intensity in using them.

Fig 1. Tool-use patterns

Learning effects of the tool-use patterns

Multiple analysis of variance reveal a main effect of students' tool-use behavior on the five performance indicators, $F(5,150) = .139$, $p = .005$. More specific, students' tool-use behavior influences their total course grade, $F(2,154) = 5.056$, $p = .007$, and their assignment score, $F(2, 154) = 7.767$, $p = .001$. As for the assignment score, students in cluster 3, $M = .09$, $SD = .96$, and in cluster 2, $M = .31$, $SD = .78$, outperform students in cluster 1, $M = -.41$, $SD = .94$. For the total course grade, a significant difference exists between students in cluster 1 and cluster 2. Students in cluster 2, $M = .29$, $SD = .89$ outperform students in cluster 1, $M = -.25$, $SD = .81$.

Discussion and conclusion

In line with our expectations, three usage patterns were found. Students in cluster 1 reflect no users, they did not use the available face-to-face and CMS tools. Students in cluster 2 are intensive users, they used all the available tools. Students in cluster 3 are incoherent users, they used the face-to-face tools, the course material outlines and the learning support. The two latter CMS tools have a clear link with the face-to-face context. The outline notes referred to the face-to-face lectures and the learning support referred to the learning support sessions.

A significant difference was found between the no-users and the other patterns in performance on the assignment and on the total course grade. Surprisingly, no significant differences were found between intensive and incoherent users. This result raises questions with respect to the functionality of some CMS tools, the consistency in the intensive users group, possible mediating variables and possible influencing student variables.

[1] Duration and mean time were expressed in seconds.

PAPER PRESENTATION

Where's the math? Locations of mathematical activity in classes with handheld technologies

This presentation will examine the locations of mathematical activity in classrooms where handheld digital technologies are used. By drawing on Actor-Network theory, it will discuss the interactions between humans and materials within the sociotechnical networks of mathematics classrooms as they form in relation to Texas Instruments' TI-Nspire™ graphing calculator. The findings indicate that while many individual elements and connections exist within classroom sociotechnical networks, they operate as a complex interconnected whole. In particular, they suggest that the ways technologies are configured in mathematics classrooms have a profound effect on the mathematical practices within them but also suggest that this is far from a one-way phenomenon.

In this presentation, I will examine the locations of mathematical activity in classrooms where handheld digital technologies are used. By drawing on Actor-Network theory, I will discuss the interactions between humans and materials within the sociotechnical networks of mathematics classrooms as they form in relation to Texas Instruments' TI-Nspire™ graphing calculator. TI-Nspire™ and related technologies are broadly advocated in curriculum documents and guidelines for teachers (Ontario Ministry of Education, 2005; Qualifications and Curriculum Authority, 2007). In addition, a growing body of mathematics education research suggests that these technologies help learners make connections with and between mathematical concepts and enrich their mathematical thinking (Kaput & Schorr, 2008). Given this support for the use of digital handheld technologies, it is important to unpack the ways they change the geography of mathematical activity in classrooms. In this presentation, I will address these changes by examining the role of TI-Nspire™ as a location of mathematical activity in relation to other materials, teachers and students.

Theoretical Perspective

As a theoretical perspective, I draw on Shaffer and Clinton's approach to understanding the relationship between digital technology and learners in mathematics classrooms (2006). In particular, following their lead I draw on the Activity-Theory concept of learning as activity that always involves cultural tools. This notion suggests that understanding the mediation of tools including technologies is vital to understanding learning itself (Saljo, Eklund & Makitalo, 2006). While Activity-Theory foregrounds the important role of tools in human activity, it considers technologies and humans to have an asymmetrical relationship. In this relationship, humans are assumed to act as agents and technologies are not (Shaffer and Clinton, 2006). This assumption may obscure the important role that particularly complex digital technologies such as TI-Nspire™ can have in mathematical learning. To address this issue, I turn to Actor-Network theory to conceptualize the relationships between humans and technology as part of social networks of humans and non-humans all mediating each other's activity (Latour, 2007). Within these sociotechnical networks the relationship between actors, both human and non-human, are conceptualised in reciprocal terms offering the notion that when interacting the capacity to act cannot be located in either party but instead emerges from their interaction (Latour, 2007). Together the combination of Actor-Network theory and Activity-Theory provide a useful perspective for examining the mediation of mathematical learning within networks of humans and materials.

Method

I observed two ninth grade mathematics classes in the Canadian province of Ontario, spending a week video recording in each classroom. Augmenting this, I conducted a series of recorded interviews with the teachers that began with an in-depth session focused on their experiences teaching with technology. Continuing the interviews, the teachers participated in a retrospective debriefing interview following each observed class. In addition, I interviewed two students from each classroom about their experiences with TI-Nspire™.

Following data collection, all video-recordings, interview transcripts and collected artefacts were examined using Interaction Analysis (Jordan & Henderson, 1995) as an analytic approach to describing the complex activities and interactions within the networks of mathematical activity. As a tool for performing this analysis, the qualitative data analysis software Transana was used. This powerful and flexible software supported a detailed examination and interlinking of all collected data, including video, in a single environment.

Findings

The findings that I will present show the complex ways that the introduction of a digital handheld technology such as TI-Nspire™ changes the geography of mathematical activity in classrooms. They speak to the relationships between TI-Nspire™, teachers, students, and a wide range of materials such as the computer lab, paper/pencil, the blackboard, and interactive whiteboards. All these materials served as locations of individual and shared mathematical activity in the two observed classrooms. While no material replaced any of the others with the introduction of TI-Nspire™, the

networks of humans and materials in each classroom reconfigured in different ways that supported different mathematical activity.

While many individual elements and connections exist within classroom sociotechnical networks, the findings of this study indicate that they operate as a complex interconnected whole. In the two observed classrooms, it was particularly evident that the effects of the teachers' decisions to include TI-Nspire™ as part of their instructional practices were not limited to, for instance, the local relationship between student and handheld technology while completing an activity. They were instead extremely broad, influencing practices as diverse as the use of the computer lab and whole-class discussion of homework. The findings of this study suggest, that the ways technologies are arranged in mathematics classrooms have a profound effect on the mathematical practices within them but also suggest that this is far from a one-way phenomenon. While teachers have enormous influence through their choices of what technological arrangements to use, the technologies themselves along with other elements of the classroom geography mediate these configurations and are highly interrelated.

References

- Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, 4(1), 39-103.
- Kaput, J., & Schorr, R. (2008). Changing representational infrastructures changes most everything. In G. Blume & K. Heid (Eds.), *Research on technology and the teaching and learning of mathematics: Vol. 2. Cases and perspectives* (pp. 211-253). Charlotte, NC: Information Age Publishing.
- Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.
- Leont'ev, A. (1978). *Activity, consciousness, and personality* (M. J. Hall, Trans.). Upper Saddle River, NJ: Prentice-Hall.
- Ontario Ministry of Education (OME). (2005). *The Ontario curriculum grades 9 and 10: Mathematics revised*. Toronto: Queen's Printer for Ontario.
- Qualifications and Curriculum Authority (QDA). (2007). *The National Curriculum 2007*. London: Crown.
- Shaffer, D., & Clinton, K. (2006). Toolthoughts: Reexamining thinking in the digital age. *Mind, Culture, and Activity*, 13(4), 283-300.
- Saljo, R., Eklund, A.-C., & Makitalo, A. (2006). Reasoning with mental tools and physical artefacts in everyday problem-solving. In L. Verschaffel, F. Dochy, M. Boekaerts, & S. Vosniadou (Eds.), *Instructional psychology: Past, present, and future trends. Sixteen essays in honour of Erik de Corte*. (pp. 73-90). Amsterdam: Elsevier.

PAPER PRESENTATION

The Adoption of Technology Innovations

Charalambos Vrasidas, CARDET - University of Nicosia , Cyprus; Christiana Aravi, CARDET, Cyprus; Katerina Theodoriodu, CARDET, Cyprus; Petros Panaou, UNIC - CARDET, Cyprus; Anastasia Economou, CPI, Cyprus; Ireneos Pattis, UNIC - CARDET, Cyprus

The adoption of innovations and technology in teaching and learning has been studied extensively. This paper presents findings from 3 year program that focused on the development of case studies of the use of ICT in the classroom and results from large-scale evaluations of technology initiatives in Cyprus public schools. A large-scale survey was conducted and 30 case studies were developed in order to examine the use of ICT by teachers, the effectiveness of teacher professional development and the challenges faced by practicing teachers with respect to the integration of Information and Communication Technologies (ICT) in the curricula. This paper discusses findings from the large scale survey and enriches the findings with qualitative data from the ethnographic case studies to illustrate insights on effective practices of ICT adoption in Cyprus education.

Introduction

Attempts to integrate technology in education provoke a variety of responses from teachers that range from enthusiasm and skepticism to fear and uncertainty. A long history of technology use in education reveals that the first reaction is to use new technology in the same traditional ways as the old technology. Old curricula and pedagogical approaches should be reformed, and if necessary replaced, to take advantage of the affordances of the new media.

Context

During the last two years, we were involved in two large scale evaluations of the Cyprus Education system and 5 developmental research programs supported by the Republic of Cyprus, EU Structural Funds, and the European Commission. The focus of these projects was on the adoption of ICT by K12 teachers and the effectiveness of existing professional development programs offered. One of the key issues that came out was the importance of both formal and informal ways for teacher lifelong learning, and the role that online environments can play to support them. In

this paper, we present the summary of findings from evaluation work conducted to investigate the adoption of ICT in Cyprus public schools. This paper discusses findings from the large scale survey and enriches the findings with qualitative data from the ethnographic case studies to illustrate insights on effective practices of ICT integration in Cyprus education.

Research Methods

Participants

For the ethnographic case studies part of the projects, a total of 30 K12 schools participated (10 high schools, 20 primary schools). From each school we had one teacher as a case study. Each teacher and his/her class comprised of one case study in a variety of subjects. Teachers were chosen by the Ministry of Education based on the following criteria: teachers must have participated in some of the professional development programs, represent all counties of Cyprus (geographical distribution), and they must have expressed interest to participate in the case studies.

Setting and Procedures

The project research team that investigated and evaluated the case studies was led by the international Research Center CARDET. A total of 55 researchers were involved in the research. In order to achieve homogeneity and ensure consistency in data collection and analysis, four half-day workshops were held during which all researchers received appropriate training. The evaluation work span a period of 20 months.

Research/Evaluation Questions

The study investigated a series of questions. For the purpose of this paper we focus on the following:

1. What factors affect teachers' efforts in technology integration?
2. How do teachers use ICT?
3. What barriers do teachers face in using technology in the classroom?

Data Collection, Instruments and Analysis

Data for this project were collected and analyzed using both quantitative and qualitative methods. Data were collected from the following sources:

- . Pre-interviews conducted with each teacher on the planning process for the unit to be implemented and the teacher expectations
- . Observations of at least ten lessons implemented by each teacher, which integrated technology in the classroom over a period of 6 weeks.
- . Teacher self-reflective journals
- . A teacher post-interview
- . Interview with each teacher's technology advisor
- . Interviews with at least 3 students from each case (selected with the help of the teacher)
- . Student pre and post-tests.
- . A large scale survey administered to K12 school teachers.

For the purpose of this paper, we focus on the findings from the large scale survey. The main objective of the survey was to analyze how teachers use technology in the classroom and what challenges they face. In the discussion below, we enrich the findings of the survey, with qualitative data from the 30 case studies. In order to develop the 8-page instrument for the survey, we relied heavily on the findings from the qualitative data (e.g. interviews and observations). In addition, we reviewed other instruments, and consulted with experts in the field. A first draft instrument was developed and pilot-tested with 10 teachers and 4 experts. Following the pilot, we finalized the instrument and administered it to a sample of 1051 teachers using stratified sampling procedures. The total population of primary school teachers in Cyprus, during 2008-2009 was 4150. We ensured that all counties and regions of Cyprus were represented from both rural and urban settings. The response rate of the questionnaire was 50.5% (531 out of 1051).

Data Analysis

During data analysis, we followed the inductive and deductive stages used in interpretive and case study research. After we collected and organized all the data, we read through the data three times and generated assertions. Once we generated assertions from the data as a whole, we entered the deductive stage. In this stage, we engaged in detailed examination of the data corpus and looked for data to confirm or disconfirm our assertions. Moreover, statistical analysis of quantitative data included tables and diagrams, whereas authentic excerpts were extracted from the qualitative data.

Results

Even though the authors have studied all research questions related to this study, this section discusses only findings on the factors that affect teachers' efforts in technology integration and the challenges they face. The findings presented in this paper shed light to the complexities of integrating ICT in teaching and learning. The research reported is the first of its kind conducted in the Cyprus context. Findings reveal that teachers are willing to integrate technology into their teaching practices. However, even though they realize the benefits of ICT integration, a lot of teachers today seem resistant to integrating technologies. This is due to several factors that were revealed through the findings, such as lack of time, the ill-structured design of the school curriculum, and lack of infrastructure

PAPER PRESENTATION

Depiction of Theme in Graphics: Its Influence in Expository Text

Robert Danielson, California State University, Chico, United States; Neil Schwartz, California State University, United States; Stefan Krause, University of Koblenz-Landau, Germany; Marie Lippmann, University of Dresden, Germany; Sevil Gonen, California State University, Chico, United States; Maryam Fallahi, California State University, Chico, United States; Steven Caldwell, California State University, Chico, United States

It is well documented that when graphics are paired with textual material, recall is enhanced. However, not all graphics operate in a similar fashion. Previous research has indicated that decorative graphics provide little to the overall understanding of textual material, while representative graphics help learners construct a cognitive model of text content. Recently, decorative graphics have been found to be more effective than previously thought. Graphics which highlight the underlying themes present in a narrative, yield comprehension that is comparatively deep. This effect has been found both immediately after reading and one week later. In the present investigation, 80 volunteers read an expository text about the conflict in Darfur in the presence of a graphic depicting either the text theme of civil war or genocide, or they saw a graphic depicting the geographic region of the conflict, or no graphic at all. Results showed that the graphics, when they are metaphors of the underlying text themes, greatly enhance recall of the text when compared to either the non-thematic graphic or no graphic at all. Results are discussed in terms of the way decorative graphics can be used to influence deep learning.

Examples of text paired with graphics are prolific throughout textbooks and the web. It is well understood that when the two appear together, performance is consistently better than text alone (Carney & Levin, 2002; Schnotz, 2002; Schnotz & Bannert, 2003; Mayer, 2003; Mayer, Hagerty, & Mayer, 2005; Lewalter, 2003). However, not all types of graphics function in the same way, and specific text-graphic combinations lead to different performance outcomes. Schnotz & Bannert (2003) demonstrated that unique graphics, paired with identical texts, create different mental representations of textual information, and poorly selected graphics interfere with mental model construction (Schnotz & Bannert, 2003). Furthermore, some graphics are less reliable in their effect on learning from text, particularly when employed to decorate a page. Levin, Anglin, and Carney (1987), in a meta-analytic review, found moderate to strong effect sizes for graphics employed to inform text by representing all or part of text content, but weak to non-existent effect sizes for graphics used for decoration.

We contend that graphics used to adorn text serve more than a simple decorative function. Instead, they convey information about the theme of a text and influence a learner's cognitive interaction with a passage (Schwartz, Battinich, Lieb & Mortensen, 2008; Schwartz, Lieb, Battinich & Kuinke, 2007). Schwartz & Collins (2008) demonstrated that decorative graphics are capable of activating the prior knowledge of learners in idiosyncratic but reliably predictable ways. Mortensen & Schwartz (2009) found that thematically-related decorative graphics increased recall of both literal details and deeper level themes embedded in text-- immediately after reading the text two weeks later.

Unfortunately, Mortensen & Schwartz (2009) found effects with a narrative passage that, because of its ambiguous nature, may have contributed to the influence of the graphics. They also failed to test the effects against a non-thematic graphic condition. This investigation focused on expository text-- more common in textbooks and media, and tested the graphics against a non-thematic graphic condition.

Methodology

Design

The design was a 4 Metaphorical Graphic Theme (Genocide vs. Civil War vs. Geographic Location vs. None) x 3 Passage Theme Type (Genocide vs. Civil War vs. Neutral) fixed ANOVA, with repeated measures on the passage theme variable.

Participants

Eighty undergraduate volunteers (mean age = 23) were randomly assigned to experimental conditions in equivalent proportions of gender.

Materials

Experimental passage. The experimental passage was an 839-word expository text describing the current conflict in Darfur, written to reveal two socio-political themes— civil war and genocide. Overall, the passage contained a total of 80 idea units—40 neutral, 20 civil war, and 20 genocide. Neutral idea units provided contextual background of the conflict, geographic information, and a historical timeline. Civil war idea units consisted of rebel groups uniting against a corrupt government for representation. Genocide idea units consisted of a planned extermination or removal of a group of individuals. To ensure idea units were properly assigned to their corresponding themes, sentences were randomly ordered, rated by a group of 40 undergraduates, and factor analyzed for the identification of evoked themes and emotional valiance. Outliers were removed, and the passage was reconstructed as a cohesive unit.

Experimental graphics. Three metaphorical graphics were designed. The first graphic was a topographical representation of the region. The graphic depicting Civil War graphic consisted of two lions of similar color and size engaged in combat. The graphic depicting Genocide consisted of two lions of similar color and size devouring a third lion of a dissimilar color and size. Graphics were normed by a separate group of 40 undergraduates to ensure they elucidated the intended metaphor without evoking the alternate metaphors. (See Figure 1).

Experimental Website. An experimental website was designed to display the materials. The website consisted of 15 hypermedia pages; informed consent, general instructions, an essay prompt, and a demographic questionnaire. Prior knowledge of the conflict was assessed by embedding a 7-point Likert scale into the demographic questionnaire.

Procedure

Participants navigated the experimental website with the experimental text presented on the right half of the screen while one of three graphics (or no graphic) were randomly presented on the left. Participants were allotted six and a half minutes to comprehend both the text and the graphic. Participants were then allotted 15 minutes to write an essay containing as much information as they could remember, including any thoughts, feelings, or reactions to the text.

Data Source

Measures of comprehension were derived by scoring the essays for the number of three types of idea units— passage-neutral material and material related to the genocide and civil war themes. Two graduate students scored half the protocols in each between-subject group, and redundantly scored 20% of the total. Inter-rater reliability was $r = .90$.

Findings

Neutral-passage idea units recalled were analyzed across Metaphorical Graphic Theme (Genocide, Civil War, Location, No graphic) in a univariate ANOVA. Results yielded a significant effect between graphic conditions, $F(3, 76) = 3.495$, $p = .02$. Post hoc Tukey tests revealed neutral passage recall was highest ($M = 6.4$, $SD = 3.68$) in the presence of the metaphorical graphic depicting the theme of genocide. By contrast, recall was significantly reduced when the graphics contained no metaphor for theme (location, $M = 3.65$, $SD = 2.65$), and no graphic at all ($M = 3.68$, $SD = 2.63$). No relation was found between prior knowledge of the conflict and number of idea units recalled. (See Figure 2).

Theoretical and educational significance

These findings support Mortensen & Schwartz (2009), revealing that thematically related graphics increase recall of both deeper level themes and literal details from text. The results support those found by Mortensen & Schwartz (2009), but underscore the presence of the effect with expository text and test it against a thematically unrelated and absent-graphic condition. It is important to note that Mortensen & Schwartz (2009) found the largest effects when learners returned two weeks after reading. Delay condition data and the extent to which recalled is mediated by critical thinking skills will be presented and explained using the model proposed by Schnotz and colleagues (2003).

PAPER PRESENTATION

What do players have to say about informal learning through games?

Ioanna Iacovides, The Open University, United Kingdom; James Aczel, The Open University, United Kingdom; Eileen Scanlon, OU, United Kingdom; Will Woods, The Open University, United Kingdom

It has been suggested that digital games can be powerful learning environments that encourage active and critical learning, including participation within "affinity groups" and "semiotic domains" (Gee, 2004). However, there is still a need to provide further empirical evidence to substantiate these claims, especially if educators want to try to replicate people's enthusiasm for games within a formal educational context. By addressing the question "How do players describe learning in the context of gaming?" this study seeks to further our understanding of how and what people learn informally through playing games by first examining the player perspective. A set of learning categories, based on a series of email interviews with a range of adult games players, is identified along with some themes to consider in relation to players' views on learning within this context. The findings indicate the importance of considering more than just what occurs during play, because, for example, players often consult external resources for advice about what to do in the game world. It is also pertinent to note players' ideas about value and transfer of learning across contexts. The research raises questions about the completeness and applicability of these learning categories, and about how these categories relate to motivations for playing games and engagement during play.

References

- Calleja, G. (2007) Digital Game Involvement: A Conceptual Model. *Games and Culture*, 2, 236-260.
- Gee, J.P. (2004). *What Video Games Have to Teach Us About Learning and Literacy*. New York: Palgrave Macmillan.
- Hamilton, R.J. & Bowers, B.J. (2006). Internet Recruitment and Email Interviews in Qualitative Studies. *Qualitative Health Research*, 16, 821-835.
- Howard-Jones, P.A. (2010). *The Teacher's Handbook of Twig: Minds, Brains and Teaching with Immersive Gaming*. www.lulu.com: NENet.
- Squire, K. (2002). Cultural Framing of Computer/Video Games. *Games Studies* 2(1). Retrieved October 15, 2010 from <http://gamestudies.org/0102/squire/>
- Richardson, J.T.E. (1999). The Concepts and Methods of Phenomenographic Research. *Review of Educational Research*, 69(1), 53-82.

PAPER PRESENTATIONS

Aligning Instruction to Individual Learning Needs in Adaptive Hypertext Learning Environments

Eniko Bezdan, Open University, Netherlands; Liesbeth Kester, Open University of the Netherlands, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Educational hypertext research on the effectiveness of pre-structured, static hypertext learning environments have greatly enhanced our understanding of how pre-structured hypertext environments affect navigation and learning outcomes. In particular, the effect of different types of graphic organizers have been extensively studied in the past two decades. In the meantime, however, the focus of hypertext and hypermedia design have moved on toward the development of ever more sophisticated adaptive techniques, yet empirical data about the cognitive effects of adaptive hypertext/hypermedia have been slow coming. The scarcity of research regarding the cognitive consequences of adaptive hypertext/hypermedia is somewhat surprising, as it has the potential to bring one of the longest standing ambitions in education one step closer: being able to provide instruction which is finely tuned to the learning needs of the individual learner. Knowledge accumulated about the learning effects of static hypertext environments, along with the results of studies about learner versus system control for task selection are examined, in order to outline possible future directions for adaptive hypertext/hypermedia research in an educational context.

When speaking of hypertext/hypermedia, the most basic kind of classification that can be made is between static and dynamic/adaptive. In static, more traditional, hypertext the sequencing of hyperlinks is fixed and the text content of the nodes remains unchanged. As the degree of interconnectedness via hyperlinks and the placement of hyperlinks between nodes determine the structure of hypertext (e.g., linear, hierarchical, network/semantic), navigation aids called spatial maps, graphical browsers or graphical organizers, depicting this structure of hyperlinks and nodes, are frequently used as a way of tackling the problem of disorientation (McDonald & Stevenson, 1998). Not surprisingly, one of the main themes of hypertext research in an educational context has been to examine the effects of different types of graphic organizers and its effects on navigation and learning outcomes (DeStefano & LeFevre, 2007).

Besides differences regarding their structure (e.g. linear, hierarchical, network), graphical organizers can also be divided into interactive and static. In the case of interactive organizers, the hypertext structure as defined by its hyperlinks, and the structure depicted in a graphic organizer need not be the same, as indeed they often are not. This is for example the case when nodes can be accessed directly by clicking on the concepts in the organizer. Once arrived at a textual node, there is only the option clicking on the back-button which leads back to the graphical organizer (e.g., Amadiou et al., 2009; Potelle & Rouet, 2003). Thus, a graphical organizer of this sort is not intended to describe the structure of the hypertext itself, as the lines drawn between the concepts in the graphical organizer do not

correspond with the actual hyperlinks of the document. Consequently, it is almost certainly not the act of navigation (i.e. navigation here simply means clicking on concept in the organizer) which enhances learning, but the repeated viewing a representation of the relationships between the important concepts and of a knowledge domain.

Although in appearance similar to the interactive organizers described above, static graphic organizers usually have a different function. Static organizers can be a way of depicting the exact hyperlink structure of the hypertext document, as was the case in the study conducted by McDonald en Stevenson (1998). By visualising all possible pathways through the document, graphic organizers of this kind are navigation aids which could be said to convey a certain kind of spatial information. Thus, these are spatial maps which show how to get from a one text node to another, as well as the relative distance of textual nodes to each other as defined by the number intermediate steps between them. What still remains unclear is, however, to what extent graphic organizers showing possible navigation paths engage same cognitive processes as graphic organisers in which the linkages (i.e. lines between concepts) do not correspond with the actual hyperlinks in the document. Besides the open questions remaining with regard to static hypertext, the cognitive effects of more complex, adaptive hypertext are largely unexplored. Today's learners encounter adaptivity on a daily bases when they for example use a search engine to browse the internet. Search engines make use of sophisticated algorithms analysing individual search histories in real time to select the hits in response of a search query, thereby adapting content presentation to the individual user. Yet, the widespread exposure to adaptive hypertext and hypermedia of the student population has so far sparked surprisingly little interest in educational research. Usability and user satisfaction studies are being carried out by the developers of adaptive hypertext/hypermedia, who come for the most part from the field of information and computers sciences. However, very little attention is paid in these studies to cognitive effects and learning outcomes (Brusilovsky, 2003).

The cognitive effects of adaptivity are being studied, however, in the specific context of adaptive task selection. Adaptations on task selection often focus on the degree of freedom the learner gets over task selection. The most common classification regarding the locus of control for the adaptations distinguishes between system controlled adaptation, user controlled adaptation, and shared control by the system and the learner (Corbalan, Kester, & Van Merriënboer, 2009). It could be argued that studies focusing on adaptive task selection, although mostly presented in hypertext/hypermedia format, are not representative of the hypertext/hypermedia that are typically encountered when browsing the web. Nevertheless, insights gained from these studies are still relevant for hypertext/hypermedia in a broader sense, as different levels of system and learner control can be incorporated and made adaptable in diverse hypertext/hypermedia formats. Utilising effectively the possibilities of adaptive hypertext and hypermedia could be the key to truly customising instruction to individual learning needs. But in order to do so, it is necessary to gain a better understanding about the extent the structural characteristics of navigation aids (e.g., graphic organizers) and hypertext structure as defined by its hyperlinks have differential effects on cognitive processes in the course of learning. Additionally, varying the locus of control in adaptive task selection is a good starting point to explore how shifting the control from the system to the learner and vice versa affects learning outcomes. There is also still much to be learnt about the possible objects of adaptive control, as the structure, content and the form and type of navigation aids in hypertext/hypermedia can all be made adaptable in a great number of ways. The focus of this paper is, therefore, to explore how adaptations regarding structure, content and navigability might interact with variations in the locus of control of these adaptations.

References

- Amadiou, F., Van Gog, T., Paas, F., Tricot, A., & Mariné, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load, and learning. *Learning and Instruction*, 19, 376-386.
- Brusilovsky, P. (2003). Adaptive navigation support in educational hypermedia: the role of student knowledge level and the case for meta-adaptation. *British Journal of Educational Technology*, 34, 487-497.
- Corbalan, G., Kester, L., & Van Merriënboer, J. J. G. (2009). Combining shared control with variability over surface features: Effects on transfer test performance and task involvement. *Computers in Human Behavior*, 25, 290-298.
- DeStefano, D. & LeFevre, J. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior*, 23, 1616-1641
- McDonald, S., & Stevenson, R.J. (1998). Navigation in hyperspace: An evaluation of the effects of navigational tools and subject expertise on browsing and information retrieval in hypertext. *Interacting with Computers*, 10, 129-142.
- Potelle, H., & Rouet, J. (2003). Effects of content representation and reader's prior knowledge on the comprehension of hypertext. *International Journal of Human-Computer Studies*, 58, 327-345.

Effects of Drawing and Diagram Selection on Learning from Multiple Representations in Biology

Carla Firetto, Pennsylvania State University, United States

Peggy Van Meter, The Pennsylvania State University, United States

Active processing of diagrams embedded in science text improves student learning. This study tests two manipulations intended to improve learners' processing of diagrams. All participants read a biology text that contained 25 diagrams. 7 of these 25 diagrams were removed in both active processing conditions. In the first of these, the Draw condition, participants constructed their own drawings to replace the missing diagrams. In the Select condition, participants selected the correct diagram from amongst a set of alternatives. These two conditions were compared to conditions in which participants studied the materials with all diagrams provided and a text only control. Learning outcomes were evaluated on a multiple-choice posttest that was divided into two subtests. One subtest tested knowledge that corresponded to content related to the 7 missing diagrams. The second subtest tested knowledge taken from other areas of the instructional material. Results show that participants who constructed drawings scored significantly higher on the correspondent subtest than did participants who studied either the text only or the text with the provided diagrams. There were no differences between the selection condition and the provided diagram condition on this subtest nor were there differences between drawing and selection. On the subtest with non-correspondent items, all three conditions that received diagrams scored significantly higher than did participants in the text only condition. There were no differences found between these three conditions on this non-correspondent subtest, however.

Student-generated drawing is a strategy in which learners draw to depict instructional text (Van Meter & Garner, 2005). Although this strategy has been shown to increase learning (Van Meter, Aleksic, Schwartz, & Garner, 2006), other studies have failed to show strategy benefits (Leutner, Leopold, & Sumfleth, 2009). This study tests the drawing strategy by comparing learning outcomes for students who draw to those who were either provided diagrams or were forced to actively process provided diagrams. Forced processing was operationalized by requiring participants to select a correct diagram from amongst alternatives (Zhang & Linn, 2010).

Research hypotheses include:

Participants who actively process diagrams will acquire more knowledge than will participants who do not actively process diagrams.

Participants who construct drawings will acquire more knowledge than will participants who select diagrams.

The benefits of active diagram processing will be found on subtests that assess both correspondent and non-correspondent knowledge.

High prior knowledge participants will benefit from active processing of diagrams to a greater degree than will participants with lower prior knowledge.

Methods

Participants and Design

106 Educational Psychology students were randomly assigned to conditions. Conditions were text only (Text), text and provided diagrams (Provided), selection (Select), and drawing (Draw).

Materials

Instructional Materials. Participants studied a paper booklet describing muscle physiology. The text contained 1,780 words and 25 diagrams. Diagrams either depicted structures or were sequenced to depict processes.

Condition Manipulations. Participants in the Text condition studied booklets containing only text. In the Provided condition, booklets contained text and all diagrams were provided. Participants in the Select condition received booklets in which seven diagrams were removed. At these locations, participants selected the correct diagram from amongst a set of alternative diagrams. Missing diagrams were dispersed throughout the instructional material. Participants in the Draw condition also received booklets with missing diagrams. Booklets in this condition contained blank space and participants drew a diagram depicting the contents of the accompanying text.

Pretest and Posttest Measures.

Participants completed a pretest assessing prior biology knowledge.

The posttest was a multiple-choice test. This test was divided into two subtests. The first tested knowledge corresponding to the content that participants either selected or drew. The second tested knowledge taken from other areas of the instructional material. There were 17 correspondent items (C) and 25 non-correspondent items (NC). The alpha coefficient for the full test was .77.

Procedures.

Participants completed experimental sessions in a computer lab. Sessions were randomly assigned to condition. The experimenter explained instructions for each condition. Participants in the Select and Draw conditions were told of the missing diagrams and of the selection or drawing task, respectively. Participants completed the demographic survey, pretest, and posttest online; instructional materials were on paper.

Results

An extreme-groups split on the prior knowledge variable divided participants into high and low prior knowledge groups. 91 participants remained following this split.

Condition effects on the posttest variables were tested in a 2 (prior knowledge) X 4 (condition) MANOVA. The interaction between prior knowledge and condition was nonsignificant. Main effects for both prior knowledge and condition were significant; $F = 7.36$, $p\&\eta^2 = .15$; $F = 6.16$, $p\&\eta^2 = .18$, respectively. Univariate tests revealed a significant main effect of prior knowledge for both NC and C subtests; $F = 11.09$, $p\&\eta^2 = .12$, $F = 10.52$, $p\&\eta^2 = .11$. High knowledge participants scored higher on both subtests than did low knowledge participants.

There was also a significant main effect of condition found for both NC and C items; $F = 5.84$, $p\&\eta^2 = .17$; $F = 10.23$, $p\&\eta^2 = .27$. Tukey's HSD comparisons revealed that the pattern of these effects differed across the two subtests. For the NC subtest, the Provided, Select, and Draw groups all scored significantly higher than did the Text group. There were no significant differences across any of the three groups that received diagrams along with text.

On the C subtest, each group that received diagrams again obtained higher scores than did participants in the Text condition. There were also differences amongst these three groups. The difference between Select and Draw was not significant, but students who drew did score significantly higher than participants in either the Text or Provided conditions. Participants in the Select condition did not obtain significantly higher C scores than did participants in the Provided condition.

Discussion

This study demonstrated that the drawing strategy can be effectively embedded into lengthy instructional materials. Participants in the Draw condition were required to construct 7 of the 25 total diagrams. We believe that the construction of some, but not all, diagrams was important to the success of the strategy. First, the diagrams that were available to Draw participants provided a necessary form of support (Van Meter & Garner, 2005) by illustrating key structures and spatial relations. Second, providing some diagrams may have reduced the cognitive load associated with the drawing strategy (cf. Leuntner et al., 2009). The differential pattern of performance on NC and C items suggests that the benefits of drawing are local. Drawing did show an advantage when the subtest assessed knowledge directly related to drawn content. When non-correspondent knowledge was tested, however, Draw participants did not obtain higher scores than did Provided participants.

This study also demonstrated that active processing of the diagrams alone, through the selection task, did not improve learning (Van Meter et al., 2006). It is possible, however, that the selection task was not sufficiently complex to support learning (Zhang & Linn, 2010).

We are currently analyzing qualitative characteristics of constructed drawings. Once this coding is complete, we will examine relationships between these characteristics and learning outcomes.

PAPER PRESENTATION

The role of teacher characteristics in promoting student engagement

Jolien van Uden, ROC van Twente/ Twente University, Netherlands; Henk Ritzen, Applied University Edith Stein, Netherlands; Jules Pieters, University of Twente, Netherlands

In this research the relationship between teacher characteristics, like their motives to become a teacher, their self-efficacy beliefs, competences and interpersonal teaching style, are examined in relation with student engagement. Disengagement is an important risk factor in the process of dropping out. Three types of engagement are being distinguished: behavioural, emotional and cognitive engagement. The relation between all three types of student engagement, and teacher characteristics are explored during a survey in vocational education and training centres in the Netherlands (VET Colleges). This survey consists of a teacher and a student questionnaire. The results of both questionnaires will be combined, so the engagement of the students can be linked to the characteristics of their teachers. The first student results show a relation between student engagement and interpersonal teaching styles. The results of the complete datasets are examined during the spring and will be presented at the Earli 14th Bienial Conference.

Theoretical framework Student drop-out is a hot item in the Netherlands (Researchcentrum voor Onderwijs en Arbeidsmarkt, 2009). From a pedagogical perspective drop-out is the result of a long term process of disengagement

and withdrawal of a student from education. This process of disengagement starts during the early years of education (pre-school and primary education) and could result in dropping out of school in higher and vocational education (Dynarski, Clarke, Cobb, Finn, Rumberger & Smink, 2008; Hammond, Linton, Smink & Drew, 2007). Drop-out is not the result of one single factor, research confirms that different factors influence the decision to drop-out. These risk-factors are interrelated, interact with each other and have a cumulative effect on the decision to quit school (Dynarski et al, 2008). Among the important factors that influence drop-out of school is student engagement (Appleton, Christenson & Furlong, 2008; Fredricks, Blumenfeld & Paris, 2004). The expectation is that if student engagement has increased and other risk factors are offset by prevention activities or special student care programs like mentoring and individual coaching programs, the drop-out rate will decline. In this research we focus on what the teacher can do to improve student engagement. The concept of engagement is a multidimensional construct consisting of three components (Appleton et al., 2008, p.370):-

Behavioral engagement: a student is behavioral engaged if he participates in the lesson. The student is on time, concentrates on the assignments given, puts effort into these assignments and undertakes action if possible.-
Emotional engagement: a student is emotional engaged if he is enthusiastic about school. He is interested in going to school, he can identify himself with school and demonstrates a positive learning attitude. –

Cognitive engagement: a student is cognitive engaged if he understands the importance of his education. He is able to formulate his own learning goals, disposes of self-regulating abilities and the extent to which he wants to put effort in receiving good learning results. According to Hattie (2003) the teacher accounts for 30 percent of the variance in the school success of students. The abilities of the student himself account for 50 percent of the variance. Other aspects, family, school and peers, explain five till ten percent of the variance. If school success is explained for 30 percent by the role of the teacher, could that mean that the teacher would have the same impact on student engagement? A lot of research has been conducted to examine the relationship between drop-out and engagement (e.g. Archambault, Janosz, Fallu & Pagani, 2009; Finn, 1989; Klem & Connell, 2004) while almost no research has been done to examine the way teachers can influence the engagement of students. In this research we examine what teachers can do to improve the engagement of students in lower educational tracks (assistant training level 1 and basic vocational training level 2). In this inquiry the teacher characteristics are limited to: The motives to become a teacher: A person can choose to become a teacher based on extrinsic, intrinsic and altruistic motives (e.g. Pop & Turner, 2009; Richardson & Watt, 2006). Which motives are important in stimulating student engagement? Competences: Teachers can develop three types of knowledge and competences: subject knowledge, didactical knowledge and pedagogical knowledge (e.g. Beijaard, Verloop & Vermunt, 2000; Borko, 2004; Darling-Hammond & Bransford, 2005). Which competences are related to higher student engagement of students in vocational education level 1 and 2? Personal characteristics: Literature suggests that students in the lower educational tracks are in need of social-emotional competent teachers. Interested, warm and careful teachers can make the difference in case of students at risk of dropping out (Jennings & Greenberg, 2008; Pianta & Allen, 2008).

A large amount of self-efficacy is related to educational innovation, good class management, offering suitable learning activities and taking responsibilities for students in need of special care. Furthermore teacher self-efficacy is associated with student's motivation and self-esteem and more positive attitudes towards school (Caprara, Barbaranelli, Steca & Malone, 2006). The motives to become a teacher, the competences and personal characteristics will probably result in specific behaviour in the class in interaction with the students. Wubbels, Créêton and Hooyman (1985) have adapted the 'Rose of Leary' for educational interaction. They call this adapted model 'Model for interpersonal behaviour' (MITB). This model distinguishes two dimensions: the amount of influence and the amount of proximity. A higher score on both dimensions correlates with better cognitive and affective results (e.g. Den Brok, Brekelmans & Wubbels, 2006; Van Petegem, Aelterman, Van Keer & Rosseel, 2008). We examine whether these results also apply for student engagement.

Research design

In this research we examine which teacher characteristics influence student engagement. Little research is done with respect to this subject, therefore we decided to start an explorative survey. This survey consists of two questionnaires, one for teachers and one for students. The student questionnaire is used to measure the student engagement (all three components) and will be correlated with the results of the teachers. We ask the teachers and students to fill in a short version of the questionnaire on teacher interaction (QTI) (Wubbels, Créêton & Hooyman, 1985). Besides the QTI teachers answer questions about their motives, competences and the mentioned personal characteristics. All teacher questionnaires will be linked to the results of their students. One completed teacher questionnaire needs at least ten completed student questionnaires to be included in the analysis. Results Several institutions of vocational education participate in the survey at this moment. The first student results (N = 370) show a relation between student engagement and the interpersonal teacher style (table 1). In the beginning of 2011 we will be able to analyze the teacher questionnaires in combination with the student questionnaires. We will present the results of those

analyses at the Earli Conference in Exeter and answer the question which teacher motives, competences and personal characteristics.

PAPER PRESENTATION

Science and technology education for the future: needs of future employees
Professional Development, Science Education, Vocational education

Liesbeth Baartman, Eindhoven University of Technology, Netherlands

Koen Gravemeijer, Eindhoven School of Education, Netherlands

Technological developments and computerisation influence many jobs. The goal of this study is to identify to what extent employees need an increased and/or different understanding of science and technology to function in their jobs than is currently taught in schools. Whereas previous research tended to focus on very general skills (e.g., problem solving, communication) or long detailed lists of content knowledge, the focus of this study is on competences such as modelling and visualising. Companies most influenced by technological developments were selected in cooperation with National Centres of Expertise on vocational education. They were asked in which companies (1) more and/or different scientific and technological competences, and (2) creativity and flexibility are required. We focused on jobs at the level of senior secondary vocational education, as these jobs are most prone to being outsourced or taken over by computers. Employees working in the different companies were asked what knowledge and skills they use during their work, for example when working with machines and computers. Preliminary results show the influence of technological developments on almost all jobs. Required knowledge and skills are for example: data-analysis, the use of graphs and thinking beyond one's own job. The need for flexibility, creativity and insight in 'black boxes' seems to depend on the level of education.

Theory and aims The increased use of information- and communication technology and the influence of scientific and technological developments have caused many countries to redefine the key competences for adequately functioning professionals. This study specifically focuses on the needs of future employees: what competences in the domains of science and technology do they need to function adequately in their jobs, now and the future? Previous studies tend to focus on very general skills such as problem solving and communication (e.g., Holbrook & Rannikmae, 2007), which do not provide any specification of what should be taught. Other studies provide long and detailed lists of content to be taught in schools (e.g., AAAS, 1993). These lists run the risk of quickly becoming outdated as the amount of technical information is doubling every two years (Binkley et al., 2010). This begs the question whether we can identify competences that are general in the sense that we may expect them to stay valuable for a long time, but at the same time not too general to offer directions for curricula. This study tries to answer this question by interviewing employees in companies that are subject to technological developments. In the literature, two domains provide input to this study. First, a number of studies focus on 21st century-skills, lifelong learning competences, or key skills. For example, Binkley et al. (2010) analysed curriculum and assessment frameworks around the world, and identified ten competences, including creativity, critical thinking and ICT literacy. Voogt and Pareja-Roblin (2010) and Dede (2009) reviewed different reports about 21st century skills, generally relying on private/business initiatives. These reports mention skills such as communication, ICT literacy, social awareness, and creativity. Problematic is, however, that explicit links to educational levels are missing and the educational community hardly participates in this debate. These reports thus provide little direction with regard to the content of education. Second, we reviewed the literature about knowledge and skills used in the workplace. Here, hardly any studies exist on the use of science and technology at the workplace. There are, however, studies on mathematics that are general enough to be useful for science and technology as well (e.g., Bakker et al., 2006; Pozzi et al., 1998). These studies show the importance of: (1) knowing what processes are 'hidden' in computers or machines, and (2) analysing relationships between variables, based on quantitative data.

Data and Methods **Participants** The context of this study was vocational education in the Netherlands, preparing students for a job at levels ranging from assistant worker to middle management. This middle-level job was chosen, as it is likely to be most affected by technological changes, while employees are not specifically educated in this domain (Levi & Murnane, 2005). To identify companies most influenced by technological developments, interviews were conducted with National Centres of Expertise, who develop national qualification profiles for the different branches. Six interviews were conducted with representatives from: animal and plant care, car mechanics, audician/optician, graphical design, commercials/presentation, and nursing/care. Seven interviews were conducted with employees of these branches: a farmer using robots, employees of Ford cars, a company developing logistical systems, an ICT desk, an outsourcing company, and an audician. In November/December 2010, more interviews will be conducted in different branches, and nursing specifically. **Interviews** Representatives of the branches were asked to describe developments with regard to: (1) the amount of science and technology, (2) the content of science and technology, and (3) flexibility and creativity needed to function on the job. Depending on their

function, the employees were asked:- what kind of machines and computer programs they work with;- if they need to know the 'invisible processes' inside;- how they are trained to work with new machines and computers;- what they do in case of an unexpected outcome or problem. All participants were asked to describe job situations in which scientific and technological knowledge and skills are used. Preliminary results Full results, including the remaining interviews and more examples from concrete job situations, are presented at the conference. - Required knowledge and skills: most employees need some basic knowledge of science and technology. For example, audicians need knowledge of the auditory organs. - Flexibility and creativity: at lower levels, employees are not expected to suggest improvements or solve non-standard problems. An exception is 'defence/tank' mechanics. They need to know the exact working of tank engines, enabling creativity in emergencies. - Insight in black boxes: opinions seem to differ here. In general, employees can work with machines without knowing 'what is going on inside'. For example, graphical designer can use software to make sketches without knowing how colours mix. Theoretical and educational significance Most jobs seem to be influenced by computerisation and technology, leading to changed requirements in terms of knowledge and skills, creativity and insight in black boxes. The identification of these changed requirements could guide curriculum adaptations, better preparing young people for their future jobs. More research seems warranted on the use of science and technology at the workplace (following studies on mathematics). This study is a first step in this direction. References American Association for the Advancement of Science (1993). Benchmarks for Science Literacy. New York: Oxford University Press. Bakker, A., Hoyles, C., Kent, P., & Noss, R. (2006). Improving work processes by making the invisible visible. *Journal of Education and Work*, 19, 343-361. Binkley, M., et al. (2010). White Paper 1. Developing 21st century skills. University of Melbourne: Assessment and Teaching of 21st Century Skills. www.atc21s.org. Dede, C. (2009). Comparing frameworks for 21st century skills. In J. Bellanca & R. Brandt (Eds.) *21st Century Skills*, pp. 51-76. Bloomington, IN: Solution Tree Press. Holbrook, J., & Rannikmae, M. (2007). The nature of science education for enhancing scientific literacy. *International Journal of Science Education*, 29, 1347-1362. Pozzi, S., Noss, R., & Hoyles, C. (1998). Tools in practice, mathematics in use. *Educational Studies in Mathematics*, 36, 105-122. Voogt, J., & Pareja Roblin, H. (2010). *21st Century Skills*. Discussion paper. Enschede, the Netherlands: University of Twente.

Using a Personal Development Plan for different purposes and its influence on learning & performance
Assessment methods, Assessment of Competence, Professional Development

Simon Beusaert, Maastricht University, Netherlands

Mien Segers, Maastricht University, Netherlands

Wim Gijselaers, Maastricht University, Netherlands

Today, organizations are increasingly implementing assessment tools such as Personal Development Plans. Although the true power of the tool lies in supporting the employee's continuing professional development, organizations implement the tool for various different purposes, professional development purposes on the one hand and certification/selection/accountability purposes on the other (Smith & Tillema, 2001). The study presented here aims at a better understanding of how the purpose of the Personal Development Plan (PDP), as perceived by the employee, influences the extent to which s/he undertakes learning activities and consequently leads to improved performance. Data were collected from 286 employees working in a regional Dutch tax office and 81 experts from an international organization that is specialized in medical technology (n=367). Data were analyzed by conducting hierarchical regression analyses. Results indicate that perceiving the PDP either as a learning and development tool or as a certification and selection tool, positively predicts the undertaking of learning activities and the employee's performance. Follow-up regression analysis indicated that the most powerful predictor of undertaking learning activities and a high-quality performance is the extent to which employees perceive PDPs as serving learning and development purposes. The results of this study suggest that if an organization wants their employees to learn by undertaking learning activities and in turn perform better, the tool should in the first place be introduced and used as a learning and development tool.

1. Aim Today, organizations are increasingly implementing assessment tools such as Personal Development Plans (PDPs) to stimulate employees to intentionally undertake learning activities and in turn improve workplace performance (London, 1997; van de Wiel, Szegedi, & Weggeman, 2004). In general a PDP can be described as an assessment tool embedded in a larger assessment cycle of development and performance interviews; used to gather and document information about the competencies the employee worked on and is planning to further develop (Beusaert et al., 2010). It is argued that although there is a trend towards using the tool for performance appraisal

(summative assessment), the power of the tool lies in supporting employees' professional development (formative assessment) (Darling-Hammond & Snyder, 2000; Smith & Tillema, 2003). Some authors even wonder whether a single assessment format such as a PDP can serve different purposes at the same time (Dochy & McDowell, 1997; Wolf & Dietz, 1998). For example, different authors question whether PDPs can be discussed in development interviews as well as in appraisal interviews, conducted by one and the same supervisor (e.g. Beck, Livne & Bear, 2005; Wolf & Dietz, 1998). When using the tool for both purposes at the same time, the purpose of the tool as well as the guidelines and the structure are not always clear (Smith & Tillema, 2003). In this respect, it is argued that one of the quality standards of assessment is making the purpose of the assessment clear (e.g. Tillema, 2003), especially in the case of PDPs because of the potential differences in content of and approach to the tool (Arter & Spandel, 1991). When it is not clear what the PDP strives toward, this jeopardizes the quality of the assessment practice. Employees' self-protection and fear of underachieving may lead to the collection of unauthentic evidence and the construction of invalid PDPs, instead of PDPs that openly reflect on the employee's learning and development (Smith & Tillema, 1998, 2001). On the contrary, other authors believe that information gathered during the learning or development process can be very useful for summative evaluation (e.g. Snyder, Pippincott & Bower, 1998). Despite the many arguments elaborated upon in literature, there is hardly any evidence on the effect of implementing PDPs for different purposes. The study presented here aims to contribute to a better understanding of how the purpose of the PDP, as perceived by the employee, influences the extent to which s/he undertakes learning activities and in turn, leads to improved performance. Based on the aforementioned literature, the following hypotheses are formulated: H1. Perceiving the PDP as a (organizational and individual) learning and development tool predicts the employee's undertaking of learning activities and the employee's performance significantly positive. H2. Perceiving the PDP as a selection and certification tool predicts neither the employee's undertaking of learning activities, nor the employee's performance significantly positive. H3. In the case both learning/development and certification/selection goals are taken into account, perceiving the PDP as a learning and development tool is the most powerful predictor of the employee's undertaking of learning activities.

2. Method Two organizations participated in the research. Participants are 286 employees (response rate 20%) of a regional Dutch tax office and 81 employees (response rate of 41%) from an international organization that is specialized in medical technology. For an overview of the different measures, example items, and Cronbach's alphas, we refer to Table 1. Data analysis was done by calculating descriptives and conducting correlational and regression analyses. Table 1 Overview of the different scales and their descriptives

Scale	N	Alpha	Example items
The perceived nature of the goals			Indicate on a Likert scale going from 1 to 5 in which way your organization is striving for the following goals by implementing PDPs:
Personal learning and development goals	3.89		Stimulate reflection or learning.
Organizational learning and development goals	4.88		Stimulating collaboration with colleagues.
Certification and selection goals	4.76		To delivering evidence to my supervisor.
Outcome variables			
Undertaking learning activities	6.90		Because of using a PDP I look up things in books, journal or on the internet.
Performance	6.97		Since I am using a PDP and have related meetings, the quality of my work improved.

3. Findings The correlational analysis indicate that the three different goal components correlate significantly positive with Undertaking learning activities and Performance. To examine the independent effect of the three perceived goals components on the employee's undertaking of learning activities and performance, three hierarchical regression analyses were executed. The findings indicate that personal as well as organizational learning and development goals predict the employee's undertaking of learning activities ($b = .18$; $p = .020$; $p < .05$) and performance ($b = .35$; $p = .033$; $p < .05$) significantly positive, which confirm Hypothesis 1. In contrast to our expectations, the Certification and selection goals also predict the undertaking of learning activities ($b = .14$; $p = .014$; $p < .05$) and the employee's performance ($b = .29$; $p = .029$; $p < .05$) significantly positive, which is not in line with Hypothesis 2. However, in order to determine which goal component is the most powerful predictor of the employee's undertaking of learning activities and performance, we conducted subsequently hierarchical regression analyses. The results show that organizational learning and development goals is the most powerful predictor of undertaking learning activities ($b = .14$; $p = .014$; $p < .05$). Next, the performance of an employee is more likely to improve because of the PDP if s/he perceives the assessment tool as a learning and development tool (personal: $b = .17$; $p = .017$; $p < .05$) and not as a certification and selection tool (not significant).

4. Theoretical and educational significance of the research Theoretical significance. To our understanding this is the first quantitative study that researches the influences of the different perceived purposes of the PDP on the undertaking learning activities and performance in an organizational context.

Practical significance. This study has implications for human resource development in organizations. First, in order to stimulate employees to undertake learning activities and improve their performances by using a PDP, introducing and using the PDP as a tool for learning and development is the most effective. Second, this research leads to the question: How to balance between certification and selection purposes on the one hand and learning and development purposes on the other, knowing that learning and development purposes are stronger predictors of undertaking learning activities and performance? First, keep learning and development interviews separate from performance interviews and have them conducted by a different person. Second, make a distinction between the criteria used for discussing the PDP during the learning and development interviews and the criteria used during performance interviews.

Exploring new horizons: teacher professional development through networked learning
Continuing professional development in Teachers, Professional Development, Social interaction

Daniel Van Amersfoort, Open University, Netherlands

Monique Korenhof, Open University, Netherlands

Nienke Moolenaar, University of Twente, Netherlands

Maarten De Laat, Open University, Netherlands

In educational practice and policy, teachers' professional development initiatives are catering to the notion that teacher learning is situated in a dynamic social context. One way in which teacher learning is shaped in practice is through networked learning. However, empirical evidence of networked learning as a means of teachers' professional development is scarce. The aim of the study was to examine teachers' perceptions of, and experiences with, networked learning to explore core concepts of teachers' networked learning in primary education. This article reports on an exploratory case study among primary school teachers of ten learning networks in two school districts in the Netherlands. We used constant comparative analysis in combination with an input-process-output approach to code the transcribed interviews on teachers' perceptions of networked learning. Findings indicated that teachers' perspectives on, and experiences with networked learning can be attributed to five main aspects referring to pre-conditions for networked learning (input), four main aspects related to the process of networked learning, and five main aspects pointing at output of teacher networked learning. Moreover, we found evidence of feedback loops connecting the input, process, and output stages. Insights from this study provide meaningful understanding of teachers' professional development through networked learning and the factors that constrain and support teachers' networked learning in daily practice. It is through these networked learning experiences that teachers' professional development will permeate teachers' daily practice and, ultimately, improve instructional practice.

References

- Coburn, C. E., & Russell, J. L. (2008). District policy and teachers' social networks. *Education Evaluation and Policy Analysis*, 30(3), 203-235.
- Earl, L. & Katz, S. (2007). Leadership in networked learning communities, *School Leadership and Management*, 27(3): 239-258
- Haythornthwaite, C. & De Laat, M.F. (May 2010). Social networks and learning networks: Using social network perspectives to understand social learning. *Proceedings of the Networked Learning Conference*, Aalborg, Denmark, May 2-3, 2010.
- Jones, C., Asensio, M., & Goodyear, P. (2000). Networked learning in higher education: practitioners' perspectives. *Journal of the Association for Learning Technology*, 8(2), pp. 18-28.
- Krackhardt, D. (1992). The strength of strong ties. In N. Nohria & R.G. Eccles (Eds.), *Networks and organizations: Structure, form, and action* (pp. 216-239). Boston, MA: Harvard Business School Press.
- McCormick, R., Fox, A., Carmichael, P., & Procter, R. (2010). *Researching and understanding educational networks. New Perspectives on Learning and Instruction*. New York, NY: Routledge.
- Moolenaar, N. M. (2010). *Ties with Potential: Nature, Antecedents and Consequences of Social Networks in School Teams*. Unpublished Doctoral Dissertation. University of Amsterdam, The Netherlands.

PAPER PRESENTATION

Languaging and identities in the construction and organization of 'Swedish for immigrants'.

Jenny Rosen, University of Dalarna, University of Orebro, Sweden; Sangeeta Bagga-Gupta, University of Orebro, Sweden

This study draws upon ongoing research in Project-KIK, Categorization of Identities and Communication. Project-KIK is interested in social practices in a tailored education for adult immigrants in Sweden and the discourses framing it. The theoretical framework employed approaches language policies in terms of a dialectical relationship between the policies (macro level) and the learning that takes place in the language classroom (micro level). Our empirical material consists of audio- and video recordings of everyday interactions at an institutional arena constituted under the name of "Swedish for immigrants (Sfi)".

Our preliminary analyses illustrate among other issues, how multilingualism and monolingualism in Sweden are reflected in and negotiated through everyday interaction and the social practices in classroom settings. By highlighting empirical examples from two separate language learning classrooms, we discuss how different learning environments are created in relation to how teachers and students negotiate their understandings of languages and identities. The understanding of Swedish as the principal and only language used for communication in this institutional setting is challenged by the multilingual languaging practices that the students employ. As a result, different opportunities for the students (both in terms of learning as well as constructing and negotiating identities), are constituted.

The study presented here draws upon the ongoing work in project-KIK, Categorization of Identities and Communication. Project-KIK is interested in both the social practices and the discourses that frame a tailored education for adult immigrants in Sweden. It focuses on conceptualizations and the "doing" of languages and identities in the specific institutionalized arena that emerged in the post-world war II period with the intention of teaching Swedish language to adult immigrants in the nation-state of Sweden.

Research concerned with the language situation of adult immigrants in different European national contexts is not uncommonly founded upon an understanding of languages in terms of being standardized, static and with defined (often national) boundaries. For example, there is an established body of literature that focuses on language policy and politics at the societal (or macro) level, with an emphasis on the legal rights and policies in different nation states. Our interest in languages lies in their dynamic and fluid nature and embraces the theoretical perspective found in dialogism (e.g., Linell 1998, 2009). This entails that our approach to language policies is both multidimensional and complex.

The theoretical framework employed in the study that is presented here approaches language policies in terms of a dialectical relationship between policy (macro level) and the learning that takes place in the language classroom (micro level). The study presented here explores how policies regarding languages are reflected in the organization of language learning for adults. More specifically, we focus upon issues of multilingualism and monolingualism and show how these are oriented towards in the mundane, everyday social practices in classroom settings. The Swedish Language Act from 2009, maintains that 'Swedish is the principal language in Sweden', and that 'all residents of Sweden are to be given the opportunity to learn, develop and use Swedish'. The Act furthermore decrees that persons with "a different mother tongue" are to be 'given the opportunity to develop and use their mother tongue'. The tension between Swedish as the principle language on the one hand, and a recognition of multilingualism on the other, and which is reflected in such central policy documents, comes also alive in the language learning classroom.

Using empirical examples from our ongoing study, we show how questions regarding the status of Swedish and multilingualism are not only issues of debate on a macro level, but are (i) reflected in and (ii) discussed by the members of the language learning classroom and (iii) shape languaging activities there. KIK-project encompasses approximately 85 hours of audio and video materials and ethnographic field notes from five different classroom settings at an institutional arena that is called "Swedish for immigrants (Sfi)". Members in the typical Sfi classroom include 10-20 adult immigrants with diverse linguistic experiences and cultural resources. A variety of monolingual Swedish language textual materials are used in these classroom settings. The diversity of the students in the classroom with regards to their educational and linguistic experiences is understood, in the specific institutional setting of 'Swedish for immigrants', as a challenge for the organization of learning and instruction. In this presentation, we juxtapose empirical examples from two different types of classrooms: in the first, the institutional categorization of the students is done in terms of "limited educational background". Most of these students have at the time of the field study been enrolled in the educational program for one semester. In the second classroom, the students are categorized in terms of "long educational background" and the students in the project classroom had been enrolled from a period of a couple of weeks to approximately one year.

Through our analyses, we discuss how different learning environments are created following how teachers and students negotiate their understandings of languages and identities in the classroom. The understanding of Swedish as the principal and only language used for communication in this institutional setting is contrasted with more multilingual languaging practices that the students employ. Our analysis raises issues regarding different types of

opportunities for the learning of Swedish as well as the ways in which identities are constructed and negotiated in the two different settings. In an environment, in which students multilingual resources are acknowledged and seen as a tool in the institutional target language learning, students are also given the opportunity to constitute a multilingual identity in their new country of residence. In contrast, when the students' use of their linguistic resources is subverted, students use resources to challenge the "Swedish only norm", rather than focusing on the language learning. Empirical examples will be used to illustrate these tensions.

PAPER PRESENTATION

Teachers' Mutual Understanding - A Systematic Analysis of Talk with Two Approaches

Inger Osterlund, Abo Akademi University, Finland; Varpu Tissari, University of Helsinki, Finland

Mutual understanding among teachers has an impact on development of school and students' success. The present study highlights the complexity in dialogues which signify the use of different approaches when analysing the data. The aim is to analyse teachers' mutual understanding during meetings by using different methods of analysis. This micro educational study on social interaction, analyse video records from teacher meetings, which are part of the data from two larger case studies. The first case study examines the multi-professional cooperation of an elementary school teacher and a subject teacher whilst they are planning a field visit to a nature school. The second case study investigates changes of codes in the collegial talk of secondary school teachers at a formal teacher meeting. Theoretically, the selected excerpts are examined from the sociocultural theories of learning, and from the sociolinguistic perspective. Methodologically, the excerpts are scrutinized by analysis of communicative functions, and according to the multimodal analysis. The results from the multimodal analysis point out a few utterances to the situated meaning that are accepted but not heard, or tolerated. The analysis of communicative function provides further insight on the thematically different communicative functions embedded in the interaction of teachers participating at the meeting. The results provide a diversity that indicates how a systematic outlining of the data varies. Thus, the study may stimulate networking of teachers both in virtual and face-to-face interaction.

Mutual understanding among teachers and between teachers and other professionals cooperating has an impact on development of school and students' success (Little, 2010; 1990; Willman, 2001; Fullan, 2002; Hargreaves, 2003). The ways in which such mutual understanding is constructed during teachers' talk vary and depend on which entries are chosen to explore talk.

In this micro educational study on social interaction, the authors analyse video records the teacher meetings, which are part of the data examined in two larger case studies (Yin, 2003). The first case study examines the multi-professional cooperation of an elementary school teacher and a subject teacher whilst they are planning a field visit to a nature school, in which the latter is working as a nature school teacher. The second case study examines changes of codes (Bernstein, 1990; Bourdieu & Passeron, 1990; Goffman, 1981; Goffman, 2000; ; Grenfell & Kelly, 1999; Lemke, 2007; Moore, 2006; Schiffirin, Tannen, & Hamilton, 2001; Tannen, 1998; Tannen, 2005) in the collegial cooperation of secondary school teachers at a formal teacher meeting.

The aim is to explore and analyse the construction of mutual understanding of teachers participating in the meetings, by using different perspectives and analysis methods. The objectives are to examine the teachers' talk in order to understand how teachers orchestrate their interaction with each other, and to analyse the obstacles and opportunities in such situations.

A sequence of the video data from both of the case studies is analysed by exploring the interaction and talk of teachers. Theoretically, the selected excerpts from the data from both case studies are examined from two perspectives. The first perspective draws on the sociocultural theories of learning (Packer & Goicoechea, 2000), and the second perspective draws on the sociolinguistic perspective using Bourdieu (Bourdieu & Nice, 1986) and with an interactional input from Gumperz (Schiffirin, 1994; Schiffirin, Tannen, & Hamilton, 2001) through Tannen (1989; 1998; 2005).

Methodologically, the excerpts from the data from both of the case studies are scrutinized by the analysis of communicative functions, and according to the multimodal analysis. The former sheds light on the thematic nature of interaction, and also on its moment-by-moment construction in the ongoing interactions (Kumpulainen & Wray, 2002; Kovalainen & Kumpulainen, 2005; Kovalainen, & Kumpulainen, 2007). The latter refers to the problematic in breaking up interaction into separate modes. This problem is overcome by looking at all the modes together at the same time, and examining how the modes interact in a small scale of data for a later exploration in the larger scale of data. (Jewitt, 2009; Bezemer & Jewitt 2010.)

The research questions are the following: 1. How mutual understanding is constructed during teachers' talk? 2. What may be the obstacles and opportunities for analyzing the talk with different methods of analysis?

The preliminary results from the multimodal analysis point out that the informing part of the meetings is dominating. However, when teachers' talk is addressed and when they form spaces for negotiations with arguments, the mutual understanding is shaped by cultural codes and quick changes of codes. A few utterances are left unnoticed which draws attention to the situated meaning as accepted but not heard, or as tolerated. The communicative functions provide insight on the thematically different communicative functions embedded in the interaction of teachers participating at the meeting. Both analysis methods are influenced by the debate of social relations in communicative practices that are in nature more for bringing in positive than negative influences.

Firstly, the results relate to the social capital and trustful networks within heterogeneous groups where both weak and strong ties (Coleman, 1990) are essential for mutual understanding. Secondly, non-verbal communication influence in the negotiations (Auer & Di Luzio, 1992; Duranti & Goodwin, 1992; Mercer, 2000; Tannen, 1989; Norris, 2004), and in the effort of finding a solution that is accepted or at least tolerated by the members (Firth, 1995; Naquin & Kurtzberg, 2009). Though the dialogues and utterances in the examples are chosen to explain the main objective of mutual awareness, it is impossible to generalize. Every speech event and utterance is strongly attached to the spatial and the contextual settings that are unique and will never occur again.

As a conclusion, the results of the analysis from different perspectives provide a diversity of systematically outlining the data. Therefore, the potential of teachers' talk and social interaction highlight differences either in the cultural sense, as different cultural codes, or in the subject, as differences in ontology and epistemology, even if the focus is the same. It is of significance to go beyond oneself, and extend the understanding even if the mutual understanding is not reached but only tolerated. Finally, the analysis in this study highlights the complexity in dialogues and multipart talk which signify the importance of the different approaches and data.

The paper argues for the essential to approach a problem, which is multifaceted, from different standpoints. The key elements (namely, talk, artefacts, gazes, gestures, etc.) in critical situations are paving the way to move forward. Therefore, the data is analysed first in a small scale, and later on in a large scale. Finally, the paper focuses on the critical situations in talk that may change overtime and space, to stimulate cooperation and networking of teachers both in virtual and face-to-face interaction.

PAPER PRESENTATION

"What's a Fourth? What's a Fifth? What's the Point?": Constructing Definitions in Scientific Inquiry

Leslie Atkins, California State University, Chico, United States; Irene Salter, CSU, Chico, United States

In a class for preservice teachers, undergraduate students observed and attempted to explain complex phenomena related to light and color. In doing so, they frequently invented terms which were negotiated and refined by the class, and some became precise, stable, and useful terminology. These include invented terms (e.g., "the seconds" and "kooshing") and everyday terms (e.g., "focus"). In this paper we provide an analysis of the evolution of one of these terms, "the seconds," and how demands of intersubjectivity, together with theory, observation, and utility, shape the evolution of the definition. In the analysis, we see not only improvements in students' understanding of light, but a shift towards academic discourse registers and a nuanced understanding of the role of definitions in science

Objectives

A debate regarding the definition of a "personal epistemology" recently appeared in the Journal of the Learning Sciences as Sandoval (2009) argued that clarity of definition is necessary for theoretical progress, while Elby (2009) countered that theoretical progress must precede the definition. "The scope of personal epistemology should not be decided entirely a priori," Elby claims, "it is more productive not to converge on a definition until further empirical and theoretical progress points us toward the best way to 'cut up [nature] ... along its natural joints'" (p. 64). We point this out not to make a statement regarding personal epistemology, but definitions. Many curricula take a "front end" approach: students are given precise definitions and they use these to enable progress on understanding key ideas. An alternative is an "iterative" approach: allow for students' inquiry to make theoretical and empirical progress before definitions reach scientific precision. There is little work, however, on how we might facilitate student inquiry to promote this iterative process, or even what such iteration might look like. The paper will describe the evolution of the definition ("the seconds") that undergraduate students constructed in a course on scientific inquiry, and addresses the question of how and why this term changes over time. We will argue that, through the communicative need to agree on a definition, theory and experiment are advanced, and students develop a shared understanding of

characteristics of light, constructing a nuanced and scientific definition that balances pragmatic constraints with theoretical ideas.

Framework and methods

Two theoretical perspectives guide our interpretation of student ideas: idealized cognitive models and knowledge-in-pieces. Idealized cognitive models were introduced by Lakoff (1990), arguing that categories arise from cognitive models that carve out a space for terms. Such models vary in size and stability; they may be constructed on the fly (Barsalou 1983) and still maintain the structure characteristic of common categories. When analyzing student terminology and the stories that provide boundaries to those terms, we take a knowledge-in-pieces framework (diSessa 1988), interpreting utterances not as evidence of beliefs but stories constructed in the moment and sensitive to context. In approaching the question of how the terminology is shaped by student inquiry, we employ Interaction Analysis (Jordan and Henderson 1995) and recent work on intersubjectivity (Nathan, Eilam et al. 2007). Transcripts are analyzed for evidence of repairs (Schegloff 1992), and how such repairs modify participants' initial descriptions. Data comes from a course, Scientific Inquiry, for undergraduate preservice elementary teachers. Every class session is videotaped, and digital copies of student work are kept, and our analysis focuses on identify events that cause shifts in terminology (here, the term is the "seconds").

Data

In the second week of the course, there are two competing ideas to explain the observation of "fuzziness" on the edge of a spot of light (Fig. 1): light "bends" around corners or "bounces" along walls. In a small-group conversation, Amanda terms these bounced rays "the seconds." The following day the whole class works to understand Amanda's idea. Below, we provide a few critical turns in the discussion of "the seconds" that foster evolution of the term. 4. Allie: [Fig. 2]...Whites are the firsts— they all get reflected...— pinks are the seconds... each time it hits a wall you add one, pretty simply. 5. Breanna: It's gonna get dimmer and dimmer...That's why we were talking about how it matters if it's a second or third or fourth. Because every time it hits something it's going to get dimmer. Other students disagree with their diagram and, by turn 30, students have noted several differences in their diagrams of "seconds," with one student (Dee) pressing for representational conventions. In time, her request is recast not as mere convention, and students identify empirical and theoretical work required to clarify the term: 31. Breanna: I don't think it matters what it hits off of as long as it hits off of something then it should be called a second. And if it hits something twice, it's a third...40. Allie: ...the mirror makes a huge difference because the the mirror does not act like a wall. It reflects much differently. ... 52. Dee: So I guess the real question is: 'when it hits the mirror is any of the light absorbed.' Because to me the definition of a second is 'when it hits something, some of the light is absorbed so not all of it is coming back out.' ...60. Steven: I think it's going to be extremely hard to differentiate what's a second, what's a third... what's the point? Might as well just break it down to 'primary light' and 'secondary light.' Like anything secondary and after will be obvious. ...We must have some agreement on definitions in order to communicate effectively, but the terminology must also agree with something useful - a 'carving at the joints' of things we wish to understand. Steven argues that distinguishing seconds from thirds is pointless for our activity: we can understand the "fuzzy edge" as being caused by light that bounced, regardless of how many times.

These interactions drive empirical investigations, which then inform the iterative development of the definition of the term, "the seconds." To create terminology, as Lakoff suggests, is to model: to construct a story that carves out relevant objects that are given names. The stories may be constructed on the fly, with terms that are provisional and contextual. These stories, however, have an audience, and the need to establish intersubjectivity with this audience drives the modification of stories; the group artifacts serve to drive stability of the stories, and, concomitantly, the terminology develops "hard edges." Over time, this interaction creates terminology that is increasingly stable, precise and clear.

This proposal highlights students' initial steps at constructing and refining terminology; a final paper will include a more complete story of the terminology that students ultimately constructed, the interplay of experiment and theory that, together with interactions, led to the final definition, and a more detailed description of methodology.

PAPER PRESENTATION

Newcomers' Learning in Communities of Practice

Julia Eberle, Ludwig-Maximilians-University Munich, Germany; Karsten Stegmann, Universtiy of Landau, Germany; Frank Fischer, Universitat Munchen, Germany

Learning in communities of practice is mainly informal without explicit learning goals. Newcomers start as peripheral members and become active members as their "community knowledge" grows. This process of newcomer's learning in communities of practice is only vaguely described as legitimate peripheral participation and hardly studied

empirically. Thereby, it is hard for communities to support newcomers learning process: knowledge on effective means how to facilitate the integration of newcomers is lacking. Approaches from group research on socialisation tactics may fill the gap. Therefore, we investigated to what extent group size, time, and different socialisation tactics as an addition to the process of legitimate peripheral participation are related to the integration of newcomers in communities of practice. A correlation study on 16 German student associations with overall 223 members was conducted using social network surveys to measure the level of integration. In interviews with experienced community members, data about tactics to foster the integration of newcomers were collected. Five socialisation tactics could be identified. In a HLM analyses two of them (positive welcoming strategies and accessibility of knowledge) showed to be significantly related to the level of integration. In this model also group size was included, which was negatively related to the level of integration, while the factor time itself played no important role. Therefore, we assume that combining the concept of communities of practice and legitimate peripheral participation with theories from group research is a promising approach for a better understanding of the learning process of newcomers in communities of practice.

Learning by working on a shared topic with a group of people, like on an open source software project, is mainly informal and explicit learning goals can hardly be defined. Groups of people who work together on a topic for some time have been conceptualised as communities of practice (CoP). Barab and Duffy (2000) define a CoP as an interdependent system that puts the individual into a larger context and provides meaning for being and acting, based on a common cultural and historical heritage of shared goals, understandings and practices among the members. Newcomers who are integrated in a CoP undergo a complex process of learning and enculturation that shapes their identity as an active member of a larger system. Lave and Wenger (1991) describe this process as legitimate peripheral participation (LPP), which seems mostly to be a matter of time that a newcomer spends in the CoP. However, this concept is so far not very well empirically investigated. Promising approaches to expand the understanding of the LPP process can be found in group research. Regarding socialisation of new employees in work groups, socialisation tactics have been found influential means (Saks, Uggerslev, & Fassina, 2006). Levine and Moreland (1991) collected important tactics, used by work groups to foster the socialization process of the newcomers; e.g. encapsulation describes activities in which older group members encourage newcomers to spend their time for the CoP and with its members. Positive welcoming strategies as another example are used, when groups try to welcome newcomers in a friendly way. In addition to this, group size has been shown to influence individual thinking and behaviour in (work) groups, e.g. voluntary turn-over rates (Hausknecht, Trevor, & Howard, 2009). This leads to the assumption that the size of a CoP could also influence integration processes of newcomers. So far it is unclear what factors structure, support or hinder the LPP process of newcomers in CoPs. We assume that the learning process is not only a matter of time, but that specific socialisation tactics are used by CoPs that shape this learning process.

Research Question

To what extent can group size, time, and the use of socialization tactics predict the integration of newcomers in CoPs? Method 223 members of 16 student associations from the University of Munich participated in this study. They were chosen as an example for CoPs as they fulfil all three criteria defining a CoP mentioned above: they are an interdependent group with a shared cosmology and a reproduction cycle. The level of the members' integration in their CoP at a certain point in time was computed for every newcomer, based on data of a social network survey. In this survey all members were asked to indicate how intensively they had worked with each of the other members during the last three months. Additionally a semi-structured interview was conducted with an experienced senior member of every student association. In this interview participants were asked how their CoP had proceeded to integrate newcomers and were then asked about the socialisation tactics described by Levine and Moreland (1991). Via a content analysis a value for the use of the found integration mechanisms was then achieved for every CoP. An exploratory stepwise multi-level regression analysis (HLM) including the individual and the CoP level was applied to test the research question.

Results

Five socialisation tactics were found that the CoP members reported to use to foster the integration process of their newcomers: supporting legitimate peripheral participation, positive welcoming strategies, accessibility of community knowledge, encapsulation, and providing information about the CoP to potential newcomers before their entry. To explore which of those aspects are actually relevant to the process of newcomer integration the found tactics and the group size were step-wise included into a multi-level regression model which in the beginning only included time to predict the level of integration. In the final model the level of integration was negatively predicted by group size ($\beta = -0.139$) and positively predicted by positive welcoming strategies ($\beta = 0.716$). Time alone had no significant effect ($\beta = 0.025$), while it predicted the level of integration negatively in combination with positive welcoming strategies ($\beta = -0.118$) and positively in combination with accessibility of knowledge ($\beta =$

0.047). In short, newcomers are better integrated in smaller groups. They are integrated faster if the groups focus on knowledge access strategies. However, the explanation of the influence of welcoming strategies is more difficult: newcomers in groups that use this strategy are better integrated in general, but slower compared to groups that put less effort in positive welcoming strategies.

Conclusions

Our results provide evidence that combining the idea of LPP and theories from group research is a promising approach to a differentiated understanding of the underlying mechanisms of learning processes in CoPs. Five socialisation tactics have been identified in this study and for two of them a significant relation to the learning process in CoPs have been proved. This implies that it seems possible for community members to actively shape the learning process of newcomers and that not every tactic applied and widely used is really effective for learning.

Literature

Barab, S. A., & Duffy, T. M. (2000). From Practice Fields to Communities of Practice. In D. H. Jonassen (Ed.), *Theoretical foundations of learning environments*.

Mahwah, NJ: Erlbaum. Hausknecht, J. P., Trevor, C. O., & Howard, M. J. (2009). Unit-Level Voluntary Turnover Rates and Customer Service Quality: Implications of Group Cohesiveness, Newcomer Concentration, and Size. *Journal of Applied Psychology*, 94(4), 1068–1075.

Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation*. Cambridge: Cambridge Univ.

Pr. Levine, J. M. & Moreland, R. L. (1991). Culture and Socialization in Work Groups. In L.B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 257-279).

Washington, DC: American Psychological Ass. Saks, A. M., Uggerslev, K. L., & Fassina, N. E. (2006). Socialization Tactics and Newcomer Adjustment: A Meta-Analytic Review and Test of a Model. *Journal of Vocational Behavior*, 70, 413-446

PAPER PRESENTATION

Meta-cognition

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature

Robert Cantwell, University of Newcastle, Australia; Janene Budd, University of Newcastle, Australia, Australia;

Jill Scevak, University of Newcastle, Australia

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature Janene Budd, Jill Scevak, and Robert Cantwell University of Newcastle, Australia A growing body of research has documented the affective, or emotional, demands associated with PhD candidature, which may include coping with social isolation and the fear of negative evaluation by significant others, such as supervisors, peers, or family, and dealing with uncertainty and intellectual change. Unfortunately, there has been a lack of research attention regarding how these affective experiences are interpreted and managed at the level of the individual PhD student, and the impact of this on persevering with doctoral candidature. To explore this issue, the results from the first phase of a large scale, mixed-methods longitudinal study investigating the metacognitive and affective profiles of over 1200 PhD students from across Australia are presented, and complemented with the results of a small-scale qualitative study of PhD students who were experiencing a 'crisis of persistence', and considering termination of candidature. Together, these findings suggest that although an affective response to the personal changes associated with the transformational nature of higher level intellectual development may be expected in doctoral study, misinterpreting this affective experience can have potentially serious consequences in terms of perseverance with PhD candidature, ranging from unnecessary attrition to suicidal ideation. The results of the two studies will be discussed in terms of the implications for doctoral pedagogy. In particular, we discuss the importance of, and strategies for, helping students to more comprehensively understand and manage the affective experiences associated with doctoral learning, and identify areas requiring further research.

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature Janene Budd, Jill Scevak, and Robert Cantwell University of Newcastle, Australia Various aspects of doctoral candidature have attracted much research attention since the recognition of the high attrition and slow completion rates that occur across institutions internationally. The background to this paper is the growing body of research documenting the affective, or emotional, demands associated with PhD candidature, which may include coping with social isolation and the fear of negative evaluation by significant others, such as supervisors, peers, or family, and dealing with uncertainty and intellectual change. Although it is generally agreed that intellectual development is expected to occur during the doctoral research process (e.g. Batchelor & Di Napoli, 2006; King & Kitchener, 2002), Stevens-Long and Barner (2006) have noted that the management of affective experiences accompanying intellectual development in higher education has been largely ignored in the literature. More importantly, there is a lack of understanding of how these affective experiences are interpreted and managed at the level of the individual PhD student, and the impact of this on progressing through doctoral candidature. To address this issue, an ongoing, large-scale, mixed-methods design study

is investigating the affective and metacognitive profiles of over 1200 PhD students from universities across Australia, to provide both cross-sectional and longitudinal data regarding the management of affect during candidature. The study is underpinned by a constructivist learning theory framework, and assumes that there will be individual differences in the application or experience of a variety of metacognitive, affective, and personality factors as students seek to manage the intellectual and other demands of doctoral learning.

The study consists of three components: 1) comprehensive online surveys assessing metacognition, affect and personality, along with demographic and candidature data, conducted at baseline and with a 12 month follow-up, 2) brief online 'journey tracking' surveys conducted monthly for 12 months, and 3) two series of telephone or email interviews. The focus of this paper is an exploration of individual differences in 'perseverance' as a personality trait, based on the initial stages of data collection. While dispositional perseverance was one of many factors assessed in the baseline survey, during the first series of telephone and email interviews for the study it was also identified by the majority of interviewees as a personal quality or characteristic that is central to success in PhD candidature. As a measure of dispositional 'perseverance and passion for long-term goals', the Short Grit Scale (Duckworth and Quinn, 2009), was employed to examine how self-reported perseverance might be related to various demographic or candidature factors, as well as to a number of different measures of metacognition and affect.

The baseline survey data indicated that mean perseverance scores for participants in this study were relatively high compared to the populations of 'high achievers' studied by Duckworth and colleagues (2007, 2009). Consistent with Duckworth, Peterson, Matthews and Kelly's (2007) findings with the original Grit scale, was the positive trend, evident via ANOVA and Scheffe analysis, between perseverance and age. There were no significant differences associated with stage of candidature. Strong and significant positive correlations were found between perseverance and a number of metacognitive measures, most notably with indicators of a student's sense of hope, agency and self-efficacy. To further investigate the responses to the Grit questionnaire, this paper draws on the findings of a small-scale qualitative study undertaken to explore and describe how PhD students discuss the experience of what could be termed a "crisis of perseverance" – a time of intense uncertainty and distress regarding whether or not to persist with the PhD (Budd, Scevak, and Cantwell, 2010). In an approach enabling a more immediate insight into this experience than that offered by retrospective reflections from attrited PhD students, and enhanced ecological validity through the preservation of participant anonymity, a number of public domain online forum discussions for PhD students were analysed to learn more about the factors at play at the time when quitting was considered.

An analytical approach based on grounded theory (Corbin & Strauss, 2008) was used. The findings of the public forum study identified that, at least for these students, uncertainty about their ability or willingness to persevere with the PhD was often associated with a sense of disappointment that the student's expectations of the PhD and of themselves as PhD students were either unmet or mismatched. Many observed in themselves a change from confident and successful graduate, to depressed, lonely, and uncertain PhD student. There was a dissonance between their expected and actual affective experience of themselves as PhD students, an uncertainty about what this meant, and a waning of motivation. Clearly, the students' decisions about perseverance in doctoral study were closely related to their interpretation of the affect associated with the PhD process. Further, these findings suggest that while such affective dissonance may be a common experience among PhD students, it is not well understood. For example, while this type of affective response and personal change may be associated with the transformational nature of higher level intellectual development usually expected in doctoral study, a lack of awareness of this possibility may result in the interpretation of this experience as indicating a lack of personal ability or suitability for the PhD process. The latter certainly appeared to be the assumption on which many students' discussion comments were based.

Analysis of these online discussions highlighted how misinterpreting this affective dissonance can have potentially serious consequences in terms of perseverance with PhD candidature, ranging from unnecessary attrition to suicidal ideation. The results of the two studies will be discussed in terms of the implications for doctoral pedagogy. In particular, we discuss the importance of, and strategies for, helping students to more comprehensively understand and manage the affective experiences associated with doctoral learning, and identify areas requiring further research.

PAPER PRESENTATION

Creating metacognitive environments in primary Religious Education lessons

Shirley Larkin, University of Exeter, United Kingdom

This paper focuses on the RE-flect project. RE-flect was a collaborative mixed methodology research project designed to create metacognitive learning environments in primary year 5 classrooms. Participants were 10 state run primary schools from one UK local education authority area. In total 10 teachers and 250 pupils age 9-10 years took part in the year long project. The aims of the project were to develop activities to enable pupils in RE year 5 primary classrooms

to reflect on and consider their own ontological positions in relation to others; create metacognitively-oriented classroom environments and improve attainment in RE support teachers in developing their own metacognition in order to reflect on their own ontological positions.

The project draws on theories of metacognition and metacognitively oriented learning environments. The paper provides findings from the quantitative pre and post test measures of attainment in RE and from a scale, REMOS designed to measure pupils' perceptions of their learning environment. An illustrative case study of one school in the project suggests the systemic and local obstacles teachers and pupils face in creating metacognitive environments in religious education lessons.

This paper describes a year long collaborative project between a team of university researchers and ten primary school teachers. The project, RE-flect, was designed to create metacognitive environments in year 5 primary religious education lessons. The guidelines for Religious Education in English Schools: Non-statutory Guidance 2010 (DCSF, 2010) are challenging, suggesting that RE should cover a wide range of goals from provoking questions about the meaning and purpose of life and what it means to be human; to encouraging pupils to explore their own beliefs as well as contributing to community cohesion by promoting tolerance. School inspectors and professional inter-faith groups have criticised the provision of RE in primary schools (Ofsted, 2007). In particular it was found that pupils do not gain a secure conceptual framework within which to fit their learning and teachers lack confidence in teaching a subject in which they are not specialists. It has been suggested that pupils cannot engage with others without first understanding their own beliefs and values ((Inter Faith Foundation, 2006). Without developing the skills to reflect on their own thinking pupils often view RE as simply a "matter of opinion" (Freathy & Aylward, 2010) and thus oversimplify the nuances of difference within faiths as well as the complexity of identity and culture more generally. Baumfield has suggested that the study of pedagogy in RE is "underdeveloped" (Baumfield, 2010). This paper argues that there needs to be a shift in emphasis away from research on content (Hayward, 2006; Rymarz, 2007) or the extent to which the representation of religious traditions may be considered truly authentic (Everington, 1996; Greaves, 1998) or representative (Jackson, 2004; Nesbitt, 2004) towards an emphasis on the pupils' "response, thinking and critical self-awareness" (van der Zee, Hermans, & Aarnoutse, 2006). The RE-flect project seeks to address these specific issues through supporting teachers in creating metacognitive environments.

Metacognition

Metacognition can be defined as everything we know and believe about our own and others' cognitive processes and the regulation and control of our own thinking (Flavell, 1979). Flavell suggested metacognition enables us to "make wise and thoughtful life decisions" (ibid pg910). This project views metacognition as enabling self understanding through a reflection on one's own thinking, beliefs, epistemological stance and values. In this way, metacognition prioritises knowledge of self before engagement with the other. Research indicates that it is not enough to train teachers to facilitate metacognition (Zohar, 2006). Teachers need to develop their own metacognition (Duffy, Miller, Parsons, & Meloth, 2009). It is plausible that some of the difficulties encountered by non-specialist teachers of RE are linked to a lack of metacognition.

This project aimed to provide teachers with a framework for developing activities, pedagogy and classroom environments to support the development of metacognition. There is a focus on metacognitive orientation. Metacognitive orientation refers to the extent to which psychosocial conditions that are known to enhance pupils' metacognition are evident within classrooms. The characteristics of metacognitively-oriented learning environments (Thomas, 2003; Thomas & Mee, 2005) suggest that the beliefs and practices of the communities within which students learn to learn and reason strongly influence their metacognition; that specific language plays a key role in relation to communication regarding thinking and learning processes to and between pupils, and that pupils require particular encouragement if they are to reflect on, critique and possibly alter their thinking processes.

Participants

250 pupils aged 9-10 years in 10 different state run primary schools from one UK education authority
10 teachers with a responsibility for teaching religious education in these schools.

Research Aims to:

develop activities to enable pupils in RE year 5 primary classrooms to reflect on and consider their own ontological positions in relation to others; create metacognitively-oriented classroom environments and improve attainment in RE support teachers in developing their own metacognition in order to reflect on their own ontological positions.

Methodology

This is a collaborative project with a mixed methodology design. Pre and post quantitative measures are illuminated by qualitative data collected during the project. Individual case studies of classes within the project provide detail of the classroom practices developed during the project.

Data Collection and Analysis related to the above aims

1. Pupils create "world view profiles" during the project – analysed qualitatively with a focus on ability to express thinking; ability to reflect on ideas and sophistication of ideas expressed
2. Pre, predicted and post level of attainment in RE using standard UK assessment Pre and post scores on REMOS a scale developed to measure pupils' perceptions of the metacognitive orientation of their classroom environment Pre and post semi-structured interviews with 6 focus children in each class 3x10 semi-participant classroom observations, including video capture of the lesson and activities - data analysed qualitatively using NVIVO and related to a theoretical framework of metacognition
3. 3 methods of developing teacher metacognition – repertory grids, reflective diaries and on-line discussion - data analysed using content analysis, concordance analysis and discourse analysis

EthicsBERA ethical guidelines were adhered to. Special consideration was given to ethical issues surrounding using reflective diaries as data and to supporting participants through the processes of producing repertory grids and reflecting on thinking.

Findings

The paper presents headline findings from the pre and post measures along with an illustrative case study which illuminates the way teachers and pupils worked together to create metacognitive environments in one RE classrooms. Preliminary data is showing that teachers face a number of system level challenges to creating such environments, these are connected to UK policy on religious education in primary schools and to wider educational factors such as whole school attainment targets. The project ends in July 2011 when the quantitative data will be available.

Discussion and ImplicationsThe paper will discuss the findings in relation to theories of metacognition and the creation of metacognitive environments. Implications for teacher development will be drawn and suggestions for future research made. It is not possible to detail these implications until the project ends.

PAPER PRESENTATION

Rethinking the scope of Metacognition: a multi-dimensional account

Robert Cantwell, University of Newcastle, Australia; Jill Scevak, University of Newcastle, Australia; Sid Bourke, University of Newcastle, Australia; Krystyna Cholowski, University of Newcastle, Australia

In this paper, we report on a study of metacognition in PhD students, examining the possibility that identified individual differences may well reflect variations at an epistemic rather than componential level. Following Veenman et al. (2006), we speculate that the scope of metacognitive knowledge includes more than strategic regulation. We suggest metacognitive knowledge also provides a higher order, multi-dimensional dispositional framework that guides the affective, intellectual and contingency appraisals individuals must make in generating regulatory decisions.

263 PhD students completed measures relating to the management of intellectual, affective and contingency demands in candidature. A two-step cluster analysis discriminated two groups differing significantly across all measures. Factor analysis identified three dimensions to the responses: "Coping" with the intellectual, affective and contingency response demands of learning; "Naivety" in conceptualising the intellectual demands coupled with a diminished sense of competence and commitment; and "Disengagement", through diminished understanding of the intellectual demands combined with an abrogation of responsibility for progress. Third, analysis of variance indicated that Cluster 1 members more highly Coping, Cluster 2 members more highly on Naivety and Disengagement.

We interpret these results as evidence of the multi-dimensional nature of metacognitive knowledge. The differences in the strength and direction of affiliation with the three factors (Coping, Naivety and Disengagement) by the two groups suggest differences in the qualities of the active metacognitive knowledge base driving engagement with the doctoral task. Such differences in epistemic metacognitive frameworks have the potential to provide explanations of problematic candidature and inform developments in supervisor pedagogy.

Traditionally, metacognitive research has focused on self-regulatory capacities and their relationships to planning, monitoring and evaluative behaviours. More recently, research has begun to extend the remit of metacognition in learning to minimally acknowledge the relationships between regulatory decision-making and other, perhaps more general, domains of individual differences. Veenman et al., (2006) gave impetus to this process by identifying the need to examine metacognition in the context of other individual differences, although they did not extend this to suggest a more general unified metacognitive construct to account for individual differences in learning. Nonetheless, there has

been some movement in extending the scope of explanation of effective metacognitive activity. A recent special issue of the journal "Metacognition & Learning" (April, 2010), for example, considered the relationships between epistemology and metacognition. For many of the contributors, the link between epistemic beliefs and metacognitive behaviours was emphasised, giving rise to at least some degree of a recognition of the potential mutuality between epistemological and metacognitive beliefs (see Mason et al, 2010; Richter & Schmid, 2010; Muis & Franco, 2010; Bromme, Pieschl & Stahl, 2010). It is our position that this observed link represents only one of many potential associations between domains of individual differences and regulatory behaviour (see Veenman et al. 2006) and that the aggregate of these potential associations may provide evidence of a more generalisable model of metacognition that explicitly acknowledges the interdependence of a multitude of potential sources of individual differences in explaining how specific regulatory decisions are derived and acted upon.

In this paper, we report on a study of metacognition in PhD students. We see the PhD as a useful medium through which the nature of metacognition can be explored. The PhD is first and foremost difficult, requiring candidates to manage intellectual tasks ranging from the basic technical through to those requiring mastery of quite high levels of complexity and abstractness. The PhD also requires completion of a multitude of (related) tasks over an extended time period. Thus the regulatory demands of the PhD exist at many levels, and require maintenance over an extended period of time. Moreover, the PhD is not only about regulation of intellectual activity: it also involves the regulation of affective responses which over time will be as many and varied as evident in the intellectual demands. Finally, as a function of both difficulty and extended time, the PhD also involves the ongoing management of the potential challenges and difficulties in candidature: how the student responds to contingency is also an issue of regulation.

In this study, 263 PhD students completed a battery of instruments relating to the management of intellectual demands (Need for Cognition, Metacognitive Awareness, Epistemological Beliefs), affective demands (Efficacy, Coping) and contingency demands (Volition, Responsibility, Procrastination) of candidature. The analysis focused on three questions: a) whether, as an elite cohort, doctoral students could nonetheless be discriminated on the basis of responses to these questionnaires, b) whether there was an underlying dimensionality to the responses to the questionnaires, and c) whether identified groupings within the cohort differed in their level of affiliation with identified dimensions in the responses. In relation to the first question, a two-step cluster analysis identified two clusters differing significantly across all measures. In relation to the second question, factor analysis identified three dimensions to the responses: "Coping" with the intellectual, affective and contingency response demands of learning; "Naivety" in conceptualising the intellectual demands coupled with a diminished sense of competence and commitment; and "Disengagement", through diminished understanding of the intellectual demands combined with an abrogation of responsibility for progress. In relation to the third question, analysis of variance indicated that Cluster 1 members identified more closely with the Coping factor, while Cluster 2 members identified more closely with the Naivety and Disengagement factors.

We interpret these results as providing evidence for the possibility of a multi-dimensional account of metacognitive knowledge. In the first instance, the cluster analysis provided evidence of heterogeneity within the doctoral cohort. Because the differences between the cluster groups were both significant and spread across all measures, and because these differences were consistently in the appropriate direction, we concluded that the students comprising Cluster 1 had a broader and more strongly internalised base upon which to generate appropriate regulatory interventions. That is, this group likely had, at an epistemic level, a more functional metacognitive framework with which to manage the intellectual, affective and contingency demands of candidature, a framework that included not only the basic self-regulatory skills of conventional descriptions of metacognition, but also the broader epistemological, efficacy, coping and volitional dimensions that provide the conditions for effective regulation to occur. The results of the factor analysis and subsequent ANOVAs gave support to this interpretation. The differences in the strength and direction of affiliation with the three factors (Coping, Naivety and Disengagement) by the two cluster groups suggests differences in the qualities of the active metacognitive knowledge base driving engagement with the doctoral task. Such differences in epistemic metacognitive frameworks, we argue, have the potential to provide explanations of problematic candidature and inform potential developments in supervisor pedagogy.

PAPER PRESENTATION

A New Framework for the Conceptualization of Epistemic Cognition

Clark Chinn, Rutgers University, United States; Luke Buckland, Rutgers NJ, United States; Ala Samarapungavan, Purdue University, United States

In previous work (Authors et al., 2010a, 2010b) we have considered how ideas prevalent in the philosophical literatures of analytic epistemology and the philosophy of science might be used to extend and improve educational research on epistemic cognition. Research on epistemic cognition examines cognitions, especially beliefs, about knowledge and the conditions and processes of attaining knowledge (e.g. Hofer and Pintrich, 1997). Our expanded

framework for models of epistemic cognition includes five categories: (1) epistemic aims and their interactions with non-epistemic aims, (2) the structure of knowledge, (3) the certainty, sources, and justification of knowledge, (4) epistemic virtues and obligations, and (5) the reliable processes by which knowledge is achieved. These categories capture many epistemic topics and concepts that feature in the philosophical literatures, but which have not yet featured in extant educational research. In this paper we further elaborate the framework, and provide a more detailed analysis of how philosophers have elaborated on the topics within these five categories. We also develop systematic analyses of the ways in which educational researchers' conceptualizations of epistemic topics diverge from those of philosophers. We argue that an expansion of the dimensions of models of epistemic cognition provides psychologists and educators with rich theoretical resources that can better explain students' thinking and learning.

A New Framework for the Conceptualization of Epistemic Cognition

Goals

Epistemic cognition refers to cognitions about topics such as knowledge and how people come to attain knowledge. The most prominent framework for conceptualizing epistemic beliefs in current educational research derives from the landmark work of Hofer and Pintrich (1997) which characterizes these cognitions in terms of four dimensions: (1) the degree to which knowledge is viewed as simple versus complex, (2) the degree of certainty of knowledge, (3) the sources of knowing, and (4) the justification of knowing. In this paper we aim to expand on this seminal framework by drawing on philosophical work to identify additional topics that educational researchers could investigate.

Method

We have extensively reviewed two philosophical literatures that discuss epistemological topics: analytic epistemology and the philosophy of science. We analyzed epistemological topics and subtopics covered in 150 significant contemporary philosophical books as well as numerous articles from prominent philosophical journals. From these sources, we developed a list of significant topics related to epistemic cognition. As a result of our analyses, we argue that epistemic cognition should be viewed in a more expansive manner than educational researchers have done. We argue specifically that important topics for researchers of epistemic cognition fall into at least five distinct categories, which we briefly describe below.

A Philosophically-Grounded Framework for Conceptualizing Epistemic Cognition

In previous work (Authors et al., 2010a, 2010b), we have provided a broad overview of the five categories of epistemic topics. In the paper for EARLI, we will provide a much more detailed analysis of how philosophers have elaborated on the topics within these five categories, and we will provide a new, systematic analysis of the differences in the frameworks of educational researchers, on the one hand, and philosophers, on the other. Given the space limitations of this proposal, we can here provide only a brief introduction to topics in these five categories. In our paper and presentation, we will provide elaborated analyses of important topics within each of these categories as well as a detailed analysis of the ways in which educators' conceptualizations of epistemic topics diverge from those of philosophers. We will argue that philosophical work suggests many new issues that could be productively addressed in future educational research. The five categories are as follows:

1. Epistemic aims and their interactions with non-epistemic aims. Philosophers have extensively investigated different kinds of epistemic aims (e.g., acquiring true beliefs, avoiding false beliefs, developing powerful explanations, and so on). They have asked what kinds of knowledge people value and thus what epistemic aims they adopt (e.g., do people seek knowledge for its own sake, or knowledge because it is useful in helping them achieving other aims such as wealth or happiness). We will summarize a broad range of issues relating to epistemic aims that philosophers have viewed as important to understanding epistemic cognition. We argue that educators have seldom addressed what epistemic aims students adopt or what their beliefs are about what kinds of aims should be adopted.

2. Structure of knowledge. Current psychological and educational research on epistemic cognition has addressed the complexity versus simplicity of knowledge. Philosophical work suggests the need to investigate more than just this one aspect of the structure of knowledge. As one of many examples we will provide, EC researchers could also examine the degree to which knowledge is viewed as universal (i.e., knowledge applies very broadly) versus contextually (i.e., knowledge is very specific to particular situations).

3. The certainty, sources, and justification of knowledge. Our third category encompasses the certainty, sources, and justification of knowledge. (We include certainty within this category because philosophers treat certainty as a function of the strength of the justification of knowledge, so that degree of certainty is closely tied to strength of justifications.) These are categories that have been explored by many educators. However, philosophers identify many specific issues within these broad categories that have been unexplored by psychologists and educators.

4. The ethics of knowledge: epistemic virtues and obligations. Epistemologists extensively investigate epistemic virtues such as intellectual honesty, intellectual courage and open-mindedness. They also address issues of

epistemic obligations—an example of this is the extent to which one is obligated to seek out information on different kinds of questions, such as the extent to which one is obligated to have a certain level of economic knowledge when voting on economic issues. EC researchers have addressed a few epistemic virtues, especially open-mindedness. Philosophical research suggests many other virtues that could be investigated, and we will present a taxonomy of these virtues. Philosophical research also suggests new avenues of research on epistemic obligations, which have not yet been investigated by psychologists or educators.

5. Reliable and unreliable processes for achieving knowledge. Epistemologists and philosophers of science intensively study processes by which knowledge is reliably produced. For philosophers who focus on these reliable processes, a belief is justified (roughly speaking) if it results from a reliable belief-forming process (or set of processes). Philosophers who address these processes ask questions about the conditions under which different processes do and do not promote knowledge. For example, philosophers may ask questions such as these about social processes of knowledge production in the mass media: What media processes promote societal knowledge, and which do not? Under what conditions do particular media processes (such as televised debates between experts) promote knowledge? Under what conditions do such debates promote knowledge in society, and under what conditions do they not? We think that there is little research by EC researchers on students' beliefs about reliable and unreliable processes for achieving any epistemic aims, including true beliefs. We will present an analysis of the many types of reliable processes that philosophers have examined as important to epistemic cognition.

In this proposal, we have provided a brief overview of our philosophically-grounded framework for epistemic cognition. In the full paper, we elaborate on the specific issues that philosophers have addressed, and we show by expanding the issues included under epistemic cognition, psychologists and educators will gain theoretical resources that can better explain students thinking and learning. We will show how this framework can be applied in educational research.

References

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67, 88-140.

PAPER PRESENTATION

Young Children's Experiences through Transition between Preschool and Primary School in Chile

Daniela Jadue Roa, University of Cambridge, United Kingdom; David Whitebread, University of Cambridge, United Kingdom

Full Title: Young Children's Experiences through Transition between Preschool and Primary School in Chile and its Relation with their Developing Resilience and Sense of Agency. Abstract: This paper discusses the preliminary findings of an ongoing PhD research in its last phase. This research was carried out in a State school in Santiago de Chile, with 16 young children aged 5 to 6 years during their transition between preschool and primary school. The research design is a multiple-case study within a bio-ecological perspective (Bronfenbrenner, 2005) and therefore, data was gathered from children, their parents and their practitioners. Video-recording, photograph interviews (book-making and poster-making), were carried out with children; the 'Children's Independent Learning Development (CHILD 3-5)' Checklist (Whitebread, Coltman, Anderson, Mehta, & Pino-Pasternak, 2005) was applied by practitioners and semi-structured interviews supported by a questionnaire (Dockett & Perry, 2000a, 2000b, 2000c, 2000d) were carried out with practitioners and parents or caregivers. The purpose of this study is to explore the transition process that Chilean young children experience between preschool and primary school and its relation with their developing resilience (Cefai, 2008; Dunlop, 2003c) and sense of agency along this period (Bandura, 1982, 1993; Bruner, 1996). This study was organized in two phases (before and after transition) and it was developed between September 2009 and August 2010.

The present study was inspired by the proposal of 'The Mosaic Approach' (Clark, 2005; Clark & Moss, 2001); by the research carried out in Australia by Dockett's and Perry's (2007) the 'Starting School Research Project'; and by Dunlop's (2003a, 2003b, 2003c) research study carried out in Scotland. Accordingly, the present study aims to explore young children's experiences in the context of an early transition between preschool and primary school in Chile, and how these experiences relate to their developing resilience and sense of agency within an educational context. Hence, this research intends to answer the following research questions:

Main question: How do young children's experiences of transition between preschool & primary school in Chile relate to their developing resilience and sense of agency?

- Further questions:
- a) How do young children experience transition between preschool & primary school in Chile?
 - b) How do parents experience young children's transition between preschool & primary school in Chile?
 - c) How do practitioners experience transition between preschool & primary school in Chile?
 - d) How do young children's resilience and sense of agency develop during their transition between preschool & primary school in Chile?

To answer these questions, the research was designed with a multiple case study approach within a bio-ecological perspective (Bronfenbrenner, 2005). Taking this into account the research methods are child-centred and seek to gather young children's perspectives on their own experiences. Therefore, visual and participatory methods such as photography, video recording, book-making and poster-making were used (Clark, 2005; Clark & Moss, 2001, 2005; Jones, 2004; Veale, 2005). In addition, and with the aim of acknowledging the social constructivist perspective of the research design proposed, data was also gathered from adults involved with the young children participating on this study. Practitioners used the 'Children's Independent Learning Development (CHILD 3-5)' Checklist (Whitebread, et al., 2005) to assess young children's self-regulatory skills; and practitioners and parents or caregivers participated in semi-structured interviews guided by the Questionnaire developed by Dockett & Perry in their 'Starting School Research Project' (Dockett & Perry, 2000a, 2000b, 2000c, 2000d). In other words, this design aims to acknowledge young children's voices and agency through their learning and developmental processes. Young children's voices are reflected in this research project by the recognition of their agency and by the inclusion of them as valid informants and active participants in research concerning their experiences (Cousins, 1999; UNICEF, 1989). Taking into account that the school year in Chile goes from March to December and the characteristics of the study, the data collection process was organised in 2 phases: (1) Phase One, from September 2009 till December 2009; and (2) Phase two, from March 2010 till August 2010.

Phase one considered a familiarisation time, video-recording of classroom activities (with a special focus in the classroom interactions); the application of the 'Children's Independent Learning Development (CHILD 3-5)' checklist (Whitebread, et al., 2005); photographs interviews with the book-making activity; and semi-structured interviews with adults participants. The purpose of selecting the book-making session as the first photograph interview was to help young children to engage with the researcher and to help them being confident to share their experiences and reflections on kindergarten. During Phase two the same data collection process was repeated, however, photograph interviews involved the poster-making activity. The purpose of doing a poster in this second phase is to help young children with reflecting about things that have changed in first grade. They are invited to think about what young children need to know about primary school, and to discuss why; also what can schools, teachers and families do to help children who are starting primary school (Margetts, 2006). All these questions are also explored with adults involved in the semi-structured interviews carried out with them.

The data analysis has had as a main purpose the co-construction of meaning with young children's perspectives and adults involved in their experiences. Therefore, data has been coded grounded in what the data reveals and supported with the theoretical framework presented for the present study. Two main coding schemes have been developed: one regarding young children's perspectives on transition; and a second one related with their expressions of resilience and developing sense of agency. In order to ensure that during this process the focus is young children's voices and the construction of meaning, the following principles for listening to young children developed by Clark and Moss (2001, 2005) have been acknowledged: . 'it is an active process of communication involving hearing, interpreting and constructing meanings . Not limited to the spoken word . A necessary stage in participation in daily routines . Participation in wider decision-making processes' (Clark & Moss 2005, p. 8) In sum, this paper invites to a discussion about preliminary findings of young children experiences in their transition and their demonstrated resilience and sense of agency. Present findings can be discussed in the light of the outcomes of previous research carried out in the field and its contributions to further research in this context are considered. Lastly, this paper aims to reflect upon the contributions of visual methods in participatory research with young children, their effectiveness in helping the researcher to listen to young children's perspectives and, particularly, young children's perspectives in the context of an early transition in Chile.

Young Children's Perceptions of the Nature and Functioning of Artifacts with Adaptive Behaviour

David Mioduser, Tel Aviv University, Israel; Asi Kuperman, Tel-Aviv University, Israel

This study examines the effect of experimenting with advanced-robotic technological systems on young children's perceptions of the Nature and functioning of controlled artifacts with adaptive behavior. 10 kindergarten children performed a series of explanatory and programming tasks of increasing complexity, in terms of the expected robot's adaptive behavior. The research questions focused on: (a) children's perceptions of behaving artifacts, whether these reflect a psychological/behavioral or a technological/functional perspective, and (b) children's ability to program behaving artifacts focusing on the representational structures used for expressing the robot's behavior (e.g., scripts or rules) and on the troubleshooting processes (debugging). Findings are indicative of young children's (both "explainers" and "programmers") ability to conceptualize the robot's behavior using a technological perspective. As well, the results convincingly show "programmers" ability to construct complex robot behaviors. Moreover, we observed children's ability to use generalizable, a-temporal and abstract representations of the desired behaviors (e.g., rules), seemingly a serious challenge for kindergarten children according to existing literature. It seems that the interaction between the concrete (the physical robot and its actual functioning) and the abstract (the symbolic interface for constructing and debugging the control program) supported children's performance at sophisticated cognitive levels.

Kindergarten Children's Perceptions of the Nature and Functioning of Artifacts with Adaptive Behavior David Mioduser, Asi Kuperman Tel-Aviv University Children are exposed nowadays from a very young age to controlled technological systems. A visit to the nearest supermarket introduces them to automatic doors, barcode readers or controlled conveyor belts. Many toys they play with are programmable? and at home they interact with complex devices such as controlled appliances, mobile phones and computers. In recent years, children from a kindergarten in central Israel have been exposed to experiences with simple robots as part of the implementation of a curriculum focused on technological thinking. The curriculum has been developed upon the idea that technological thinking integrated into the kindergarten's culture will stimulate the children's curiosity and will support, and even demand, the use of high-order thinking, analytic capabilities, abstraction and problem solving, laying out the road to meaningful knowledge building processes. Such technological-thinking related skills are not part usually of the curriculum in kindergartens.

This study examines the influence of experimenting with advanced-robotic technological systems on children's perceptions of the Nature and functioning of controlled artifacts with adaptive behavior. The main goal was to explore how kindergarten children perceive and program the behavior of an adaptive robot.

Method

The population included 10 kindergarten children aged 5-6 (chosen randomly from a group of 25). Data was collected using observations and interviews. A qualitative research paradigm was chosen for the study, due to the small sample. Two types of tasks were implemented: (a) explanatory tasks in which children were requested to describe and explain the observed behavior of a robot, and (b) programming tasks of a robot's adaptive behavior. The tasks were built as a progression of increasing complexity, defined by the number of program components (e.g., rules, routines) required for generating the robot's behavior. The programming environment, "RoboGan", was developed for kindergarten children. It is icon-based, enabling to define the control rules in intuitive manner not requiring reading or writing code. The research questions addressed in this presentation focus on: (a) children's perceptions of behaving artifacts: whether these reflect a psychological/behavioral or a technological/functional perspective. (b) children's ability to program behaving artifacts, focusing on the representational structures used for expressing the robot's behavior (e.g., scripts or rules) and on the troubleshooting processes (debugging).

Findings

On children's perception of the robot's behavior Findings indicate that the children referred unevenly to the robot as a behaving artifact from psychological/behavioral and technological/functional perspectives. The utilization of anthropomorphisms (as indicator of a psychological perspective) was not dominant, compared to usage of technological language (Figure 1). When used, it was mostly due to the linkage made by the children to the task's underlying story, thereby recurring to the usage of anthropomorphisms, e.g.: "walking on the bridge", "careful not to bump into an obstacle", "getting the goal". In contrast, the technological perspective, and the usage of technological language, was dominant. This finding emphasizes the children's ability (both "explainers" and "programmers") to conceptualize the robot as functioning artifact. Figure 1: Children's perception of the robot's behavior as a function of task complexity A decrease in the use of anthropomorphisms as the task's complexity increases was observed both amongst the 'explainers' and the 'programmers'. This indicates that in more complex tasks children describe what they see or do in more "professional" terms. Thus for complex behaviors, anthropomorphism is not sufficient - when children understand the connection between the task, the robot and the interface, they perceive the robot from a technological/functional perspective. This indicates also children's ability to establish the linkage between the robot as concrete artifact and the programming environment as abstract or symbolic space. This abstraction is evident in the

children's explanations, in their analysis of the robot's behavior and in the capabilities they exhibit in the programming process.

On children's ability to program the robot's adaptive behavior Among alternative constructs used for representing a device's behavior, in this study we focused on three: episode (description of a one-time event), script (a sequence of events in a temporary structure and re-usable as routine) and rule (general and a-temporal construct, using condition/action terms such as "if... then..."). Findings indicate that children were able to use all three constructs, as required by the programming tasks (Figure 2). Usage of rules indicates the ability of kindergarten children to generalize and use a-temporal abstract representations, something seemingly beyond the capabilities of kindergarten children according to existing literature. Additional support to this claim in the findings is the relatively low usage of episodic descriptions. The programmers seldom used concrete terms for describing the robot's behavior, and were inclined to use the more complex structures (i.e scripts and rules). Figure 2: The robot's behavior representation as a function of task complexity

Regarding troubleshooting and problem solving, different strategies were used by the children until satisfactory completion of the task was reached, e.g. deleting the whole program and starting over, or replacing one command at a time till the expected behavior was observed. In summary, technological thinking entails an important, interesting and unique experience which has the potential to contribute to young children's conceptual understanding, problem solving and learning of complex phenomena in the everyday environment. Kindergarten children are at a stage in which their curiosity is at its peak. They ask, examine and try to discover the world in which they live in, hence meaningful authentic and relevant experience leads to learning. The tasks they were exposed to were real: they were required to learn and to use their acquired knowledge to fulfill tasks in the real world: programming a functioning artifact in the real world. These conclusions encourage the need for further studies focusing on implementation of technological thinking in the kindergarten curriculum as well as on additional questions beyond the scope of this study, e.g. the importance of adult mediation, mental models developing from these experiences, educational tools which may be developed following the study's findings, and naturally, the collaborative learning taking place in technological thinking-based group activity.

PAPER PRESENTATIONS

Teacher's talk about toddler's early literacy experiences at preschool

Sara Hvit, Jonkoping University, Sweden; Polly Bjork-Willen, Linkoping University, Sweden

Early literacy experiences are important parts of toddler's literacy development at preschool. The importance of children's literacy is also emphasized in the new Swedish preschool curriculum. Kress (1997) points out, that a literary sign is a combination of meaning and form, and that the meaning making should be seen in a social and cultural context as well as an activity. From this point of view young children's literacy does not consist of reading and writing only. It also includes all visual information that communicates to the children in their everyday world. The present paper aims to explore how teacher teams at 10 diverse preschools during focus group interviews, talk about and discuss toddler's literacy experiences. Detailed analyses of the interviews are made. The analyses show that three main areas of toddlers' literacy are highlighted in the talk; 1) toddlers' own manifestation of literacy, 2) how to work with toddlers' literacy, and 3) what characterizes the literacy environment. However, the majority of the teams were not used to verbalize and openly discuss toddlers' literacy and its implication on the preschool practice. The latter finding is a challenge for the teacher education and the implementation of the new curriculum.

Aim and theoretical background. In Sweden most children begin preschool at the age of one, and 80 % of the children between one to three years old go to preschool for education and care on a daily basis (Skolverket, 2009). Hence, the way the curriculum is implemented is of great importance for the children's learning and development, particularly when the youngest children aged one to three (named toddlers in the present paper) are concerned. In the new curriculum for the Swedish preschool there are clarifications in the area of language and communication. Language and communication are described as inextricably connected with children's identity and understanding of self and others (Ministry of Education, 2010). Furthermore the curriculum calls attention to the fact that language environment in preschools should offer children opportunities to explore and use written language. The conclusion drawn from the curriculum outline above is that the expectations laid on the preschool teachers' way of realizing a 'good' language environment are very high.

The focus of this paper is to investigate the language environment for toddlers at preschool, and the study takes its theoretical starting point from Barton's (2007) ecological view of literacy. It also uses a multimodal approach of children's meaning making in different modes (Kress, 1997, 2010). Consequently, to understand toddlers' intentions in literacy events, it is important to pay attention to their verbal as well as non verbal way of expressing themselves and

to create meaning (Lökken, 2006, 2009). More specifically the aim is to explore how literacy is talked about and discussed by teacher teams working with toddlers.

Method

In the present study focus group interviews with ten teacher teams are analyzed in detail with respect to the teachers talk about literacy events with toddlers. Each team was interviewed at two distant occasions, hence the data includes in total 20 interviews. The interviews originate from a larger corpus of interview data and this in turn is a part of a comprehensive study that investigates preschool as a context for children's language development at 60 preschools, being equally distributed over three communities in Sweden. As the literacy of toddlers is the focus of the present study, only interviews with teams working solely with toddlers were selected. The interviews were transcribed, and a collection of sequences including the teachers' talk and discussions about literacy and literacy events were selected for the analysis. Transcriptions were prepared using conversation analytic notations (cf Hutchby & Wooffitt, 1998). The sequences of talk were analyzed in detail with a participant-oriented perspective on interactional conduct (Schegloff, 1999). All names of persons and places have been changed to preserve participants' anonymity.

Preliminary findings

Preliminary findings indicate that literacy is defined and discussed in most varying ways between the teams, but also within a team. To verbally express what signifies toddlers' literacy seemed to be an unusual issue for many of the teams. Although, the areas that gradually became emphasized were 1) toddlers' own manifestation of literacy, 2) how to work with toddlers' literacy and 3) what characterizes the literacy environments. When literacy was described from the perspective of the child, a common description in the interviews were how toddlers use books, and how obvious it is that toddlers identify themselves as readers as well as writers. For example it was described how the children read for each other and for the dolls, and that they turn the pages and sounds like reading. The toddlers also encourage their listeners to be really quiet and listen carefully (c.f. Björk-Willén & Cromdal, 2009). However, most of the teams declare that they oppose to teach toddlers reading and writing. They preferred methods that are embedded in everyday practice, and that literacy should be highlighted in situ, for instance asking a child "do you want to read for me or do you want me to read?", or "what are you writing?". One of the teachers points out that "the physical language environment in total aims to learn them (the children) to read and write, but we do not coach them to read and write". The environment and the pedagogic material are not referred to as an isolated unit, but the connection between physical aspects of the environment, language and teaching attitudes are often discussed in the interviews. So is the kind of artifacts and its locations that are used to improve toddlers' literacy.

Theoretical and educational significance of the research

The teachers' talk and discussions about toddlers' literacy strengthens the way of viewing toddlers style (i.e. Lökken, 2006, 2009) and their manifesto of literacy (Björklund, 2008). The discussions about the language environment also have a clear multimodal approach to small children's literacy (see Kress, 2010). However, the teacher's talk about toddlers' literacy was unreflecting and based more on experiences than theory. The talk also derives from a play based rather than a teaching view of toddlers' early literacy.

References

- Barton, D. (2007). *Literacy: An introduction to the ecology of written language*: Malden MA:Blackwell.
- Björk-Willén, P& Cromsal J. (2009). When education seeps into 'free play': How preschool children accomplish multilingual education. *Journal of Pragmatics* 41: 1493-1518
- Björklund, E. (2008). Att erövra litteracitet: Små barns kommunikativa möten med berättande, bilder, text och tecken i förskolan. Göteborgs universitet.
- Hutchby, I & Wooffitt, R. (1998). *Conversation analysis: principles, practices and applications*. Cambridge: Polity Press.
- Kress, G. (1997). *Before writing: Rethinking the paths to literacy*. London: Routledge
- Kress, G. (2010). *Multimodality a social semiotic approach to contemporary communication*. London:Routledge.
- Lökken G, Haugen S, Råthle, M & Trädgårdh, E. (2006). *Småbarnspedagogik: fenomenologiska och estetiska förhållningssätt*. Stockholm:Liber.
- Lökken, G. (2009). The Construction of 'Toddler' in Early Childhood Pedagogy. *Contemporary Issues in Early Childhood* 10 nr 1:35-42.
- Schegloff, E. A. (1999). 'Discourse, Pragmatics, Conversation, Analysis', *Discourse Studies* 1: 405-435.
- Skolverket. (2010). *Statistik: Förskola-barn och Grupper. Barn och grupper i förskolan 15 oktober 2009. Riksnivå: Tabell 1B. Uppdaterad den 30 mars av Utbildningsenheten*. Skolverket. (2010). *Läroplan för förskolan Lpfö 98: reviderad 2010*: Skolverket

PAPER PRESENTATION

Early development of self-regulation and the use of communicative signs in educative interactions

From a socio-cultural approach, the role of language as a tool to support the self-regulation (SR) of physical and cognitive activity has been widely studied, yet there is little evidence on the role of pre-linguistic semiotic systems in the early development of self-regulatory skills. By extending Vygotsky's hypothesis on the development of SR to a pre-linguistic level, the purpose of the study is to analyze the transition from other-regulation to SR through mediated activity. We observed four children longitudinally at 11, 13 and 15 months old in triadic interaction (child-adult-object) with one of their parents. The object for the interaction was a toy which conventional use requires the understanding of rules, the execution of successive sequences of actions and the use of a hammer as an instrument. We coded for parents' use semiotic utterances to scaffold the object's conventional uses to their children, (i.e. verbal utterances, demonstrations, ostensive signs, pointing gestures, etc), and for children's use of signs related to their activity (ostensive gestures, pointing gestures, vocalizations). Parents used complex semiotic mediators during the interaction, and children engaged in progressively more complex conventional uses of the object over time. We identified 44 events in which children used pre-linguistic signs with a self-regulatory function (4, 4 and 36 at 11, 13 and 15 months old respectively). We analyzed and classified these events according to their semiotic modality and their function. We present qualitative observations that illustrate these categories.

A global networked society means fast changes that demand for the ability to adapt to new circumstances. Supporting children to become self-regulated independent learners is probably one of the most important goals of education in this context. During the last decades, the awareness of the importance of quality Early Years Education especially during the 0-3 period has increased. From a vygotskian perspective, the role of language as a tool to support self-regulation (SR) has been widely studied (on children older than 3 years old, Winsler, 2009)) and numerous educative tools have proven to effectively promote SR. However, there is little evidence on the role that pre-linguistic semiotic systems might play in the early development of self-regulatory skills (i.e. Rodríguez & Palacios, 2007, Valloton, 2008, Delgado, Gómez y Sarriá, 2009).

This study aims to address this gap in the literature. We aim to understand when and how do children start using semiotic tools with a self-regulatory purpose. Understanding the early development of SR and it's relation with non-linguistic semiotic tools, has great implications for early years education. The questions of the study are: (1) what kind of communicative semiotic tools do parents use to regulate the children's behavior? (2) Do children use similar communicative semiotic tools (ostensive gestures, pointing gestures, vocalizations) to regulate their action, either directed towards the adult, or to themselves?

Four infants and one of their parents were videotaped at their homes while interacting with a complex object during five minutes. The object of the interaction is described in Basilio & Rodríguez (in press) It is a wooden toy with different parts: a box with three holes on the top, three balls that fit in the holes, but they do not fall inside the box unless they are pushed down. There is a hammer to hit the balls and push them down and make them fall. The bottom of the box is inclined so the balls exit through a hole in one side of the box (Figure 1). Parents were told to "Play with their babies as they would normally do".

We conducted a microgenetic analysis of interactions from a semiotic-pragmatic perspective of development and objects (Rodriguez and Moro, 1999). We coded for parents use semiotic utterances to scaffold the object's conventional uses to their children, (verbal utterances, demonstrations, ostensive signs, pointing gestures, symbolic gestures), and for children's use of signs related to their activity (ostensive gestures, pointing gestures, vocalizations). We identified 44 events in which children used pre-linguistic signs with a self-regulatory function (4, 4 and 36 at 11, 13 and 15 months old respectively). We analyzed and classified these events according to their semiotic modality and their function. We present qualitative observations that illustrate these categories. We describe the categories used to characterize these behaviours (both, used in previous studies and developed in this study) and we analyze observations that illustrate them. The following is an example.

Observation 4. duration: 28 seconds.

C1 (Child 1, girl) 15 months old; A (Adult, father)

Indexical sign, Ostensive gesture and vocalization; requesting specific help to the adult.

C1 hammers the balls that she has placed in the holes previously. A encourages her action saying "Very good, very good, very good, another one, come on!". C1 hammers over the box, but does not aim at any specific ball, so she just manages to introduce partially the three of them, but none of them would fall inside the box. C1 stops hammering and tries to take out one of the balls. A grabs the child's hand holding the hammer and says "it's about to fall, it's about to fall. Once again, once again, hit it one more time", directing her arm so that the hammer is over a ball, and making the movement up and down, like hammering but not hitting the ball. Then A, holds N1's arm higher and says "come on,

you hit it!" letting her arm go, so when it falls it hits the ball with the hammer and makes the ball fall into the box. A celebrates saying "Good!". After this immediate demonstration. N1 takes the ball from the exit hole, she places it again and hammers three times, but doesn't manage to hit the ball. A says "Come on, hit it harder". Then C1, points at the ball with the hammer, she looks at her father's hand and still holding the hammer, she shows him her wrist and vocalizes "hmm", requesting for his help to hammer. A grabs her hand and says "Do you want me to help you? Come on" and guides her hand hammering with her until the ball falls into the box.

In this observation the child has the goal of hammering the ball, but she is not succeeding. After trying by herself, she asks the father to help her. She manages to communicate him what she wants without words, using an indexical sign (when she points toward the ball using the hammer) an ostensive sign (when she shows her wrist with her hand holding the hammer) and a vocalization. The father understands her intention and helps her, so she succeeded in her goal. This behaviour indicates that the girl, as young as 15 months old is capable of: - holding a goal in mind, - she understands the sequences of actions necessary to complete the goal, - she knows that her father can help her, - and she communicates effectively what she wants. In this case, she is not yet capable of achieving the complete use of the object but herself, but instead of giving up and do something else, or instead of giving the hammer to the father for him to do it, she keeps the hammer, and request for help in the specific part of the action where she has difficulties. We conclude that sensitive microgenetic analysis of triadic interactions allows to evidence that children develop self-regulatory skills even before they learn to use language, non-verbal communicative tools also fulfil a self-regulatory function from early in life.

PAPER PRESENTATION

Antecedents and consequences of initial and sustained interest during a learning task

Anna Tapola, University of Helsinki, Finland; Marjaana Veermans, University of Turku, Finland; Markku Niemivirta, University of Helsinki, Finland

In two related studies, the change in students' on-task interest was examined as a function of individual and task characteristics. Elementary school students worked in two groups with a different simulation task type to learn the basics of electricity. Students' personal goal orientations and interest in math and science were measured before the task. Pre- and post-tests were used for measuring relevant content knowledge on the subject. On-task interest was recorded repeatedly in different phases of the task. The results of Study 1 (n=52) were tested for replication and extended with measures on students' self-reported use of motivational regulation strategies in Study 2 (n=120). Repeated measures ANOVA and partial least squares method were used for analysing the data. The role of task characteristics in students' on-task interest was reflected in the results showing, first, that the general level changes in on-task interest were different in the two simulation task groups. Second, the learning outcomes seemed partly to depend on the changes in students' on-task interest, in favour of the task group where an increase in on-task interest was observed. On the other hand, students' initial interest at the beginning of the task depended on their individual characteristics. Time sequenced on-task interest ratings also strongly predicted one another, regardless of the task condition. Students' self-reported tendency to use motivational regulation strategies was related to their on-task interest throughout the task. Discussion focuses on the importance of acknowledging both individual and situational factors in the development of students' on-task interest.

Summary

Introduction

In order to cope with a learning task, students need a sufficient level of initial motivation to get started, as well as maintained motivation to perform it (Sansone & Thoman, 2005). To better understand the formation of this 'motivational chain', integrated knowledge on the factors affecting students' motivational state at the very beginning and during the learning task is needed. The separate roles of various antecedents and consequences of motivational states have been studied within different research traditions. However, there have been only a few attempts to integrate distinct motivational constructs from different theoretical frameworks (Harackiewicz et al., 2008). Also studies that would have examined the dynamic changes of motivation over the course of a learning task are scarce. ObjectivesConsequently, two related studies were conducted to address these shortcomings. Central concepts of goal orientation and interest theory were used to study the dynamics, as well as the antecedents and consequences of students' on-task interest during a learning task. More specifically, we wanted to know 1) how students' on-task interest change in the course of a learning task, 2) how students' individual and task characteristics affect students' on-task interest, and 3) which factors predict students' learning outcome measure.

Method

In order to examine the role of task characteristics, a condition comparison was created. Elementary school students (10 to 12 years old) worked either with a semi-concrete or concreteness fading simulation task to learn the basics of electricity. Before the simulation task, students' personal goal orientations and subject-specific interest in math and science were measured. Taking into account the dynamic nature of on-task interest (Ainley & Hidi, 2002), repeated measures in different phases of the task were used. Students' prior knowledge on the subject (pre-test) was measured before, and learning outcomes (post-test) one day after the simulation task. The change in students' on-task interest was analysed using repeated measures of ANOVA. Partial least squares (PLS) path modeling was used to examine the effects of antecedents and consequences of on-task interest.

Results

In Study 1 (n=52), the simulation task condition had an effect on the way students' on-task interest changed during the learning task. Students' level of interest increased among those who were working with the semi-concrete simulation type, while a decrease in interest was found in concreteness fading condition. However, students' initial on-task interest was dependent on their interest in science and math, which, on their part, mediated the effects of mastery-intrinsic and avoidance orientation on initial on-task interest. It was also found that independently of the task condition, the effects of time sequenced interest measures on one another were notably strong. Further, our results gave indications that the changes in students' motivational state were reflected in their learning outcome measure after the task. At the group level, students who experienced an increase in their interest during the task also performed better in the post-test. In Study 2 (n=120) the same design was replicated with slightly revised methodology and a larger sample. We also wanted to gain more knowledge of the factors related to the development of students' interest during the task. It has been suggested that students' tendency to use motivational regulation strategies affect whether the initial level of motivation will be sustained (Wolters, 2003). We used a modified questionnaire developed by Wolters (1999) to measure students' self-reported use of motivational regulation strategies after the learning task. Thus, we were able to examine students' on-task interest also from the perspective of their self-regulatory tendencies.

The preliminary results of the Study 2 indicated that, as in Study 1, there was an increase in students' level of on-task interest in the semi-concrete simulation condition. In the concreteness fading condition, on-task interest maintained at the same level throughout the task. The effect of mastery-intrinsic orientation, mediated by students' interest in math and science, on initial on-task interest was replicated. Like in Study 1, repeated on-task interest measures strongly predicted one another. Students' tendency to use motivational regulation strategies was related to their personal goal orientations (except avoidance orientation) as well as on-task interest measures.[1]

Conclusions

Although acknowledged in theory, there is a lack of empirical studies concerning the changes in motivational states during a learning task. The results of the two studies reported here illustrated the dynamic nature of students' on-task interest. The differences found in the two task conditions showed, first, that besides maintaining students' interest, task characteristics may have the potential to even enhance it. Second, although the level of students' interest was rather high in both conditions throughout the task, it was the positive change that seemed to matter when considering students' learning outcomes. While the general level changes could partly be attributable to the differences in task conditions, the results showed that students entered the task situation with different motivational backgrounds which affected the level of their initial on-task interest. The importance of the initial interest at the beginning of the task was highlighted in its predictive effect on subsequent interests during the task. Further, as shown in Study 2, students who reported having used motivational regulation strategies more often during the learning episode were also more interested throughout the task. The results of the studies speak in favour of acknowledging individual factors that affect, not only the initial level but also the maintenance of students' transient motivational states. Consequently, besides considering the "interestingness of the environment", the influence of students' motivational background should be taken into account in study designs as well as in practical implications.

References

- Ainley, M., & Hidi, S. (2002). Dynamic measures for studying interest and learning. In P. R. Pintrich, & M. L. Maehr (Eds.), *Advances in motivation and achievement: New directions in measures and methods*, Vol. 12 (pp. 43-76). Amsterdam:
- JAI. Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink Garcia, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, 100, 105-122.
- Sansone, C., & Thoman, D. T. (2005). Interest as the missing motivator in self-regulation. *European Psychologist*, 10, 175-186.
- Wolters, C. A. (1999). The relation between high school students' motivational regulation and their use of learning strategies, effort, and classroom performance. *Learning and Individual Differences*, 3, 281-299.

Wolters, C. A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist*, 38(4), 189-205.[1] As the analyses are still in progress, a more detailed examination of motivational strategies as well as the effects of pre- and post tests will be included in the final version.

PAPER PRESENTATION

Motivational approaches to the study of theology in relation to theology students study path

Laura Hirsto, University of Helsinki, Finland

The aim in this study is to explore the relationships between motivational approaches to the study of theology and theology students' curricular choices during their study path. Relationships were explored through follow-up data. During their first year, they completed a questionnaire which included motives for studying theology. On the third and fifth year they were asked to respond to questions concerning their curriculum choices. There are empirical indications that spirituality is one of the determinants of career behavior (Lips-Wiersma, 2002): it influences career purpose, sense-making and coherence. Duffy and Blustein (2005) argue that individuals who have a strong spiritual relationship with a higher power and are religious through intrinsic motivation tend to be more confident in their ability to make career decisions and are more open to exploring a variety of career options. The theological studies provided an interesting context to investigate religious and spiritual aspects of motivation, for those aspects usually are more detectable in choices of theology students compared to university students in other fields. According to preliminary results, certainty of curriculum choice, curriculum choices and reasons given to them were significantly related to the motivational approaches for the study of theology reported in the beginning of university studies. However, the pattern was different when third and fifth year relationships were compared.

AimsThe aim in this study is to explore the relationships between motivational approaches to the study of theology and theology students' curricular choices during their study path. Vocational psychologists have conducted a great deal of research into the effect of contextual variables on career development, but have yet to explore adequately the role of spirituality and religiousness (Duffy & Blustein, 2005, p. 431-432). Theoretically, religious questions are intertwined in the personal worldviews (cf. Hirsto, 2001) and values of students and affect motivational constructs. Spirituality and religiousness can provide people with an ultimate sense of purpose (Emmons, 1999; McIntosh, 1995). There are also empirical indications that spirituality is one of the determinants of career behavior (Lips-Wiersma, 2002): it influences career purpose, sense-making and coherence. Duffy and Blustein (2005) argue that individuals who have a strong spiritual relationship with a higher power and are religious through intrinsic motivation tend to be more confident in their ability to make career decisions and are more open to exploring a variety of career options.

The theological studies provide an interesting context to investigate religious and spiritual aspects of motivation for those aspects usually are more detectable in choices of theology students compared to university students in other fields. Faculties of theology in Finland offer a general theological education and the education required to become a teacher of religion, as well as qualifications for students wishing to become pastors in the Evangelical-Lutheran church. It could be assumed that more students in these faculties than in higher education in general have some sort of spiritual motivations for their study. However, the teaching at these faculties is non-confessional and students come from various Christian spiritual traditions. Studies on motives for studying theology have produced some classifications: a spiritual calling, the instrumental approach, the scientific approach, self-fulfilment, a helping orientation, being assured of a place to study, and other people's influence (Niemelä, 1999; Baylis, Cargas, Hartley, Rowland, Sabri, Stavrakopoulou and Wyatt, 2004). The relationships with motivational approaches and curricular choices will be explored through the following questions: How are the motives in the beginning of the theological studies related to a) certainty of curriculum choice b) curriculum choices, and c) reasons given for the choices in the third and the fifth year of university studies?

Methodology

This is a follow-up study among theology students. During their first year, they completed a questionnaire which included motives for studying theology. On the third and fifth year they were asked to respond to questions concerning their curriculum choices. The response rates were 70.4 % in the first year, 41.8 % in the third year and 25.9 % in the fifth year. Missing data-analysis will be reported in this presentation.

Findings

In the beginning of the university studies similar factors of motivational approaches were found compared to earlier research (c.f. Hirsto & Tirri, 2009). Of the third year students, 79.9 % reported to be certain of their choice of the curriculum, while in the fifth year 85.7 % were certain. The distribution of the choices in third and fifth year represented very well the distribution of the graduating Masters' of Theology. According to preliminary analysis, experienced spiritual calling is related to the certainty of curriculum choice in the third year of the university studies

($t=2,540$, p In addition to certainty of curriculum choice, also the actual curriculum choices were investigated in relation to motives to start to study theology. Of the motivational approaches in the beginning of the university studies, spiritual calling, a helping orientation, assuring a place to study, other people's influence were significantly related to the curriculum choices students had made in the third year of their theological studies. Also, uncertainty of career choice was significantly related to curriculum choices. In the fifth year spiritual calling and a helping orientation in the beginning of the theology studies were related to curriculum choices in the fifth study-year. Also, in the fifth year, uncertainty of career choice in the beginning of the studies was related to curriculum choices. The contents of the reasons students gave for their curriculum choices were qualitatively analysed and classified. Top level categories were named: calling or certainty, exclusion and other. However, the nature of the explanation differed according to curriculum choices, which students had made. Therefore, the relationships of these curriculum choice bound explanations were investigated further. This revealed interesting significant relationships and variety of the motivational approaches of the students following different curriculum paths. The study path of religion teachers and pastors seems to be somewhat coherent, but students' in general theological education curriculum seems to have more or less dissonant approach to their studies.

Theoretical and educational significance of the research

This study sheds light to university students study paths in a specific context of theological education. The findings will be discussed in terms of the theoretical background, self-regulation (e.g. Pintrich, 2004; Zimmerman, 2002; Boekaerts & Cascallar, 2006) and curriculum development. Through this empirical starting point, implications are discussed also in terms of more general academic education. This research contributes to the understanding of how motivational approaches in the beginning of university studies may affect the choices later in the study-path. It seems that spiritual calling, which, in case of other curriculum choices except that of becoming a pastor, seem to take a form of unquestioned certainty, plays an important role in certainty of choices during university studies. More generally, results also suggest that there are students trying to progress in their university studies, but who may not have a very clear vision of their goals. If this lack of perspective is persistent, which it seems to be according to these results, this phenomena would need more intensive elaboration in developing higher education curricula.

PAPER PRESENTATION

Achievement Goals Over Time: How Changes in Mastery and Performance-Approach Predict Deep Knowledge

Daniel Belenky, University of Pittsburgh, United States; Timothy Nokes, University of Pittsburgh, United States; Matthew Bernacki, University of Pittsburgh, United States

The current study examines two factors that are critical to understanding the role of achievement goals in classroom learning; how goals change over time and the relation between those goals and what is learned. Students' achievement goals were measured in relation to three exams completed during a Cognitive Psychology lecture course ($N = 154$). The exams included items that assessed different kinds of knowledge including factual, conceptual, and application based understanding. Performance on the initial exam was predicted by student performance-approach goals, while performance on the third exam was predicted by mastery-approach goals. Moreover, a positive change in mastery-approach goals from Exam 1 to Exam 3 led to increased performance on the third exam, while a positive change in performance-approach goals led to decreased performance. This effect was driven by an advantage for mastery-approach goals on the application-based items. These results indicated that mastery-approach goals may be particularly important for the development of deeper forms of understanding, and that movement towards such goals over the course of a semester may be a pedagogically important aim for instructors.

The relationship between achievement goal orientations and academic performance is mixed (see Linnenbrink-Garcia, Patall, & Tyson, 2008). In some cases, mastery goals predict achievement, while in others, performance goals are better predictors. In the current study, we focus on two factors that may be contributing to the conflicting findings in the literature; the type of knowledge being measured on achievement tests, and how goals change over time. Specifically, we analyzed exam items, differentiating between fact-based, concept-based, or application-based questions. We test the hypothesis that advantages observed for performance-approach goals reflect performance on items that assess a fact-based understanding, while advantages for mastery-approach goals reflect deeper forms of understanding as measured by concept- and application-based items (see Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). Furthermore, we examined how achievement goals change over the course of a semester, and how these changes influence exam performance.

Methodology:

Participants were students in a Cognitive Psychology course at the University of Pittsburgh ($N = 154$). Students completed questionnaires at four time points throughout the semester; on the first day, before the first exam (5 weeks in), before the second exam (9 weeks), and before the third exam (14 weeks). Questionnaires assessed a range

of motivational and self-regulatory variables. For the purposes of this paper, we focus on achievement goals and their relationship to exam performance. We measured mastery-approach, performance-approach, and performance-avoidance goals using three 7-point Likert scale items for each construct (1 = Strongly Disagree, 7 = Strongly Agree) from the Achievement Goal Questionnaire – Revised (Elliot & Murayama, 2008).

For each multiple-choice exam, the percentage of total items correct was calculated to measure overall performance. The items on each exam were analyzed and coded into sub-categories of fact-based, concept-based, or application-based items by two raters ($r = 0.94$, $n = 125$, $p < .05$). Fact-based items assessed the direct recognition of information from the course, concept-based items required students to reason with concepts and theories covered in the course, and application-based items required students to apply knowledge to a given scenario or analyze given information in light of particular concepts or theories.

Findings:

Mean values for each goal score at the first and third exam are given in Table 1. Each construct showed a decrease in endorsement of these goals across time points.

To analyze the effect of achievement goals on Exam 1 performance, the three achievement goal constructs were entered as predictors into a linear regression predicting exam scores. Overall performance was not predicted by any achievement goal. However, when examining the subscales, we found that performance-approach was a marginal predictor of factual and applied item performance ($B = .27$, $p = .07$ and $B = .28$, $p = .06$, respectively), performance-avoidance goals negatively predicted performance on the applied items ($B = -.31$, $p < .05$), and mastery-approach goals did not predict any subscales. In contrast to the first exam, mastery-approach goals predicted performance on the third exam ($B = .25$, $p < .05$). When looking at subscales, mastery-approach predicted performance for factual and applied ($B = .26$, $p < .05$ and $B = .31$, $p < .05$, respectively) and was marginally predictive of performance on conceptual items ($B = .16$, $p = .10$). Neither performance goal was predictive of subscale scores at Exam 3.

The effect of mastery-approach at the third exam is particularly interesting in light of the fact that, as a whole, the class reported less mastery-approach goals at the third exam than at the first (see Table 1). To examine the effect of this change on an individual basis, we calculated a difference score for each student by subtracting goals at Exam 1 from goals at Exam 3. This resulted in a “change score” value for mastery-approach, performance-approach, and performance-avoidance goals. A negative change score indicates that the student decreased in their endorsement of that particular goal. These change scores were entered into a regression predicting performance on Exam 3. Mastery-approach change scores positively predicted exam performance ($B = .23$, $p < .05$), while performance-approach change scores negatively predicted exam performance ($B = -.24$, $p = .05$). Looking at the subscales, we see that performance on applied items is positively predicted by changes in mastery-approach goals ($B = .33$, $p < .05$), but marginally negatively predicted by changes in performance-approach goals ($B = -.22$, $p = .08$). Increases in mastery-approach goals promoted deep understanding, while increases in performance-approach goals inhibited the development of such understanding.

Summary:

Exam 1 performance was positively predicted by performance-approach goals but not mastery-approach goals. However, at Exam 3, mastery-approach goals positively predicted performance whereas performance-approach goals did not. Furthermore, changes in these goals over time predicted exam performance. Students who became more mastery-oriented had higher Exam 3 scores, while those who became more performance-approach oriented had lower scores. These changes were especially strong for the applied items that required a deeper understanding of the material.

Theoretical and Educational Significance:

In order to shed light on inconsistent findings in the literature on the relationship between achievement goals and achievement we focused on how student goals change over time and the types of measures used to assess achievement. We found that an increase in mastery-approach goals over time leads to better performance on measures of deeper understanding. In contrast, increases in performance-approach goals were associated with lower performance on such measures. Focusing attention on variation of achievement goals across time and context may improve our conceptualization of how achievement goals positively influence students, and how educators can maximize these benefits.

References:

Elliot, A.J., & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration, and application. *Journal of Educational Psychology*, 100, 613-628.

Harackiewicz, J.M., Barron, K.E., Pintrich, P.R., Elliot, A.J., & Thrash, T.M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology*, 94, 638-645.

Linnenbrink-Garcia, L., Tyson, D.F., & Patall, E.A. (2008). When are achievement goal orientations beneficial for academic achievement? A closer look at main effects and moderation factors. *International Review of Social Psychology*, 21, 19-70.

PAPER PRESENTATION

Longitudinal relationships between achievement goal orientations, well-being and educational choice

Markku Niemivirta, University of Helsinki, Finland; Katariina Salmela-Aro, Helsinki Collegium for Advanced Studies, Finland; Heta Tuominen-Soini, University of Helsinki, Finland

The purpose of this study was to examine the developmental characteristics of secondary school students' achievement goal orientations, and, especially, the relative benefits of adopting either mastery vs. performance-focused goal orientations in terms of students' subjective well-being. The participants were of 549 students secondary school students of whom 176 (42% females) chose the vocational track and 373 (52% females) chose the general academic track after the ninth grade. The design included four measurement points, two before and two after the transition from lower secondary to upper secondary education. All students completed a questionnaire with scales assessing achievement goal orientations, self-esteem, depressive symptoms, and satisfaction with educational choices. Latent growth curves were estimated for each type of achievement goal orientation. Later ratings of self-esteem, depressive symptoms, and satisfaction were regressed on the trajectories of change in achievement goal orientations, while controlling for the effects prior level of self-esteem, frequency of depressive symptoms, and school performance. The results showed some systematic changes in achievement goal orientations over time, which, to some extent, were moderated by the educational context. Changes in achievement goal orientations independently influenced the students' later well-being. The patterning predictive effects showed that positive changes mastery tendencies were related to parallel changes in well-being, whereas increases in performance-focused tendencies, especially in performance-avoidance orientation, were associated with decreases in well-being. The findings of this study contribute to our understanding of the long-term changes in students' academic motivation during the transition from lower secondary to upper secondary education.

Achievement goal orientations refer to individuals' tendencies to strive for certain outcomes and to favor some types of goals over some others. Much of the recent research on achievement goal orientations has focused on their achievement-related antecedents and outcomes (for a review, see Kaplan & Maehr, 2007). Fairly little attention has been paid on the developmental aspects of different orientations and how changes over time in them relate to some personal factors other than achievement, such as subjective well-being. Quite lively debate has also focused on the relative benefits of adopting either mastery tendencies (i.e., striving for gain in competence) vs. performance-related tendencies (i.e., striving for the demonstration of competence), although the criteria for evaluating such adaptiveness have mostly revolved around achievement-related indicators (Midgley, Kaplan, & Middleton, 2001). The main objective of this study was thus to contribute to the current discussions by examining the developmental characteristics of secondary school students' achievement goal orientations, and, especially, whether the striving for some types of goals in the long run proves to be more beneficial in terms of subjective well-being than striving for some other types of goals.

The few studies available addressing the linkage between achievement goal orientations and well-being suggest that tendencies reflecting the strive for self-improvement and growth (i.e., mastery focus) are related to more adaptive socio-emotional functioning and more positive self-evaluations, whereas the tendency to validate and demonstrate one's personal qualities (i.e., performance focus) is associated with adjustment problems and socio-emotional vulnerability (e.g., Sideridis, 2005; Tuominen-Soini, Salmela-Aro, & Niemivirta, 2008). In this study, we expected to find similar relationships between achievement goal orientations and subjective well-being in a longitudinal setting. That is, we assumed that changes over time in different types of achievement goal orientations were predictive of later well-being in such a way that increases in mastery-focused tendencies were associated with higher well-being, and increases in performance-focused tendencies were related to lower future well-being.

The participants were of 549 students secondary school students of whom 176 (42% females) chose the vocational track and 373 (52% females) chose the general academic track after the ninth grade. The design included four measurement points, two before and two after the transition from lower secondary to upper secondary education. All students completed a questionnaire with scales assessing different achievement goal orientations (e.g., mastery, performance-approach, and performance-avoidance orientations) and two important aspects of general well-being, self-esteem and depressive symptoms. Also, students' ratings reflecting their satisfaction with their educational choices were assessed at time 4. Within the structural equation modeling framework, latent growth curves were

estimated for each type of achievement goal orientation. Later ratings of self-esteem, depressive symptoms, and satisfaction were regressed on the trajectories of change in achievement goal orientations, while controlling for the effects prior level of self-esteem, frequency of depressive symptoms, and school performance.

The results showed an increase in mastery goal orientation over time, whereas no change was detected in performance-approach and performance-avoidance orientations. The trajectories of change were moderated by educational track so that stronger increase in both mastery and performance-approach tendencies were evident for vocational students. When examining the predictive effects of growth trajectories of achievement goal orientations on well-being, the results showed that later self-esteem was predicted by lower initial level of performance-avoidance orientation as well as by increases in mastery orientation and decreases in performance-avoidance orientation. Depressive symptoms were influenced by both prior school performance and increases performance-avoidance orientation. The initial level of mastery orientation as well as increases in mastery orientation and decreases in performance-avoidance orientation had an effect on students' satisfaction with their educational choices.

The findings of this study suggest some systematic changes in achievement goal orientations over time, which, to some extent, are moderated by the educational context (i.e., educational track). Changes in achievement goal orientations also seem to independently influence the students' later well-being. The patterning predictive effects further show that positive changes mastery tendencies appear to be related to parallel changes in well-being, whereas increases in performance-focused tendencies, especially in performance-avoidance orientation seem to contribute to decreases in well-being. The findings of this study add to understanding of the long-term changes in students' academic motivation during the transition from lower secondary to upper secondary education. The results also importantly contribute to the recent debate on the benefits of adopting either mastery-focused or performance-focused achievement goal orientations in school settings.

References

- Kaplan, A. & Maehr, M. (2007). The contributions and prospects of goal orientation theory. *Educational Psychology Review*, 19, 141-184.
- Midgley, C., Kaplan, A., & Middleton M. J. (2001). Performance-approach goals: Good for what, for whom, under what circumstances, and at what cost? *Journal of Educational Psychology*, 93, 77-86.
- Sideridis, G. D. (2005). Goal orientation, academic achievement, and depression: Evidence in favor of a revised goal theory framework. *Journal of Educational Psychology*, 97, 366- 375.
- Tuominen-Soini, H., Salmela-Aro, K. & Niemivirta, M. (2008). Achievement goal orientations and well-being: A person-centred analysis. *Learning and Instruction*, 18, 251-266.

PAPER PRESENTATION

Mathematics with eyes wide shut: Facing challenges and overcoming barriers

Claudia Ventura, Faculdade de Ciencias e Tecnologia da Universidade Nova de Lisboa, Portugal; Nuno Santos, Escola Secundaria de D. Dinis, Lisboa, Portugal; Margarida Cesar, Universidade de Lisboa, Instituto de Educacao, Portugal

In Portugal, students categorised as presenting Special Educational Needs attend mainstream classes (ME, 2008). Mathematics presents high levels of rejection and low achievement (Céêsar, 2009). Considering mathematics knowledge as socially constructed, giving a meaning is an essential step to access mathematical tools (Vygotsky, 1934/1962). Representing mathematical objects is a barrier blind students experience. Braille writing specific features must be considered when teachers talk about mathematics in classes including blind students (Santos & Céêsar, 2007). They need a thick descriptive discourse and language adapted to Braille writing. In a mainstream classroom teachers must consider the blind student(s) and the non-impaired students, facilitating all students' participation. Communication plays an essential role in students' mathematical knowledge appropriation (Sfard, 2001). Collaborative work can be used as a mediator of students' learning (Céêsar, 2009). This study belongs to the Interaction and Knowledge project whose aims were to study and promote collaborative work in formal educational scenarios. We assume an interpretative approach and an action-research design. The main participants are the students (N=190) from classes including blind students (N=11), two teacher/researchers and a psychologist. The data collection instruments are: observation, questionnaires, documents, informal conversations and students' protocols. Inductive categories emerged from the content analysis (Hamido & Céêsar, 2009). We analyse some examples of students' solving strategies and social interactions illuminating teachers' role in blind students' learning process and the particularities of mathematics Braille. They also illustrate the importance of the communicative processes due to the use of mathematical Braille, particularly differences among blind and non-blind students.

The Salamanca Statement (UNESCO, 1994) symbolises a rupture: changing from the integration into the inclusion paradigm. In the integration paradigm, schools and society looked for students' normalization. After the Salamanca

Statement students' characteristics are respected and teachers try to potentiate them (Céêsar & Ainscow, 2006). In the Portuguese curriculum mathematics is a compulsory subject until the 9th grade (14/15-year-olds). It is one of the most selective, as many jobs and university courses ask mathematics as a condition to be admitted (Céêsar, 2009). Failing in this subject puts students' school path and professional life at risk. Mathematics is one of the subjects that more often contribute to early school dropouts. Therefore, it is crucial to promote all students' access to mathematics achievement, particularly blind ones. Mathematics uses abstraction, an ability that is more difficult to develop when students use a symbolic system (Braille) different from the one used by non-impaired students. This is a barrier blind students need to overcome in order to mobilize/develop their mathematical abilities and competencies (Santos & Céêsar, 2007). Communication is also very important to a blind student because s/he does not have access to the information captured through sight. Thus, we need alternative forms of communication that can surpass this problem. A mathematics teacher of a mainstream class with blind student(s) must adapt his/her practices to each student, including the blind one(s). A way to include every student in the mathematical activities is through the promotion of peer social interactions. Social interactions play an important role in students' socio-cognitive and emotional development (Vygotsky (1934/1962) and in giving students a voice (Wertsch, 1991). Collaborative work in mathematics classes is a way to promote peer and dialogical social interactions (Céêsar, 2009). The problem that originated this research was the difficult inclusion process experienced by many blind students in a mainstream mathematics class. We aim to understand the sort of communication that is established between mathematics teachers and blind students included in mainstream classes, the adaptations that can be observed in the practices developed by teachers and the interactive patterns between students (blinds and non-blind).

The research questions we address are:

- (1) Which are the facilities and the difficulties that blind students experience to have access to the cultural mathematical tools?
- (2) What can be done to facilitate their access to them?

This study is part of Interaction and Knowledge (IK) project. Its main aims were to study and to promote collaborative work in formal educational scenarios, contributing to a more inclusive and intercultural education (Hamido & Céêsar, 2009). This research project lasted 12 years (1994/95 to 2005/06), included 69 mathematics teachers and more than 600 mathematics classes. We focus in those attended by blind students (N=11) included in mainstream schools. We assume an interpretative approach (Denzin, 2002) and developed action-research projects (Mason, 2002). The participants were these blind students (7th to 12th grades – 12 to 18 years old), their classmates (N=190), their mathematics teachers, a psychologist and significant others (colleagues, friends, families, other educational agents).

During the first week of the school year (September), students answered to a questionnaire, a task inspired in projective techniques and an instrument to evaluate abilities and competencies. They also answered two other questionnaires in the begging of the second term (January) and the end of the school year (June). Participant observation (registered in teacher/researchers' diaries, audio/video taped, photos), informal conversation, documents and students' protocols were collected during all school year. Data treatment and analysis is based in a narrative content analysis (Clandinin & Connelly, 1998) from which inductive categories emerged (Céêsar, 2009) illuminating empirical evidence.

We analyse some examples that illuminate teachers' adaptations to practices and to the communication with blind students. We also present some examples of solving strategies and mathematical thinking, discussing the particularities of the Braille writing. This analysis illuminated that there were complements of verbal information to respect the blind students' characteristics. Some complementary information was presented through movement, touch and materials adapted to befit their needs. But teachers also performed some adaptations to the tasks to allow the blind students to participate in the same mathematical activities as their peers. Thus, the results illuminate how dialogical social interactions can contribute to a more inclusive mathematics education and facilitate blind students' access to the cultural tools of mathematics.

References

- Céêsar, M. (2009). Listening to different voices: Collaborative work in multicultural maths classes. In M. Céêsar, & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 203-233). Rotterdam: Sense Publishers.
- Céêsar, M., & Ainscow, M. (Eds.) (2006). *European Journal of Psychology of Education*, XXI(3).
- Clandinin, D. J., & Connelly, F. M. (1998). Personal experience methods. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 150-178). Thousand Oaks, Sage Publications.
- Denzin, N. (2002). The interpretative process. In A. Haberman, & M. Miele (Eds.), *The qualitative researchers companion* (pp. 349-366). Thousand Oaks: Sage Publications.

Hamido, G., & Céêsar, M. (2009). Surviving within complexity: A meta-systemic approach to research on social interactions in formal educational scenarios. In K. Kumpulainen, C. Hmelo-Silver, & M. Céêsar (Eds.), *Investigating classroom interaction: Methodologies in action* (pp. 229-262). Rotterdam: Sense.

Mason, J. (2002). *Researching your own practice: The discipline of noticing*. London: Rand Falmer.

Ministêrio da Educação (ME) (2008). Decreto-Lei nº 3/08, de 7 de Janeiro, Diário da República – I Séérie, N.º 4. Lisboa: INCM.

Santos, N., & Céêsar, M. (2007). Eu não vejo como tu... mas podemos falar de matemática. In E. C. Martins (Ed.), *Cenários de educação/formação: Novos espaços, culturas e saberes*. Castelo Branco: SPCE. [CdRom]

Sfard, A. (2001). There is more to discourse that meets the ears: Learning from mathematical communication things that we have not known before. *Educational Studies in Mathematics*, 46, 13-57.

UNESCO (1994). *Final report. World conference on special needs education: Access and quality*. Paris: UNESCO.

Vygotsky, L. S. (1934/1962). *Thought and language* (Myshlenie I rech' Trans.). Cambridge MA: MIT Press. [Original work published in Russian, in 1934]

Wertsch, J. (1991). *Voices of mind. A sociocultural approach to mediated action*. Hemel Hempstead: Harvester Wheatsheaf.

PAPER PRESENTATION

The relationship between naming-speed and spelling in dyslexia

Erlin van Genuchten, Knowledge Media Research Center, Germany; P. C-H. Cheng, School of Informatics, University of Sussex, United Kingdom; Paul A. Kirschner, Open Universiteit, Netherlands; Paul Leseman, Utrecht University, Netherlands

Literature about dyslexia proposes two competing theories. The phonological deficit theory holds that people with dyslexia have problems with their phonological representations, whereas the double deficit theory holds that people with dyslexia show an additional naming-speed deficit that is claimed to be equally important in causing reading problems. Research on the relationship between naming-speed and reading has shown that reading problems are related to the commonalities between phonological processing and naming-speed, which supports the phonological deficit theory. However, research on the relationship between naming-speed and spelling has shown that naming-speed remains a significant predictor for spelling when phonological problems are controlled, which supports the double deficit theory. A problem with studies relating naming-speed to spelling is that they use the standard naming-speed test used in reading research. In this test, individuals have to verbally name letters, instead of presenting them graphically. Also, this test does not distinguish between information processing speed and pronunciation speed. To this end, we implemented an adapted naming-speed test — measuring the speed of retrieving a letter from memory during writing — to investigate the relationship between naming-speed and spelling. The results confirm previous findings that naming-speed and spelling are unrelated. Our findings imply that future studies should use adapted naming-speed tests to shed light on why the phonological deficit theory explains the relationship between naming-speed and reading and the double deficit theory the relationship between naming-speed and spelling.

Literature about dyslexia proposes two competing theories. One, the phonological deficit theory, holds that people with dyslexia have problems with their phonological representations affecting performance on any task requiring phonological processing (Pennington, Cardoso-Martins, Green, & Lefly, 2001). The other, the double deficit theory, holds that people with dyslexia show an additional naming-speed deficit that is claimed to be equally important in causing reading problems (Vaessen, Gerretsen, & Blomert, 2009).

The phonological deficit is defined as difficulties in storing and/or retrieving words and in processing information in working memory, whereas the naming-speed deficit is defined as the inability to rapidly retrieve phonological codes from memory (Vellutino, Fletcher, Snowling, & Scanlon, 2004). Although many studies have shown that people with dyslexia indeed have phonological processing problems (e.g., Pennington et al.), it is still unclear whether naming-speed is a separate problem or a problem caused by phonological processing weaknesses.

Research on the relationship between naming-speed and reading has shown that reading problems are related to the commonalities between phonological processing and naming-speed (e.g., Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002), which supports the phonological deficit theory. However, research on the relationship between naming-speed and spelling has shown that naming-speed remains a significant predictor for spelling when phonological problems are controlled (e.g., Savage, Pillay, & Melidona, 2008), which supports the double deficit theory. A problem with studies relating naming-speed to spelling is that they use the standard naming-speed test used in reading research. This test measures the time individuals take to encode and verbally name a series of letters (Denckla & Rudel, 1976). In contrast, letters are decoded and presented graphically during writing. Another problem is

that the time needed to utter the name of a letter is included in the measured time. However, as people with dyslexia have problems with rapid naming, it is more relevant to examine how long they take to retrieve a letter name from memory. To this end, we implemented an adapted naming-speed test—measuring the speed of retrieving a letter from memory during writing—to reinvestigate the relationship between naming-speed and spelling. MethodParticipants were 95 Dutch children ($M_{age} = 8.28$ years, $SD = .64$), namely 29 grade 3 children with dyslexia (DYS), 33 grade 3 chronologically age matched (CA) children without dyslexia, and 33 grade 2 reading age matched children (RA) without dyslexia. Children wrote four types of sentences ($N = 24$) from memory. In familiar sentences (e.g., Have go hungry), syntactic, semantic, and phonologic support facilitated remembering. In jumbled sentences, syntactic support was removed by presenting words in random order (e.g., You the dog). In sentences containing language-like non-words (e.g., Rummer hoat barden), semantic support was removed by presenting non-existing words that sounded Dutch.

Finally, in sentences containing language-unlike non-words (e.g., Knuk greupeg), phonological support was removed by presenting non-existing words that did not sound Dutch. Children also wrote their first names, which served as a writing baseline. To evoke pauses between letters, children wrote sentences on a piece of paper attached to a graphics tablet containing horizontal rows of rectangles. They wrote one letter in each rectangle (Figure 1). Naming-speed was measured as pause lengths by gauging the time that the pen was lifted from the paper between writing two consecutive letters.

Figure 1. Example sentence. After the experiment, we counted the number of phonological spelling errors. These errors were marked when a word sounded completely different than the stimulus (e.g., 'knuf' instead of 'knuk'). Results We predicted naming-speed or the number of phonological spelling errors with type of sentence, group and writing baseline simultaneously in a regression analysis. This analysis revealed that CA children exhibited shorter pause lengths and made fewer phonological spelling errors than RA and DYS children. RA and DYS children did not differ in pause lengths; however DYS children made more spelling errors than RA children. A second regression analysis testing whether pause length mediated the effect of group on spelling errors yielded no significant results.

Discussion

The double deficit theory was confirmed by two findings. First, DYS children lagged behind in their spelling development compared with their peers; this disadvantage was clearer for phonological processing than for naming-speed problems. This supports the double deficit theory as a similar pattern would be expected for similar deficits. Second, the finding that naming-speed did not mediate the effect of group on spelling errors also confirmed that the naming-speed and phonological processing deficits are independent. These results are in line with previous studies on the relationship between naming-speed and spelling. These findings imply that future studies should use adapted naming-speed tests?measuring time to retrieve a name from memory instead of total performance time?to shed light on why the phonological deficit theory explains the relationship between naming-speed and reading and the double deficit theory the relationship between naming-speed and spelling.

References

- Denckla, M., & Rudel, R. G. (1976). Rapid "automatized" naming (RAN): Dyslexia differentiated from other learning disabilities. *Neuropsychologia*, 14, 471-479.
- Pennington, B. F., Cardoso-Martins, C., Green, P. A., & Lefly, D. L. (2001). Comparing the phonological and double deficit hypotheses for developmental dyslexia. *Reading and Writing: An Interdisciplinary Journal*, 14, 707-755.
- Savage, R., Pillay, V., & Melidona, S. (2008). Rapid serial naming is a unique predictor of spelling in children. *Journal of Learning Disabilities*, 41(3), 235-250.
- Schatschneider, C., Carlson, C. D., Francis, D. J., Foorman, B. R., & Fletcher, J. M. (2002). Relationship of rapid automatized naming and phonological awareness in early reading development: Implications for the double-deficit hypothesis. *Journal of Learning Disabilities*, 35, 245-256.
- Vaessen, A., Gerretsen, P., & Blomert, L. (2009). Naming problems do not reflect a second independent core deficit in dyslexia: Double deficits explored. *Journal of Experimental Child Psychology*, 103, 202-221.
- Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry*, 45(1), 2-40.

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PAPER PRESENTATION

Dyslectic trainee teachers' views of their educational trajectory and their future vocational role

Lena Ivarsson, Mid Sweden University, Sweden; Ulla Damber, Mid Sweden University, Sweden

The objectives of this study was to explore how Swedish dyslectic trainee teachers view their past educational trajectory, their present studying situation, their adjustment to university studies, and their future vocational role. To get an inside perspective of the students' perceptions, in-depth interviews were chosen as method of inquiry. As the conditions for dyslectic students in school have changed according to different policy documents over time a life history perspective was employed in the interviews. This was made in order to get a full description both of the individual experiences and the conditions provided by the school environment. Even though all ten students have a diagnosis of dyslexia, a majority of them were not diagnosed until they were in upper secondary school or even at the university. One major finding was that no extra support was given until the diagnoses were made. The students perceived that their university studies required rigorous planning and lots of time, and they claimed that the compensatory support they had been given was crucial to them to meet the academic demands. In describing their Future Time Perspective the students emphasized their ability to understand and help children with special needs. This was a major driving force for them to apply to become trainee teachers. A major implication of these findings is that dyslectic children are not identified so that remedial assistance can be brought in as early as possible. Secondly, these students' capacities and strengths should earn more attention both in practice and research.

The overarching objectives of this study were to explore how Swedish dyslectic trainee teachers view their past educational trajectory, their present studying situation, their adjustment to university studies, and their future vocational role. The study was conducted in Sweden at a small university, predominantly carrying out distance education. A substantial part of the student body has a working-class background. The informants, all women, were varying in age from twenty to fifty. The distribution of the sexes reflects the fact that the majority of the trainee students are women. To get an inside perspective of the students' perceptions, in-depth interviews were chosen as method of inquiry. The student counselor, who was the contact person for dyslectic students, distributed invitations to the students to participate in the study. This procedure was chosen to guarantee the students' anonymity in case they rejected the invitation. In order to get a picture of the compensatory support the students were offered at the university, the student counselor was also interviewed. The theoretical framework is based on a social cultural view of the individual and his/her learning (Wertsch, del Rio, & Alvarez, 1995).

We aimed to employ a broad perspective on the students' life situations, including their social, cultural, and historical background, and not only their clinical background. The social, cultural, and historical perspective also encompasses the view of learning employed in the study. As the conditions for dyslectic students in school have changed according to different policy documents over time, a life history perspective was employed in the interviews (Goodson, 1994), together with a Future Time Perspective (FTP), as FTP is an important predictor of school investment and academic success (Peetsma, 2000). A simplified version of the Zimbardo time perspective inventory was employed in the student interviews (Zimbardo & Boyd, 1999). The life history perspective was chosen in order to get an extended description both of the individual experiences and the conditions provided by the school environment. Even though all ten students have a diagnosis of dyslexia, a majority of them were not diagnosed until they were in upper secondary school or even at the university. In Sweden children are seldom diagnosed with dyslexia in elementary school. It seems like the students were able to handle the rather simple texts, often fictional, used in early reading instruction. In the students' narratives it is clear that the problems with reading got more apparent when they encountered more abstract and complex non-fictional texts in upper secondary school and, above all, at the university level.

Most students were diagnosed with dyslexia as upper secondary school students or as university students. The student narratives revealed that the need for support was clearly manifested in upper secondary school, but no support was offered. One major finding was that no extra support was given until the diagnoses were made. Even those students, who had an earlier diagnosis, were dependent on the help each individual teacher could or would offer. Some students reported that their self-esteem suffered a lot as they linked their reading problems to a view of themselves as "being stupid". In particular, for those students, the diagnosis of dyslexia was a relief. At university level the students perceived that their studies required rigorous planning, a lot of time, and many hours of reading. They claimed that the compensatory support they had been given, was crucial to them to meet the academic demands. The compensatory actions will be described in the presentation. In describing their Future Time Perspective the students emphasized their ability to understand and help children with special needs. This was a major driving force for them to apply to become trainee teachers. Firstly, a major implication of these findings is that dyslectic children are not identified so that remedial assistance can be set in as early as possible. Secondly, it is obvious that the condition of dyslexia, in these students, is not only linked to the problems associated with reading, but also to a strong Future Time Perspective and ability to large investments in their studies. Our conclusion is that these students' capacities and strengths should earn more attention both in practice and research.

PAPER PRESENTATION

Academic self concept in children with special educational needs attending different school types

Dietmar Grube, University of Oldenburg, Germany; Lieselotte Scheewe, University of Bremen, Germany; Julia Nicklaussen, Carl-von-Ossietzky Universität Oldenburg, Germany; Susanne Mayer, Carl von Ossietzky Universität Oldenburg, Germany

Some children with a mild intellectual disability or with socio-emotional problems visit classes at special schools, some others are integrated within classes in regular elementary schools. The academic self-concept is an important variable for life-long learning. From the theoretical view of the big-fish-little-pond-effect (Marsh, 1987) lower self-concept scores can be predicted in children that are integrated in classes at regular schools than in children instructed in special classes.

The present study is aimed at testing this hypothesis. Self-concept and other school related variables were collected from 13 children attending special classes and from 13 children attending regular classes. All children had been diagnosed as needing special educational help. The children attending schools in the rural regions of Germany were matched for age (about 9 years) and sex. For reasons of statistical control individual reading, arithmetic and working memory were assessed. Each child completed a questionnaire regarding emotional and social school experience ("Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen", FEES 1-2; Rauer & Schuck, 2004). The groups of children differed significantly regarding academic self-concept, attitude toward school and enjoyment to learning with children educated in special classes showing more advantageous values than children integrated within regular elementary schools. An analysis of covariance showed that the significant differences were saved after controlling cognitive variables.

Findings

Show that self-concept of children with special needs is at risk if the children are schooled within regular schools. A disadvantageous self-concept seems to reduce the attitude toward school and the enjoyment to learning.

Children who fail to profit from regular instruction at school in the long term may be categorized as children with special educational needs. Some children with a mild intellectual disability or with socio-emotional problems visit classes at special schools, some others are integrated within classes in regular elementary schools. In former times, special classes were arranged in order to give special instruction to children with special needs and in order to save them from learning standards they can't reach. Nowadays, directed by the Convention on the Rights of Persons with Disabilities (2006), more and more children with special needs receive their special education while attending regular schools.

Children with special educational needs should be encouraged regarding both, cognitive and socio-emotional aspects. On the socio-emotional side, the academic self-concept is an important variable. In this theoretical context the well known big-fish-little-pond-effect (Marsh, 1987) predicts a disadvantageous self-concept in children with classmates whose mean capability is much higher than their own. Therefore one could predict lower self-concept scores in children that are integrated in classes at regular schools than in children instructed in special classes. On the other side, teachers of regular classes that integrate children with special needs should be well trained and prepared to be conscious of the big-fish-little-pond effect and to fight against it. From this point of view one should predict no differences between the two groups of children educated in different contexts.

The present study is aimed at investigating the self-concept of children with special educational needs attending special classes compared to children attending classes in regular schools. Self-concept and other school related variables were collected from 13 children attending special classes (four girls, nine boys, mean age = 9;0 years, SD = 0;3) and from 13 children attending regular classes (four girls, nine boys, mean age = 9;1 years, SD = 0;4). All children had been diagnosed as needing special educational help. The children attending schools in the rural regions of Germany were matched for age and sex. For reasons of statistical control individual reading and arithmetical skills as well as working memory were assessed. Each child completed a questionnaire regarding emotional and social school experience ("Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen", FEES 1-2; Rauer & Schuck, 2004) that gives information about the following seven variables: social integration, class climate, academic self-concept, attitude toward school, effort tendency, enjoyment to learning, feeling to be accepted.

Simple t-tests ($\alpha = .05$) did not show significant differences between both groups of children regarding reading and arithmetical skills and working memory. However the groups of children differed significantly regarding academic self-concept ($d = 1.04$), attitude toward school ($d = 0.92$) and enjoyment to learning ($d = 0.99$) with children educated in special classes showing more advantageous values than children integrated within regular elementary schools. For the other socio-emotional variables analyses did not show any significant differences. Because there were tendencies

toward better cognitive skills in children attending special classes an additional analysis of covariance was carried out. This analysis showed that the significant differences found for socio-emotional variables were also significant after controlling reading skills, arithmetical skills and working memory.

These findings show that the self-concept of children with special educational needs is at risk if the children are schooled within regular elementary schools. A disadvantageous self-concept seems to reduce the attitude toward school and the enjoyment to learning. Consequently, teachers instructing children with special needs within regular schools have to take the risk for the self-concept of the children into account. Educational research has to yield further knowledge and schools of education have to impart the knowledge about how to save the self-concept of students from being damaged by the context of more capable peers.

PAPER PRESENTATION

The role of text production processes in the development of understanding through writing

Veerle Baaijen, Center for Language and Cognition Groningen, Netherlands; David Galbraith, Staffordshire University, United Kingdom; Kees de Glopper, Faculty of Arts, University of Groningen, Netherlands

Writing is often used as a tool for learning in schools. Current theories of writing, however, have different conceptions of the processes responsible for its epistemic effects. The knowledge-transforming model (Bereiter and Scardamalia, 1987) attributes it to deliberate planning designed to satisfy rhetorical goals. By contrast, the dual-process model (Galbraith, 2009) claims that it depends on the spontaneous formulation of thought during dispositionally-guided text production. Two groups of writers - high self-monitors, whose writing is assumed to be directed towards rhetorical goals, and low self-monitors, whose writing is assumed to be dispositionally-guided - were asked to write an article for the university newspaper. Half the participants were asked to make an outline before writing (outline planning); the other half were asked to sum up their main point before writing (synthetic planning). All participants were asked to rate their understanding of the topic before and after writing, and, in order to assess the extent to which content was modified during text production, keystroke logs were collected. The results are broadly compatible with the dual-process model: (i) writers reported significantly more development of understanding after synthetic than after outline planned writing; (ii) low self-monitors writing synthetically planned text showed much higher levels of text modification during writing; (iii) developments of understanding within the synthetic planning condition were significantly related to the extent of text modification during writing. Alternative explanations for the findings, and their implications for designing school writing tasks, will be discussed.

Writing is often used as a tool for learning in schools. However, there are contrasting conceptions about what is responsible for the epistemic effect of writing. Problem solving models of writing (e.g. Bereiter and Scardamalia, 1987) attribute the development of understanding through writing to deliberate planning designed to satisfy rhetorical goals. By contrast, Galbraith (2009) claims that the development of understanding depends on the extent to which text production is dispositionally driven. This paper focuses on the fundamentally different role that these two theories attribute to text production processes. For the problem solving models of writing, text production is a passive process of translating thoughts into words, whereas the dual process model (Galbraith, 2009) suggests that text production is an active knowledge constituting process in its own right. 42 high self-monitors (whose writing is assumed to be directed towards rhetorical goals) and 42 low self-monitors (whose writing is assumed to be dispositionally driven) were asked to plan and write an article for the university newspaper. Half the participants were asked to make an outline before writing (planned text production) while the other half were asked to write down a single sentence summing up their overall opinion (non-planned text production). We used the latter as a control planning condition, which we defined as synthetic planning.

To assess the development of understanding, participants were asked to list ideas and to rate their understanding of the topic both before and after writing. To assess the extent to which content was modified during text production, keystroke logs were collected during writing (Leijten & Van Waes, 2006). In order to capture text production processes we used a simple indicator of content modification during text production, which we will label as the text modification index. The text modification index is the number of process words registered by Inputlog as a proportion of words in the final text. This index is taken as the extent to which text is modified during writing. Because only the dual process model attributes an active role to text production processes we will take the perspective of the dual process model to state the predictions. If the dual process model is right then the text modification index should be at a maximum when low self-monitors write synthetically planned texts, since it is assumed that low self-monitors' writing is dispositionally driven and that outline planning reduces the extent to which text production is spontaneous. Furthermore, if the dual process model is right, high levels of text modification should also be associated with increases in subjective understanding.

This experiment showed three important results. First, writers reported significantly more development of understanding after synthetic than after outline-planned writing. Secondly, low self-monitors writing synthetically planned text showed much higher levels of text modification during writing than the high self-monitors writing outline planned texts. Third, developments of understanding within the synthetic planning condition were significantly related to the extent of text modification during writing. Taken together, the latter two results suggest that dispositionally-driven (i.e. low self-monitors') writing leads to more modification of thought during text production than writing that is directed towards rhetorical goals (high self-monitors), and this is associated with the development of writers' subjective understanding. This effect is reduced when writing is outline planned. These results are, therefore, compatible with the main claims of Galbraith's dual process model. However, a key question that remains is the nature of the process by which text modification occurs during writing. Is it a consequence of the spontaneous formulation of thought in language, or of a more deliberate planning and rhetorical evaluation of sentences as they are produced? In order to examine this, a further, more detailed analysis of the key-stroke logging data is currently in progress. To date, this analysis has supported the assumption that the text modification index is a valid measure of differences in the number and nature of production and revision phases during writing. More detailed analyses of these findings will be reported in the paper, in addition to the data described above. These results have potentially important implications for the way that writing is taught in schools. Outline planning is one of the most common writing strategies taught in schools, and this is often accompanied by a focus on the rhetorical goals of different forms of writing. Our results suggest that, at least so far as learning is concerned, more exploratory, less structured forms of writing, may be equally important.

PAPER PRESENTATION

Bursts of written language production increase across the initial years of schooling

Rui Alexandre Alves, Universidade do Porto, Portugal; Ilda Jesus, Universidade do Porto, Portugal

Writers compose in bursts, that is, texts are produced by adding up stretches of words, which in adults have an average length of about nine words (Kaufer, Hayes, & Flower, 1986). How do writers progress to achieve this length? Do children readily start by adding up segments of about nine words? Likely not. Here we report a study conducted with Portuguese children that we set up to find if burst length develops throughout the initial four years of schooling. To test this, we formed groups of first, second, third, and fourth graders ($N = 166$). The children handwrote narratives (elicited by a cartoon like drawing) into a digitizing tablet that recorded pauses and bursts. Regarding pauses, we found that its duration decreased from 1st to 4th grade. Regarding bursts, we found a steady increase in burst length from 1st to 4th grade, the average burst size for the four groups were, respectively: 1.84, 3.53, 5.26, and 7.86 words. This result shows for the first time that burst length heightens during the initial years of schooling. Overall, across grades the picture that emerges from this study is one of writing becoming progressively more efficient, as reflected by decreasing pause duration, and increased burst length. These results are of educational relevance, because online measures of writing, such as pauses and bursts, can be thought as markers of writing efficiency, thus teaching us more about identifying and promoting writing skills in the initial years of schooling.

Writers compose in bursts, that is, texts are produced by adding up stretches of words, which in adults have an average length of about nine words (Kaufer, Hayes, & Flower, 1986). How do writers progress to achieve this length? Do children readily start by adding up segments of about nine words? Likely not, because several studies have already shown that in adults burst length is affected by several factors including domain expertise (Kaufer et al., 1986), language skill (Chenoweth & Hayes, 2001), available working memory capacity (Chenoweth & Hayes, 2003), and transcription skill (Alves, Castro, Sousa, & Stromqvist, 2007; Alves, Olive & Castro, 2010). Since many of these skills show developmental trends with age and schooling, it is likely that in children they might contribute to a steady progression of burst length. Nevertheless, bursts of written language production have been seldom studied in children (but see, Alves, Branco, Castro, & Olive, in press), and this topic is unexplored. Here we report a study conducted with Portuguese children that we set up to find if burst length develops throughout the initial four years of schooling.

The first scientific report that writers compose in bursts was made by Kaufer et al. (1986). They compared expert to novice writers, and showed that the experts had larger bursts and wrote generally better texts. For many years this topic of research was overlooked, but has recently seen a handful of studies. Chenoweth and Hayes (2001) compared undergraduates writing two texts, one in their native language (L1), the other in their second language (L2). As predicted, they found that writers were more fluent and had larger bursts in L1 than in L2. Also in a sample of adult writers, Chenoweth and Hayes (2003) have further shown that reducing verbal working memory capacity by articulatory suppression (saying "tap, tap, tap..." to a metronome) decreased both writing fluency and burst length. Two recent studies by Alves and colleagues have argued that automatizing transcription leads to larger bursts. Alves et al. (2007) asked low and high skilled typists to compose written narratives from a set of pictures. They found that the later group used larger bursts. In an experiment, Alves et al. (2010), randomly assigned undergraduates to one of four

conditions resulting from the crossing of output modality (handwriting vs. typing) and transcription skill (low vs. high). They have shown that, irrespective of modality, the high skilled groups composed in larger bursts.

All the skills just discussed have typical progresses during the first years of schooling, thus it is reasonable to expect that they might contribute to more efficient bursts from first to fourth grade. To test this, we formed groups of first, second, third, and fourth graders. The mean ages, size of the groups and gender distributions were, respectively, as follows: M = 6.4 years old, n = 30, 20 girls; M = 7.5 years old, n = 47, 20 girls; M = 8.4 years old, n = 48, 24 girls; and M = 9.5 years old, n = 41, 24 girls. These groups were asked to write a narrative from a simple line drawing depicting a child strolling with a balloon. The children handwrote the stories into a digitizing tablet, that was controlled by an E-Prime script programmed to measure pauses and bursts of language production.

Two-way Gender X Grade ANOVAs were computed on the means of pause duration and burst length. Regarding pause duration, main effects of both gender, $F(1, 158) = 5.42, p < .05, \eta^2 = .03$, and grade, $F(3, 158) = 7.71, p < .01, \eta^2 = .13$, were found. No interaction was found in this analysis. Girls made shorter pauses than boys. Pause duration decreased from 1st to 4th grades, which is compatible with more efficient composing processes. Regarding burst length, main effects of gender $F(1, 158) = 7.70, p < .01, \eta^2 = .05$, and grade, $F(3, 158) = 40.15, p < .01, \eta^2 = .43$, were found. Also, the interaction between gender and grade was significant, $F(3, 158) = 4.22, p < .01, \eta^2 = .07$. While there were no gender differences in the initial two years of schooling, girls in the 3rd and 4th grade showed larger bursts than boys. A similar gender advantage has been reported before in fourth graders (Alves et al., in press), and seems to be accounted by an early advantage of girls in transcription skills (Berninger & Fuller, 1992). As expected, a steady increase was found in burst length from 1st to 4th grade, the average burst size for the four groups were, respectively: 1.84, 3.53, 5.26, and 7.86 words. This result shows for the first time that burst length increases during the first years of schooling. Overall, across grades the picture that emerges from this study is one of writing becoming progressively more efficient, as reflected in decreasing pause duration, and increasing burst length. These results are of educational relevance, because online measures of writing, such as the one studied here, can be thought as markers of writing efficiency, thus teaching us more about identifying and promoting writing skills in the initial years of schooling.

References

- Alves, R. A., Branco, M., Castro, & Olive, T. (in press). Effects of handwriting skill, composition mode and gender of fourth graders on pauses, written language bursts, fluency and quality. In J. Hayes, M. Fayol, P. Boscolo, & V. Berninger (Eds.), *Past, present, and future contributions of cognitive writing research to Cognitive Psychology*. New York: Psychology Press.
- Alves, R. A., Castro, S. L., & Olive, T. (2010). Transcription skill constrains bursts of language production. In M. Torrance (Ed.), *Learning to write effectively: Current trends in European research*. Brussels: OPOCE.
- Alves, R. A., Castro, S. L., Sousa, L., & Stromqvist, S. (2007). Influence of typing skill on pause-execution cycles in written composition. In M. Torrance, L. van Waes & D. Galbraith (Eds.), *Writing and cognition: Research and applications* (pp. 55-65). Amsterdam: Elsevier.
- Berninger, V. W., & Fuller, F. (1992). Gender differences in orthographic, verbal, and compositional fluency: Implications for assessing writing disabilities in primary grade children. *Journal of School Psychology Review*, 30, 363-382.
- Chenoweth, N. A., & Hayes, J. R. (2001). Fluency in writing. *Written Communication*, 18, 80-98.
- Chenoweth, N. A., & Hayes, J. R. (2003). The inner voice in writing. *Written Communication*, 20, 99-118.
- Kaufer, D. S., Hayes, J. R., & Flower L. S. (1986). Composing written sentences. *Research in the Teaching of English*, 20, 121-140.

PAPER PRESENTATION

Instruction as Mediated Practice: a critical analysis of an intervention study

Susan Jones, Exeter University, United Kingdom; Debra Myhill, Exeter University, United Kingdom

Abstract

This paper will present qualitative findings from a nationally-funded study measuring the impact of contextualized grammar teaching. This study was designed in response to calls for a Randomised Control Trial to establish 'if grammar teaching works', but the trial itself was embedded within a qualitative framework. The focus of this paper is the qualitative data, including teacher interviews and observation data. Both the observations and the interviews were coded using a grounded approach employing NVIVO software to facilitate the coding process. The RCT revealed a positive effect of 1.53 for those classes being taught explicit grammar. However the classroom observations and interviews with the teachers reveal that the pedagogic materials used in the intervention were mediated differently by different teachers and key themes informing these differences were linguistic subject knowledge and beliefs about

the value of explicit grammar teaching. This presentation seeks to show the different and nuanced ways in which an intervention shown to be effective, is realised in the classroom context.

Introduction

The study from which this data is drawn aimed to measure the impact of contextualized grammar teaching. The term 'contextualized' was used to indicate that grammar features were taught at the point of writing, as a set of linguistic choices the students might employ for purposeful rhetorical reasons. The research took place against a contested background regarding the value of explicit teaching of grammar (Gordon 2005). As a consequence of this debate there had been calls for a Randomised Control Trial to establish empirically 'if grammar teaching works' (Andrews et al 2006). This study employed an RCT but embedded the trial within a qualitative framework. It is this qualitative data that reveals that while there was a positive effect for those classes being taught explicit grammar, the pedagogic materials were mediated differently by different teachers. Thus it is argued that a simple 'what works' approach to educational research misrepresents the complexity of classroom contexts; the aim here is to reveal some of this complexity through a presentation of the findings from the teacher interviews and classroom observations.

Methodology

32 schools were recruited and randomly assigned to intervention and comparison groups. Both groups were taught three types of writing, Fictional Narrative, Argument, and Poetry Writing, through the year, employing schemes of work designed by the research team. In both conditions the learning focus, period of study, resources and learning objectives were the same; however, the intervention group received detailed lesson plans and a day's training in their use and a pedagogic rationale for the teaching. This rationale was informed by a view of grammar teaching that promoted the exercise of informed choices regarding the multiple possibilities of linguistic expression, rather than the teaching of grammar knowledge for its own sake. The comparison group received medium term plans but no pedagogic support or training and taught in their usual manner. Both groups completed pre and post test writing assessments which were scored by an independent organization responsible for marking the National Key Stage tests in the UK. However informed by a belief that 'to undertake a trial of an educational or social intervention without an embedded qualitative process evaluation would be to treat the intervention as a black box, with no information on how it worked, how it could be improved, or what the crucial components of the intervention were.' Moore, Graham and Diamond (2003) the RCT was embedded within a qualitative design. The qualitative data included teacher and student interviews, observation data and examples of student writing. Contextual data relating to individual teachers such as length of service, academic background and linguistic subject knowledge, together with the demographics of the schools were also collected.

Findings

The headline findings of the study indicated a positive effect size of 1.53 for the intervention group. However, the RCT does not provide a simple answer to the question 'does grammar teaching work.' Embedded within the data are the complexities of the classroom context and the differential ways by which the schemes of work were taught and understood. Both the observations and the interview analysis reveal teachers adapting the schemes of work to accommodate either the teachers' own practice and approach, or to avoid areas that challenged their own subject knowledge. In the interviews the teachers frequently air their own concerns about their lack of linguistic subject knowledge. The teachers also reveal their own beliefs about students' ability to engage with grammatical concepts and the pedagogic decisions that resulted from these beliefs. More positively however, there are also examples of teachers being surprised by unexpected outcomes, experimenting with linguistic possibilities and making connections between the schemes of work and pedagogic practice.

Conclusion

While the headline findings indicate the efficacy of contextualized grammar teaching, the qualitative data reveals that this is mediated in different ways by different teachers. The effectiveness of the teacher is informed by a complex set of understandings and skills of which subject knowledge is only part of the equation (Phelps and Shilling 2004). Schulman (1986) speaks of pedagogic content knowledge as the integration of subject knowledge with pedagogy such that the teacher needs to translate what they know into a form that can be taught to others. What is revealed in this data is the struggle to make this translation. At the same time teaching as a profession is the focus of competing discourses whereby both what is taught and how it is taught is a contested agenda frequently aired in professional, research and social contexts. The place of grammar; the role of the teacher and the purpose of writing instruction have all been subject to significant pedagogic shifts. This ranges from progressive approaches to a more prescriptive skills-based curriculum and more recently, attempts to reduce centralised strategy making, returning autonomy to teachers and schools. This shifting pattern and the tensions created are also articulated by these teachers and visible in their pedagogic decision making. This presentation seeks to show the different and nuanced ways in which an intervention shown to be effective, is realised in the classroom context.

References

- Andrews, R. Torgerson, C. Bevertson, S. Freeman, A. Locke, T. Low, G. Robinson, A and Zhu, D. (2006) The effect of grammar teaching on writing development. *British Educational Research Journal* 32 (1) 39-55
- Gordon, E (2005) Grammar in New Zealand Schools: Two Case Studies *English Teaching: Practice and Critique* 4 (3) 32-47 48-68
- Moore, L. Graham, A. and Diamond, I. (2003) On the Feasibility of Conducting Randomized Controlled Trials in Education *British Education Research Journal* 29 (5) 673-689
- Phelps, G., & Schilling, S. (2004). Developing measures of content knowledge for teaching reading. *Elementary School Journal*, 105, 31-49.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15, 4-14.

PAPER PRESENTATION

A new perspective into writing regulation: Regulation Episodes in expert research article writing

Anna Inesta, ESADE Business School, Spain; Montserrat Castello, Universitat Ramon Llull, Spain

The present study tests a new unit of analysis, the Regulation Episode, with the objective of identifying patterns in the writing regulation activities implemented by 2 expert writers while producing a research article in Spanish as their L1 in ecological conditions. Qualitative analysis of video-recorded writing sessions (Writer 1: 660 hours in 11 writing sessions; Writer 2: 1016 hours in 12 writing sessions), all produced drafts (Writer 1: 14; Writer 2: 13) and writing diaries (Writer 1: 11; Writer 2: 15) showed that Regulation Episodes took place along the writing processes. Two morphological factors were found to characterize Regulation Episodes: explicitness/implicitness (whether or not Episodes appeared after writers' challenge declaration) and continuity/discontinuity (whether or not Episodes required more than one session to solve the challenge). Also, explicit Episodes focused on molar challenges while implicit episodes focused on local, especially those related to the construction of their authorial voice.

We understand by Regulation Episode the sequences of actions that authors strategically implement with the objective of solving a difficulty or challenge identified during the writing process. We expected that this unit of analysis would allow us to approach the regulation of a challenging task such as research article (RA) writing in a comprehensive way and find meaningful writing strategy patterns in ecological conditions.

Participants were two experienced researchers in the field of psychology, who decided to write a RA in Spanish as their academic writing L1[1] in co-authorship conditions. For the purpose of research, Writer 1 and Writer 2 accepted to work separately on the whole article to compare their versions and negotiate a joined one for submission. Writer 1 devoted 660 hours distributed in 11 sessions to write the RA while Writer 2 devoted 1016 hours distributed in 12 writing sessions.

Two independent judges participated in the categorization of the data at two different levels of analysis. Macro-level analysis involved distinguishing the objectives, challenges, solutions as declared in the writing diaries participants were asked to fill in for every writing session, as well as in the process and retrospective interviews. Micro-level analysis, on the other hand, involved analyzing the transcripts of the researchers' video-recorded writing activity (for each of the writing sessions) to identify the actions implemented while working on the RA as well as infer the intentionality underlying these actions.

Results obtained through macro-analysis confirmed the existence of Explicit REs in the writing process of both participants, which were found to be either continuous (challenge and solutions are cited and implemented in one same writing session) or discontinuous (challenge and solutions are cited and implemented in different writing sessions). Finally, micro-level analysis showed evidence of intentional challenge resolution that had not been explicitly identified by the writers. We considered this to be evidence of implicit Regulation Episodes, which we defined as those sequences of actions of at least 10 bursts[2], some of which are aimed at reformulating or adjusting various elements of the sentence, showing an intention to address a challenge, despite not having made any explicit reference to it during the writing process. Examples of these two kinds of Regulation Episodes will be shown in the session.

[1] In the context of the study there are two official languages, Spanish and Catalan, and while the writers considered Catalan to be their first language, they considered Spanish to be their first language for academic writing purposes.

[2] We use the unit of burst in the same way as Chenoweth & Hayes (2001, 2003) or Beare & Bourdages (2007).

PAPER PRESENTATION

Professional Development through Reflection. A Video and Interview based Analysis.

Corinne Wyss, Educational University Zurich, Switzerland

The conventional Universities of Teacher Education in Switzerland, as well as in the surrounding countries are in a changing phase. Teacher education is part of a critical and controversial discussion and new methods and criteria for teacher education are being looked for. With the definition of standards, the quality of teacher education and the teaching competencies of the students should be secured.

One outcome of these discussions about teacher education and professional career is the image of the teacher as "reflective practitioner". The reflecting competency of a teacher is assumed to be an important factor for professional learning and development. Further more, it is the basis for teaching progression and qualitative instruction. But, there is little known about the reflecting competency of teachers and their reflecting practices.

This study tries to find some evidence by questioning novice and expert teachers with different methods and instruments. The analysis is proceeding on the basis of videotaped lessons which are taken at the beginning and at the end of the job entry phase. The longitudinal study reveals how the reflecting competencies are changing in the first year on the job. The coeval study identifies differences between the novice teachers and the expert teachers.

Affiliation

This paper is written within a national project of the Universities of Teachers Education of St. Gallen and Zürich called "Assessing Standards of Teaching Competency in Initial Teacher Training and in the Job Entry Phase".

PAPER PRESENTATION

Reflecting on Reasoning by Studying Videos

Carolyn Maher, Rutgers University, United States; Cindy Hmelo-Silver, Rutgers University, United States; Marjory Palius, Rutgers University, United States; Robert Sigley, Rutgers University, United States

This study examines the features identified by teachers studying videos of children's mathematical reasoning in an online environment. Analysis of small group discourse about the videos indicate that teachers related the video to their own and classmates problem solving, identified connections to other videos, indicated the enjoyment of studying the videos, and related the videos to opportunities to improve their own teaching. Also, teachers made key connections of the videos to assigned and non-assigned readings. Significant findings are (1) that the video offered a context to discuss the undiscovered potential for reasoning in children and (2) that assigned and other readings were introduced by teachers to support the ideas that were offered.

Aims:

When learning is viewed as a process in a social context, it is crucial to consider ways in which technology influences how students engage in building new knowledge (Collins & Halverson, 2009; Peters & Slotta, 2010). Researchers have argued that technology can serve as cognitive and metacognitive tools that extend classroom experiences beyond the physical classroom to enable learning in virtual spaces (Azevedo, 2005; Lajoie & Derry, 1993). The view that such tools can change the nature of teaching and learning as students enable new forms of activity requires study. It is important to understand how learners develop and deepen their understanding through interactions with each other and with computer tools. Asynchronous discussions offer opportunities to students to be more reflective than they might be in face-to-face groups that call for immediate feedback. They also provide instructors a window into the development and extension of knowledge, offering formative assessment and facilitation of multiple groups (Andriessen, 2006; Bonk et al., 1998). It is claimed that student reflection about their learning is essential in order think about the broader contexts in which they might apply their knowledge (Etkina et al., 2010; Salomon & Perkins, 1989). Opportunities to reflect and revisit ideas, and discuss them within a community of learners, have shown to be especially powerful in the development of mathematical reasoning (XXX, 2010). Blending asynchronous online discussion with access to electronic resources, particularly videos, suggests a potent model for catalyzing learning among mathematics teachers.

The Study:

This research examines online discussions of groups of teachers enrolled in a technology-enriched, hybrid course in mathematics education. A goal for the instructional intervention is that teachers learn to recognize children's reasoning as presented on video clips that come from a seminal collection on children reasoning in mathematics being preserved for worldwide accessibility. Setting/intervention: The intervention model involves studying videos of students across K-12 grades as they engage in cognitively challenging mathematical tasks and providing explanations of children's justifications for their solutions. We analyze online discussion within a course management system, where four groups of about 6-7 teachers engage in conversation about their mathematical problem solving. The data source include postings from a group of seven students, over a three day period, coded for Unit 8, five weeks into the strand. Full paper data will be expanded to all four groups.

Research Questions:

The questions that guide the study are: (1) How, if at all, does discussion of studying of videos contribute to knowledge of children's reasoning; and (2) What are indicators of contributing factors? Data Source: A unit over two weeks involved teacher problem solving in class, and online discussions about a video and related readings. The video involved 5 tenth graders, working in groups of two and three working on the following problem: How many different block towers can be built selecting from three colors of blocks such that the towers have at least one of each color? For the online portion, teachers were asked to describe tenth grader Romina's solution to the problem, indicate whether it is convincing and why or why not. They also were asked to compare Romina's solution strategy with those that emerged in class, and to comment on how explaining and justifying contribute to learning mathematics.

Results:

Data emerging from online discussion were coded with time stamp and for initial (I) and response (R) posts. The categories that evolved from the assignment related the videos to: problem solving (VP), value of the video (VA), examples of student reasoning (VR), and examples from the literature (VL). Teacher postings about connections of the readings to practice were also coded (RP). Studying video proved to be a strong catalyst, with 76% of the reasoning related the video and 24% related to the paper. Teacher comments reflected acknowledgement of Romina's proof as correct, clever, convincing, elegant, impressive, similar/different than that of their/other class members, to the way other members of their class solved it, similarity in notation, cleverness in notation, personally insightful, brilliantly represented, etc. The full paper will elaborate on these results, reporting on all four groups and blending quantitative analysis with qualitative evidence in the form of examples of postings made by the teachers.

Implications:

Understanding what a knowledge community looks like in practice is important for advancing our understanding of how to create and facilitate collaborative knowledge building on line and how carefully selected videos made available globally can enhance collaborative learning. Attention to student reasoning is an important aspect of mathematics teaching that can be enhanced through studying videos and thinking deeply about them.

Andriessen, J. (2006). Collaboration in computer conferencing. In A. M. O'Donnell, C. E. Hmelo-Silver & G. Erkens (Eds.), *Collaborative learning, reasoning, and technology*. Mahwah, NJ: Erlbaum.

Azevedo, R. (2005). Computers as metacognitive tools for enhancing learning. *Educational Psychologist*, 40, 193-197.

Bonk, C. J., Hansen, E. J., Grabner-Hagen, M. M., Lazar, S. A., & Mirabelli, C. (1998). Time to "connect": Synchronous and asynchronous dialogue among preservice teachers. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 289-314). Mahwah, NJ: Erlbaum.

Collins, A., & Halverson, R. (2009). *Rethinking Education in the Age of Technology: The Digital Revolution and Schooling in America*. New York: Teachers College Press.

Etkina, E., Karolina, A., Ruibal-Villasenor, M., Rosengrant, D., Jordan, R. & Hmelo-Silver, C. (2010). Using design and reflection to help students develop scientific abilities. *Journal of the Learning Sciences*. 19,

Lajoie, S. P. & S. Derry (1993). *Computers as cognitive tools*. Hillsdale, NJ: Erlbaum.

Peters, V., & Slotta, J. D. (2010). Scaffolding knowledge communities in the classroom: New opportunities in the web 2.0 era. In M. J. Jacobson & R. P. (Eds.), *Designs for Learning Environments of the Future: International Perspectives from the Learning Sciences*, (pp. 205-232). New York: Springer.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist*, 24, 113-142. XXX. (Eds.), (2010). *Combinatorics and reasoning: Representing, justifying and building isomorphisms*. New York: Springer.

PAPER PRESENTATION

Adaptive Teaching Strategies in German Primary Schools

Jasmin Warwas, German Institute for International Educational Research (DIPF), Germany; Andju Sara Labuhn, German Institute for International Educational Research, Germany; Silke Hertel, German Institute for Internat.Educational Resarch, Germany; Eckhard Klieme, Deutsches Institut fur Intern. Padagogische Forschung, Germany; Marcus Hasselhorn, DIPF, Germany

Dealing with students' heterogeneity and providing individual support to students in classroom instruction are key to teachers' work in every day school life, and are important demands of educational policy. To reach this goal, teachers can make use of several adaptive teaching strategies such as individualised worksheets and expert groups. When investigating classroom practices, teachers' beliefs play a major role. The aim of our study is to investigate what adaptive strategies teachers use, and which role both the heterogeneity of students and the teachers' beliefs play for their use. Teachers in German primary schools (N=26) reported their use of adaptive teaching strategies and their constructivist beliefs. To measure heterogeneity, we assessed the variability of grade level 3 students' (N=469)

competencies in reading comprehension and mathematics in each class. Using linear regression analyses, we could not confirm a relationship between the heterogeneity of students' competencies and the self-reported use of adaptive teaching strategies. Furthermore, teachers holding a constructivist view reported a more frequent use of individualised worksheets, but they did not report to prefer expert groups. Additionally, we found significant interaction effects between the teachers' constructivist view and the heterogeneity of students' competencies regarding the self-reported use of adaptive teaching strategies. The present study reveals important implications for the development of intervention studies designed to provide individual support to students, and for implementing adaptive teaching strategies in teachers' classroom instruction.

Dealing with students' heterogeneity and providing individual support to students in classroom instruction are key to teachers' work in every day school life, and are important demands of educational policy. To this end, Corno and Snow (1986) defined adaptive teaching as "teaching that arranges environmental conditions to fit learners' individual differences" (p. 621). To reach this goal, teachers can make use of several adaptive teaching strategies such as individualised worksheets and expert groups. The former emphasise students' individual learning strategies and are quite popular in German classroom instruction. The latter is a cooperative learning method assigning students to "expert" roles, as the Jigsaw method does (Aronson et al., 1978). A large body of research shows cooperative learning methods to be effective for dealing with heterogeneity and fostering the students' achievement (e.g. Cohen, 1994; Johnson, Johnson, & Stanne, 2000). When investigating classroom practices, teachers' beliefs play a major role. Here, a direct transmission view is contrasted with a constructivist view (see Peterson, Fennema, Carpenter, & Loef, 1989; Staub & Stern, 2002). According to a direct transmission view, teachers are transmitters of knowledge. Within a constructivist framework, students are active constructors of knowledge and teachers support students' self-regulated learning strategies. Therefore, the aim of our study is to investigate what adaptive strategies teachers use, and which role both the heterogeneity of students and the teachers' beliefs play for the use of these strategies.

Hypotheses:

We hypothesize that (1) teachers use individualised worksheets as an adaptive teaching strategy in primary schools more frequently than expert groups, (2) teachers use adaptive teaching strategies particularly in classes with high heterogeneity, (3) teachers with a constructivist view use adaptive teaching strategies more frequently, and (4) teachers with a constructivist view use adaptive teaching strategies more often when they are teaching in classes with high heterogeneity.

Methods:

Teachers (N = 26) in German primary schools completed a questionnaire about their adaptive teaching strategies (e.g. 'How often do you use expert groups as an adaptive teaching strategy in your current classroom instruction?' 1 = never to 4 = in every lesson) and their beliefs (e.g. 'Students should create new ideas on their own and use individual learning strategies.' 1 = I disagree to 4 = I totally agree; three-item scale measuring a constructivist view; Cronbach's alpha = .80). Teachers were predominantly female (89%) and about a half of them had professional experience of more than ten years. Furthermore, we assessed their students' (N = 469) competencies in reading comprehension and mathematics using German standardized diagnostic instruments, such as Wuerzburg Silent Reading Test (Kuespert & Schneider, 1998) and German Mathematics Test (Hasselhorn, Marx, & Schneider, 2004). About half of these students in grade level 3 were female (52%) with a mean age of 8,8 years. To assess heterogeneity, we used the variability of students' competencies in reading comprehension and mathematics in each class. We conducted pairwise comparisons of the self-reported use of two adaptive teaching strategies: individualised worksheets and expert groups. Using stepwise multiple linear regression analyses, we tested main and interaction effects of (a) the heterogeneity of students' competencies for each class, and (b) the teachers' beliefs on the use of these strategies.

Results:

In line with our first hypothesis, a comparison of mean values revealed that teachers reported they used individualised worksheets more often than expert groups ($t(1,24) = 4.63$, $p < .05$, $R^2 F(2,22) = 7.55$, $p < .05$, $R^2 F(2,22) = 7.04$, $p < .05$, $R^2 F(3,21) > 6.95$, $p < .05$, $R^2 = .50$) or in mathematics ($F(3,21) > 10.70$, $p < .05$, $R^2 = .61$). Regarding the self-reported use of expert groups, we found a significant interaction effect between teachers' beliefs and heterogeneity of students' reading comprehension ($F(3,21) = 3.18$, $p < .05$, $R^2 = .31$), whereas the interaction between teachers' beliefs and heterogeneity of students' competencies in mathematics did not reach significance ($F(3,21) = 1.99$, $p = .15$, $R^2 = .22$). However, the significant regression weight for the interaction term ($b = 0.41$, $SE = 0.29$, $p < .05$).

Conclusion and further discussion:

In our study, the heterogeneity of students' competencies within classes was not directly related to the self-reported use of adaptive teaching strategies. However, heterogeneity in a classroom can stem from different reasons and can

also be assessed in other ways, such as socioeconomic background or migration status. Also, the direction of the effects found in our explorative study should be confirmed in longitudinal studies. Furthermore, previous research shows social learning arrangements such as expert groups to be a teaching strategy dealing with students' heterogeneity as well as fostering the students' achievement. Nevertheless, this adaptive teaching strategy is quite rarely used in German primary school classroom instruction. Most likely, teachers report to use this strategy when holding a constructivist view and facing the challenge of teaching students with comparatively heterogeneous competencies. In this study, we aimed to investigate the relationship between self-reported teaching strategies and beliefs, and the heterogeneity of students' competencies. For implementing adaptive teaching strategies in teachers' work in every day school life, it is necessary to examine the teachers' current practices. Thus, the present study reveals important implications for the development of intervention studies designed to provide individual support to students.

PAPER PRESENTATION

Effects of experience and kind of information in making achievement judgments in schools

Assessment of Competence, Cognitive Skills, Continuing professional development in Teachers; Julia Herfordt-Stopel, University of Luxembourg, Luxembourg; Sabine Krolak-Schwerdt, University of Luxembourg, Luxembourg

In a series of experiments, judgment biases and their formation in teachers' assessment of students' performance were investigated. These experiments focused on specific student attributes which, in general, should not influence the achievement assessment, e.g. socioeconomic status or migration background. Previous experiments have provided evidence that experienced teachers are less influenced by these characteristics, especially when the accountability for their decision is high (cf. Krolak-Schwerdt & Rummer, 2005). The difference between experienced and inexperienced teachers might be that they process students' characteristics in a different way. The ability of experienced teachers to ignore irrelevant student characteristics was the focus of three experiments involving different types of participants representing different career levels (experienced teachers as experts, student teachers as novices, and students as laypersons). In these experiments, a special paradigm (Mouselab; cf. Payne, Schkade, & Bettman, 1986) was used. The Mouselab paradigm makes it possible to specify which information is retrieved in what order and which information is ignored when participants search for information about students. The kind of student information which was retrieved in our experiments differed among the three groups. Experts preferred information on achievement characteristics, whereas laymen and novices favored information more connected to person evaluations in daily life. Furthermore the reproduction of the students' attributes was more correct for experienced teachers when the accountability for their judgment was high, than for laymen or novices. For the laymen, no such differences could be shown, whereas, the effects for novices were inconclusive.

Theoretical background Assessment of students is an important task for teachers. However, this assessment may be influenced by student attributes that are not achievement characteristics, such as migration background or socioeconomic background. Until now, it is not known which kind of information (grades, information about solved tasks, additional personal information, etc.) is integrated in what way into judgments. The continuum-model (Fiske & Neuberg, 1990) may help in modeling such judgments. The continuum-model distinguishes two kinds of judgment strategies.

The first strategy is the category based strategy. In this strategy, an activated category (e.g. one based on socioeconomic background or migration background) is used to judge a student. To apply the category based strategy, only low cognitive and motivational effort is needed. For this reason, the category based strategy is used for most judgments, especially when the accountability for the judgment is low. When the accountability for a judgment is high, the second strategy, the attribute based strategy, is used. In this strategy, any available information about the student is integrated into a judgment. This strategy requires much more cognitive effort but leads to less biased judgments. Beyond this, previous research has provided evidence that experienced teachers are less affected by these additional characteristics than inexperienced teachers (Krolak-Schwerdt & Rummer, 2005). This supports the assumption that certain level of expertise is needed to switch between the two strategies (Krolak-Schwerdt & Rummer, 2005), and suggests that not only the amount of information used for the judgment differs with differing levels of expertise, but also the kind of information used.

Methods

In a series of three experiments, the study tested how experts (experienced teachers), novices (student teachers), and laymen (students) search and discern information about students. For these experiments, a special paradigm, Mouselab (cf. Payne, Schkade, & Bettman, 1986) was used. By using Mouselab, it was possible to measure which kind of information (grades, sample tasks, additional information like manners or social behavior) was used to evaluate

students. In Mouselab, it is not only possible to record which information is read by the participants but also the length of time and order in which information is viewed. In these experiments, half of the participants were instructed to form an impression (low accountability) while half were asked to predict the future development of a specific student (high accountability). After the instruction, participants read information about students presented in form of the Mouselab paradigm. After they were informed about a student, the participants had to give a description of that student. Furthermore, the novices took part in a special condition involving retrospective thinking aloud. Research questions and hypotheses

When the goal impression formation is activated, experts encode the student information in a category based manner. Therefore, their reproductions are biased by the activated category and they should produce more inferences. The processing data (Mouselab data) should show that participants retrieve less information under the impression formation goal. In contrast, when the goal for the experts is to give a prognosis of the students' academic development, they should integrate all information about the student in an attribute based manner. In this case, experts are expected to produce much more correct reproductions and fewer inferences. The processing data should show that experts search for more information when accountability is high.

For laymen, we expect no effects of the induced goal, because the continuum-model would predict that they are not able to switch between the two different goals. Furthermore, we believe that not only information processing itself, but also the kind of information used differs between experts and laymen. Experts should retrieve more information associated with achievement, as they are trained to do, whereas laymen should concentrate more on additional information resembling that used in daily life. For the novices, no concrete research questions were formulated. Their judgment process was only observed in an explorative manner.

Results

Concerning the recognition data, experts made more correct reproductions when they worked under the instruction to give a prediction (high accountability). Furthermore, experts made more inferences when they reported their first impression of a certain student (low accountability). For the laymen, no such differences could be shown. The novices showed no effect for the correct reproductions. However, they showed a marginally significant effect for inferences in the same direction as experts. Concerning the information which was used for judgment (Mouselab data), experts revealed a preference for information related to a students' achievement, while novices and laymen preferred information more connected to daily life (e.g. manners).

Discussion

This series of experiments gives evidence that experience is a crucial factor in making achievement judgments. For laymen and experts (experienced teachers) the expected effects on memory could be shown. Furthermore, these experiments support the assumption that information processing between experts and laymen is different and that the two groups base their judgments on different kinds of information. In summary, these results indicate the progression from laymen to experts and give important insight into the search and processing of student achievement information. On a further level, these results may help in developing training programs for student teachers. A very important point which is suggested by these experiments is that student teachers must be trained to concentrate on the important information (achievement information) and to screen out other information (migration background).

References

- Fiske, S. T. & Neuberg, S. L. (1990). A continuum of impression formation from category-based to individuating processes: Influence of information and motivation on attention and interpretation. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 23, pp. 1-74). New York: Academic Press.
- Krolak-Schwerdt, S. & Rummer, R. (2005). Der Einfluss der Expertise auf den Prozess Der schulischen Leistungsbeurteilung. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 37, 205-213.
- Johnson, E.J., Payne, J. W., Schkade, D. A., & Bettman, J. R. (1986). Monitoring information processing and decisions: The mouselab system. Unpublished manuscript, Center for Decision Studies, Fuqua School of Business, Duke University.

PAPER PRESENTATION

Assessing ck, pck- and pk-components of prospective teachers' diagnostic competence

Claudia von Aufschnaiter, Institute of Physics Education, Germany

Among the competences outlined to be relevant for pre- and in-service teachers, assessment and diagnosis is frequently mentioned. Teachers need to be able to identify students' conceptions and their learning outcomes and

they have to monitor students' learning trajectories in order to design instruction accordingly. Even though such diagnostic competence plays an important role in teachers' professional knowledge it is yet rarely explicitly addressed in educational research. Using the distinction between content knowledge (CK), pedagogical content knowledge (PCK) and pedagogical knowledge (PK) we have set up a model to describe diagnostic competence. The model serves as a framework for both, the development of a pre-service curriculum that establishes this competence and the evaluation of prospective teachers' professional competences. Research reported focuses on first results for CK, PCK, and PK which were gathered on prospective teachers of science and mathematics. These prospective teachers demonstrate middle or high knowledge of science content and science methods but show difficulties in diagnosing students' competences. Furthermore, no interrelation was identified between assumed moderating factors, such as attitudes or reported motivation, and the prospective teachers' PK.

Theoretical Framework and Research Aims

During the last couple of years, an increasing number of research projects have addressed teacher profession. Shulman's distinction between subject matter/content knowledge (CK), pedagogical content knowledge (PCK), and pedagogical knowledge (PK) (e.g., Shulman, 1987, see also Park & Oliver, 2008) is often used to describe teachers' professional knowledge. Even though knowledge about students' learning and methods by which this knowledge can be achieved are considered to be important aspects of professional competences, typically these are not addressed in detail in current research projects. In particular, a coherent model to describe diagnostic competence on which the design and evaluation of curricula in teacher education can be built can hardly be found in current frameworks. In order to establish and evaluate prospective teachers' diagnostic competence at university level, we have developed a framework aiming to model subject-matter related diagnostic competence (Figure 1). The framework draws on Shulman's distinction and identifies facets of (subject-matter) diagnostic competence in all three areas (CK, PCK, PK). These facets are either a prerequisite of assessment (such as content specific knowledge about the topic/subject that is to be diagnosed) or refer to the methods and results of diagnosis (such as questionnaires to assess students' prior conceptions). Furthermore, we have included competences which refer to making use of methods and results of assessment for the design of instruction. For each facet, several standards are developed which describe related competences.[Figure 1. Model for diagnostic competence]In our project, the model serves as a heuristic for two research aims. First, it informs us about the design of a curriculum which aims to establish prospective teachers' diagnostic competence. Second, the model provides the frame of reference for assessing prospective teachers' competences and the development of these competences during university training.

Procedure, Sample and Methods

The project lasts for four years (10/2008-09/2012) and comprises two cohorts of prospective teachers (at the beginning typically about 20 years old) who are monitored through their university education (which takes about 3-4 years). Cohort 1 has started in 2008, cohort 2 in 2009. All prospective teachers are included who have chosen either two sciences as subjects or a science subject and mathematics. The number of participants in each cohorts are calculated for each subject individually, numbers vary from roughly 50 (physics) to roughly 140 (biology). For educational psychology all prospective teachers are included who study for a teacher exam (N roughly 800 per cohort).In each subject and for educational psychology the prospective teachers' competences are assessed about once a year. Early in their education, the focus is on CK-components shifting slowly to increasing complex PCK-components; anchor items are included in all tests. Instruments are based on established questionnaires and tests used, for instance, in German research on teacher profession. Sample items for CK, related PCK and PK are presented in Figures 2a-c. Assessments in educational psychology also include items focusing on the assumed influencing factors (Figure 1). [Figures 2a-c. Sample items of CK-, PCK- and PK-tests aiming to assess diagnostic competence (based on Halloun et al., 1995; Riese, 2009)]In addition to summative assessments, formative assessments take place in physics and biology education. Here, the prospective teachers are videoed while working on CK- or PCK- tasks. Videos are then analyzed using surface and deep level coding procedures. These analyses have recently begun so that we cannot yet report sound results but will have those ready for the conference.

Results

During their first year of university education, our prospective teachers demonstrate similar subject matter learning difficulties than pupils do. However, the prospective teachers seem to have a good understanding of Nature of Science and science methods. Our hypothesis that a limited understanding of the content also limits the prospective teachers' ability to diagnose students' learning opportunities and difficulties seems to hold true for the majority of our population. However, some of the students (about 30%) either demonstrate high CK but low PCK or, more surprisingly, low CK and high PCK. It has to be stressed that these results are gained with relatively small sample sizes of physics students and without controlling that the level of difficulty for CK- and PCK-tests is similar. Our first analysis of participants' videos indicates that CK is important for PCK: For CK-tasks the prospective teachers rarely discuss PCK-aspects whereas for PCK-tasks a noticeable amount of time is spent on discussing the science content. The final grade

in school and gender have the largest impact on prospective teachers' PK but regression analysis indicates that moderating factors for CK are different than those for PK. Those prospective teachers who hold a higher tolerance regarding bad exams show less achievement. During one year, the prospective teachers' self-evaluation of their educational skills has significantly increased even though their educational training is at the beginning.

Conclusions and Implications

The project is novel in its emphasis on trying to model and identify diagnostic competence and its development in prospective teachers. It can be expected that the model itself and results gained in the project contribute to research on teacher profession. Even though the project is explorative in its nature, it can reveal as to whether prospective teachers will establish competences we consider to be relevant, how long such a process takes (even though it might become shorter with better learning opportunities) and what kind of learning difficulties prospective teachers encounter.

References

- Halloun, I., Hake, R. & Mosca E. (August, 1995). Revised version of the Force Concept Inventory. <http://modeling.asu.edu/R&E/Research.html> [01.08.2009]
- Park, S., & Oliver, J. S. (2008). Revisiting the conceptualisation of Pedagogical Content Knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research of Science Education*, 38, 261-284.
- Riese, J. (2009). *Professionelles Wissen und professionelle Handlungskompetenz von (angehenden) Physiklehrkräften*. [Professional competence of (prospective) teachers.] Berlin: Logos.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.

PAPER PRESENTATION

Surprising differences, hidden difficulties: findings from a teacher education pilot

Christopher Deneen, Hong Kong Institute of Education, Hong Kong; Ronnie Shroff, Hong Kong Institute of Education, Hong Kong

In the last several years, Hong Kong has undergone significant changes in quality assurance and enhancement at the tertiary level. Within this context, the Hong Kong Institute of Education, the region's largest teacher education provider has conducted an exploration of an outcome-based approach to course design, implementation and assessment within teacher education programs.

This paper reports findings from an institute-wide pilot study on OBL, implemented in 2009-2010. Pilot aims included trialing of teacher education course modifications across all undergraduate departments, analyzing and comparing students' and tutors' perceptions of the trial courses, identifying challenges within the trial process, generating evidence-based recommendations to the Institute for larger-scale implementation, and providing evidence-based findings towards to the larger teacher education community on issues of quality assurance and enhancement.

35 instructors and 672 students across 12 departments participated in the pilot. Survey, interview, focus group and related data were collected and analyzed using both quantitative analysis (item/factor scoring, ANOVA, factor analysis) and qualitative analysis (modified grounded theory). Findings include significant discrepancies between instructors' and students' perceptions of course design, assessment and implementation elements. Data analysis also revealed the significance of hidden barriers at multiple levels to change implementation. Theoretical and practical implications for institutions of teacher education contemplating or engaging in quality assurance and enhancement are discussed.

Context

In the last several years, Hong Kong has undergone significant changes in quality assurance and enhancement at the tertiary level (Kennedy, 2008; 2009). One manifestation of this has been the Hong Kong University Grants Committee's (UGC) suggestion that regional universities adopt an outcome-based learning (OBL) approach (Ewell, 2006). The Hong Kong Institute of Education is a tertiary institution serving over 7000 students. The principal focus of the Institute is teacher education. In 2007, the Institute began an exploration of OBL as a means to learner-centered quality assurance and enhancement. This paper reports on findings from the second institute-wide pilot study (Pilot II) on OBL, implemented in 2009-2010.

Aims

Five principal aims of Pilot II:

1. Within an OBL paradigm, enact a trial of teacher education course improvements across all undergraduate departments
2. Analyze and compare students' and instructors' perceptions of trial courses
3. Identify challenges within the trial process
4. Generate evidence-based recommendations to the Institute for larger scale implementation
5. Generate evidence-based findings that may inform the larger teacher education community on issues of quality assurance and enhancement

Methodology

Sample

35 instructors and 672 students participated across 12 departments.

Data collection

Two survey instruments were developed, an Instructor Survey Instrument and a Student Survey Instrument. Instruments were constructed from the same item matrix, which allowed for comparisons in response between instructors and students. Both instruments used a positively-loaded six-point scale (Lam & Klockars, 1982), and open-response items. Qualitative data was collected through instructor professional development sessions, instructor group sharing sessions, and student focus groups. Ethnographic interviewing techniques (Spradley, 1979) and Morgan's (1997) focus group protocols were utilized.

Data Analysis

Data was subjected to qualitative and quantitative analysis. Confirmatory Factor Analysis (CFA) was used on student survey data. CFA was not used with instructor survey data due to sample size restrictions. Analysis of mean, mode, standard deviation, was applied to both instructor and student survey data as well as ANOVA. Qualitative data was coded using a modified Grounded Theory technique (Strauss & Corbin, 1990).

Findings

Factor Analysis

CFA demonstrated the existence of five factors. Inter-correlation values and fit statistics indicated that respondents saw these factors as separate but related components of the pilot course:

1. Course Intended Learning Outcomes (CILOs)
2. Planning, design and alignment
3. Learning and teaching activities
4. Course assessment
5. Feasibility/Comparison

Findings from the fifth factor have been integrated into the discussion of the four course planning and implementation factors.

CILOs

Students evaluated this factor quite highly; CILO factor mean on the student survey was 4.31. Mean factor score on the instructor survey was 4.42, indicating strong parity between students' and instructors' evaluation of CILOs. This factor represents the area in which there was greatest course change as seen through analysis of professional development and sharing session data. Student-generated data reinforced the above findings; students perceived CILO-specific differences from other courses they had taken. Data indicated students placed a high value on outcomes that were practice-oriented.

Planning, design and alignment

This factor received positive ratings from both students and instructors. However, there were concerns as to whether this factor was conceptualized similarly by students and instructors. CFA analysis of the student survey revealed a strong (.97) inter-correlation between this factor and the factor, learning and teaching activities of the course." Fit statistics revealed that despite this inter-correlation, a model with separate factors was more viable. One hypothesis to explain this finding is that students viewed course planning and design differently than instructors. Qualitative and quantitative data from instructors support the hypothesis.

Learning and teaching activities

This factor received highest overall evaluation by students. Factor mean was 4.33. Qualitative data supports this positive impression. However, student ratings negatively correlate to year in degree program. This finding held across the first four factors but it was most pronounced within learning and teaching. One hypothesis is that students'

evaluative criteria become more refined as they progress in the degree program. This interpretation is supported by related research into variance in SET scores by student characteristic (Sailor, Worthen, & Shin, 1997).

Course assessment

Students evaluated this factor category lowest out of all four impact categories. Factor mean was 4.08. This factor category yielded the greatest variance between student and instructor evaluation. Assessment factor mean on the tutor survey was 4.82. Larger-scale analysis of data suggests that classroom assessment was the area of least change within Pilot II. Findings suggest this lack of change was due to multiple factors including administrative barriers and participating instructors' response to change initiatives.

The subset of instructors and students who did make/experience changes in course assessments experienced significantly different results. Open-ended survey responses as well as interview data yielded strong positive response from both groups.

Theoretical and educational significance

Pilot II had strong interaction with unanticipated context issues, such as institutional policy and procedures. Impact was especially pronounced in assessment findings. Attention within the paper is given to understanding these interactions and how findings could be of significance to institutions engaged in quality assurance and enhancement.

Understanding the significant aggregate gap between instructor and student evaluations of classroom assessment has theoretical significance in relation to an emerging field of inquiry: stakeholder conceptions of assessment (Brown, 2006; 2009; 2010). The subset of courses where there were changes to assessment produced significantly different results. The paper discusses theoretical implications and practical possibilities for fostering change in course assessment and addressing challenges to implementation and adoption.

Findings related to planning and teaching are of special significance to teacher education and the preparation of student teachers in the practice of course planning and teaching. Designing transparency into courses is discussed, both as a design element within teacher education courses and as a skill to be taught to student teachers.

The paper also discusses findings on teaching and learning in relation to strategizing student engagement according to progress within degree programs. Implications for teacher education program design are discussed, in terms of outcome development, course leveling, and course mapping/sequencing.

PAPER PRESENTATION

Personalisation in (Initial) Teacher Education

Christian Kraler, Teacher Education and School Research, Austria

Globalisation influences teacher education in Europe especially since the introduction of the Bologna process. This forces governments and universities to reform their teacher education programs. Competence-oriented programs imply the chance to plan initial teacher education outcome oriented and at the same time to increase the process specific flexibility for the course of education of individual students. Thus the idea is to develop a flexible curriculum matrix for a teacher education program with regard to the objective profession-specific course of education defined by competencies and the individual, personal course of education concerning choices, prevailing conditions and other biographical aspects.

In this talk the main findings of a study based on interviews with graduates of a competence oriented teacher education curriculum, a curriculum analysis and quantitative context data will be presented. The research question of the study is: "What are student based developmental tasks during a competence oriented teacher education program?" One result is that we do have two different only partially overlapping cultures of initial teacher education. Based on the concepts of developmental tasks and personalised learning we try to integrate the different approaches into the design of a flexible curricular matrix for initial teacher education with regard to the findings of the study and the existing literature.

One of the effects of the technology-based globalisation of markets is the current status of the individual. The logic behind this seems to be that everything is potentially available at any time for anybody. The responsibility is delegated to the individual. On the other hand, we find that institutions or governments control processes of all kinds increasingly by prescribing detailed structural and content-specific standards for the individual's actions. The same, at least in the German speaking countries, goes for educational systems and especially for teacher education. The modularisation of teacher education programs at universities initiated by the Bologna process (following the logic of global or continental markets) has led to more choice and flexibility for students. Yet on the curriculum level we now find a higher fragmentation of contents. This probably makes the essential profession-specific task of integrating the different elements of initial teacher education for both, the individual teacher student and teacher educators, more challenging than before.

On the other hand, the consequences of this global thinking can be a big chance for teacher education and in particular for the very specific, traditionally government controlled and inflexible teacher education systems in Austria and Germany. The changing framework forces governments and universities to reform their teacher education programs. Thus the internationalisation of teacher education and the necessary governmental reaction to the big international student assessments has led to the implementation of competence-oriented teacher education curricula. As the increasing research literature on this topic since the turn of the century shows, the definition of profession-specific competencies at least improves transparency regarding the efficacy of the teacher education system. Curricular competencies and Bologna modules would offer a profession-specific raster for the individual teacher education student. Carefully implemented, such curricula for teacher education imply the chance to plan initial teacher education in view of the outcome (what are minimum requirements for beginning teachers?) and at the same time increase the process-specific flexibility for the individual course of education. Students have more choices with regard to their individual strengths and weaknesses.

The study presented moves within this context. The underlying question is this: How can a competence-oriented university-based teacher education program be developed further into a profession-specific, personalised course of education?

The theoretical framework of our research into teacher education at the University of Innsbruck is threefold. The starting point is Kant's pedagogical question: How can I cultivate freedom under constraint? Based on this question we adapt Havighurst's concept of developmental tasks (cf. Trautmann 2004), the concept of the course of education (Meyer M. 2007) and put it in the context of personalised learning (Des 2006). The idea is that teachers need to experience successful ways of teaching for our changing society during their own professional education at university that implies personalised learning and an individual course of education. Taking into account institutional limits and reasonable common standards for beginning teachers a matrix of curricular modules and profession-specific competencies might lead to a flexible set of specific developmental tasks for students. Personalisation would imply that not all these tasks need to be taken on by every student and that the order must remain flexible.

The University of Innsbruck has implemented a competence-oriented, portfolio-supported teacher education program in 2000 (Kraler 2008). It is based on curricular developmental tasks for every academic year (e.g. 1st year: trial identification, self-assessment, shift in perspective from pupil to teacher, introduction & fit). After ten years of experience we get positive feedback from schools and school authorities. But at the same time an ongoing evaluation study has shown that the students view their education as too inflexible and rigid. The next logical step for program development was to systematise the feedback and the student experiences (Kraler 2009). So the central research question of the study is: What are student-based developmental tasks during a competence-oriented teacher education program? The objective, ultimately, is to develop a flexible curriculum matrix for our teacher education program with regard to the objective profession-specific course of education defined by competencies and the individual course of education concerning choices, prevailing conditions, etc. In the context of our personalised concept we used a qualitative approach and held 25 profession-specific biographical interviews, on a voluntary basis, with graduates of our teacher education program. The interviews covered questions from the origin of the idea of becoming a teacher, the school career, the experiences at university, familial and private influences, up to next steps after graduation. The average duration of the interviews was between 1h20min and 2 hours. In keeping with our gender distribution, there were 7 male and 18 female interviewees. In addition to the interviews we could analyse the portfolios of the interviewees and, as a quantitative element, take into account all the students' grades. The data analysis was done computer-supported (MaxQDA), using a combination of grounded theory, metaphor analysis and hierarchical content analysis. The grades contextual biographical data were analyzed with SPSS. We also analysed the curriculum (18 different subjects), focusing on the description of competencies.

The main findings are:

Prescribed program/curriculum-based developmental tasks: - Trial identification - Understanding fundamental ideas of the relevant subjects - Teaching internships to test out acquired competencies - Readjustment & amendment (based on the experiences from the internship) - Diploma certification
Student-based developmental tasks (interviews, portfolios): - Role allocation: growing into the role of the student - Relations: disengaging from the parental home, relationship/new friendships/old friendships sustained, students studying together - Dealing with frustration concerning course organisation and specific contents - Subject-specific socialisation (faculty culture) - Change of perspectives through periods spent abroad (especially when studying languages) - Earning money (subject-related, e.g. tutoring, or non-subject-related, often also just to get a change)
The last part of the presentation will deal with our first approaches to designing a flexible curricular matrix for initial teacher education based on the findings of the study mentioned.

PAPER PRESENTATION

Wisdom-related competence in teacher education - an adapted model of psychological wisdom research

Robin Stark, Saarland University, Germany; Miriam Hoffmann, Saarland University, Germany

Wisdom-related competence supports effective action in complex social situations as for example in an educational setting. Our concept of wisdom-related knowledge postulates 14 knowledge and attitude categories which constitute wisdom-related competence. We distinguish wisdom-relevant and wisdom-specific knowledge and attitude dimensions. In order to investigate the level of wisdom-related competence in teacher candidates, we generated complex scenarios situated in an educational context. 49 teacher candidates processed these scenarios in two different learning conditions: problem-based learning (n=24) and analysis of erroneous examples (n=25), plus a control group of n=9. In the pretest, we assessed "wisdom" through the three-dimensional Wisdom Scale (3d-WS) and the Self-Assessed Wisdom Scale (SAWS) and tolerance of complexity through the Tolerance of Complexity Scale. We performed a content analysis on the written answers of pre- and posttests using a specific coding manual and the software MaxQDA. Means were higher in the post- than in the pretest but still at only 35% (problem-based condition) resp. 36% (erroneous example condition) of the theoretical maximum. There were no significant differences between experimental conditions, but both experimental conditions outperformed the control group. A significant predicting factor for posttest achievement proved to be the prior level of wisdom-related competence as assessed in the pretest. Posttest total scores' correlations to the three additionally implemented scales missed statistical significance, whereas posttest scores of some wisdom-related dimensions correlated at least partially to the 3d-WS, SAWS and the Tolerance of Complexity Scale.

Aims: Based on the Berlin Wisdom Paradigm (e.g. Staudinger & Baltes, 1996a) and the Balance Theory of Wisdom (Sternberg, 2001), our model of wisdom-related competence distinguishes 14 wisdom-relevant and wisdom-specific knowledge and attitude dimensions (Hoffmann & Stark, 2009), the first being necessary, but not sufficient prerequisites for the development of wisdom whereas the latter describe aspects characteristic for people whose actions could be considered to be "wise".

We tried to reveal the level of wisdom-related competence in teacher students as we consider everyday school life as a highly complex and very dynamic working environment where dealing with wisdom can provide valuable "orientation knowledge" (Staudinger & Baltes, 1996a) in order to facilitate complex problem-solving.

We investigated whether wisdom-related competence can be fostered by a short scenario-based learning environment with either a problem-based learning approach or by processing erroneous examples.

In order to validate our wisdom model respectively our coding system, we compared the results of our assessment method to two existing wisdom scales (3dWS, Ardelt, 2003; and SAWS, Webster, 2003) and a scale for assessment of tolerance of complexity (Radant & Dalbert, 2006).

Methodology

Sample

Participants were teacher students (n=63, 40 female, 23 male), between 19 and 36 years old (M=22.13; SD=3.80), who during their studies underwent a practical training of five weeks. They all participated in the pre- and posttest; the two experimental groups worked with a learning environment in the problem-based learning (n=24) or the erroneous example (n=25) condition.

Scenarios

We developed four scenarios dealing with problematic situations in everyday school life. Two of them were used in the pre- and/or post tests, two only in the experimental conditions.

Problem-based learning vs. Learning from erroneous examples

In the problem-based learning condition, participants had to process a scenario and compare their own answer to a sample solution given by a fictitious psychologist.

In the erroneous example condition, the erroneous example consisted of a given answer by a fictitious laymen. This erroneous example had to be compared to the sample solution.

Coding manual

The coding manual comprises 14 categories (Hoffmann & Stark, 2009). Answers are coded according to their congruence with an ideal answer on a 7-point-scale.

Wisdom Scales

3d-WS: This scale by Ardelt (2003) consists of 39 items belonging to either the cognitive, affective or reflective subscale, each item is rated on 4- resp. 5-point Likert scales.

SAWS: The SAWS (Webster, 2003) comprises 40 items belonging to one of the five subscales "Experience", "Emotional Regulation", "Reminiscence/Reflection", "Humour" and "Openness" with a 6-point Likert scale.

Tolerance of Complexity Scale: This scale (Radant & Dalbert, 2006) assesses tolerance of complexity in three subscales ("Challenge", "Pressure" and "Necessity") of 20 items each on a 6-point Likert scale.

Findings

Concerning pretest performance and tolerance of complexity, learners of the three groups did not differ significantly. Total scenario scores (theor. max.: 98 points) in the posttest ranged from 21 to 56 points in the erroneous example condition ($M=35.72$; $SD=9.14$; 36% of theor. max.), from 14 to 49 points in the problem-based learning condition ($M=34.58$; $SD=10.81$; 35% of theor. max.), and from 17 to 35 points in the control group ($M=26.67$; $SD=5.96$; 27% of theor. max.). There were no significant differences between the two experimental groups. Both experimental groups clearly outperformed the control group. For all groups, pretest scores were strong predictors for posttest performance. There was no interaction between pretest scores and experimental condition. Correlations between posttest results and the Tolerance of Complexity Scale, 3d-WS and SAWS missed statistical relevance. Tolerance of Complexity correlated with "domain-specific background knowledge" ($r=.29$, $pr=.29$, $pr=.27$, $pr=.29$, $pr=.27$, $pr=.34$, $pr=.27$, $pr=.30$, p

Theoretical and educational relevance

On an abstract level, results indicate an existing deficit in teacher candidates concerning wisdom-related competence. More concretely, our results show that aspects of wisdom-related competence can be fostered effectively and economically by a scenario-based learning environment. Similar results can be achieved by problem-based learning and learning by erroneous examples. However, they also show that both approaches are not effective enough to develop wisdom-related competence. We suppose that in order to come closer to this goal, both approaches have to be implemented for a longer period. They should be combined with additional instructional support, e.g. innovative feedback methods. Based on findings by Staudinger & Baltes (1996b), we propose that these methods could be realized by implementing forms of cooperative learning (e. g., reciprocal teaching; Palincsar & Brown, 1984). The correlations between aspects of wisdom-related competence assessed by our coding procedure and the two wisdom scales can be interpreted in terms of first indicators for convergent validity.

References

- Ardelt, M. (2003). Empirical assessment of a three-dimensional wisdom scale. *Research on Aging*, 25(3), 275-324.
- Hoffmann, M.C. & Stark, R. (2009). Weisheitsbezogene Kompetenz im medizinischen Kontext. *GMS Zeitschrift für Medizinische Ausbildung*, 26(4), Doc41.
- Maercker, A. (1995). Existentielle Konfrontation: Eine Untersuchung im Rahmen eines psychologischen Weisheitsparadigmas. Unpublished doctoral dissertation, Max-Planck-Institut für Bildungsforschung, Berlin, Germany.
- Palincsar, A. S., & Brown, A. L. (1984). Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities. *Cognition and Instruction*, 1(2), 117-175.
- Radant, M., & Dalbert, C. (2006, September). Dimensionen der Komplexitätstoleranz: Ergebnisse einer Synopse von Persönlichkeitsstrukturen. Paper presented at the 45th Congress of the Deutsche Gesellschaft für Psychologie (DGPs), Nürnberg.
- Staudinger, U. M., & Baltes, P. B. (1996). Interactive minds: A facilitative setting for wisdom-related performance? *Journal of Personality and Social Psychology*, 71(4), 746-762.
- Staudinger, U. M., Smith, J., & Baltes, P. B. (1994). Handbuch zur Erfassung von weisheitsbezogenem Wissen. Materialien aus der Bildungsforschung Nr. 46. [Handbook for the assessment of wisdom-related knowledge. Educational research materials No. 46.] Berlin: Max-Planck-Institut für Bildungsforschung.
- Sternberg, R. J. (2001). Why schools should teach for wisdom: the balance theory of wisdom in educational settings. *Educational Psychologist*, 36(4), 227-245.
- Webster, J. D. (2003). An Exploratory Analysis of a Self-Assessed Wisdom Scale. *Journal of Adult Development*, 10(1), 13-22.

PAPER PRESENTATION

An investigation into the analogies used for teaching the mole in secondary classrooms

Chemistry, Science Education, Secondary school

Su Chi Fang, The University of Melbourne, Australia; Christina Hart, The University of Melbourne, Australia;

David Clarke, University of Melbourne, Australia

The mole is a fundamental concept in chemistry. Using analogies when introducing the mole is common in textbooks. However, what type of analogies and how they are used in introducing the mole in classrooms needs to be investigated.

This paper is part of my PhD research program in which I intended to look into the reasons why the mole concept is difficult to be taught and learned by comparing two countries (Australia and Taiwan). Data included video records of the lessons and the chemistry teachers' and students' interviews. The aims of this paper are (1) to explore what are the analogies used to introduce the mole concept, and (2) to inquire into how these analogies play a role in helping learning the mole concept.

The findings showed that using analogies in introducing the mole was popular in secondary classrooms. The analogy of 'a dozen' was employed the most frequently. In addition, a second group of analogies like 'packages of rice' or 'trucks of oranges', and a third group related to chemical reactions were also used in classrooms. In fact, different analogies highlight different aspects of the mole concept. However, it seems that these analogies were used without making explicit the aspect they actually address. Moreover, the essence of the mole concept, that it depends on a proportional relationship, was not conveyed by these analogies. Suggestions about effectively using analogies in teaching the mole concept are also presented.

Using analogies in teaching and learning chemistry is deemed a powerful strategy because analogies provide a bridge connecting between the unfamiliar target concept and familiar analogy (Duit, 1991). Previous research has showed that generally in textbooks the mole concept was introduced with analogies, such as a dozen (Staver & Lumpe, 1993). However, what kinds of analogies are used and how they are used in teaching and learning in classrooms has not been previously explored. Therefore, the aims of this paper are (1) to identify what analogies are used to introduce the mole concept. (2) to inquire into the role these analogies may play in helping students' learning of the mole concept. This study is positioned as a classroom study, based on the perspective that learning science is not only a personal meaning making process but also a social interactive activity. Seven chemistry classrooms were participating in this study, including two year-8 and three year-10 classrooms in Taipei, and two year-11 classrooms in Victoria. Data generation included videotaping the lessons, teacher and student interviews. Analysis of the empirical data was based on a content analysis of the mole concept.

In these seven classrooms, a dozen was the most frequently used analogy in the lessons on the mole. The analogies could be categorised into three different groups: (1) The number group, (2) The mass group (3) The chemical reaction group. The number group includes analogies such as a dozen, a box etc, and they stress the point that the mole represents a number, 6×10^{23} . The analogies in this group suggest that it is possible to count and know exactly what the number is. The mass group comprises analogies like trucks of oranges and packages of rice. The mass group of analogies emphasized the situation where the number involved is huge, so 'weighing' is used as a strategy to quantify the amount. Therefore, within this context, 'weighing instead of counting' is the point and exactly how many there are is NOT important. The analogies in the chemical reaction group are not directly related to the mole concept, but implicitly involve the application of the mole in chemical reactions, for example, monkey and banana, and the process of baking a cake.

Teachers used one or more of these analogies at the time when they introduced the mole. However, it appeared that their students accepted the number group most readily. The number group of analogies seemed to be easier to grasp because the connections between the analogy 'dozen' and the target 'mole' are straightforward (Duit, 1991). In other words, it is simple to relate a number to the term, 'mole', just like we relate 12 to a dozen. In contrast, the connections between the analogy 'packages of rice' and the 'mole' were not explicit. Also whenever the mass group of analogies was presented, the teachers did not explicitly make the link with the mole. The teachers alluded to 'weighing instead of counting', but they did not explain how this strategy works with the mole in chemistry. Consequently, the students could not actually see the connection between these analogies and the mole and in interviews they did not refer to them as helpful for their learning. The third group of analogies seems to be more problematic because the analogies concern the ratio between reactants and products in chemical reactions and not the mole concept itself. This connection, again, was not made explicit and the students did not appear to find this type of analogy meaningful.

Nevertheless, these analogies used in the classrooms do not perfectly match the mole concept. They were limited in that they did not explain the proportional relationships between $12C$ and other elements. An activity that is more analogous to the use of the mole concept in chemistry will be provided. Two significant issues pertaining to how

teachers can use analogies more effectively in science teaching are discussed. First, the connection between the analogue and the target should be made as explicit as possible to the students. In other words, students' attention should be guided and directed to the intended way of using the analogy (Coll, 2006), otherwise students might see and interpret analogies in a different way from their teachers (Treagust & Harrison, 2006). Second, it is important that teachers discuss "the scope and limitations of an analogy" (Justi & Gilbert, 2006, p. 128) with students. For instance, in the case of mole, although 'a package of rice' is a promising analogy for students to learn the mole, the meaning it conveys is still limited, since this analogy cannot reflect the essence of the use of the mole in chemistry. Therefore, as Justi and Gilbert (2006, p. 129) suggested, teachers might adopt "discuss and guide" approach rather than "show and tell" when they teach with analogies.

PAPER PRESENTATION

A Practice of Science as Varied as the Members of the Science Classroom Community Culture and Education, Inquiry learning, Science Education

Michele Koomen, Gustavus Adolphus College, United States

This paper reports on a qualitative study of nine culturally, linguistically and academically diverse students as they studied insect biology and ecology in their inclusive seventh grade life science class. Three fundamental data collection methods of qualitative research (student observations, interviews and artifact analysis) framed the data collection portion of this study. Constant comparative and microanalysis frameworks for grounded theory were used to systematically analyze the data set resulting in a practice of science that is different for each of the nine youth: A practice of science that is fragile and tentative and tied with the language of science; a practice of science that is dutiful and pragmatic although absent in passion or curiosity, and a practice of science positions one student to be dis/abled. Implications of this study to the greater research community and insights for instructional practice and structure of learning opportunities for all students are discussed.

Aims/Purpose

Many, many science classrooms across the world represent our global society and as such are rich in diversity, language, culture and ability. The United States is no exception to this new normal where 20 percent of school-aged children have at least one parent who is an immigrant and 5 percent of the students were immigrants themselves with language minority students speak an amazing 400 + languages (Nieto, 2004). On top of the growing linguistic and cultural differences in the school age population, science classrooms increasingly are places where students with exceptionalities are mainstreamed (Hobbs & Westling, 2002) as a result of legislative initiatives such as the Individuals with Disabilities Education Act (IDEA, 1990) and subsequent amendments (IDEA, 2004). Science for all Americans (AAAS, 1989, 1993) call for egalitarian access to science education is based on beliefs that all youth can learn science. The theme of the 2011 EARLI conference is "Education for a Global Networked Society." If our science classrooms illustrate the richness of our global society, doesn't it make sense that we try to understand how some members of that global diversity contextualize and experience learning as we position ourselves to embrace education for a global networked society? This paper will describe a research study focused on learning for students from diverse backgrounds who have been underserved in the education system (Basu & Barton, 2007; Upadhyay, 2008).

Theoretical Frameworks

Research featuring members of our global society by nature would be complex and necessitate interdisciplinary theoretical frameworks including: 1) science for all; 2) critical feminist theory; 3) a practice of science using inquiry and 4) public policy. Science for all Americans (AAAS, 1989, 1993) call for egalitarian access to science education based on beliefs that all children can learn science. If science is to be for all a research lens using critical feminist theory is appropriate because critical theory does not merely describe a situation, place or practice but attempts to "realize a society that is based on equality and democracy for all its members" (Cohen, Manen and Morrison, p. 28). Researchers would agree that inquiry is defined as a process of posing questions, generating and analyzing data, drawing conclusions, communicating the results, applying the conclusions back to the original question and perhaps following up with a new question (Sandoval, 2005; Cuevas, P., Lee, O., Hart, J., & Deaktor, R, 2005). Science is considered to be one of the most valuable subjects for inclusion of students with exceptionalities because they, like all students, can benefit greatly by the systematic study of the universe with promotion of scientific reasoning and inquiry (Mastropieri & Scruggs, 1992 & 1994; Bell, 2002).

Methodology

This study featured nine students who represent as a group: diverse cultures (Hmong and African-American); second language acquisition (Hmong); special education (LD and EBD) and gifted and talented who attended a public middle school in an urban metropolitan area with 88 percent students of color. An interpretive research design was guided by the following research question (a) What are the experiences of learning and the underlying contexts and structures

for the nine students in their science classrooms? On-site data collection included 19 video taped science teaching and learning episodes across 13 weeks with extensive field notes, individual semi-structured interviews of students (3) and teacher (2) over the course of the research, and examination of student artifacts and projects. The analytic process was based on immersion within the data with repeated sorting, coding, and constant comparison characteristic of the grounded theory method (Morrow & Smith, 1995).

Results

Several important findings illuminate a practice of scientific inquiry that is as varied as the students who make up the class. Inquiry for William and Dion is experienced as fragile and tied to language arts. Their perception of practicing science is that it is more about understanding the words of science and moderated by their academic difficulties that make it seem that all they ever do is have "boring long lectures" or "whole packets to read." For Mai, her practice of science is pragmatic. Her desire is simply to look "good" in the classroom by taking on a "bored" affect about science, getting her work done and "listening to my teacher." Her practice of science is dutiful and devoid of passion and curiosity.

Finally, the practice of science for Dion is dis/abled. At the surface, Dion appears to realize the intent of the reform efforts of science for all, however, taking a closer look at the meaning of these experiences finds that Dion is positioned in this class as dis/abled with an identity that is compromised and negative. His teacher, Maren does many things well. She has high expectations and strong beliefs that all of her students can learn. However, Maren, unintentionally, positions Dion as dis/abled rather than able by assigning other adults to work with Dion and assigning him a front row center seat near the overhead projector where she can keep an "eye" on him. Skrtic (1991) describes this view as a naive pragmatism or "a mode of analysis and problem resolution that is premised on an unreflective acceptance of the assumptions that lie behind social practices" (p. 150). In this case, this naive pragmatism reproduces a status quo for Dion that positions him at a "functional" level and places him within a classroom learning community as dis/abled.

Significance

This study sheds some light on how we might re-imagine what we mean by science for all. First of all, we need to think reflectively as to how we position our more challenging students within the classroom culture. It might be easier to keep an eye on a student by placing him or her front and center, but what message does this present to the other students within the classroom about said students. Secondly, inquiry science still encompasses reading and literacy skills. How can these skills be de-emphasized so that our students with exceptionalities are not excluded from the meaning and intention of an equitable science for all? These findings may help us to design instructional programs that better meet the needs of our complex and diverse classroom populations as we move toward more culturally responsive teaching pedagogies.

PAPER PRESENTATION

Scaffolding teachers in inquiry-based learning and teaching through design

Computer supported Learning Environments, Inquiry learning, Science Education

Alexia Sevastidou, University of Cyprus, Cyprus; Costas Constantinou, University of Cyprus, Cyprus; Eleni Kyza, Cyprus University of Technology, Cyprus

This study explores teachers' ability to make the transfer from inquiry-based learning to inquiry-oriented science teaching. Prior research has demonstrated that teachers encounter many challenges in conceptualizing inquiry-based approaches. The purpose of this study is to give evidence, through the cases of two pairs of pre-service teachers, about constraints and affordances of design-based learning as a method for enculturating teachers in an inquiry-based learning and teaching framework in science. Our research was conducted during a professional development course about new technologies and learning in science. Participants were presented with the task of designing web-based inquiry learning environments on a specific platform that offers tools for reflective inquiry; they received scaffolding for this task through their participation in the course and through their interaction with a web-based teacher learning environment. Data is drawn from two cases of participants who shared similar characteristics, namely in educational background, age and teaching experience, but displayed markedly different performance: one case succeeded in working with relevant scaffolding and in translating challenges with inquiry-based learning into design knowledge; the other case failed to do so. We discuss the implications of this study for efforts to engage teachers in complex design tasks, with the intent to help them grapple with the nature and complexity of inquiry-based pedagogy. Even in the cases where teachers do not find their way around the design task, they gain valuable experiences and insights into inquiry as a teaching and learning framework.

Background

As inquiry-based teaching and learning in science education is increasingly becoming a more consistent paradigm with the needs of today's societies (Sawyer, 2006), exploring ways for introducing teachers in this framework has become a significant task.

Inquiry, the pursuit of open questions, is a fundamental scientific practice, and it is also recognized as a valuable, authentic context for science learning. Required teacher competencies for teaching science as inquiry include scaffolding students in complex tasks like framing questions, grappling with data, creating and critiquing explanations, in some cases, publicly (Crawford, 2007). As reported in prior studies, teachers encounter many challenges in adopting an inquiry learning and teaching framework: they are not prepared for the role of giving students intellectual space as well as structure in open-inquiry approaches; even when they intend to use scaffolding, they hardly listen to students, they tend to be directive, they have trouble in supporting the negotiation of ideas and conceptual evolution and, at the same time, introduce students to inquiry processes (van de Valk & de Jong, 2009; Holbrook & Kolodner, 2000).

Purpose

The purpose of this study was to explore the transfer from teachers' own learning to designing teaching and to identify affordances of a design-based learning approach as a way to scaffold teachers in developing an inquiry-based learning and teaching framework. Our main research questions were: a) what are the challenges that teachers encounter when asked to design an inquiry-based learning environment with scaffolding features? b) How do teachers respond to tools that aim to scaffold their design process?

Method

Participants were ten science teachers enrolled in 13 three-hour sessions of a professional development course about new technologies and learning in science. The course assumed a design-based learning approach and was structured around three key features: a) a design task that engaged teachers in the design of inquiry-based learning environments, b) a design tool, STOCHASMOS, a web-based authoring tool that employs inquiry scaffolding features and c) design scaffolds, provided through a web-based teachers learning environment, in the form of (i) design principles, through the structured presentation of research-derived theoretical and practical information, (ii) prompts for planning and reflecting on the design task and (iii) web-based peer collaboration activities. Throughout the course, participants were grouped in pairs. Each pair developed a web-based inquiry-learning environment, which they submitted as an assignment at the end of the course.

Data collection and analysis

The study used data from multiple sources including: (a) researcher's notes from participants' observations; (b) teachers' written definitions of inquiry; (c) log files recording participants' interactions with the scaffolding provided on the course web-based environment; (d) participants' final learning products, the web-based learning environments that they designed as part of their course work, (e) interviews with teachers after the completion of the course.

Data were analyzed qualitatively using the constant comparative method (Glaser & Strauss, 1967). Different kinds of analyses (e.g. the analysis of the teachers' definitions, the analysis of their final learning product) were synthesized to triangulate findings. In each of these, we tracked the emerging themes for each pair of participants and iteratively compared them to the themes emerging from the analysis of the other pairs.

Findings

The data analysis showed that challenges with inquiry-based learning and teaching were exemplified in the learning environments that teachers designed. Teachers' difficulty in balancing between space and structure was evident in the way they designed scaffolding for students, and in the underlying inquiry patterns on which they structured their environments' activity sequences. Subsequent analysis, which drew on the framework proposed by Quintana et. al (2004), revealed that all pairs followed the same trend in the distribution of the three types of scaffolding prompts across their environments (figure 1,2): process management prompts presented more than the 50% of all prompts provided, reflection and articulation prompts were used at a lower frequency, while sense making prompts were scarcely employed. Teachers seemed to be concerned about the flow of activities and over-emphasized the sequence of steps that students needed to follow; in effect, they often prescribed situations rather than designing opportunities for learning; they used many routine directions as scaffolding prompts, in a way that is inconsistent both with inquiry and with the platform's designer intentions.

Another finding was that four out of five pairs of teachers responded in a common way to the scaffolding provided by the web-based environment: they accessed scaffolding, submitted reflections but did not engage in a constant reviewing process of their design judgments. Data from two cases of participants capture the range of the affordances and constraints of design-based learning as a method of enculturating teachers in an inquiry-based learning and

teaching framework. Even though these two pairs shared similar backgrounds, they had contradicting performances and experiences with design-based learning. According to our analysis pair1 produced the least coherent whereas pair5 the most coherent inquiry-learning environment (table 1). Their experiences with design-based learning are illustrated in the excerpts below:

...we realized that this (design) was a recurring process, although at first we were thinking that we finished with our driving question and so we will move on... somewhere along the process you realize that all stages are interconnected and affect each other, and we returned, reviewed and moved forward (pair5, interview)

...recording our design decisions was not helpful for us...many times we wrote that we will do something and then we found out that it doesn't work. This was stressful. We had to do it because we already described it... (pair1, interview)

Conclusion

The teachers who participated in our design-based learning approach faced similar challenges in designing inquiry-based learning. Four out of five pairs interacted with the reflective scaffolding provided in a similar way. Design as a task was useful in exemplifying challenges with inquiry-based learning and teaching, giving them a more tangible than theoretical character. Being reflective through the whole process of design allowed one pair of teachers to overcome challenges brought about through the design task. As prior research informs us that teachers' ability to teach science as inquiry is affected by the complex interactions of contextual or personal factors, there is further need to explore approaches that engage teachers in reflective practices, like design, as a means of enculturating them with inquiry as a teaching and learning framework.

PAPER PRESENTATION

Exploring the graphical representations in the high-school Earth Science textbooks

Comprehension of Text and Graphics, Instructional Design, Science Education

Yi-Chun Chen-, National Taiwan Normal University, Taiwan, Province of China; Fang-Ying Yang, National Taiwan Normal University, Taiwan, Province of China

By classifying graphical displays, the main purpose of this study is to examine the graphical representations in earth science textbooks used in the senior high school in Taiwan. The material to be analyzed is the tenth-grade earth science textbooks. There are 5 versions of the textbooks. Three versions with highest rates of adoption in schools are involved in the study. Based on previous studies and considering the structure of scientific knowledge (Duschl, 1990), each graphic is classified with respect to its form and content aspects. There are four categories regarding the form of graphical representation: Real Photo, Apparatus Photo, Diagram and Graph. To analyze the content of each graphic, we adopt the goal-of-science hierarchy for teaching science proposed by Duschl (1990). Accordingly, five content categories are applied to the analysis, namely Data, Concept, Relation, Theory and Map or Figure. In so far, we have examined one version of the to-be-analyzed textbooks. Some preliminary findings are presented here. First, it was found that the highest number of the category in form is Graph. Second, regarding the content of graphical representation, our analysis shows that the proportion of each category differs in topics. Considering the first four categories in the content of graphical representation, Concept is dominating in every topic. Such a result implies that concept teaching takes up the highest proportion of the knowledge organization in the textbook. The topic characteristics also affect the proportion of the distribution. The study is still in progress. More findings will be presented in the conference.

Objective

By classifying graphical displays, the main purpose of this study is to examine the graphical representations in earth science textbooks used in the senior high school in Taiwan.

Theoretical Background

According to the constructivist theory of learning, students develop their own understanding by internalizing information either through words or graphics in science textbooks. Words and graphics are different systems of knowledge representation. They differ not only in the displayed form but also in the internal structure. Compared to words, graphics are composed of discrete and easily identified elements that are polymeric or nonnotational (Vekiri, 2002). Paivio's (1986) dual coding theory suggests that verbal information and pictorial information are processed in different cognitive systems and stored in different memory areas (Anderson, 1995). Accordingly, the graphics along with texts would bring about additive effects on learning. The "visual argument" theory also supports that graphics communicate information more effectively in that they insert low demands on working memory (Vekiri, 2002). However, the use of graphics is not always beneficial for the acquisition of knowledge. Schnotz & Bannert (2003) found that reading of graphics is task-dependent, and individual difference must be considered. They argued that graphics

facilitate learning only if individuals have low prior knowledge or if the subject matter is visualized in a task-appropriate way. These dissimilar results may be owing to the problems regarding definitions and entities of graphic representations. In literature, there are few relevant studies (Vekiri, 2002). Thus in the study, an attempt is made to examine the graphical representations in the high-school earth science textbooks.

Methodology

Material The material to be analyzed is the tenth-grade earth science textbooks. There are 5 versions of earth science textbooks used in the senior high schools in Taiwan. Three versions with highest rates of adoption in schools are involved in the study. Currently, four topics related to "Global Warming" are being analyzed, including Atmosphere, Ocean, Natural Hazard and Climate Change. **Method** Based on previous studies and considering the structure of scientific knowledge (Duschl, 1990), each graphic is classified with respect to its form and content aspects. The classification details are interpreted as follows:

1.The form of graphical representation There are four categories regarding the form of graphical representation: Real Photo, Apparatus Photo, Diagram and Graph. Apparatus Photo means that the graphic is photo taken by equipments such as telescope, microscope, satellite and so forth. In other words, it can't be read by raw eyes (Real Photo). Diagram is the part, structure, simulation or operation of real objects, abstract entities or processes (Vekiri, 2002). The water cycle and the formation process of a typhoon belong to this category. Graph is the relation, sequence, statistics or values showing how two or more variables are related to each other. Noticeably, some textbook authors used more than one form in creating graphics.

2.The content of graphical representation To analyze the content of each graphic, we adopt the goal-of-science hierarchy for teaching science proposed by Duschl (1990). The bottom of the hierarchy is data collection where all science investigations begin. After collecting sufficient data, scientists would seek the lawlike relationships or patterns in collected data to develop science theory. The process is a rational feedback loop which suggests that scientific theory is subject to change. New theories would either emerge from different interpretations on existing data because of the development of new technology or from newly found data. In either case, the theory development restarts from data collection. Based on the hierarchy, the content of graphics was sorted into five categories, namely Data, Concept, Relation, Theory and Map or Picture. The first four categories are adopted from the themes of the goal-of-science hierarchy. Notably, since in textbooks, data are usually presented to students in lawlike patterns, Relation in our coding scheme indicates the relation between science concepts. The category of Map or Picture is an additional category. According to Vekiri (2002), Map is the feature (or data) and their location (or distribution) in real territory while Picture shows people, objects or scenes. Each graphic is allowed to be assigned to more than one category if necessary. Data analyses After coding, descriptive and Chi-square analyses are employed for further statistical analysis.

Results and Discussion

The study is still in progress. In so far, we have examined one version of the to-be-analyzed textbooks. Some preliminary findings are presented here. As shown in Table 1, numbers of graphics in each topic are not equally distributed. Across the four topics, the highest number of the category in form is Graph, followed by Diagram, but in the topic of Natural Hazard, it is Apparatus Photo (25.00%) coming in the second place. Regarding the content of graphical representation, our analysis shows that the proportion of each category differs with topics. For instance, Map or Picture is most frequently seen in Natural Hazard but in Atmosphere, it is Concept that appears most often. Besides, different topics have different scopes and aims. For example, in the topic of Natural Hazard, the textbook is full of real disaster photographs, satellite photographs, weather map etc. Whereas, the topic of Atmosphere and Ocean focuses more on illustrating relevant concepts. Considering the first four categories in the content of graphical representation, Concept is dominating in every topic. The result implies that concept teaching takes up the highest proportion of the knowledge organization in the textbook. The topic characteristics also affect the proportion of the distribution. For example, the percentage of Theory in Climate Change is higher than those in other three topics because theories about climate change are by nature uncertain. Consequently, a lot of graphics in this topic are devoted to making predictions and building theoretical models. As mentioned before, some graphics may carry more than one category of form or content. Table 2 shows the numbers of categories found in individual graphics as well as their counts and proportions. In the form aspect, no more than 2 categories are ever found in one graphic while there might be up to four categories found in the content of a graphic. As seen in the Table 2, Climate Change and Natural Hazard have the highest variety in the number of categories. The results suggest that since the two topics deal with multi-dimensional problems, the use of multiple representations in graphics is necessary to convey relevant knowledge.

PAPER PRESENTATION

The Speed of Data Extraction from Decorated Graphs

Irit Aharon, University of Hifa, Israel; Billie Eilam, Faculty of Education, University of Haifa, Israel

Quantitative graphics combine quantitative information with pictorial elements. One example is the decorated graph, commonly used for communicating quantitative information in mass media and school textbooks. This prevalent mode of representing information calls for the examination of possible effects of decorative pictorial elements on individuals' ability to read the graph. Therefore, the present study investigated students' response time, required for extracting simple data from different types of decorated graphs. Participants comprised 9th graders ($n=86$ boys and girls). Three sets of graphs were used, each containing 24 items, presented successively in a random sequence on a computer screen: (a) pie graphs, (b) bar graphs, and (c) scatter graph. Each set comprised 6 different graphs, each presented in four different types of graphical design: a plain graph lacking any decorative elements; a graph placed on a background picture; a graph with a picture beside it; and a graph composed of illustrated specifiers. For each graph, students responded to a dual-choice question by pressing one of two assigned computer keys. Differences were found between students' response time to the different graphic types. Furthermore, for plain graphs but not for decorative ones, response time shortened as the number of data points increased. Findings suggest that decorative elements change students' focus of attention, requiring additional time for processing the perceived information. This extra time is required for distinguishing presented quantitative data from accompanying decorations. These findings bear direct implications for the design of learning materials, including, textbooks, tasks sheets, tests, and computer programs.

Graphs are powerful tools for presenting and analyzing quantitative information. As such their use and comprehension by students are extensively researched (e.g. Shah & Hoeffner, 2002). In the last few decades, due to the accessibility of graphical tools, the display of quantitative data has undergone a revolution. Pictorial elements are combined with quantitative information to create decorated graphs that are more appealing to the casual observer (Tufte, 1983). This mode of presenting quantitative information has become prevalent in mass media and textbooks. Some assume that these decorative elements enhance observer's ability to identify patterns, group visual elements into an object or a figure, and elicit semantic contexts relevant to the information presented in the graph, thus decreasing time on task. Others claim that these additions to the display divert observer's attention from the main information and increase the time required for its extraction (Kosslyn, 1994; Tufte, 1983;). Nevertheless very little research has been done on the effect of decorative elements on the interpretation and comprehension of graphs. The aim of the present study was to assess the effect of pictorial elements on the speed of students' extraction of simple data from different types of decorated graphs

Method

Participants: Eighty two students (33 boys and 49 girls) ages 14-15 participated in the study. They all learned in the ninth grade, at a private school in northern Israel. All students were of medium-class background.

Instruments and variables:

Graph types, graphic types and complexity. Three sets of graphs, each containing 24 items, were presented successively but in a random order, on a computer screen: (a) pie graphs, (b) bar graphs, and (c) scatter graph. Each set consisted of 6 graphs differing in their complexity, expressed in an increase in the number of data points. Every graph was presented in four different types of graphical design: a plain graph lacking any decorative elements; a graph placed on a background picture; a graph with a picture beside it; and a graph composed of illustrated specifiers.

Speed of data extraction. For each graph students responded to a dual-choice question, by pressing one of two assigned computer keys. Time (response time) between the appearance of each graph and the pressing of the appropriate key was measured in seconds (accuracy of ± 0.1 sec) Correct responses were distinguished from erroneous ones.

Spatial ability was assed using the following tests from the Kit of Factor-Referenced Cognitive Tests (Ekstorm, French, Harman & Dermen, 1976): The Flexibility of Closure tests (CF): hidden figures (CF-1) and hidden pattern (CF-2); and the Speed of Closure tests (CS): Gestalt completion (CS-1) and snowy pictures (CS-3).

The spatial ability tests were administered prior to the graphs task with a week interval between each test. Students were classified as having low (bottom 25% of the distribution of students' scores), average (middle 50%) and high ability score (top 25%) for each separate ability.

Findings

Average response time to data extraction questions for the full graphs set, and the total number of errors were calculated for each student.

Average response time was significantly longer for low-spatial ability students with regard to CF(1+2) tests($F(1,38)=4.745$, $p(1,43)=4.078$, $p \leq 0.05$) but not with regard to the CS-1 test ($F(1,24)=0.389$, $p>0.05$). No significant differences were found between low- and high- spatial ability groups with respect to the total number of errors. As may be expected, correlation between average response time and total number of errors show a significant increase in number of errors as the average response time decreases ($r(80) = -.315$, p

A general linear model for repeated measures was conducted to determine differences in response time with regard to within-subject variables of graph type, graphic type and complexity; and between subject variables of spatial ability: CF and CS-3. Differences were found in students' response time to the different graphic types (Pillai's Trace $F(2,77)=60.682$, $p(3,76)=5.501$, $p(5,74)=74.000$, p

Conclusions

Findings indicate that decorative elements have a certain affect on the speed of data extraction from graphs. Longer response time for extracting data from decorated graphs especially those with a picture on the side suggests that decorative elements change students' focus of attention and thus require additional time for processing the perceived information. Moreover, the decrease in time response with increase of number of data points in plain graphs may hint at students' application of Gestalt grouping processes during data extraction. The absence of the effect in the decorated graphs suggests a possible interference between decorating elements and grouping processes. Altogether, the present data may imply that excess time is needed for distinguishing presented quantitative data from accompanying decorations.

These findings bear direct implications to the design of learning materials including textbooks, tasks sheets, tests and computer programs. Students at all ages and levels of education encounter major difficulties while reading and comprehending graphs (e.g. Shah & Hoeffner, 2002;). It seems that the addition of decorative elements to the graphs would present little assistance in coping with these difficulties and could lead to their enhancement. Further research is needed to assess the possible affect of decorative elements on graph comprehension.

References

- Ekstorm, R. B., French, J. W., Harman, H. H., & Derman, D. (1976). Manual for Kit of Factor-Referenced Cognitive Tests. Princeton, NJ: Educational Testing Service.
- Kosslyn, S. M. (1994). Elements of graph design. New York, NY: W. H. Freeman and Company.
- Shah, P., & Hoeffner, J. (2002). Review of graph comprehension research: Implication for instruction. *Educational Psychology Review*, 14(1), 47-69.
- Tufte, E. R. (1983). The visual display of quantitative information. Cheshire, Co: Graphics Press.

PAPER PRESENTATION

Educational and school effectiveness for different groups of students in China

Assessment methods, Secondary school, The role of research on learning and instruction in developing education systems

Sally Mary Thomas, University of Bristol, United Kingdom

This paper reports key findings from a UK DFID/ESRC funded study: Improving Educational Evaluation and Quality in China. In collaboration with key stakeholders (national and local policy makers, teachers, students) the study aims to develop innovation in school evaluation and guidelines for implementation to enhance school improvement efforts in mainland China. The specific focus of this paper will explore the nature and extent of educational effectiveness in mainland China, using innovative quantitative methodology (multilevel modelling) to analyse longitudinal examination, student background, school process and context data from 120+ senior secondary schools. The findings indicate significant differences in effectiveness between schools and regions in China as well as significant differential effectiveness within schools for different groups of students – a key issue related to equity. Other findings include the considerable influence of school input, process and context factors on student's attainment and progress at senior secondary school. The implications of the findings are discussed in terms of educational policy and practice in mainland China and internationally.

Introduction

This paper presents key findings from a UK Department for International Development [DFID]/Economic and Social Science Research Council [ESRC] funded study: Improving Educational Evaluation and Quality in China (IEEQC, 2010). Overall the study aims to provide quality in-depth data to enhance understanding of the complex nature of school effectiveness in China and how local context may play a key role in determining definitions of educational effectiveness & quality. Understanding education quality, learning and evaluation processes also assists in achieving

wider goals including social justice and cohesion and equal opportunities, especially for girls and disadvantaged students.

The study objectives include:

1. To identify and define the dimensions of secondary school effectiveness in China, using innovative quantitative (multilevel) techniques to create "value added" measures for different student outcomes and student groups, across three regional (west & east) LEAs, and to compare and contrast these findings to equivalent results from the UK and elsewhere.
2. To develop new theoretical insights and models of educational and school effectiveness in China that highlights the potential role and impact of different educational priorities and contexts.
3. To contribute to educational policy development (and capacity building) by providing robust and relevant new evidence, in an area where empirical data is lacking.

Theoretical framework and methods

In mainland China, raw measures of pupils' academic outcomes and entrance levels to higher education are frequently viewed as the key indicators of school quality. As a result schools with disadvantaged intakes tend to be judged unfairly, while complacency is possible amongst schools with more able pupils, and it is difficult to identify best practice. An alternative 'value added' approach aims to provide a fairer approach to accountability and evaluating school performance than the 'raw' examination results (Thomas et al, 2007). Essentially this is achieved by adjusting for students' previous attainment and other relevant factors outside the control of the school to estimate their progress, in comparison to students in other schools. The concept of value added is, therefore, both an indicator of a school's effectiveness and a tool for head teachers and their staff to use to analyse the extent to which they have effectively raised pupil achievement. Value added evaluation methods emerged from empirical studies of effective schooling that can be traced back more than 40 years and subsequently to improved statistical methodology. The latter developments involved the establishment of comprehensive and longitudinal datasets and sophisticated analysis techniques (multilevel modelling) used to create 'value added' measures of school effectiveness outlined above. The findings of school effectiveness research, largely conducted in western countries, demonstrate that schools do have a significant impact on children's attainment and progress and also that there are substantial differences between the effects of some schools (Teddlie & Reynolds, 2000). However, empirical studies of school effectiveness have only rarely been reported in mainland China, which is also notably missing from international comparative studies of school effects. Of the few limited and small-scale studies conducted to date the findings are intriguing, suggesting that senior school effects may account for up to 40 percent of the total variance in students' academic achievement and that in rural areas the equivalent figure may be higher (Peng et al, 2006, Ding & Xue 2009). Across a landscape as huge as mainland China, more large-scale and representative studies are clearly needed to provide robust quantitative evidence about the range and extent of school effectiveness in order to inform local and national policy development.

Data sources

IEEQC study 2 uses innovative quantitative methodology (multilevel modeling) to analyze the 2009 Entrance Examination to Higher Education (EEHE) examination scores, 2006 prior attainment scores and other pupil, class and school background data, collected from 97,532 students in 120+ senior secondary schools across three western and eastern LEAs in China.

Findings and Discussion

The findings from the application of a variety of different MLwin models indicate that in mainland China there are substantial and statistically significant differences between the estimates of senior secondary schools' value added effectiveness and that these differences vary across regions. Not surprisingly, across three LEAs and different subject outcomes, the percentage of total variance in student's unadjusted EEHE scores attributable to differences between schools is considerable, ranging from 20% to 40%. However, after controlling for students previous attainment on entry to senior secondary school the equivalent figures are somewhat reduced (13% to 28%). Estimates of differential school effects in terms of different academic subjects and for different student groups (eg by gender) are also reported as well as the impact of a variety of student intake, classroom, school process and contextual factors on student and school performance are examined in detail. The findings are discussed in relation to how school effectiveness, educational quality and equity may be better understood and evaluated in the Chinese context and the implications of the findings for educational quality in other international contexts.

Educational Importance of the Study Improving the quality of education and student learning is a major goal in both developed and developing countries, given the clear links drawn between better student access and outcomes and poverty reduction and stronger economic growth (EFA, 2004). In this context, school effectiveness research has

stimulated and focused educational policy makers' attention on the potential to raise overall levels of educational standards and student achievement. For example, western governments such as the UK have placed a strong focus on encouraging schools and teachers to use innovative evaluation methods and data to inform their own evaluations of the education they provide as well as to feed into accountability and inspection frameworks, and these approaches have been linked to improved student outcomes. However, there is very little comparable empirical research evidence on the range and extent of school effectiveness in mainland China and this paper aims to address this crucial gap. This evidence will inform new policy developments in mainland China; especially given the far-reaching educational reforms currently in progress (MOE, 2009). Moreover, the findings regarding school effects in China across different regions critically develops and extends the international and comparative educational effectiveness research.

PAPER PRESENTATION

Teaching for understanding: A perspective on university-students' learning for a globalized world?

Deep learning, Higher education, New Modes of Assessment

Antonia Scholkmann, Technische Universität Dortmund, Germany; Bianca Roters, Technische Universität Dortmund, Germany

When it comes to university learning, mere acquisition of declarative knowledge is no longer enough to meet the demands of a globalized world. Only if students develop skills and competencies to deal with what they have learned, teaching has reached the goals that universities stand for in Western societies. The levels of how well students are able to understand a complex scientific theory or the implications of a scientific argument might be a potent indicator for state-of-the-art university learning, as show results from an in-depth analysis of n=274 qualitative essays on the content of a scientific text. The essays were created by first-year students of Educational Psychology, taught in traditional or problem-based classes, and then classified in different levels of understanding according to a framework with references to the SOLO-taxonomy by Biggs and the taxonomy by Bloom. Results show significant variation amongst these answers, giving important hints for further discussion about the potential of the concept of understanding for teaching and testing academic success.

Introduction to Problem

The objective of student learning in higher education as a main teaching goal stands without doubt as most challenging alike: Universities and colleges are the most prominent locations for learning to take place in Western societies. But what is it that has to be learned in order to meet the demands of a globalized world, and which skills for the 'knowledge age' should universities and colleges aim to teach for?

Some evidence can be seen from research on 'state-of-the-art' teaching approaches such as problem based learning (PBL) and reflective teaching. Those approaches not only focus on fostering the acquisition of generic skills and competencies such as presenting, communication or reflecting – all of which are doubtless important domains of university learning. More importantly, these approaches claim to also enhance students' capabilities to deal with the knowledge they have acquired in a non-trivial, constructivist and even innovative way.

But what puts students in the place to apply what they have learned to new situations, problems, tasks? How can knowledge be operationalized in a cross-cultural and cross-curricular manner, so that it reflects not only declarative aspects? Which kind of testing knowledge-acquisition is appropriate and fair to students of various academic disciplines and taught by different teaching methods? And, with respect to the internalization of education: Are there certain indicators of knowledge that occur across cultural and national boundaries?

Theoretical Approaches

Our paper focuses on student learning being more than mere knowledge acquisition, but the acquisition of skills and competencies that allow dealing constructively with the specific content of a certain field or discipline. Dealing professionally with what one has learned becomes more and more superior to mere acquisition of declarative facts, as shows research on expertise (Leinhardt & Greeno, 1986; Bereiter & Scardamalia, 1993), reflection (Schön, 1983; Moore, 2004) and satisfaction and success of students (NSSE, 2010).

A concept which might help bridge all the different approaches to knowledge-related student learning is the ability to understand the content of a concept or the implications of an academic argument. We hold this idea of 'understanding' (Marton & Booth, 1997; Dahlgren, 1997) to be a central domain of university teaching. Different levels of understanding can be seen with respect to university learning, as has shown significant prior research (Wahlström et al., 1997), with some inconsistencies concerning relation to a specific teaching method (Rahimi, 1995). Given these implications the research question for this study was: Can the concept of understanding be applied as a global indicator for university learning across different countries and different teaching approaches?

Empirical Evidence

As part of a greater research project which investigates learning through different teaching methods in different universities in Sweden, the Netherlands, Switzerland and Germany, we tested for students' understanding of a complex text. By bringing together qualitative and taxonomic approaches such as Biggs' Solo-taxonomy (Biggs 2003) or the domains of Bloom (see Anderson & Krathwohl, 2001), a framework was developed to classify qualitative answers with respect to different levels of complexity in understanding.

The texts to which we will refer to in our presentation were $n = 274$ answers by first to third year students in courses of developmental psychology from Switzerland and Germany. These students were taught in either 'traditional' form or enclosing an amount of problem-based elements during the academic term. All students gave written answers to the question "What is the text about?" after reading it. Stimulus was an essay on conditions and consequences of brain development (Hyther, 2006). Tests with further groups are under way in Germany, Sweden and the Netherlands. Results from the initial sample show significant differences between the levels of understanding displayed between students in both courses (PBL vs. non-PBL), thus differentiating them in at least five groups. Amongst the answers there can be seen a pattern going from only capturing the innermost fundamental message of the text via understanding one or more than one argumentative figures given by the author, and, at the higher levels, capturing also the implication of examples and differentiating aspects to foster these arguments and connect them to an overall academic discourse.

No statistic effect could be seen for age, gender, previous studies or any predictor of academic achievement on the performance in this test, thus indicating its diagnostic uniqueness. "Missing-the-point"-answers give important hints for further theoretical refinement of the concept 'understanding'.

Implications and Relevance

The implications of this study follow a twofold way: firstly, new contributions might be inferred from the idea of 'understanding' as core concept for university learning in bringing together related concepts such as reflection, comprehension and expertise. Secondly, conceptualizing university learning from the angle of how well students are able to understand complex scientific arguments rather than simply reproducing facts allows for new ways of testing academic success, and at the same time fosters ideas of combining more alternative teaching approaches like PBL with competence-oriented testing.

PAPER PRESENTATION

Research synthesis on the effectiveness of early education programs focused on social development

Franziska Egert, German Youth Institute, Germany; Andrea G. Eckhardt, German Youth Institute, Germany

A growing body of evidence reinforces the assumption of the positive impact of early childhood education programs on the individual development of young children. While (quasi)experimental research findings clearly indicate positive effects on cognitive and academic achievement, the effects of early education programs on the social development are inconsistent, ranging from positive to negative. Therefore, the research synthesis examines to what extent center based childhood education or specialized trainings in early education programs affect the social emotional development of children birth to six years of age. To obtain eligible studies published between 1960 and 2010, electronic search in international databases and hand search in reviews and renowned journals was conducted. An extensive coding scheme was developed a) to retrieve relevant information on study design, program characteristics, structural features of center based care settings as well as child characteristics and, further, b) to cluster and characterize the studies included in the research synthesis.

The research synthesis presents eligible studies that provide sufficient findings on the impact of early childhood programs. The synthesis contributes to existing knowledge and organizes the current state of the art with an emphasis on type and quality of studies. Furthermore, it provides lineages of research from 1960 to 2010. The findings summarize the evidence of effectiveness of education programs and deduce principal contributions on structural program features for policy makers and child care providers.

Aims

Over the last decade, a number of studies had been conducted that investigate the impact of early childhood programs on child development. In general, findings indicate positive effects on cognitive and academic development. The impact of early educational programs on social development are, however, less conclusive. Results from (quasi-)experimental studies rang from positive effects to negative effects.

In order to provide a better understanding of the inconsistency, a research synthesis was conducted. The synthesis targets on (quasi-)experimental studies that assess the effects of various early childhood programs on the social

development of children birth to six years of age. It aggregates the evidence of program effectiveness of research conducted between 1960 and 2010. Focused categorization of eligible studies were used to gain a systematic overview of relevant research and to explain differential effects due to study design, program features, child care setting and child characteristics. The purpose of this presentation is a) to depict the search process and b) to present the findings of the research synthesis by characterizing eligible studies.

Methodology

The research synthesis was conducted to provide detailed information on the state of the art in the field of early childhood education program effectiveness. The methodological framework of the research synthesis consists of five major steps.

First, an electronic search in the databases ERIC, PsycINFO, Francis, BEI, AEI, ProQuest Dissertations and Theses, WISO and FIS and, in addition, a hand search of publications was conducted and approximately 3.000 citations found. Secondly, titles and abstracts of the citations found were reviewed in terms of a) having an (quasi-) experimental design, b) evaluating early education programs that target at the social development of children under 7 years, and c) using quantitative assessment instruments. In a third step, full papers of the citations were screened with a short form using 21 selective criteria. Studies had to fulfil scientific inquiries with regards to study design, assignment and matching procedure, outcome measurements, sample characteristics and program features to be included in the synthesis. Approximately 70 studies met the selective criteria. Fourth, the relevant literature was reviewed with an extensive coding scheme with 79 questions that extract more detailed information on the studies. The whole reviewing and screening process was conducted by two independent reviewers; disagreements were solved through discussion. In a fifth step, the relevant studies were analyzed and categorized with regards to information gathered in the extensive coding scheme.

Findings

The electronic search and hand search of publications resulted in 3.087 findings of relevant publication. After titles and abstracts were screened from all citations 724 publications were identified. From these approximately 70 studies met the selection criteria to be included in the research synthesis.

It has to be noticed, that quite a number of studies had to be excluded during the coding process because of missing comparison groups or insufficient information on statistical analysis. The following synthesis of study characteristics is based on the 19 results. Findings from the complete sample will be presented at the conference.

Publication characteristic: Publication years of studies relevant for the synthesis range from 1982 to 2008. However, most of the studies (70%) are published in the last 15 years. The majority of studies (80%) of the studies were conducted in North America (13 in the United States and 2 in Canada) while 20% were accomplished in Europe (3 in Germany and 1 in Sweden). About one third of the studies are characterized as unpublished (e.g., governmental reports, dissertations and thesis). The inclusion of unpublished papers is important to prevent and reduce publication bias. Because of the high ratio of unpublished papers included, screwed results caused by a lack of unpublished findings are not expected.

Study design: Most accurate estimations of the program effectiveness can be derived from random-assigned controlled experiments. Nevertheless, the current state demonstrates a lack of accurate experimental designs, because only 3 out of 19 studies used an experimental design with random assignment. All of them were conducted in the United States. Focusing on the participants, the sample size of studies included in the synthesis reach from 40 children to 3.376 children. Aggregating the data of all relevant studies, the overall sample consists of $N = 9.496$ children. Nevertheless, most of the studies (17) had child outcomes measurements at age 3 to 6, whereas only two studies offered outcome data below the age of three. Due to the lack of studies aiming at children below three years, it is not possible to synthesize general program effectiveness based on the findings of this age group.

Early education program and the child care setting: About one third of the child care programs evaluations ($N = 7$) included in the syntheses aim at children at risk, all of the programs were conducted in the United States of America. Children at risk can either be disadvantaged due to socioeconomic status of the family, migration background or due to developmental risks of the children or a combination thereof (not including children with physical or mental impairment). The other two thirds of the studies do not aim at a specific group of children. About half of the study participants are cared for in mixed age groups ($N = 9$), ranging from 0-6 years (child care centers ranging from 0-6 years or German Kindergarten ranging from 3-6 years) or homogenous groups (preschool or Pre-k serving 4 year olds and kindergarten serving 5 year old children; $N = 10$).

Theoretical and empirical significant evidence based conclusions are necessary for policy decision makers and child care providers to offer appropriate and effective services for young children. The research synthesis summarizes the evidence of effectiveness of early childhood programs by reviewing the state of the art across-the-board. Furthermore, it provides particular knowledge of structural program features that impact the level of effectiveness which lead to improved child outcomes.

PAPER PRESENTATION

Who Benefits from Meta-cognitive Instruction and Under What Conditions?

Tova Michalsky, Bar-Ilan university, Israel; Zemira Mevarech, Bar-ilan University, Israel

The purpose of the present study is twofold: (a) to examine who benefits from meta-cognitive instruction and under what conditions; and (b) to analyze the meta-cognitive processes that higher and lower achieving, activate under the different conditions. The present study is a continuation of a previous study (Author, 2007) in which we examined the differential effects of meta-cognitive support provided at different phases of elementary school students reading scientific texts: before (beMETA), during (duMETA), after (afMEA), or without meta-cognitive support (noMeta). In the present study, we focused on the differential effects of these methods on higher and lower achievers' scientific literacy, and we analyzed the meta-cognitive processes that the pupils indeed activated under the different conditions.

Theoretical Framework

The main goal of the current science education reform is the enhancement of science literacy for all students. Science literacy (SL) involves the abilities to comprehend scientific phenomena (the big ideas) and to communicate these ideas to others (PISA, 2006,). Clearly, reading scientific texts plays an essential role in enhancing science literacy, because in reading students must learn how to access, evaluate, and interpret scientific information from books, periodicals, databases, electronic communication systems, and other resources (National Research Council [NRC], 1996). It is widely believed that reading comprehension and reading strategies could be enhanced by explicit meta-cognitive instruction implemented by the regular classroom teacher (Author et al, 2005, 2007; Simonsen & Singer, 1992). Although the effects of metacognitive instruction has been documented (Author et al, 2005, 2007) many research questions are still open. In particular, who benefits from meta-cognitive instruction and under what conditions? The specific format of the meta-cognitive instruction and its potential transferability are not fully known. The purpose of the present study is threefold: (a) to examine the different conditions under which metacognitive instruction is most efficient in enhancing SL (b) to compare the effects of this conditions on higher and lower achieving students' SL; and (c) to analyze the meta-cognitive processes that higher and lower achieving students activate under the different conditions.

Research Design

Four research condition were employed: metacognitive instruction – before reading (beMETA), during reading (duMETA), or after reading (afMETA) – and a control group received none (noMETA). The metacognitive instruction was based on Mevarech and Kramarski's (1997) IMPROVE method.

Participants - Participants were 108 fourth grade pupils (mean age: 9.5 years, SD = 0.77) who studied in four heterogeneous classes, randomly selected from four Israeli elementary schools.

Data collection – All students were pre- and post-tested on Israel national, standardized test based on PISA (Organization for Economic Co-operation and Development, 2002) science literacy tests (SLT). The students were asked to 'think aloud' continuously while they were answering the pre and post tests. All 'thinking aloud' protocols were audio-taped and transcribed verbatim.

Data analysis –quantitative analyses: The SLT included 15 items: 9 open-ended questions and 6 multiple-choice items such as "What did the pupils want to research in this experiment? (a - The effects of light on the beans' seeds, b - The effects of the number of seeds on the beans' growth, c - The effects of the amount of water on the beans' growth, or d - The effects of the ground on the beans' growth). Each item was scored as either 1 (correct) or 0 (incorrect), with the total score ranging from 0-15. Inter-judge reliability, was assessed by two experts in science education, the reliability coefficients ranging from $r = .82$ to $.95$ for all skill dimensions.

Qualitative analyses- the analysis of "thinking aloud" data followed Marshall and Rossman's (1999) four stages, namely, organizing the data, generating tentative themes, testing the emergent themes, and searching for alternative explanations. In doing so, data analysis crystallized participants' metacognitive process during reading scientific text.

Results

The quantitative analysis indicates significant main effects of science literacy for both the learning conditions ($F(3,100)=6.38$, p Also the interaction between learning conditions and achieving groups was significant ($F(3,100)=15.24$, p The analyses show no significant differences between conditions for the higher achievers, whereas the lower achievers in the afMeta significantly outperformed their counterparts in the beMeta, who in turn significantly outperformed their counterparts in the duMeta, whereas the noMeta students achieved the lowest mean scores. For the lower achievers the main effect for time and the time*treatment interaction were statistically significant for all five components, $MSe = 16.21$, $F(1, 41)$, p $\eta^2 = 0.46$ and 31.25 , respectively; formulating hypotheses, 92.36 , $\eta^2 = 0.43$ and 37.12 , $\eta^2 = 0.31$, respectively; identifying dependent variables, 122.32 , $\eta^2 = 0.51$ and 43.25 , $\eta^2 = 0.35$, respectively; identifying independent variables, 146.14 , $\eta^2 = 0.57$ and 48.34 , $\eta^2 = 0.37$, respectively; and describing results and drawing conclusions, 101.21 , $\eta^2 = 0.48$ and 37.68 , $\eta^2 = 0.32$, respectively. Post hoc analyses of the lower achievers adjusted mean scores based on the pair-wise comparison t-test indicated that on the SLT all five components (describing phenomena, formulating hypotheses, identifying dependent variables, describing results and drawing conclusions), the afMETA group statistically significantly outperformed all other groups; the beMETA research group statistically significantly outperformed the duMETA group; and the noMETA group attained the lowest mean scores (all p values)

The qualitative analysis provides deeper understanding of these findings. It focuses on the meta-cognitive processes that higher and lower achievers indeed activated in the different conditions. The qualitative analyses revealed two interesting phenomena: (a) higher and lower achievers activate different kinds of meta-cognitive processes; and (b) the exposure to the different kinds of meta-cognitive support indeed resulted in the activation of different kinds of meta-cognitive processes (see table 1).

Educational Significance

The study has both theoretical and practical implications. Theoretically, the study shows how young children at the age of fourth grade pupils employ metacognitive strategies under different conditions. In addition the study indicates in what way higher achievers differ from lower achievers. Practically, the study provide evidence on efficient condition in developing SL in elementary schools.

References

- Mevarech, Z. R., & Kramarski, B. (1997). IMPROVE: A multidimensional method for teaching mathematics in heterogeneous classrooms. *American Educational Research Journal*, 34, 365-394.
- Marshall, C., & Rossman, G. B. (1999). *Designing qualitative research* (3rd ed.). Thousand Oaks, CA: Sage.
- Simonsen, S., & Singer, H. (1992). Improving reading instruction in the content area. In S.J. Samuels & A.E. Farstrup (Eds.), *What research has to say about reading instruction* (2nd ed., pp. 200-219). Newark, DE: International Reading Association.

PAPER PRESENTATION

Accuracy of Immediate and Delayed Judgments of Learning in Worked Examples and Problem Solving Tasks

Martine Baars, Erasmus University Rotterdam, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Fred Paas, Erasmus University Rotterdam, Netherlands; Anique de Bruin, Maastricht University, Netherlands

The assessment by a student of how well information is learned is called a judgment of learning (JOL). Only with an accurate JOL can a learner judge accurately what information needs to be restudied and how study time can be allocated efficiently. In Experiment 1, primary school children in grade 3 engaged in solving arithmetic problems, gave immediate or delayed JOLs and rated their invested mental effort. It was found that immediate JOLs were more accurate than delayed JOLs. Moreover, participants in the immediate JOL condition more often chose to restudy problems they did not manage to solve during the first test, suggesting more efficient study time allocation. Whether this also positively affected learning could not be established due to lack of learning gains in both conditions. In Experiment 2 it is investigated whether these findings can be replicated with secondary education students and worked examples are included to investigate effects on learning.

Research has shown that students' judgments of what information they have or have not yet learned play an important role in self-regulated learning: these judgments guide study time allocation and subsequent restudy choices (Metcalf, 2009), and as a consequence, need to be accurate to result in optimal study choices. Research on Judgments of Learning (JOLs) has mainly focused on language learning tasks (e.g., word pairs or texts; see Thiede et al., 2009). Immediate JOLs are given immediately after studying an item (e.g., text or word pair), whereas delayed JOLs are provided after studying several items. By comparing the JOLs to the performance on those items on a subsequent test, their accuracy can be measured. Research on word pairs has shown higher accuracy of delayed JOLs prompted by

the first word of the word pair (Nelson & Dunlosky, 1991). This "delayed-JOL effect" was not found, however, for learning texts with JOLs prompted by the title of the text (Maki, 1998). When providing learners with additional instructions such as to generate keywords (Thiede et al., 2005) or summarize the texts (Thiede et al., 2003), they are able to establish the accessibility of information from the text at a delay, and delayed JOLs become more accurate than immediate ones. Little is known about JOLs in the kind of procedural problem solving tasks typically seen in math and science curricula. Because self-regulated learning is also considered important in those domains, we aim to investigate JOLs in problem solving tasks. Problem solving differs from texts and word pairs in important ways. A JOL about problem solving concerns knowledge of a procedure. Learners are not supposed to judge whether they have learned the answer to this particular problem, but rather, should judge whether they know the solution procedure required for solving this type of problem.

Consequently, as with texts, only a "title", that is, a description of the problem type, is available when making a JOL. Therefore, we hypothesized that as in texts without any additional instructions, immediate JOLs would be more accurate than delayed JOLs with problem solving tasks. Experiment 1. Participants were 76 Dutch third graders who were randomly assigned to either the Immediate (N = 35) or Delayed (N = 41) JOL condition. The study was run in group sessions in classrooms (both conditions present in each session). It consisted of five phases: pretest, learning phase, first test, restudy, and second test. In the learning and test phases, the children were asked to solve four arithmetic problems, one of each of the following types: addition without carrying, addition with carrying, subtraction with borrowing tens and subtraction with borrowing tens and hundreds. During the learning phase, the children provided JOLs on a 5-point rating scale (Dunlosky & Lipko, 2007; Thiede, et al., 2003) immediately after each problem or after all four problems, depending on their assigned condition. At the end of the learning phase children could indicate which problems they would like to solve again (cf. restudy in research with texts or word pairs). Subsequently, they completed the first test, were allowed to 'restudy' problems, and completed the second test. JOL accuracy was measured by means of gamma correlations between JOLs and first test performance.

Accuracy of restudy choices was measured by comparing whether a problem was chosen for restudy or not, to performance on the first test (i.e., if a problem was not chosen for restudy, 1 point was given when it was performed correctly and 0 points when it was performed incorrectly; vice versa if a problem was chosen). A t test performed on the JOL accuracy data revealed higher accuracy in the immediate JOL condition than in the delayed JOL condition ($t(74) = 2.05$, $p = .04$, $r = .23$), which confirmed our hypothesis. For the analysis of restudy choice accuracy, data from half of the participants had to be excluded because they did not restudy only those problems they had indicated. There was a significant difference between the conditions in restudy choice accuracy, $t(36) = 2.29$, $p = .03$, $r = .36$: Children in the immediate JOL condition made more accurate choices than children in the delayed JOL condition. This higher accuracy of study choices did not lead to better learning outcomes, because no learning gains were found in either condition. Since the children in Experiment 1 were quite young (i.e. 8-10 years), the procedure of giving delayed JOLs based only on the titles of problems might have been too difficult.

To establish whether age affects the accuracy of JOLs prompted with the title of a problem, secondary school students will be involved in a second experiment on JOLs and problem solving tasks. Furthermore, to be able to investigate the effect of restudy choices on learning gains, a worked-examples condition will be added: Research on the worked-example effect has shown higher learning gains of instruction consisting of examples compared to problem solving for novices (Sweller, 2006; Paas & Van Gog, 2006). Experiment 2. Approximately 120 Dutch secondary education students will participate in this experiment. A 2x2 factorial design with factors JOL (Immediate vs. Delayed) and Problem Format (Worked Examples vs. Problems) will be used. Students will be randomly assigned to one of the four conditions. The study will be run in group sessions in classrooms (all conditions present in each session). Consistent with Experiment 1, there will be five phases: pretest, learning phase, first test, restudy, and second test. In the learning and test phases, the students will solve/study problems about electrical circuits and during the learning phase they will provide JOLs immediately after each problem or once after all problems, depending on their assigned condition. It is hypothesized that immediate JOLs will be more accurate than delayed JOLs, that students in the worked examples condition show greater learning gains, and that accuracy of restudy choices positively affects learning gains—at least in the worked examples condition. Data collection is finished in 2010 and results will be available well before the conference.

PAPER PRESENTATION

Promoting Metacognition in Industry Courses for Trainees in Lower Level VET programmes

Nadine Kipfer, IFFP, Switzerland; Ursula Scharnhorst, IFFP, Switzerland; Nicole Grolimund, Eidgenössisches Hochschulinstitut für Berufsbildung, Switzerland

Observations in industry courses with trainees in lower level vocational education and training (VET) programmes showed that they are rather passive learners. Previous research in vocational schools showed that a metacognitive training helped these trainees to become more strategic and to perform better in school tasks. The present research involves the development of a metacognitive training embedded in industry courses to support the acquisition of occupational knowledge and skills of car mechanic assistants. We expect the training to foster the apprentices' use of cognitive and metacognitive strategies in learning and problem solving. It should further enhance the trainers' efficacy in offering differentiated forms of support and guidance. Multiple research steps were conducted: (1) Field observations helped to understand the particular learning and teaching context of industry courses and to identify the occurrence of difficulties. (2) An online questionnaire was administered to assess the perception of trainers concerning trainees' cognitive and motivational learning difficulties. Trainers were also asked to describe their usual instructional approach. These first two steps allowed to identify which strategies should be trained and how their use may be fostered. (3) In collaboration with the trainers, different training components were developed, which they can integrate in their occupational-specific goals. Finally, the trainers implemented the training in their industry courses. (4) First effects have been analysed. In the paper we will present and discuss the developed metacognitive training components and first qualitative results regarding their use by the trainers.

Swiss VET programmes comprise theoretical courses at vocational school, work-based training in a host company and industry courses. The latter combine theoretical and practical aspects of VET and are also a part of the final certification. The purpose of industry courses is to instruct the competent use of machines and tools of the specific trade by teaching the trainees the corresponding knowledge and skills. Besides, soft skills (methodological, personal and social competencies) should be fostered.

Our research focuses on competencies taught in industry courses for car mechanic assistants. 'Car mechanic assistant' is one of the newly created occupational profiles in Switzerland which is trained in a two-year, lower level, VET programme.

Trainees in industry courses are often expected to solve tasks, which are organized in work stations, in an autonomous way. First observations showed that they often have difficulties to self-regulate the corresponding learning and working processes by using effective strategies to plan, monitor and control their problem solving and memorize it. In other words, they are often too passive learners.

Concerning the trainers, our observations revealed that they do not sufficiently encourage the trainees to use strategies and to develop their metacognitive awareness. Their support often focuses on the product of the tasks and not enough on the learning and problem solving processes.

A previous quasi-experimental research (Berger, Kipfer, & Býchel, 2009) showed that a metacognitive training in the vocational school setting helped the trainees to become more strategic learners and to be more aware of their own cognitive functioning in classical school tasks (e.g. mathematical and text comprehension tasks). However, it was pointed out that these positive effects may be limited and their transfer on practical problem solving contexts (e.g. at the workplace or in industry courses) was not assessed.

Considering these limitations, we adopted a design-based research approach to develop a metacognitive training in collaboration with industry course trainers so that the training components can be embedded or blended into their occupation-specific and practice-oriented training programme. The embedded metacognitive training should improve teaching and learning in industry courses: The trainees should become more strategic learners if they follow such a training. And trainers should become more competent in fostering cognitive and metacognitive strategies of their trainees besides teaching specific course contents.

Different research steps were conducted: (1) Detailed exploratory observations of teaching and learning in industry courses were undertaken. These observations were discussed with trainers to identify strengths and also major weaknesses of trainees. (2) Further, 32 trainers, who are currently teaching car mechanic assistants in industry courses, completed a questionnaire about their perceptions of the trainees' cognitive and motivational learning difficulties as well as about their own instructional approach. The results indicated which strategies should be trained and how their use may be encouraged. (3) Two working groups composed of researchers (experts of metacognitive theory and intervention) and vocational trainers (experts of occupational practice) were established. They regularly met to discuss useful and possible changes in the teaching and learning arrangement of industry courses, thus trying to adapt and enrich the trainers' instructional approach. They also developed a script for incorporating metacognitive

training components directly into the content-based, practical learning goals of the industry courses. (4) Finally, the trainers implemented these new components in their courses and the effects on teaching and learning were assessed. Multiple instruments were used to assess the effects and the practicability of this training: (A) Each trainer followed a group of trainees (approximately 10) during 8 days. (B) Each day, researchers interviewed trainers about the experiences done of the current day. (C) At the end of the 8 days, they were interviewed about their experiences in implementing the metacognitive training. (D) The trainees answered a metacognitive questionnaire before and after the 8 days of intervention. (E) The trainees were also interviewed after the solution of a specific practical task. (F) The training sessions were videotaped and coded according to an observation grid. A total of 40 apprentices from four different industry course centers participated in the study.

The paper will focus on the developed metacognitive training components and on first qualitative data concerning trainers' efficacy to implement and promote the use of metacognitive training components.

PAPER PRESENTATION

Is it helpful to force readers to search an available text? Effects of comprehension skills and JOLs

Amelia Mana, University of Valencia, Spain; Eduardo Vidal-Abarca, Universidad de Valencia, Spain

This paper examines whether forcing readers to search information in the text enhances their performance on comprehension questions. Furthermore, we are interested in study if comprehensions skills and the reader's judgments of learning (JOL) moderate that effect. To do this, we conducted an experiment in which 18 skilled and 17 less-skilled readers from 8th grade read two texts and answered eight questions per text on a computer using Read&Answer, a software tool that records the whole text-reader interaction (i.e. reading sequence). After reading each question, students rated their confidence about giving the right answer using a scale from 0 (I'm completely unsure to be able to give the right answer) to 100 (I'm completely sure to give the right answer). Students were randomly assigned to be in either the Non-Forced condition (n=18), where they were told that they were free to refer back to the text whenever they wanted, or the Forced condition (n=17), where students were required to refer back to the text in all questions. Results showed that both high and less-skilled readers in Forced condition outperformed readers in Non-Forced condition, showing a facilitative effect of forcing readers to search in both skills levels. However, this effect was different depending on the JOLs, being especially helpful for medium-level JOLs (40%-60%). On-line data of search process allows us to explain the reasons of to force to search effect

Answering questions from an available text has specific metacognitive demands due to the high level of interaction between the reader, the text and the questions, which involves monitoring and self-regulation processes (i.e. whether to search in the text or not, or what information to search). In a recent study, Vidal-Abarca, Mana, Gil & Martínez, (2009) found that readers seem to have self-regulation problems. Readers often decided not to search the text even though they were not certain to give the right answer, which seems a risky decision. The current work sought to test whether forcing readers to search the text after every question would facilitate their comprehension, and whether reading skill and their certainty of giving the right answer without re-reading the text moderates this benefit.

Comprehension monitoring has been investigated within the framework of the Judgments Of Learning (JOL) paradigm (Maki, 1998), in which students assess their level of learning or comprehension after studying some information and then they perform a learning task. JOLs predict the students' decisions to search the text, which may also explain performance (Thiede, Anderson & Theriault, 2003). In a previous study Vidal-Abarca, et al. (2009) found that high-skilled and especially less-skilled readers often decided not to search (around 50% and 70% of the time respectively) when they were not totally sure about providing the correct answer (JOLs 40-60).

Our specific interest in this study was to examine in detail the effect of forcing readers to search the text on final performance and to analyze whether comprehension skills and JOLs modulate this effect. We expected that forcing readers to search would be helpful for both less and high-skilled readers and we also expected different benefits from different JOLs.

Method

Eighteen high-skilled and seventeen less-skilled readers from 8th grade read two texts and answered eight questions per text. After reading each question, they made a JOL by responding to the following question: "How sure do you feel to give the right answer to this question without rereading the text?", though students knew they would have the text available. Students had six options from 0 (I am completely unsure to be able to give the right answer) to 100 (I am completely sure to give the right answer), using intervals of 20 units. Then, students in Forced condition had to search the text in all questions whereas students in Non-Forced condition were free to search the text at their will. Students

performed the task on a computer using software Read&Answer (Vidal-Abarca et. al, in press) which recorded readers' actions (i.e. search decisions, what information were read and the final response)

Results and discussion

As we had predicted, readers in Forced condition ($M=10.35$; $SD=2.51$) marginally outperformed readers in Non-Forced condition ($M=8.66$; $SD=2.65$), $F(1, 31)=3.923$, $p=.057$, $\eta^2_p=.11$. High-skilled readers ($M=10.55$; $SD=2.5$) also outperformed less-skilled readers ($M=8.35$; $SD=2.45$), $F(1, 31)=7.095$, $p=.019$, with no effect of interaction. Thus, we can conclude that forcing readers to search in the texts is beneficial for both less and high-skilled, because both groups improve their performance in forced condition. Our results also showed that the benefit of forcing students to search depends on the level of JOL (see fig. 1). For low-level JOLs (0-20), forcing readers to search was not helpful since the scores distribution (scores 0, 0.5 and 1) was the same in Forced condition than in Non-Forced condition for both groups ($\chi^2(2, 81)=.903$, $p=.637$; $\chi^2(2, 72)=.301$, $p=.860$, less and high-skilled respectively). For intermediate-level JOLs (40-60), forcing readers to search was helpful for both groups because they obtained significantly better scores (more scores 1 and less 0) in Forced condition than in Non-Forced condition ($\chi^2(2, 111)=9.254$, $p=.009$; $\chi^2(2, 85)=6.106$, $p=.008$; $\chi^2(2, 131)=10.691$, $p=.004$). Force condition are explained by the increase of searching opportunities, since in Non-Forced condition readers decided not to search less than 50% of the times in medium JOLs and high-skilled only 8.5% in high JOLs. Thus, forcing high-skilled readers to search is always helpful, while forcing less-skilled readers to search is only helpful in medium JOLs.

Detailed analyses of readers' behaviour when they search the text, more specifically the strategy of "using relevant information" (going directly to answer the question after reading a relevant piece of information) may explain the benefit of forcing readers to search. Forcing readers to search did not affect the frequency for readers to visit relevant information (high-skilled 74% and less-skilled 62%). However it affects the usefulness of using that information; only in Forced condition high-skilled readers, when used relevant information, obtained significantly better scores than less-skilled ($\chi^2(2, 203)=15.546$, $p=.000$).

In conclusion, forcing readers to search information in the text helps them to get better comprehension scores; however comprehension skills and JOLs modulate this effect. Forcing readers to search is helpful almost always for high-skilled readers and only helpful in intermediate-level JOLs for less-skilled readers. Furthermore, forcing high-skilled readers to search helps them to better interpret relevant information.

Maki, R.H. (1998). Test Predictions over Text Material. In Hacker, D.J.; Graesser, A.C. and Dunlosky, J. (Eds.). *Metacognition in Educational Theory and Practice*. (pp.117-144) Mahwah, N.J.: Lawrence Erlbaum Associates

Thiede, K. W., Anderson, M. C. M. & Theriault, D. (2003). Accuracy of metacognitive monitoring affects learning from texts. *Journal of Educational Psychology*, 95 (1), 66-73.

Vidal-Abarca, E., Maóá, A., Gil, L. and Martínez, T. (2009) Monitoring the decisions to search in the text in question-answering activities: Differences between good and poor comprehenders. 13th Biennial EARLI Conference. Amsterdam. August

Vidal-Abarca, E., Martinez,T., Salmerón,L., Cerdán, R., Gilabert,R., Gil, L. Maóá, A. Llorens, A. & Ferris, R. (in press) Recording online processes in task-oriented reading with Read&Answer. *Behavior Research Methods*

PAPER PRESENTATION

Enhancement of students' reading motivation and reading activity

Katrin Arens, University of Göttingen, Germany; Rainer Watermann, University of Göttingen, Germany;
Marcus Hasselhorn, DIPF, Germany

This study deals with the issue how to promote students' reading motivation after the transition from primary to secondary school with a school-based intervention. Respective interventions might have to facilitate students' needs for competence, autonomy, and relatedness as preconditions of intrinsic motivation stated by self-determination theory. However, reading motivation is shown to be primarily predicted by reading achievement. Thus, the implementation of skill development techniques fostering students' need for competence might be sufficient to promote students' reading motivation. In a pretest-posttest-follow-up design, three literacy training conditions were realized in a German secondary school attend by girls only. In order to promote students' need for competence, the teacher of one class directly taught several reading strategies. In a second class this literacy training was combined with an extended form of jigsaw, which was expected to facilitate all three needs described in the self-determination theory. A third class served as a control group. Both forms of literacy instruction were capable of increasing students' reading motivation in the short term. However, only the teacher-directed condition also showed a significant effect on reading activity. At follow-up the groups did not differ with respect to students' reading motivation and reading activity. The results hint again at the unjustified liability to overestimate the potency of cooperative learning methods

in order to foster students' motivation. In fact, the effectiveness of cooperative learning seems to depend on the concomitant learning conditions.

Due to the decrease of students' reading motivation and reading activity after the transition from primary to secondary school (e.g. Jacobs, Lanza, Osgood, Eccles & Wigfield, 2002), school-based interventions are requested to counteract this unfavourable development. However, there is still a debate on the classroom practices and instructional methods suited to foster students' reading motivation after the transition to secondary school. According to self-determination theory (Deci & Ryan, 2000) intrinsic motivation depends on the satisfaction of needs for competence, autonomy and relatedness. Consequently, learning environments facilitating these needs might enhance students' reading motivation. However, it has been shown that students' reading motivation is primarily influenced by reading achievement (McElvany, Kortenbruck & Becker, 2008). Accordingly, skill development techniques emphasising students' need for competence might be sufficient to promote students' reading motivation.

The purpose of this study was to conduct initial steps for testing which of these both approaches might be adequate to enhance students' reading motivation during the first months after the secondary school transition. As in Germany the transition to secondary school takes place after the 4th grade, 5th grade students of a girls-only school were randomly allocated to one of three literacy training conditions. These different forms of literacy training were realised by the teachers over about six weeks immediately after students' transition to secondary school. In one class the teacher directly taught five reading strategies in order to develop students' literacy skills facilitating students' need for competence in turn. In the second class ($N = 27$), this skill development technique was embedded in a learning environment prone to satisfy all three basic needs stated by self-determination theory. For this purpose the literacy training was combined with an expanded form of the cooperative learning method of jigsaw. The classical form of jigsaw was used first, since it has been empirically shown that it is suited to foster students' intrinsic motivation through its positive impact on the three basic needs described in self-determination theory (Hänze & Berger, 2007).

The classical way of jigsaw was extended twofold: To augment the probability to satisfy students' need for competence, teacher-directed lessons were included. Secondly, a practical phase was supplemented, during which students were asked to exercise the instructed reading strategies in teams. This practical phase was assumed to facilitate students' need for autonomy, competence and relatedness simultaneously. A third class served as a control group ($N = 28$), for which the reading instruction method and contents of literacy lessons were not predetermined. The students' level of intrinsic reading motivation and reading activities were assessed in a pretest-posttest-follow-up design using psychometrically sound measures of PISA 2000.

Analyses of covariance with teaching condition as between-subject factor were conducted. In order to differentiate between short-term and long-term effects two steps of analyses were conducted. First, posttest scores of reading motivation or reading activity were taken as dependent variables with pretest scores as a covariate. In the second step follow-up scores were examined controlling for pretest and posttest data. In view of the small sample size the level of significance was set at $\alpha = .10$. With posttest reading motivation as dependent variable the effect of teaching condition marginally failed to gain statistical significance ($F [2,68] = 2.24, p = .12$). Nevertheless, pairwise post-hoc analyses revealed that both forms of literacy instruction were capable of enhancing students' reading motivation in the short term with no significant difference between the two experimental conditions themselves. In the second analysis of covariance based on follow-up data there was no significant effect of teaching condition on reading motivation ($F [2, 63] = 0.25, p = .78; n.s.$). With respect to reading activity a slight superiority of the teacher-directed condition compared to the combined instruction and the control group could be shown for the short-term ($F [2, 68] = 2.41, p = .10, \text{partial } \eta^2 = .07$). Inspection of group mean levels indicated a decline of students' reading activity in the combined instruction and control group between pretest and posttest while it maintained in the teacher-directed condition. In the analysis of covariance integrating follow-up assessment no group differences in students' reading activity could be shown ($F [2, 63] = 0.71, p = .47; n.s.$).

These results indicate that at least in the short term a skill-based intervention approach facilitating students' need for competence is equally capable of promoting students' reading motivation as is an extended form of jigsaw addressing all three basic needs. Consequently, methods of cooperative learning should not be one-sidedly approved as the best way of enhancing students' motivation and these results hint again at the potency of teacher-guided learning. However, this implication must not be overgeneralized, as other cooperative learning methods than jigsaw might yield superior effects on students' intrinsic motivation and the sample of this study was restricted to German 5th grade girls. Thus, further research is still necessary in order to better understand whether there are instructional tools capable of alleviating or even stopping the decline of students' reading motivation and reading activity in the first months after the transition to secondary school.

References:

- Deci, E. L. & Ryan, R. M. (2000). The "what" and "why" of goals pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11, 227-268.
- Hänze, M. & Berger, R. (2007). Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning and direct instruction in 12th grade physic classes. *Learning and Instruction*, 17, 29-41.
- Jacobs, J. E.; Lanza, S.; Osgood, D. W.; Eccles, J. S. & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grade one through twelve. *Child Development*, 73, 509-527.
- McElvany, N., Kortenbruck, M. & Becker, M. (2008). Lesekompetenz und Lesemotivation. Entwicklung und Mediation des Zusammenhangs durch Leseverhalten [Reading literacy and reading motivation: Their development and the mediation of the relationship by reading behavior]. *Zeitschrift für Pädagogische Psychologie*, 22, 207-219.

PAPER PRESENTATION

Effects of motivation on transfer: A meta-analysis

Andreas Gegenfurtner, University of Turku, Germany

This meta-analysis (148 studies, $k = 197$, $N = 31,718$) examined effects of motivation on transfer in professional training. Based on prevailing theories in research on training motivation, the analysis included relations of transfer with motivation to learn, motivation to transfer, pre- and post-training self-efficacy, goal orientations, expectancy, and instrumentality. Results of the primary meta-analyses indicated the presence of moderator effects. Four alternative theory-driven moderator analyses tested study design artifacts with regard to instruction and knowledge type; the transfer context; time; and assessment conditions. New directions for future theory development and research are suggested, and practical implications of the findings are discussed.

1. Aims and Hypotheses

The study aimed to examine the relationship between motivation and transfer in professional training. Based on prevailing theories in training motivation research, analysis included motivation to learn, motivation to transfer, self-efficacy, goal orientations, expectancy, and instrumentality (Bandura, 1977; Dweck, 1986; Noe, 1986; Vroom, 1964). Although motivation is widely believed to be important for knowledge application and transfer (Noe, 1986; Pugh & Bergin, 2006; Renkl et al., 1996), little systematic investigations exist on the size, direction, and boundary conditions of motivation-transfer relationships. Specifically, an analysis of the boundary conditions of existing theories could contribute to future theory development. Therefore, this study also sought to identify potential moderating effects of study design artifacts. Four moderator effects were hypothesized. First, we assumed that instruction (lecture-based instruction vs. active learning; Iran-Nejad, 1990; Schwartz & Bransford, 1998) X knowledge type (declarative, procedural, self-regulatory; Schraw, 2006) would moderate motivation-transfer relationships. Second, we hypothesized that near transfer contexts would be more motivating than far transfer contexts for both social, physical, and modal dimensions (Barnett & Ceci, 2002). Third, we hypothesized that training length X measurement time would function as boundary conditions (Beier & Kanfer, 2010; Cole, 2008), with higher correlations for longer trainings and shorter time lags between the end of training and the transfer measure. Finally, we assumed that assessment criterion (transfer assessed as subsequent use, frequency of use, increased effectiveness, or correct performance) X source (self, peer, supervisor, external) would influence the size of motivation-transfer correlations, being highest for self-ratings of increased effectiveness due to the presence of self-serving bias (Mullen & Riordan, 1988).

2. Method

2.1. Database

Moderator estimation techniques available in psychometric meta-analysis seemed appropriate to address the study goal. To be included in the database, a study had to report an effect size r or other effect sizes that could be converted to r (b coefficient, t statistics, F , Z , Cohen's d). We searched the PsycINFO and Web of Science databases for the period of 1986 through 2010. We also cross-referenced previous literature reviews, and contacted researchers to send unpublished manuscripts, conference papers, or dissertations. A total of 148 articles were located and coded.

2.2. Meta-analytic procedure

We used the meta-analysis methods by Hunter and Schmidt (2004). Using full artifact distribution analysis, correlations were corrected first for sampling error and then for error of measurement. We computed population correlations, 80% credibility intervals around population correlations, and the percentage of variance explained.

2.3. Moderator analysis

Spans of the 80% credibility interval (Whitener, 1990) and the percentage of variance explained (Hunter & Schmidt, 2004) were used to detect moderator biases. Theory-driven hierarchical sub-group analyses were used to estimate confounding moderator effects.

3. Results

3.1. Study characteristics

The 148 articles reported 197 independent data sources with 376 effect sizes. Total sample size was 31,718 participants, with a mean age of 30.72 years ($SD=9.42$) and 6.88 years of work experience ($SD=6.47$). 43.62% of the participants were female ($SD=25.26$).

3.2. Estimating population correlations

Complete results of the primary meta-analyses are shown in Table 1 (appendix 1). In all motivational dimensions, the span of the 80% credibility interval and the percentage of variance explained indicated the presence of moderator effects.

3.3. Estimating moderator effects

To account for effect size heterogeneity, we conducted four theory-driven analyses of possible moderator effects.

3.3.1. Effects of instruction and knowledge type. Results indicated that, for declarative and self-regulatory knowledge, correlations between motivation and transfer tended to be higher for active learning than for lecture-based instruction. For procedural knowledge, the pattern was reversed.

3.3.2. Effects of transfer context. Results indicated higher correlations for near transfer contexts at social and modal dimensions. Contrary to our expectations, however, the pattern was reversed for the physical dimension.

3.3.3. Effects of training length and measurement time. For short trainings, correlations tended to be highest for transfer measures at immediate training end. For longer trainings, correlations were highest for measures 1 to 8 weeks post-training.

3.3.4. Effects of assessment criterion and source. Irrespective of the assessment criterion, self assessments tended to show highest motivation-transfer correlations.

4. Discussion

This meta-analysis examined the relationship between motivation and transfer in professional training. Overall, it can be concluded that motivation is an important prerequisite for knowledge application and training effectiveness (Noe, 1986; Pugh & Bergin, 2006; Renkl et al., 1996). However, the size and direction of motivation-transfer relationships was found to be moderated by study artifacts. Identification of these boundary conditions added to the understanding of motivation in professional training.

4.1. Implications for theory development

Implications for theory development are on global and local levels. On a global level, it seems that research on transfer efficiency needs to consider the profound impact of motivation that has been reiterated in this meta-analysis. Without denying the relevance of cognitive factors for transfer (Paas & Van Gog, 2008; Van Merriënboer & Sweller, 2005), motivational and affective dimensions can refine existing theory models (Schnitz et al., 2009).

On a local level, moderator analyses illustrated temporal dynamics of goal orientation. This finding is unexpected, since Dweck (1986) and others (Brett & VandeWalle, 2001) conceptualized goal orientations as stable motivational traits. This would imply a certain stability over time. Future research may further explore our meta-analytic finding of goal orientation's variance as a function of increased time lag in professional training.

4.2. Practical implications

Practical implications are significant for organizational training and for research practice. First, concerning organizational training, results indicated that traditional lecture-based trainings had high motivation-transfer relationships for procedural knowledge only; when training programs focus on declarative or self-regulatory knowledge, active learning may be more effective.

Second, concerning implications for research practice, the study identified biasing effects of study design artifacts. Decisions on assessment criteria, rating sources, and measurement times influence size and direction of motivation-transfer relationships, as does the similarity between the training and the transfer situation. Ideally, the use of longitudinal multitrait-multimethod designs may seem to help minimize the biasing effects of study artifacts, making individual research outcomes more rigorous and robust.

PAPER PRESENTATION

Relation between personal computer uses at home and achievement motivation in science

Normand Roy, University of Montreal, Canada; Roch Chouinard, University of Montreal, Canada

The aim of this study is to validate a motivational model including information and communication technology (ICT) personal uses as a predictor. Technology is now part of everyday students' life. OCDE (2006) study had shown that

90% of the students frequently use computers at home. Moreover, recent studies showed that students who use ICT at home have better grade in key subject matter (Beltran, Das et Fairlie, 2008; OCDE, 2006). To achieve the aim of this study, several auto-reported attitude scales in science and socio-demographic questions were administered to a sample of about 332 French-Canadian students (boys and girls) from five junior high-schools in grade 8th at the beginning of the school year. Cluster analyses were first conducted to create three ICT user profiles. From those profiles, achievement motivation models based on an Expectancies-values model (Chouinard, Karsenti and Roy, 2007) were tested with a multi-group structural equation. Our results showed difference between profiles. Users with various usages have higher motivation whatever uses they make of ICT. However, social-gamer users, who use ICT mostly to communicate and play games, have lower scores on motivational scales, akin to casual users. Moreover, the only negative indicator of the model is communication uses. Students in casual or social-gamer profiles who passed more time in front of a computer to communicate (chatting and emailing) also show less commitment in science. Nonetheless, teachers and parents should not think computers as a negative factor on general commitment in science, but should favour positive uses of computer at home.

Aims

Studies showed great incomes of using ICT for student in many contexts (BECTA, 2003); many variables must be studied to be able to define models and effective pedagogy with ICT. One of the key elements is to determine which factors could prevent or enable the effectiveness of the use of ICT in school. Some research groups think that the use of computers at home could greatly impact school achievement (Beltran et al., 2005; Locke and Andrews, 2004; OECD, 2003; Piette, Pons and Giroux, 2006). Studies by these groups showed emphasis on the relation between computers and grades. However, motivation could give a more global picture of the learning process and the school achievement. Researchers have showed that motivation could be linked to achievement-related behaviours, such as effort and achievement (Bandura, 1997; Pintrich & Schunk, 1996; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

Therefore, in the present study, we examine the relationship between the frequencies of use of computers at home and motivational attitudes in science.

Methodology

Participants

Data were collected in October 2005 from students who were attending five French-speaking public high schools in the Montreal area (Canada). The seven classes selected for recruitment were all regular science classes enrolled in 7th and 8th grade; all students in each classroom were asked to participate. The sample consists of 332 French-Canadian students (179 boys and 153 girls).

Procedures

The questionnaire was completed during students' science classes at the beginning of the school years. Several self-reported attitude scales from different sources were compiled into one. This questionnaire took approximately 25 minutes

Measures

Motivational scales

Six scales were used to test our achievement motivation model: Self-Efficacies in science, Mastery-Approach Goals, Performance-Approach Goals, Work-Avoidance Goals, Interest for studies in science, Commitment in science.

Self-Efficacies in science has been taken from the SMTSL Attitude Scales (Hsiao-Lin, 2005), was used to measure participants' competence beliefs ($\alpha = .72$).

Three types of goals have been measured with an instrument produced and validated by Bouffard et al. (1998). The Mastery Goals Subscale ($\alpha = .83$) entailed seven statements assessing the extent to which participants wished to master the content of their science courses. The Performance Goals Subscale ($\alpha = .68$) consisted of six statements measuring the degree to which participants set personal goals to be amongst the best in their class and to obtain high marks in science. The Avoidance Goals Subscale ($\alpha = .65$) was comprised of six statements measuring the degree to which participants set their goals to do the least possible work to pass.

To measure interest for studies in science, a new scale of six items was created ($\alpha = .88$) by the researchers.

General commitment in science represents the challenge given by a task in science. The subscale General Commitment ($\alpha = .71$) was adapted from a French version of Fennema and Sherman's (1976) Mathematics

Attitudes Scales, translated and validated by Vezeau, Chouinard, Bouffard and Couture (1998), combined with items from Hsiao-Lin and his collaborators (2005).

Items from all of these scales were rated on a six point Likert-type scale, ranging from 1 ("Strongly disagree") to 6 ("Strongly agree") for motivational scales

ICT Usages

ICT usages were measure with seven different questions about how many times students use ICT for : email, chatting, word, play games, learning programs, research for personal and research for school works. Their usage was measured with a scale ranging from 1 (Never) to 4 (Almost every days).

Data Analysis

Multi-group structural equation modeling with latent variables was performed with Amos 17.0. Profiles were composed with a two-steps cluster analysis based on ICT usages (email, chatting, word, play games, learning programs, research for personal and research for school works) performed with SPSS 18.

Findings

Clusters analysis showed three profiles. The first cluster, or multi-users, reported using all types of uses more often than other students. The second cluster, or social-gamer users, was using ICT especially to communicate and play games. The last cluster, or casual users, used ICT less often the other two profiles. Results showed some distinctions between clusters in the multi-group SEM models (multi-users/social-gamer users/casual users respectively).

Use of ICT for pedagogical applications has a positive relation with self-efficacies in science ($\beta=.24^*/.32^*/.31^*$) for all profile. Communication usage has a negative relation with interest ($\beta=.03/- .23^*/-.09$) and commitment in science ($\beta=-.06/- .20^*/.06$), only for those of the social-gamer profile. Entertainment has positive relation with self-efficacies in science ($\beta=.16/.19^*/.25^*$).

Motivation part of the model has some similarities between profiles. Self-efficacies have high positive relation ($\beta=.66^*/.62^*/.59^*$) with mastery-approach goals. Mastery and performance-approach goals have positive relation with general commitment in science ($\beta=.06/.19^*/.25^*$) and $\beta=.86^*/.86^*/.98^*$ respectively).

Two surprising results are observed. The work-avoidance goals have no direct relation with commitment in our achievement motivation model, and therefore were removed from the final model. Moreover, interest in science has little relation on both achievement goals. We observe a negative relation between interest and performance goals only for multi-users ($\beta=-.71^*$), and a relation between interest and mastery-approach goals only for social-gamer users ($\beta=.34^*$).

Significance of the research

Our research sheds new light on personal uses for computers. It seems that the type of usage, combine with the amount of time passed in front of a computer, is related to your motivation in science. Teachers and parents should not see computers as a negative influence on school performance, but should instead think to promote pedagogical use of the computer. Negative impact of computers is mostly observed in students with a limited usage of computers: social-gamer and casual users, limited to communication uses. Our hypothesis is that good and diverse use of technology allows student to develop computer skills and facilitate learning of science. However, relation between personal use and motivation is not causal. It is difficult to determine if motivation in sciences increase ICT usage or good ICT uses increase motivation. To further investigate the subject, studies designed for more in-depth exploration of computer usage at home would be required. Moreover, we should delve into the relation between computer uses, computer competencies and motivation at school.

PAPER PRESENTATION

Engineering Undergraduates' Goal Setting for Their Future and Its Motivational Implications

Wen-Ting Chung, Arizona State University, United States; Jenefer Husman, Arizona State University, United States; Jonathan Hilpert, Indiana University Purdue University Fort Wayne, United States

Undergraduate students are engaged in a learning process in which they are expected to explore, evaluate, and determine their majors, and invest time and efforts in the chosen profession in order to achieve anticipated future careers and lives. In the US, engineering, compared with other majors, has been identified as a field that students are most likely to switch to other majors or drop out. This study investigated engineering undergraduates' goal setting for their future, and its relationships with their future time perspective, perceived instrumentality of their coursework,

self-efficacy, and perceived active learning strategy use. Our results suggested that (1) engineering students set goals in many domains their future; however, only engineering-relevant professional goals (e.g., get accepted into civil engineer's corps) rather than academic goals were associated with their reported use of deep learning strategies in engineering courses; (2) engineering students who perceived more connectedness between their current course learning and their future as engineers set more professional goals relevant to engineering. Our results imply that engineering instructors might need to consider fostering students to develop their future goals beyond academic level because it is the long-term professional goals which are mostly likely to motivate students' to actively seek meanings and gain deep understanding about their course materials. In our final paper, we will also discuss the theoretical contribution regarding the relationships between Goal setting and other critical motivational variables.

Theoretical Framework

Undergraduate students are engaged in a learning process in which they are expected to explore, evaluate, and determine their majors, and invest time and efforts in the chosen profession for achieving anticipated future careers and lives. In the US, engineering has been identified as a field that students are most likely to switch to other majors or drop out. Our research team has been interested in examining how engineering students' future time perspective (FTP) could impact their classroom behaviors as well as academic and professional trajectories.

FTP theory has been growing in popularity among educational psychology researchers (Seginer, 2009). The theory suggests that individuals mentally construct episodic future paths which guide and dictate present behaviors and decision making (Husman & Shell, 2008; Nurmi, 2005; Zimbardo & Boyd, 1999). However, there is little research designed to examine what the content of students' mental representations of the future looks like and its impacts on students' academic and professional paths. This study primarily investigated engineering undergraduates' goal setting, and its relationships with other critical motivational variables.

Research hypotheses: (1) Students who perceived more connectedness between their current learning and engineering future would report more academic and professional goals relevant to engineering. (2) Students who reported more academic or professional goals relevant to engineering would also reported that they (a) engaged more in using deep learning strategy, (b) had higher confidence to succeed in engineering courses, and (c) perceived their current learning in engineering courses was more useful for their future; (3) Students' goal setting partially mediated the relationships between connectedness to engineering and deep learning strategy use as well as perceived instrumentality.

Methods

Participants

Participants (N=366) were recruited in a large sample of post-secondary mechanical and aerospace engineering students from a variety of undergraduate courses.

Open Ended Measures

Future Goals – Participants were asked to describe ten important future goals and list the age at which they would like to achieve those goals. We coded their personal goals using an emergent approach; six categories emerged: Academic, Professional, Monetary, Domestic, Community Building, and Personal. For the purposes of this study, we focused on professional and academic goals relevant to engineering. An Academic goal would be “to graduate”; an Engineering Academic goal would be “to graduate as an engineer.”

Survey Measures

Connectedness to Engineering– measured using an adapted version of the connectedness subscale of the FTPS (Husman & Shell, 2008). Example items: “One should be taking steps today to help realize future engineering goals.”

Perceived Instrumentality (PI) – measured using the endogenous subscale of the Perceived Instrumentality Scale (Husman et al, 2004). Example items: “I will use the information I learn in [Engineering Course] in other classes I will take in the future,”

Deep learning strategy use – measured using the knowledge building subscale of the Student Perceptions of Classroom Knowledge Building Scale (SPOCK) (Shell, et al., 2005). Example items: “In [Engineering Course], I focus on developing my own understanding of the important ideas in what I am studying or reading.”

Self-efficacy – measured using Motivational Strategies for Learning Questionnaire (MSLQ) (Pintrich et al, 1993). Example items: “I am confident I can do an excellent job on the assignments and tests in this course.”

Analysis and Results

Hypothesis 1

Bivariate correlations were conducted between Connectedness-to-Engineering and the number of Goals, either Academic (not significantly correlated, $r < .01$) or Professional (weakly significantly positively correlated, $r = .14$). To further examine whether engineering-relevant goals were correlated with Connectedness-to-Engineering, engineering relevant and non-engineering goals were separated within either professional or academic goals.

Non-engineering goals (either academic or professional) are normally distributed, but engineering relevant goals (either academic or professional) were positively skewed. Approximately half of the student did not report explicit engineering goals. For both Academic and Professional goals, students' were split into two groups: Students who reported ANY or NO engineering related goals.

Bivariate correlations were first conducted between Connectedness-to-Engineering and non-engineering goals. As expected, the results were not significantly (non-engineering academic: $r = -.05$; non-engineering professional, $r = .04$). To determine if students who reported engineering goals also reported significantly higher Connectedness- to-Engineering, two t-tests were conducted. Students who reported engineering academic goals were not significantly different from those that did not. Students who had Engineering Professional Goals reported significantly higher Connectedness-to-Engineering, $t(364) = -3.02$, $p < .01$.

Hypothesis 2

To determine if there is a relationship between students reporting of an engineering Academic or Professional goal and the variables of interests, a series of t-tests were conducted: (1) Engineering Academic Goal: the results were significant for Self-efficacy, $t(364) = -2.06$, $p < .05$, and PI, $t(364) = -3.29$, $p < .01$; (2) Engineering Professional Goal: the results were significant for deep learning strategy use, $t(364) = -2.69$, $p < .01$, and PI, $t(364) = -2.17$, $p < .05$.

Hypothesis 3

Bivariate correlational analysis between Connectedness-to-Engineering and students' reported strategy use and their motivational beliefs replicated previous research. Reported learning strategy use ($r = .24$), and PI ($r = .30$) are significantly related to Connectedness-to-Engineering.

These findings indicate that students who are Connected to their future as engineers are more likely to have professional engineering goals as well as to use deep learning strategies and perceive engineering courses as instrumental. We further examine the potential of students' future professional goals to partially mediate the relationship between students Connectedness- to-Engineering and their motivational beliefs and approaches to learning.

When split into two groups, the relationship of PI to their Connectedness-to-Engineering is lower for students who reported engineering professional goals ($r = .15$, $p = .06$); who do not report ($r = .29$, $p < .01$). The relationship of deep learning strategy use and their Connectedness-to-Engineering is lower for students who reported engineering professional goals ($r = .17$, $p < .05$); who do not report ($r = .38$, $p < .01$).

Significance

Our results imply that engineering instructors might need to consider helping develop students' future goals beyond academic level because it is the long-term professional goals which motivate students to actively seek meanings and gain deep understanding about their course materials. Our final paper will also discuss the theoretical contribution regarding the role of Goal setting and its relationships to other motivational constructs.

References

Please find the references in the uploaded appendix image.

PAPER PRESENTATION

Research Ethics Education: a descriptive map

Valentina Mazzoni, University of Verona, Italy; Luigina Mortari, University of Verona, Italy

When we have decided to realize a study on Ethic education we developed a literature review, in order to know the different perspectives using by the researchers in this field. Because of the great number of empirical approaches developed in the research practices and the different themes faced by the researchers in any topic we have decided to conduct a systematic review.

Systematic Review is used in order to determinate what is know and what is not know about a topic of interest, reflect on the processes and perspectives of the relevant body of research, explore the underlying methodological decisions and theoretical influences and suggest future directions for researchers (Paterson & Thorne, 2003).

The aim of our systematic review is to know the current research landscape about ethic education. What kinds of researches are realized? Which are the theoretical frameworks the researchers take into account in developing their works? What are the predominant methods used?

The objective of the inquiry is to delineate a descriptive map of the studies in order to define ethic education from the ground-up that is describing ethic education as it is developed in the research practice.

The finding of the systematic review will be a descriptive map, which give to researchers a tool to clarify the "state of the art" on researches in ethic education and to discuss where placing ourselves as researchers in this field.

The research

This study is part of a complex theoretical and empirical research on ethic education with primary school's children. Two main focuses compose the research: a theoretical focus and an empirical one.

The theoretical focus aims to develop a theory of Ethics education grounded in the ancient Greek philosophy, with particular attention to the Aristotle's idea of Ethics and in the current Gilligan's perspective on the ethic of care. The empirical study is oriented to realize a research with children on virtues, in order to outline which kind of education enables children to develop an ethical disposition to virtues.

In order to develop this research project, from both the theoretical and the empirical side, one of the main aspects is to place our work in the current paramount of researches on this topic. From the theoretical perspective, we choose to place the project in the Virtue Ethics approach. From the empirical perspective the choice was more difficult, because of the great number of empirical approaches used in the research practices and the different topics faced by the researchers.

In order to place our study in the present research's landscape we decided to develop a literature review to know the different perspectives using in ethic education's research projects. The recent increase of sources in delivering primary studies changes the way in which researchers realize literature review on a particular topic and systematic reviews (both meta-analysis and meta-synthesis) become the new methods to reviewing the studies (evaluating and interpreting them) in order to synthesize the scientific literature.

Aim

Systematic Review (Meta-Synthesis) is used in order to determinate what is know and what is not know about a topic of interest, reflect on the processes and perspectives of the relevant body of research, explore the underlying methodological decisions and theoretical influences and suggest future directions for researchers (Paterson & Thorne, 2003).

The aim of the systematic review we have conducted is to know the current research landscape about ethic education. What kinds of researches are realized? Which are the theoretical frameworks the researchers take into account in developing their works? What are the predominant methods used?

The objective of the inquiry is to delineate a descriptive map of the studies in order to define ethic education from the ground-up that is describing ethic education as it is developed in the research practice.

Methodology

The review is conducted on primary studies, which were collected searching through Electronic databases - three databases were included in the study: ERIC, A+Education and ERC – and the research was conducted combining thesaurus's criteria - the different –subjects» that concern the moral education's category – and time's criteria – the last 5 years. The discussion of the criteria adopted is part of the presentation.

The analysis process of the articles aims to interpret and synthesize the findings in order to realized a theoretical description (comprehensive and thickly), which is useful to explain theories, methods and models used in ethic education's studies.

Findings

The result of this systematic review on the research in ethic education is a descriptive map, which outlines:

- the different perspectives in ethic education;
- a list of key words, which give an idea about what are the concepts that perform ethic education in the researches practice;
- a list of topics that concern the ethic education today.

Significance

The great number of projects in ethic education gives new efforts to the researchers in this field as well as increases the complexity of the research landscape. Which is the –quality» of these studies?

In order to answer this prime question it's firstly necessary to design a descriptive map, which gives to the researchers a paramount of what is the idea of ethic education in the research practice (i.e. approaches, methodologies and methods). The finding of the systematic review will be a descriptive map, which give to researchers a tool to clarify the "state of the art" on researches in ethic education and to discuss where placing ourselves as researchers in this field.

PAPER PRESENTATION

Figures' value and place - a learning study on arithmetic in grade seven

Mona Holmqvist, University of Gothenborg, Sweden

This study aims to describe in what way pupils in grade seven experience the base 10 positional numeration system (place-value system) before and after three different designed lessons in a learning study, each one given to one group of students (A, B and C). By analyzing the three video-recorded research lessons differences in the students' ways of developing knowledge can be answered by what actually happened in the class room. The model used in this study is learning study with three different designed research lessons, one per students group, where the results of the former is due to the developed design of the later. The design of the research lessons are based on variation theory. In total 52 students participated in three different groups (A=13, B=19, C=20) together with their five teachers and one researcher. A test was taken by the students before and after the research lesson, which included 8 questions and 5 of those have sub queries, which resulted in 23 as a total score. A delayed post-test was given the students four weeks after the research lessons. The results from the pre- and post-test show a change in learning outcome which varies in the different groups of students (A +4, B +1, C +14).. In lesson C at least one critical aspect, namely the difference between ten and tenth, hundred and hundredth, and so on this was offered the students to discern which was not offered in the other two lessons in the same distinct way.

Aim

This study aims to describe in what way pupils in grade seven experience the base 10 positional numeration system (place-value system) before and after three different designed lessons in a learning study, each one given to one group of students (A, B and C). By analyzing the three video-recorded research lessons differences in the students' ways of developing knowledge can be answered by what actually happened in the class room. When the students solve two different kinds of arithmetical tasks; how to use decimal terms in addition and decimal factors in multiplication, their knowledge on the base 10 positional system are crucial. One hypothesis is that the different ways of solving the two tasks, in which one requires knowledge about place-value, affect their possibilities in different ways. The multiplication $0.5 * 0.5$ does not require knowledge about the base 10 positional numeration system as it is possible to count the amount of decimals in the factors (two) and by that put the dot two steps to the left (0.25). But the addition of the terms 0.2 and 0.22 is difficult to solve without knowledge about the base 10 positional numeration system. Otherwise it is easy to get the sum 0.24 instead of 0.42.

Methodology

The model used in this study is learning study (Marton & Tsui, 2004) with three different designed research lessons, one per students group, where the results of the former is due to the developed design of the later. The design of the research lessons are based on variation theory (Marton & Booth, 1997), which means critical aspects of the object of learning are offered the students in different ways. This variation of in what way the features are offered gives the students different ways to experience and by that learn. In total 52 students participated in three different groups (A=13, B=19, C=20) together with their five teachers and one researcher. The learning study started with two meetings with the teachers to present the theory which the study is based, variation theory, and to plan tests and lessons. The test was given to another class to see if the questions were suitable and the time it takes to answer the questions were reasonable (10-15 minutes). The test included 8 questions and 5 of those have sub queries, which resulted in 23 as a total score. The test was taken before and after the research lesson in each group, and a delayed post-test was given the students four weeks after the research lessons.

Findings

The results from the pre- and post-test show a change in learning outcome which varies in the different groups of students. In group A, 27% of the answers were correct in the pre-test and 31% in the post-test (+4). Group B showed the less improvement – from 51% in the pre-test to 52% in the post-test (+1). Finally, in group C the results increased from 50% to 64% (+14). This was due to the finding of at least one critical aspect, namely the difference between ten and one tenth, hundred and hundredth, and so on. In lesson C this was offered the students to discern which was not offered in the other two lessons in the same distinct way. The results also show in what way the students' abilities to solve the addition and multiplication tasks develop.

Theoretical and Educational significance of the research

In previous studies, children's difficulties with base ten numeration was studied in a teacher training course (Sawada & Atkinson, 1981). The results in a study of 106 students shows that work with a nondecimal numeration system including new number symbols and names can lead to heightened awareness and appreciation of difficulties that children might have in understanding base ten numeration. In another study, preservice teachers' knowledge of decimal numeration was tested (Stacey, Steinle, Baturo, Irwin & Bana, 2001). The results showed that pre-service teachers had inadequate content knowledge of decimals and were confused about the size of decimals in relation to zero. The results of the study described in this abstract shows both how the aspects critical for learning are possible to find by examining the students' learning outcome in relation to what happens in the research lessons. It seems as the knowledge on the base 10 positional numeration system, or lack of such knowledge, are important not only to solve additions and multiplications correct, but also to understand why a multiplication with decimals ends up in a product smaller than the factors; $0.5 * 0.5 = 0.25$. If the students understand the base 10 positional numeration system and the difference between the left and right side (ten and one tenth), they might understand multiplication of decimals as a division as the term is divided several times in smaller parts. The lack of an overall comprehension seems to make it difficult even for students at later levels of the educational system, and as pre-service teachers also seem to lack this kind of knowledge it is an area important to study.

PAPER PRESENTATION

Conjoint analysis as an instrument to measure student perceptions of education quality

Margriet van der Sluis, Maastricht University, Netherlands

In this paper we apply conjoint analysis to measure students perceptions. Conjoint requires respondents to simultaneously evaluate aspects following trade offs and is therefore seen as more realistic than traditional survey methods. Our students repeatedly ranked descriptions of 4 courses, existing of 9 quality aspects with varying scores. Subsequently, the students completed a traditional survey with statements on several aspects of educational quality, including the 9 aspects used in the conjoint task. 334 students of administrative, social pedagogical and building studies, aged 17-19, participated in the study. The scores of the conjoint task, indicating the relative importance of aspects, appear to yield a different insight in the ideas of students towards aspects of education quality than the survey questions. Some aspects with high average scores in the survey, lost significance in the conjoint task, whereas other aspects gained significance. By systematically comparing both methods on subgroups we further explore the differences and argue that conjoint is a valuable addition to traditional surveys in educational research.

Conjoint analysis as an instrument to measure student perceptions of education quality AimsFor school administrators, teachers, policy analysts and educational researchers, it is important to know how students value different aspects of educational quality and what they find important. Especially in secondary and higher (vocational) education, student evaluations are used more and more to shape or improve the educational practice. Often, however, students' opinions are measured with traditional surveys, in which aspects of quality are assessed independent of each other. Shaping the educational practice though, is in fact full of trade-offs. There is a limited budget, and there are choices to be made in which part of the educational process the investment is most worthwhile. Conjoint analysis uses the principle of trade-off and might therefore do more justice to reality. This article explores the use of conjoint analysis in the field of educational quality. The aim is to find out what students find important when being forced to make choices, and to compare this with how they evaluate the same aspects in a traditional survey. MethodologyOur study uses conjoint analysis (Batsell & Louviere, 1991; Leslie & Ettenson, 2000; Neil, 1992; Jeffries & Maeder, 2005; de Wolf, 2000). In a conjoint study, a hypothetical product or service is defined in terms of a few important characteristics. Instead of valuing the characteristics separately, the respondent simultaneously evaluates and combines the information on multiple product-service characteristics.

The objective of conjoint analysis is to determine what combination of a limited number of indicators is most influential on respondent choice or decision-making. We chose to include 9 characteristics in the study. In a pre-study among students this number turned out to be manageable. We wanted the 9 characteristics to fulfill three requirements. Firstly, three in a pre-study described perspectives are reflected in the characteristics: the labor market perspective, the educational effectiveness perspective and the social economic perspective. Secondly, the set of characteristics encompasses both process and product aspects of education. And finally, each characteristic plays a significant role in the present-day Dutch Vocational Education and Training (VET) sector. We assigned two or three possible values to each character. Participants were shown four sets of four profiles on the computer. The values were assigned to the profiles according to pre-set rules, which maximized variation in each set. Figure 1 shows an example of the profiles the participants saw on their computer screen. The question above is "Which course matches most with your idea of quality? Rank the courses according to your preferences". On the left the nine characteristics are shown. The respondents had to rank the vocational courses using the bottom four blocks with the options from 1 (the best) to 4 (the worst). Figure 1. Example of 4 profiles the participants faced on the screen.[In appendix]

To identify the impact the course characteristics on the choices of students in the conjoint task we used rank ordered logistic regression. This model interprets the 4x4 rankings assigned to the courses by our respondents as a rank ordering of choices out of a given choice set. After the conjoint task, students had to value quality aspects on a 10 point scale, in which 5 indicated 'I find this very important', 0 'neutral', and -5 'I'd rather not have this'. In the survey 37 aspects were valued, including the nine aspects that were selected for the conjoint task. Findings In the study 334 students from administrative studies, building and construction studies, and social pedagogic studies were surveyed. They completed the survey in the classroom. 56% of the students were male. The results of the both the survey and the conjoint task are seen in table 1. In the survey, teacher quality and diploma result scored highest, with a mean score of 4,05 and 3,89. The second column represents the outcomes of the conjoint task. The coefficients indicate the weight that the four participants groups placed on each of the nine quality aspects when ranking the courses.

In the conjoint task diploma result was the most important characteristic (.25) directly followed by structure (.24). Schooling hours and guiding hours in workplace learning were of minor importance for the students. The three aspects with the highest scores in the survey, teacher quality, diploma result and employers' satisfaction, are also highly valued (over .20) in the conjoint task. Furthermore, schooling hours appeared to be the least important aspect for the students in both the survey and the conjoint task. There are, however, some striking differences between both outcomes. Civic education, that scored only 0,43 in the survey, appeared to have substantial influence on the choices made in the conjoint task (.19). For the aspect guidance in workplace learning it is the other way around; it had a high average score in the survey (3,73), whereas in the conjoint task it is completely overruled by the other aspects (.03). Figure 1 shows the differences between both methods in a bar chart. Figure 2. Bar Chart. The importance of nine course characteristics according to the students in a survey compared to a conjoint task. [In Appendix] In the final paper we will further explore the differences between both methods. We will compare the results of subgroups (divided according to gender, age, study field, personality traits) on both methods.

Theoretical & educational significance 1.

This study shows how conjoint can be applied to the subject of educational quality. It explains the different steps of the conjoint study: the selection of aspects, the number of aspects and vignettes, the (digital) programming of the study and the analyzing of the outcomes. 2. Conjoint analysis is a relatively new way to examine perceptions of education quality. This study shows the differences of the conjoint analyses with the more traditional survey.

References

- Batsell, R., Louviere, J. (1991). Experimental Analysis of Choice. *Marketing letters* 2(3), 199-214.
- Lesley, L., Ettenson, R., Cumsille, P. (2000). Selecting a Child Care Center: What Really Matters to Parents? *Child & Youth Care forum*, 29 (5), 299-322.
- Neil, A. (1992), *Conjoint Analysis: A Guide for Designing and Interpreting Conjoint Studies*, Chicago, American Marketing Association, Market Research Division.
- Jeffries, C. & Maeder, D.W. (2005) Using vignettes to build and assess teacher understanding of instructional strategies. *The professional educator*. 27 (1&2), 17-28
- de Wolf, I. (2000). *Opleidingsspecialisatie en arbeidsmarktsucces van sociale wetenschappen*. Doctoral thesis, Utrecht University.

PAPER PRESENTATION

A new approach to 'text quality'

Victoria Johansson, Lund University, Sweden; Asa Wengelin, Lund University, Sweden; Roger Johansson, Lund University, Sweden

This paper is an approach to discuss the complicated measure of text quality – what do we mean by it, and what to we measure? We present a method for training reviewers to evaluate texts, and we investigate the text quality in a data set consisting of 84 expository texts, produced in ScriptLog, by four groups: 1. University students without reading and writing difficulties (RWD), 2. University students with RWD, 3. 15-year-olds without RWD, 4. 15-year-olds with RWD.

After a training process involving both holistic and analytic methods, the reviewers evaluated the data set with unusually high interreliability (Cronbach's alpha = .917). Not surprisingly, the texts by the adults without RWD were ranked the highest, followed by adults with RWD, 15-year-olds without RWD and 15-year-olds with RWD.

Further, we compared the text quality between adults and 15-year-olds without RWD, using writing speed and text length as co-variables. The results show that the quality evaluations are not dependent on either. This opens up for some new interpretations, since text quality has usually correlated with text length.

It is important that teachers or researchers, using increased text quality as evidence for development of any kind define what is meant by this notion.

In writing research, the importance of various writing process, as well as the written product is often related to text quality. Typically, text quality is related to various sets of text characteristics, e.g. text length, production rate, lexical measures, or the writer's age or schooling, and often increased text quality is seen as an important outcome of e.g. an intervention (cf. e.g. Rijlaarsdam et al, 2008). However, it is not always discussed what is meant by text quality, or how it is measured.

This paper is an approach a) to discuss the complicated measure of text quality, b) to present a method for training reviewers to evaluate texts, and c) to investigate the text quality in a data set consisting of 84 expository texts, produced using a keystroke-logging program (ScriptLog) by four different groups: 1. University students without any reading and writing difficulties (RWD), 2. University students with RWD, 3. 15-year-olds without any RWD, 4. 15-year-olds with RWD.

We engaged three reviewers (with a background including at least a master exam with linguistics; only one of them had worked as a teacher). Their task was to agree on a scale to use for judging text quality, and thereafter to identify properties, characteristic for each grade in the scale. Prior to the evaluation of the data set in our investigation, the three reviewers were trained on several sets of texts of the same type (e.g. expositorys) written by different age-groups (ranging from age 13 to adult university students; however no texts in the training data were produced by persons with RWD). In the first stage, their task was to evaluate texts on holistic grounds. The second stage was to group the rated texts, and agree on a scale to use, based on the grouping of the text. This led to a four-grade scale. The third stage was then to agree on text properties typical for each grade, and to select one or two model texts from each grade. The fourth stage was to train on a set of texts grading them using the model texts and the criteria for each text. In the fifth, and final stage, they graded the data set that we investigate in this study. The reliability between the reviewers proved to be high (Cronbach's $\alpha = .917$). This is notable, since e.g. Lofqvist (1990) report that a correlation around .70 will be considered a high agreement between teachers' judgements of student papers. The high interreliability in our study is thus a sign of that the method of working with both holistic and analytic methods to rate text quality can increase the certainty of how texts are evaluated.

When we relate the quality ratings to the four groups of writers in the data set we were interested in, we find that the texts written by the adults without RWD have the highest quality, followed by the adults with RWD. Thereafter follow the 15-year-olds without RWD and the group with the lowest quality is the 15-year-olds with RWD. This is not an unexpected result, considering the age differences between the groups, and the difficulties with text production that are typical for the groups with reading and writing difficulties. The question is whether this approach to measure text quality would have been the same if we e.g. had compared groups that were more similar in age, education or writing ability. Another question is whether the use of a more fine-graded scale would have led to a different grading.

Further, we compared the text quality between adults and 15-year-olds without RWD, using writing speed (e.g. median transitions between keystrokes within a word) and text length (e.g. number of keystrokes in the final texts) as co-variables. The results show that the quality evaluations are not dependent on text length or writing speed. This opens up for some new interpretations, since we know from other studies (e.g. Grandin & Lindskog) that text length (and thus also the ability to produce much text fast) is usually strongly correlated with text quality.

It is important to continue to discuss the notion of text quality, what is meant by it, and what contributes to an increased quality, in the light of recent changes in the educational system. For instance, in Swedish schools, a new set of additional national testing is proposed. How could children's writing development be discussed and judged if there are no reliable methods of measuring text quality? If 'text quality' is used for proving the developmental outcome in any way, it is finally of equal importance for every researcher who uses the notion of text quality to clarify exactly what is meant by it.

References:

- Rijlaarsdam, G., Braaksma, M., Couzijn, M. Janssen, T. Raedts, M, van Steendam, E. Toorenaar, A., van den Bergh, H. (2008) "Observation of peers in learning to write. Practise and research." in *Journal of Writing Research*
- Grandin, S. & Lindskog, M. (2007) *Logopeders bedomning av textkvalitet*. Masterthesis in logopedics, Lund University
- Lofqvist, G. (1990) *The IEA Study of Written Composition in Sweden*. Lund: *Studia psychologica et paedagogica – series altera*, nr 93.

PAPER PRESENTATION

Predicting Adolescent Truancy – Individual Judgments and Classroom Factors

Christine Saelzer, Education (IfE), Germany

Only little is known about the association of classroom characteristics with adolescent truancy. An unresolved critical question is whether high achievement standards, high workload, and high pace do protect against or increase adolescent truancy. In this study, self-reports from 3,500 Swiss middle and high school students in 202 classes (in 28 schools) were used to predict truancy. The multilevel latent covariate approach (MLC) implemented in Mplus was implemented to specify hierarchical models. These models served to differentiate between the student and the classroom level. It was found that high achievement standards were associated with a lower truancy rate at both the student and the classroom level, whereas a high pace during lessons was associated with more truancy. At the student level, the perception of low workload was an additional predictor of high truancy.

Predicting Adolescent Truancy –

Individual Judgments and Classroom Factors Research Topics and Objectives

Truancy is known to be an important predictor of premature school dropout (Rumberger, 2000). Skipping lessons is seen mainly as an individual student's behavior within an institutional context (Claes, Hooghe & Reeskens, 2009; Rothman, 2001). Focusing at the individual level, students who truant are often thought of as being academically weak and over-challenged at school (Fogelman, Tibbenham & Lambert, 1980; Tyerman, 1986). On the other hand, there is a reasonable argument that truancy may also be linked to high academic potential (Rumberger, 1987; Voss, 1966).

According to Walberg and Ahlgren (1970), learning outcomes represent a function of three distinct construct domains including aptitudinal variables, instructional variables, and environmental variables. Key to this claim is that environmental variables explain variance in learning outcomes over and above the amount of variance explained by instructional and ability variables. This paper applies Walberg and Ahlgren's theory to truancy and thus bridges a gap in truancy research by taking into account two aspects: (a) classrooms as learning contexts and (b) predictors of truancy. The focus is given to students' workload, pressure to perform, and pace during lessons. Two research questions are focused on: How can individual characteristics explain truant behavior? And how are classroom characteristics related to truancy?

Data and MethodsSample

Participants consisted of a total of 3491 Swiss seventh to ninth graders ($n = 1142$ grade 7, $n = 1314$ grade 8, $n = 1089$ grade 9) in 202 classes in 28 schools and their teachers and principals.

Instruments

Truancy was measured by a weighted frequency index consisting of seven items which focus on skipping single lessons, half and whole school days as well as several days in a row. Students' background factors were collected including gender, grade level, grades, class repetition, nationality, school level, and SES ([HISEI]) as well as individual and family-related scales. School characteristics were measured using structural criteria (e.g. school size, geographic situation) and students' and teachers' opinions concerning processes and classroom climate issues. Most of the scales were adapted from Eder's (1998) school study.

Analyses

For this analysis, the multilevel latent covariate approach (MLC) implemented in Mplus was adopted, which takes the unreliability of the group mean into account when estimating the contextual effect. The group average is thus treated as a latent variable. A nested multilevel model was specified using Mplus 5.2 (Muth  n & Muth  n, 1998-2007) in order to predict truancy from individual covariates, individual student judgments and aggregated class level (latent) covariates.

Results and Conclusions

Table 1

Most strikingly, in model 3, both pressure to perform and pace during lessons were significant predictors of truancy ($b = -.09$; $b = .12$) at the individual level and were associated with truant behavior when used as latent covariates at the class level (pressure to perform: $b = -.28$; pace during lessons: $b = .25$). Explained variance was low at the individual level (6%) and intermediate at the class level (35%). It was thus verified that shared classroom perceptions mattered for a student's decision to play truant.

Educational and Scientific Importance of the Study

Truancy is still seen as a minor problem by teachers and principals, but it is likely to become a major social problem during the next few years. The importance of truancy as a step towards school dropout is of immense social

importance given the costs of students disconnecting themselves from the educational process. Understanding how truancy is related to classroom characteristics and how individuals respond to these features is useful in finding effective levers to prevent and deal with truancy as an unwanted student behavioral pattern. The level of perceived challenge is, both at the individual and the contextual level, a possible lever to prevent truancy.

References

- Claes, E., Hooghe, M., & Reeskens, T. (2009). Truancy as a contextual and school-related problem: A comparative multilevel analysis of country and school characteristics on civic knowledge among 14 year olds. *Educational Studies*, 35, 123–142. doi:10.1080/03055690802470258.
- Fogelman, K., Tibbenham, A., & Lambert, C. (1980). Absence from School: Findings from the National Child Development Study. In L. Hersov & I. Berg (Eds.), *Out of School* (pp. 25–48). Chichester: Wiley.
- Rumberger, R. W. (1987). High school dropouts: A review of issues and evidence. *Review of Educational Research*, 57, 101–121.
- Tyerman, M. J. (1968). *Truancy*. London, England: ULP.
- Voss, H. L., Wendling, A., & Elliot, D. S. (1966). Some types of high school dropouts. *Journal of Educational Research*, 59, 363–368.
- Walberg, H. J., & Ahlgren, A. (1970). Predictors of the Social Environment of Learning. *American Educational Research Journal*, 7, 153–167. Retrieved from <http://www.jstor.org/stable/1162157>.

PAPER PRESENTATION

Schooling and students' well being: a review of qualitative studies

Mara Westling Allodi, Stockholm University, Sweden

A systematic literature review of qualitative studies on the experiences and perceptions of school of Swedish children and adolescents was performed after literature searches in international and national databases. A narrative synthesis of 38 studies is presented focusing on the relationship between schooling and students' well being and mental health. Four themes were identified: general experiences (emotions, self-concept, choices); protective experiences (activities, participation, supportive relationships), risk experiences (tests, stress, school failure, negative evaluations, learning difficulties, lack of interest, negative relationships with teachers and peers); specific individual risks (disability, stigma, family problems, abuse, addiction, body image). The results are discussed in relation to developmental theories, special educational practices and current evaluation practices. The methodology of systematic review of qualitative studies applied in the field of educational research is discussed.

People's experiences and perceptions that are collected with non-experimental and qualitative studies can make a valuable contribution to an understanding of the meanings of processes and of relationships between phenomena. The object of this study was the relationships between educational experiences and students' well being and mental health. The methodologies of systematic review of qualitative research have been applied to a review of qualitative studies on Swedish children and adolescent's experiences of mental health and well being at school. The review was conducted as a part of a systematic review of research on "School, learning and mental health" performed by appointment of the Swedish Royal Academy of Sciences. The motives for doing a review of studies reporting children's and adolescents views on these matters was the ethical consideration to consider children and adolescents as subjects, having a right to express their views in matters that affect them; and the need to take account of the specific Swedish social and educational context through the experiences of the students that actively take part of it.

The aim of the review was to gather testimonies that can give indications of the experiences of mental health and well being of students in the Swedish educational system. Literature searches in several research databases with international and national publications were performed during spring 2009. A systematic screening of titles and abstracts was done on 527 references; 107 references were then screened in full text and 38 reports were judged to meet the inclusion criteria, requiring the presence of reports of children or adolescents' views, and that both aspects of mental health and of educational factors were treated in the study. The studies included were written by authors from fifteen Universities; they consisted of doctoral dissertations, academic papers, peer-reviewed articles and reports from agencies and organisation, representing the disciplines of science of education, disability studies, psychology, public health, youth studies, social work and interdisciplinary. The studies included in the review collected the students' views by mean of individual interviews, focus group interviews, observations, texts, phone conversations, internet messages, surveys and drawings. The results from the studies that were relevant for the aims of the review are structured in four themes: general views (well being, emotions, self-concept, stress, choices); protective experiences (activities, achievement, enjoyment, mastery, relationships, participation); risk situations (tests, school failure, academic expectations, lack of meaning, lack of adaptation, conformism, alienation,

relationships, victimization, exclusion); individual risk (disability, special educational settings, stigma, family problems, abuse, addiction, mental illness, body image).

The results are presented in a narrative synthesis, giving a particular weight to the direct and indirect report of children's and adolescents' own views. The theme general views is represented by six studies. The adolescents defined mental health as emotional experiences, seen both as internal feelings and as relational feelings. Family, friends and educational environments as social and physical environments were perceived as determinants of mental health. A great number of feelings were related to school. The students expressed what characterize a healthy school environment and also that harassment and rejection at school, performance stress, worries about grades and future prospects could be threats against self-worth and self-esteem, while teachers that do not care could generate negative experiences. Various kind of stress could be described and various strategies to resist stressful situations: for instance emotional support, safety and involvement.

The educational environments can be an arena for social, cognitive and emotional experiences, relationships and accomplishments that are enriching the individuals and increase their well being. General structural characteristics of the educational environments may also affect well being in different directions: performance, evaluation and feedback, freedom of choice and responsibility for the future may be perceived as a burden. The protective experiences were described in nine studies that emphasised the protective role of supporting relationships with teachers and friends. Caring relationships with the teacher involve their instructional skills, their beliefs in the students' potentials, and their firmness in keeping helping the students, never giving up their efforts.

The relationships with peers are important for the students' well being and even for their commitment to school work. A relationship with caring staff at school could be a decisive turning point for students with family troubles. Success and mastery experienced at school can make the students feel empowered and more competent. The learning environment could be also experienced as a healthy heaven, a safe place filled with activities, that make you feel purposeful and engaged. Risk experiences in school was the fourth theme, represented by 25 studies. School difficulties and special educational interventions could be perceived as stigmatizing and contributing to embarrassment, lowered status or simply to an undesired separation from the company of peers, and sometimes also to harassments.

The competition, the pressure to get good grades experienced in certain groups could cause performance anxiety, concentration difficulties and psychosomatic symptoms. The social life of the group can be very deprived and unhappy for isolated and rejected students. Conflicts with the teachers are identified as contributing to lowered interest and motivation in school work, but also detached and indifferent behaviours may affect motivation and self-confidence negatively. The theme of specific and individual risks emerged in nine studies. Among students that experienced learning disability (dyslexia) secondary emotional problems had been common. Having a disability that influences the social behaviour may increase the risk to be victimized by peers. The students reported that the victimizations caused school difficulties, sickness, absenteeism and depression. Other social problems (family conflicts, abuse, addiction, refugee status) could also make the students more easily exposed to negative experiences at school.

Some reflections: The studies reporting views of younger children on the matters of this review were less well represented. The negative experiences may be expressed in rather cautious terms by younger children. The experiences of the students change when they grow older, go through developmental processes and encounter different educational situations. Several developmental trajectories can be identified. The systematic review of qualitative studies is a valuable methodological approach that can be applied in the field of special educational needs.

PAPER PRESENTATION

Success at adult education: The situation of 16 to 18 year-old students with special needs

Nadia Rousseau, Université du Québec à Trois-Rivières, Canada; Karen Tetreault, Université du Québec à Trois-Rivières, Canada; Ghislain Samson, Université du Québec à Trois-Rivières, Canada; Sylvie Frechette, Université du Québec à Trois-Rivières, Canada

Many students with special needs leave high school before getting a diploma but reconnect with school through adult education. However, very few studies examine the situations experienced by these students. Therefore, this study aims to document the factors explaining why youths with special needs register in adult education programs at the age of 16, and to describe and analyse the school experiences of these students until they leave adult education with or without diploma. A sample of 165 youths with special needs, registered in an adult education program, answered a questionnaire outlining their past, present and expected situation as students. Also 45 of them accepted to participate in focus groups. 59 youths who left the adult education participated in phone interviews discussing their adult student

experience and their expectations about the future. Factors explaining the shift from youth to adult education are presented in order of significance. Students report a very positive perception of their school experience at the adult education. Recommendations are made to maintain this positive perception of adult education.

Introduction

Many teenagers abandon school before getting a high school diploma. In 2007-2008, 25.7% of Quebec teenagers were not enrolled in school and had not completed high school (MELS, 2009). They are unlikely to find a job in this complex society without the minimum credentials required in the job market. An important decrease in available jobs for youths without a high school diploma has been observed in the past years (Vultur, 2003).

Many youths reconnect with school through adult education. A significant increase of registration has been observed. Indeed, the number of students enrolled in adult education has increased from 128,200 in 1999-2000 to 158,793 in 2005-2006 (CSE, 2008). Many of them are students with special needs. Unfortunately, very few Canadian or Quebec studies examine the situations experienced by youths with special needs enrolled in adult programs. Therefore, it is advisable to examine the matter.

Objectives:

1. Document the factors explaining why youths with special needs register in adult education programs at the age of 16
2. Describe and analyse the school experiences of these students until they leave adult education with or without diploma.

Theoretical framework

Students that drop out of general education give the following reasons: lack of motivation, academic reasons, personal or family related issues, hoping to earn a living or have a job, their training perceived as completed, wanting to continue their schooling elsewhere, and repeated academic failures. (Potvin et al 2004). These reasons are associated with a number of challenging characteristics listed in several studies relating to dropouts : male gender, unproductive coping strategies, low self-esteem, poor social skills, negative perception of school, academic difficulties (especially in writing and reading), lack of motivation, behaviour problems (Fortin, Potvin & Royer, 2000), and negative school experiences (Rousseau, 2005). Finally, negative class atmosphere, negative teacher-students relationship and negative teachers' attitudes towards students with special needs (Potvin, 2005) are also associated with dropping-out. Many dropouts will register to the adult education in order to get a first diploma.

Methodology

A microethnographic analysis of case studies is conducted.

a) Participants and procedure

First objective

The sample is composed of 165 youths with special needs in high school school and registered in an adult education program in autumn 2007. They answer a questionnaire containing mainly metaphors (see Steinhoff and Owens, 1989) outlining their past, present and expected situation as students. Also 45 of them participate in focus groups.

Second objective

59 youths of the above sample that left the adult program with or without a diploma also participate in a twenty-minute phone interview on their adult student experience and their expectations about their future.

b) Data source

Two independent coders conduct a qualitative network approach of analysis that implies an inductive coding. The Cohen's Kappa coefficient of inter-rater agreement is 0.82. Frequencies are calculated in terms of proportion of meaning units in interviews.

Findings and discussion

According to frequency accounts, factors explaining the shift from youth to adult education are presented in order of significance in three broad themes: negative high school experiences, possibility of getting credits or a diploma, individual students' characteristics. Factors associated specifically with adult education are fulfillment of distal (getting a job) and proximal (getting a diploma) objectives. Factors associated with school are individual support, respect of individual learning pace, less stress and anxiety, and hope of success. Factors that explain leaving adult education without certification are the following: employment and persistence of school problems.

The participating youths with special needs left high school for adult education because they do not like school. The negative feelings are stronger with those in special education classes. When leaving adult education, they all have,

without exception, a very positive perception of their school experience, which represents a complete turnover. Students report working at their own pace in their books. Individual progress is monitored without references to the group. Moreover, positive feedback is given frequently and without prejudice. Unlike common belief, these students are persevering.

Conclusion and educational significance of the study

An increasing number of high school students who experience academic difficulties switch to adult education to get a high school diploma or the credits required for professional training. Throughout their schooling, they persist to overcome obstacles and progress at their own pace. Recommendations are made to maintain this positive perception of adult education.

References

- Conseil sup rieur de l' ducation (2008). De la flexibilit  pour un dipl me d' tudes secondaires de qualit  au secteur des adultes. Qu bec : Gouvernement du Qu bec.
- Dumont, M., Leclerc, D. & McKinnon, S. (2009).  volution temporelle du stress, du rendement scolaire et des ressources psychosociales selon cinq profils de d tresse psychologique d'adolescents. In R. Rousseau (ed.), *Enjeux et d fis associ s   la qualification. La qu te d'un premier dipl me d' tudes secondaires* (p. 121-160). Quebec : PUQ.
- Minist re de l' ducation, du Loisir & du Sport, (2009). Indicateurs de l' ducation –  ditions 2009. Quebec : Quebec Gouvernement.
- Potvin, P. (2005). La relation m tre/ l ves et  l ve en difficult  scolaire. In L. DeBlois (ed.), *La r ussite scolaire. Comprendre pour mieux intervenir* (p.149-159). Quebec : PUQ.
- Potvin, P. Fortin, L., Marcotte, D., Royer,  . & Deslandes, R. (2004). Guide de pr vention du d crochage scolaire. Loretteville: Centre de transfert pour la r ussite  ducative du Qu bec.
- Rousseau, N. (2005). L'expression du sentiment de r ussite ou d' chec scolaire : qu'en disent les principaux int ress s? In L. DeBlois (ed.), *La r ussite scolaire. Comprendre pour mieux intervenir* (p.149-159). Quebec : PUQ.
- Steinhoff, C.R. & Owens, R.G. (1989). The organisational culture assessment inventory: A metaphorical analysis in educational settings. *Journal of Educational Administration*, 27(3), 17-23.
- Vultur, M. (2003). L'insertion sociale et professionnelle des jeunes "d sengag s": analyse du programme d'intervention de La R publique. Sainte-Foy : INRS.

PAPER PRESENTATION

Can preschool education prevent the incidence of later emotional and behavioural difficulties?

Pamela Sammons, University of Oxford, United Kingdom; Yvonne Anders , University of Bamberg, Germany; Kathy Sylva, University of Oxford, United Kingdom; Edward Melhuish, University of London , United Kingdom; Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Brenda Taggart, University of London, United Kingdom

Drawing on a large data set collected as part of the Effective Provision of Preschool and Primary Education 3-11 Project (EPPE 3-11) this paper looks at children identified as showing special educational needs in England at age 10. The present study investigates which child, family and home predict primary teachers' identification of children's SEN status in relation to emotional and behavioural difficulties at age 10 using logistic regression models. Further, the analyses explore whether children's earlier preschool experience is related to later incidence of SEN. The sample consists of 2509 EPPE3-11 children. 8.3 % of the children were identified by their teachers as showing SEN related to emotional or behavioural problems. Early health problems or behavioural problems, having been a premature child, low maternal education, self employment of the mother, low socioeconomic status and eligibility for free school meals show to be risk factors for the identification of SEN at age 10. Also, boys have a higher risk than girls whereas child age has a protective impact. Analyses further showed that the quality of preschool attended still was significantly associated with SEN identification, even when other background factors were controlled. The results of the present study underline the continuing effect of preschool quality as a factor that has a specific role in reducing the likelihood of later emotional and behavioural problems. High quality preschool may be viewed as an effective intervention for enhancing resilience in young children.

Aims

More than 30 years ago the Warnock Report (Department of Education and Science,1978) suggested that about 20% of children would at some stage in their school career experience special needs of some kind. There has been much debate about this figure, which was largely based on teachers' estimates, but it still reflects current levels of SEN identification in England (e.g. Croll and Moses, 2003). The early identification of SEN in primary school is considered one important prerequisite for children to reach their full potential (Davie, 1996). But rather than relying solely on

strategies implemented in primary school, it may be more effective to investigate what influences children's development at an earlier age (in preschool). Preschool education programs which may promote better adjustment to school and school readiness (e.g. Magnuson et al., 2004; Sammons et al., 2008; Sylva et al., 2010) might therefore be hypothesised to be a means to help protect children from later being identified as having some form of SEN while they move through primary and secondary school. Only a few studies have investigated longer-term benefits of preschool education so far and very little attention has been paid to the question of whether preschool has particular benefits with respect to children with SEN or at risk of developing SEN (Anders et al., 2010; Taggart et al., 2006).

Drawing on a large data set collected as part of the Effective Provision of Preschool and Primary Education 3-11 Project (EPPE 3-11), - a major longitudinal study of preschool and primary school influences on children's developmental outcomes - this paper investigates children identified as showing special educational needs in England and explores the factors that help predict SEN status at age 10. The present study investigates which child, family and home factors predict primary teachers' identification of children's SEN status in relation to emotional and behavioural difficulties at age 10. Further, the analyses explore whether children's earlier preschool experience is still related to later incidence of SEN.

Methodology

Sample

All data are drawn from EPPE3-11, which followed children's cognitive and social/behavioural development between the ages of 3 and 11 in England and was funded by the Department of Children, Schools and Families (DCSF). The project collected a wide range of data on over 3000 children, their background and the preschool settings they attended. At each assessment of the longitudinal investigation, primary teachers completed a child social behavioural profile for each EPPE child and reported details of any SEN. This investigation uses the child profiles completed at the end of Year 5 (age 10). The sample for this study consists of 2509 EPPE3-11 children with a valid profile.

Measures

Outcome measure

Teacher reported on present SEN in the child profiles. The current analyses focus on special needs related to emotional and behavioural difficulties.

Predictors

Child factors included gender, English as additional language (EAL), age in months, ethnic group, birth weight, early behavioural problems, number of early health problems and number of early developmental problems as reported by the parents in preschool interviews, premature child and number of siblings.

Family factors included family structure, parents' employment status, parental education, family salary at time of preschool education, family SES and child eligibility for FSM (a proxy measure for low income).

Parent-child activities and routines during the preschool years which provide an indication of aspects of the early years home learning environment (HLE), such as reading to the child, listening to the child read, teaching songs and nursery rhymes etc, were aggregated to a scale measure of the quality of HLE (Melhuish et al., 2008).

Preschool measures: The duration of preschool attendance and the quality (based on environment ratings using ECERS-R and ECERS-E) and effectiveness of the preschool centre were regarded as potentially protective factors and tested as potential protective factors.

Statistical analysis

First, all child, family and home characteristics were tested as potential risk or protective factors for SEN. Stepwise analyses were conducted and only significant variables were retained in the models. Subsequently, the impact of indicators of preschool education was tested individually in logistic regression models controlling for all statistically significant variables retained in the background model. Standard errors adjusted for the multilevel structure of the data were estimated.

Findings

8.3 % of the children were identified by their teachers as showing SEN related to emotional or behavioural problems. Early health problems, behavioural problems in the early years, having been a premature child, low maternal education, self employment of the mother, low socioeconomic status and eligibility for free school meals show to be risk factors for the identification of SEN at age 10. Also, boys have a higher risk than girls whereas child age has a protective impact with older children in the sample being less likely identified as SEN. The quality of HLE is not significantly related to SEN identification. With respect to the influence of preschool experience, analyses revealed that the most basic indicator – preschool attendance versus no preschool – was not found to be significantly related to SEN identification when other background variables were controlled. The same holds for duration of preschool

attendance and preschool centre effectiveness. In contrast the quality of preschool attended still was significantly associated with SEN identification, even when other background factors were controlled.

Theoretical and educational significance of the research

The results of the present study suggest that a range of preventive strategies that support children's development in the early years may improve 'school readiness' and therefore reduce the number of children who may be at risk of developing SEN in later years. An important point concerns the continuing effect of preschool quality as a factor that has a specific role in reducing the likelihood of later emotional and behavioural problems. High quality preschool may be viewed as an effective intervention for enhancing resilience in young children. The findings of the study are highly relevant to educational policy-making and the politics of change and improvement.

PAPER PRESENTATION

PowerPoint Does Not Make Us Stupid – But Extensive Slides Impair Recall of Oral Information!

Christof Wecker, University of Munich, Germany

This study investigated whether information presented on slides is more easily recalled than information presented orally, whether information presented orally is recalled more easily if concise slides are presented than if extensive slides are presented, whether concise and extensive slides are superior to purely oral presentation overall and whether any such effect of the presentation mode can be explained by differences in cognitive load. A field study with a one-factorial design with the conditions no slides, concise slides and excessive slides was conducted in tutorials about literature search and supply. Cognitive load as well as recall of information presented orally and information presented on slides were measured separately in all three conditions. The results show no general negative effect of slides with respect to the recall of orally presented information, but a superiority of concise slides compared to extensive slides with respect to orally presented information and compared to no slides with respect to overall recall of information. Information presented on slides is recalled more easily than orally presented information. Differences in cognitive load can be ruled out as explanations for any of these effects. Given these findings it seems advisable to keep presentations concise, but more research is needed in order to delineate the optimal amount and kinds of content on slides.

Presentation software has become ubiquitous in educational institutions. However a fear that "PowerPoint makes us stupid" (Gralla, 2010) has been voiced. Research evidence about the effects of the use and of design features of slides on cognitive learning outcomes is sparse. In one study a negative effect of a PowerPoint lecture compared to a traditional lecture was found with respect to the recall of information that was presented exclusively orally, with recall for oral information being as low in the condition with electronic slides as in a condition that did not receive any instruction on the topic (Savoy, Proctor & Salvendy, 2009). One potential explanation for this finding would be that the extensive use of slides might place to excessive demands on learners' cognitive resources. Another explanation could be that an extensive use of slides might induce the impression that only information presented on slides is important.

The present study aims to contribute to a broader research base about these issues and to provide some constraints for potential explanations for effects on recall of orally presented information. In particular, it addresses the following research questions: (1) How does the presentation of information on slides vs. purely oral presentation affect the recall of information? (2) How do concise vs. extensive slides affect the recall of information presented only orally and information presented on slides? (3) How does the presentation of information without slides, with concise slides and with extensive slides affect the overall recall of information? (4) Can differences in recall of information between presentation modes be due to differences in cognitive load?

Method Instructional setting.

The study was conducted in tutorials in which skills in searching and obtaining literature were taught. These started with a presentation about the scientific publication system and basics of literature research and supply, which was followed by a quiz that served as a posttest. Design. Three conditions were compared in a one-factorial design: No slides, concise slides and extensive slides. Four tutorial groups were nested within each condition. Independent variables. Content was constant across conditions. In the condition without slides all information in the presentation was given orally. In the conditions with slides the same information was presented orally, but in the condition with concise slides key points were listed on projected slides during some parts of the presentation, whereas in the condition with extensive slides also detailed information and key statements were projected on slides throughout the presentation. All slides contained a maximum of eight lines or six bullet points.

Dependent variables.

Recall of information was measured by 18 multiple choice items. One third of them covered information that was presented orally in all three conditions, information that was presented on slides in the condition with extensive slides, and information that was presented on slides in both conditions with slides, respectively. To equate these subtests, scores were z-standardized using the means and standard deviations from the condition in which all three kinds of information had been presented orally (no slides). Then two equally weighted scores were formed for recall of information presented only orally and for recall of information presented on slides separately for each condition. Cognitive load was measured by a single Likert type item with a nine-point answering scale. Participants. The sample comprised 294 freshers (86 % female, 14 % male) in a degree program in education from two subsequent years. Results (1) Recall of information presented on slides in the conditions with slides was higher than (i) recall of the same information in the condition without slides, $F(1; 282) = 14.48$; $p = .05$, and than (ii) recall of information presented only orally in the same conditions, $F(1; 181) = 43.78$; $p = .20$. (2) While there were no differences between concise and extensive slides with respect to the recall of information presented on slides, $F(1; 181) n. s.$, concise slides were superior to extensive slides with respect to the recall of information presented only orally, $F(1; 181) = 4.36$; $p = .02$. Although recall of orally presented information in the condition with concise slides was descriptively higher than in the condition without slides, these conditions did not differ significantly. (3) When recall for information presented only orally and for information presented on slides were weighted equally and combined to an overall indicator of recall of information, the three conditions differed in this respect, $F(2; 282) = 3.24$; $p = .02$. While concise slides were superior to no slides with respect to overall recall of information, $F(1; 191) = 5.53$; $p = .03$, the corresponding difference between extensive slides and no slides could not be secured against chance, $F(1; 192) = 1.47$; $n. s.$ (4) Cognitive load was generally moderate and did not differ between the three conditions, $F(2; 275) = 1.58$; $n. s.$

Discussion

A general negative effect of slides on recall of orally presented information as suggested by Savoy et al. (2009) could not be found. Instead, a positive effect of concise vs. extensive slides with respect to orally presented information was demonstrated. This effect cannot be explained by excessive demands on learners' cognitive resources. Presenting information on slides has an advantage with respect to the recall of these particular pieces of information. However, in many cases it seems unfeasible to put all the information one wants to convey on slides. Some information will almost certainly need to be presented orally. When equal value is attached to information irrespective of its presentation mode, concise slides appear superior to purely oral presentation whereas extensive slides do not. Therefore it seems advisable to keep slides concise. Future research has to delineate the boundaries of "conciseness".

References

- Gralla, P. (2010). U.S. Army discovers PowerPoint makes you stupid. Retrieved from http://blogs.computerworld.com/16006/powerpoint_makes_you_stupid, 28th October 2010.
- Savoy, A., Proctor, R. W. & Salvendy, G. (2009). Information Retention from PowerPoint and Traditional Lectures. *Computers & Education*, 52(4), 858-867.

PAPER PRESENTATION

Demonstration of Procedures in Face-to-Face Instruction: Effect of Animated Steps in Worked Examples

Christof Wecker, University of Munich, Germany

This paper deals with the question how worked examples for procedures should be demonstrated in face-to-face instructional situations. A plausible way of transferring the findings from research on worked examples to face-to-face instruction would be the use of presentation software. In particular, the requirement of making intermediary results transparent could be achieved by using animation functionalities for the stepwise presentation of intermediary results. The present study investigates whether such an animated stepwise presentation has a positive effect on procedure acquisition compared to a static presentation of the whole solution path.

A within-subjects design was implemented in a one-year university course about empirical research methods in two subsequent years: One of two procedures was demonstrated with animated stepwise presentation of intermediary results, whereas the other was demonstrated with a static presentation of the whole solution path. The order of the manipulation was counterbalanced. Procedure acquisition was measured in the regular examinations at the end of each term. The scores were z-standardized topic-wise in order to allow for within-subject comparisons of the two presentation modes. A significant positive effect of animated stepwise presentation of intermediary results compared to static presentation of the whole solution path was found, which was specific for the procedures in focus. This effect is remarkable given that it was obtained in a field study within a regular course where outcomes were measured several weeks after manipulation. In practice, intermediate steps should be presented stepwise using animation functionalities, which once was common in the age of the blackboard.

In many learning settings the acquisition of procedures such as performing statistical tests is a main goal of instruction. A central source for the acquisition of a procedure is the study of worked examples, i. e. the induction of the procedure based on the trace of intermediary results of the solution steps performed during its application (VanLehn, 1990): During the study of worked examples, the current knowledge of the procedure is applied to each intermediary result. Thereby, the subsequent intermediary result is either predicted or explained (anticipatory reasoning and principle-based explanation, cf. Renkl, 1997). An important prerequisite for this mechanism of procedure acquisition is specified by the so-called "show-work principle" (VanLehn, 1990): All intermediary results need to be transparent. Furthermore, step-wise presentation of intermediary results has been found to foster learning (Renkl & Atkinson, 2002). In face-to-face instructional settings, presenting the types of worked examples used in laboratory research often would appear somewhat strange. Instead, the more natural and common way of presenting worked examples is an instructor providing a demonstration of the procedure (cognitive modeling).

In fact, [o]ne could argue that studying worked examples is a type of observational learning" (van Gog & Rummel, 2010, p. 156). Therefore, the research literature on worked examples can be regarded as basic research that needs to be transferred to face-to-face demonstrations in practical application settings (Atkinson, Derry, Renkl, Wortham, 2000). A plausible way of transferring the findings from research on worked examples to face-to-face instruction would be the use of presentation software (e. g. PowerPoint) that has become ubiquitous anyway. In particular, the requirement of making intermediary results transparent could be achieved by using the animation functionalities of this kind of software for stepwise presentation.

The present study investigates whether such an animated stepwise presentation has a positive effect on procedure acquisition compared to a static presentation of the whole solution path. Method Instructional setting and content. The study was conducted as a field study in the context of a one-year university course about empirical research methods in two subsequent years during the winter and summer terms. Design and manipulation of the independent variable. A within-subjects design was implemented: Of two procedures (winter term: Cohen's kappa, summer term: t-test for independent samples), in each year one was demonstrated with animated stepwise presentation of intermediary results, whereas the other was demonstrated with a static presentation of the whole solution path. The order of the manipulation was counterbalanced across the two topics in the two years without changes in content or amount of accompanying verbal explanations.

Dependent variables.

Procedure acquisition was measured by calculation tasks in the regular examinations at the end of each term. In both cases, the occurrence of the steps of the procedure in the solutions was coded and counted (winter: Cronbach's $\alpha = .85$, summer: Cronbach's $\alpha = .90$). Furthermore, the unspecific learning outcomes (for the other topics of the course) were measured in these examination by means of 21 and 16 multiple choice items, respectively (winter: Cronbach's $\alpha = .63$, summer: Cronbach's $\alpha = .65$). Both measures were z-standardized using the means and standard deviations for the respective topic to allow for within-subjects comparison between the two manipulated conditions. Participants. The sample comprised 324 students from the lecture who participated in it for the first time and took both examinations in the same year. They were on average 21.4 years old ($SD = 3.2$); of them 88 % were female and 12 % were male.

Results

The z-standardized scores for procedure acquisition were higher for the topic covered with animated stepwise presentation of intermediary results than for the topic introduced with static presentation of the whole solution path was implemented, $t(323) = 2.25$, $p = .01$, $d = 0.12$. To rule out the possibility that this difference might be due to variations between terms confounded with the manipulation, the unspecific learning outcomes were compared in the same way. The z-standardized scores for this variable from the terms in which animated stepwise presentation of intermediary results with respect to the particular topics chosen was implemented were not higher than the z-standardized scores from the terms in which static presentation of the whole solution path was implemented, $t(323) = -1.83$, n. s. Rather, the descriptive results tended in the opposite direction.

Discussion

In line with research on worked examples (Renkl & Atkinson, 2002), these findings indicate that animated stepwise presentation of intermediary results is more effective for procedure acquisition than static presentation of the whole solution path when demonstrating a procedure. In particular, potential confounding that might occur in a field setting using intact courses could be ruled out by means of the within-subjects design and the test for the specificity of the effect for the topics selected for manipulation. The effect on procedure acquisition is remarkable in spite of its low magnitude given that it was obtained in the context of a field study within a regular university course where the

learning outcomes were measured several weeks after a rather small-scale manipulation. For instructional practice it might be concluded that when using presentation software for the demonstration of procedures, intermediate steps should be presented stepwise using the animation functionalities of the software. This was actually the typical way of presentation in the age of the blackboard, but in the age of slides it requires additional effort during preparation.

References

- Atkinson, R. K., Derry, S. J., Renkl, A. & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, 70, 181-214.
- Renkl, A. (1997). Learning from worked-out examples: A study on individual differences. *Cognitive Science*, 21(1), 1-29.
- Renkl, A. & Atkinson, R. K. (2002). Learning From Examples: Fostering Self-Explanations in Computer-Based Learning Environments. *Interactive Learning Environments*, 10(2), 105-119.
- van Gog, T. & Rummel, N. (2010). Example-Based Learning: Integrating Cognitive and Social-Cognitive Research Perspectives. *Educational Psychology Review*, 22, 155-174.
- VanLehn, K. (1990). *Mind bugs: The origins of procedural misconceptions*. Cambridge, MA: MIT Press.

PAPER PRESENTATION

The Mere Exposure to a Problem Prepares Teacher Students for Learning

Inga Glogger, Institute of Psychology, Germany; Lars Holzapfel, Educational University of Freiburg, Germany; Elmar Offenwanger, University of Freiburg, Germany; Rolf Schwonke, University of Freiburg, Germany; Matthias Nuckles, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany

There are approaches that try to optimize receptive forms of learning and direct forms of instruction by problem-oriented activities (e.g., Schmidt et al., 1989; Schwartz & Bransford, 1998). Such approaches typically use generative group activities that are quite time consuming. These activities are thought to generate useful forms of prior knowledge. Simply knowing about target problems might, however, already sufficiently prepare for learning from direct instruction, as the goal of learning and the application context becomes salient. In an experimental pretest-posttest design, 89 student teachers learned about assessing learning strategies in students' learning journals by a computer-based learning environment. The problem-first group were shown an authentic problem (evaluating learning journals and giving feedback) prior to a "receptive" learning phase and they worked on the problem after the learning phase. The problem-after group received the problem subsequent to the learning phase and then worked on it. The open-ended questions of the posttest were coded for identification of learning strategies and their quality and for suggestions to students for improving strategies (i.e., feedback). Providing the problem first enhanced learning in terms of identifying learning strategies and their quality. Surprisingly, suggestions for improving learning strategies were made more often by the problem-after group, even though they did not identify strategies and their quality as well as the problem-first group. Hence, receiving an authentic problem prior to learning prepared teacher students to providing feedback that was based on specific observation rather than sparsely founded suggestions.

Aims of the study.

There are approaches that try to optimize receptive forms of learning and direct forms of instruction by problem-oriented activities (e.g., Schmidt, De Volder, DeGrave, Moust, & Patel, 1989; Schwartz & Bransford, 1998). These approaches typically use generative group activities that should lead to forms of prior knowledge that allows for subsequent elaborative processes. For example, Schmidt et al. activated prior knowledge by letting students discuss explanations for a problem central to the learning domain. There are little attempts to systematically study which features of the work on the problems are crucial. Does it actually require solving the problem? Attempts to solve the problem let learners encounter lacks of understanding or knowledge which is thought to be productive (Kapur, 2008, "productive failure"). Simply knowing about an authentic problem might, however, also hint to knowledge deficits. Knowing an authentic problem makes the goal for learning and the application context more salient. If knowing about a problem already suffices to prepare for learning from direct instruction, this option would be more time efficient.

In a previous study, teacher students learned about learning journals and how to diagnose learning strategies in such journals. By writing learning journals, students are encouraged to use learning strategies such as elaboration, organisation, and metacognitive strategies. For example, they could explain how a new concept relates to something they already knew (elaboration strategy). In order to apply learning journals as a method to foster learning strategies in students, teachers have to be able to identify learning strategies, their quality, and formulate useful feedback. Therefore, as an authentic starting problem, student teachers received learning journals of students. They were asked to find learning strategies and criteria for evaluating them. They showed more transfer than a control group that received explanations instead. In the present study, which was part of the research program "Bildungsforschung" ("Educational Research") of the Baden-Württemberg Stiftung, student teachers only knew about the authentic problem (i.e., evaluating and providing feedback on students' learning journal), but they worked on it after learning.

We expected that getting to know an authentic problem prior to learning enhances teacher students' diagnosis and feedback skills with respect to learning strategies.

Methods.

Eighty-nine student teachers (71 female, 18 male) from two equivalent seminars at a German University of Education participated in the study (title of the seminars: "Selected topics of mathematics instruction"). Two weeks prior to the intervention, they all worked on a pretest during their seminar. The pretest assessed diagnosis skills regarding learning strategies by three open questions. At the intervention, participants were randomly assigned to two conditions: (a) they received an authentic problem prior to learning with a computer-based learning environment and had 5 minutes to familiarize themselves with the problem (problem-first group, $n = 42$); (b) they received the same problem after learning (problem-after group, $n = 47$). The problem consisted of learning journal entries and a description of a situation ("Here you see two learning journal entries of two students. Your challenge is the identification of learning strategies and the formulation of a feedback to the students. Use the information from the learning environment. Before you start the learning environment, we would like to ask you to read the learning journal entries in detail (5 minutes)."). All participants learned in the computer-based learning environment for 30 minutes. In the learning environment, the diagnosis of elaboration strategies in learning journals was taught. Providing feedback was not specifically taught. After learning, the problem-first group had 10 minutes to solve the problem, that is, to identify learning strategies in the learning journals and to write feedback to the students. The problem-after group now received the problem, read it carefully (5 minutes) and worked on it for 10 minutes, that is, time-on-task was equal across groups. The open-ended questions of the posttest were coded by two independent raters (ICCs $> .80$). Learning outcome scores were (1) the number of sections coded as "identify and feedback learning strategies and their quality" and (2) the number of sections coded as "suggestions for improving learning strategies".

Results.

Teacher students who first familiarized themselves to the authentic problem achieved higher scores in identify ($F(1, 87) = 4.91$, $p = .029$, $\eta^2 = .05$). Suggestions, however, were made more often by the problem-after group ($F(1, 87) = 14.24$, $p = .001$). Prior knowledge was not significantly related to the learning outcome scores.

Theoretical and educational significance. Research on preparation to learn from direct forms of instruction used time-consuming instructional methods. Results of this study suggest that adult learners such as student teachers, however, can be prepared by the mere exposure to a problem taken from their professional context. The phase of (un)productive failure while struggling with a problem might not be necessary for all kinds of learners.

Unexpectedly, the problem-after group gave more suggestions to students how to improve their learning strategies even though they were less successful than the problem-first group in identifying learning strategies and explaining why the learning strategies were suboptimal. However, well-grounded specific and, thereby, helpful (Shute, 2008) suggestions can scarcely be made without detailed identification of learning strategies and their quality. We will reanalyse the suggestions in order to test if the problem-after group's suggestions were of lower quality than the suggestions of the problem-first group. In summary, receiving an authentic problem prior to learning prepared teacher students to learn and transfer their knowledge to giving feedback that was based on specific observation.

References

- Kapur, M. (2008). Productive Failure. *Cognition and Instruction*, 26, 379-424.
- Schmidt, H. G., DeVolder, M. L., De Grave, W.S., Moust, J. H. C., & Patel, V.L. (1989). Explanatory models in the processing of science text: The role of prior knowledge activation through small-group discussion. *Journal of Educational Psychology*, 81, 610-619.
- Schwartz, D. L., & Bransford, J. D. (1998). A time for telling. *Cognition and Instruction*, 16, 475-522.
- Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, 78(1), 153-189.

PAPER PRESENTATION

Expository Instruction before Inquiry Learning: Fostering Understanding of "Undiscoverable" Theories

Alexander Rachel, University of Munich, Germany; Christof Wecker, University of Munich, Germany; Eva Heran-Dorr, University of Bamberg, Germany; Christine Waltner, University of Munich, Germany; Hartmut Wiesner, University of Munich, Germany; Frank Fischer, Universität München, Germany

Some scientific theories that students are supposed to learn through inquiry learning involve assumptions about unobservable theoretical entities and relations among them. This study investigated whether prior expository instruction and summary expository instruction can foster the understanding of these theories. In an experimental study with a 2x2-factorial design 604 high school students from 23 classes participated in an inquiry unit about

magnetism. Prior expository instruction fostered the understanding of the explanatory theory both in an immediate and a delayed posttest. Summaries produced an effect on understanding of the explanatory theory only in an immediate, but not in a delayed posttest. The findings suggest that prior expository instruction can provide learners with explanatory theories they can apply to phenomena observed during their inquiry activities and thereby foster the understanding of such explanatory theories.

One of the main goals of science education is to foster the understanding of scientific theories that can explain observable phenomena. Inquiry learning is regarded as functional for accomplishing this goal (de Jong, 2006). However, explanatory theories in science that students are supposed to learn often go beyond functional relationships among observable variables that can be discovered by observation in a straightforward way. For example, in phenomena related to magnetism, (theoretical) molecular magnets cannot be observed directly. Accordingly, the learners' hypothesis space (Klahr & Dunbar, 1988) will hardly contain assumptions about them, and they have little chance to discover them on their own. This suggests expository instruction about possible explanatory theories as an approach to foster theoretical understanding during inquiry learning. In principle, expository instruction can be provided prior to inquiry activities, but the same content can also be presented in a summary afterwards.

In the former case, learners could use these theories to explain the phenomena they encounter during inquiry activities, which could help them develop a robust understanding of them. In the latter case, however, this use of the theories is not possible: Without the opportunity to use them to make sense of the phenomena observed, learners may be less likely to build up a robust understanding of them. To test these assumptions, we conducted an empirical study to investigate the effects of prior expository instruction and summary expository instruction on the acquisition of understanding of scientific theories. We hypothesized that prior expository instruction improves understanding of scientific theories compared to no prior expository instruction in a test immediately after the learning phase as well as several weeks later. We further expected that summary expository instruction improves understanding of scientific theories compared to no summary expository instruction only in a test immediately after the learning phase, but not several weeks later.

Methods and data sources

Participants. The participants in this study were 604 German high school students from 23 7th grade classes (60 % female, 40 % male; age: $M = 12.66$, $SD = 0.59$). **Design.** Five to six intact classes were randomly assigned to each condition of a 2x2-factorial design with prior expository instruction (without/with) and summary expository instruction (without/with) as independent variables. **Procedure and learning environment.** Whole classes of students first completed a 10 minute pretest. Then they worked on an inquiry unit about magnetism for 100 minutes. In all conditions the students conducted hands-on experiments in dyads at up to eleven learning stations. They completed an immediate 20 minute posttest and about two months later a 20 minute delayed posttest in their classrooms.

Independent variables.

In the conditions with prior expository instruction, first a 25-minute introduction to the theoretical background of magnetism was provided by a teacher. No such introduction was given in the conditions without prior expository instruction. In the conditions with summary expository instruction a 25-minute teacher-led wrap-up phase about the same topics as in prior expository instruction took place afterwards, while there was no such phase in the conditions without summary expository instruction. **Dependent variable.** Understanding of the scientific theory of magnetism was measured by means of 16 multiple-choice and true-false items (immediate posttest $\alpha = .71$; delayed posttest $\alpha = .74$). A test for knowledge about functional relations among observable variables associated with magnetism was used as the pretest (13 items, $\alpha = .62$).

Statistical analysis.

Data were analyzed by means of single ANCOVAs with the respective posttest measure as the dependent variable, prior expository instruction and summary expository instruction as independent variables, class as a random factor nested within the cells of the design and the pretest measure for knowledge about functional relations among observable variables as a covariate. The significance level was set to 5 %. Results A main effect of prior expository instruction in favour of the conditions with prior expository instruction compared to the ones without prior expository instruction could be detected in the immediate posttest, $F(1; 19.14) = 12.39$; $p = .002$; partial $\eta^2 = .05$. An analogous main effect of prior expository instruction was found in the delayed posttest, $F(1; 19.37) = 10.87$; $p = .004$; partial $\eta^2 = .03$. Furthermore, a main effect of summary expository instruction in favour of the conditions with summary expository instruction compared to the ones without summary expository instruction was found in the immediate posttest, $F(1; 19.12) = ; p = .001$; partial $\eta^2 = .06$. However, this effect disappeared at the delayed posttest, $F(1; 19.38)$ n. s. In both posttests, no significant interactions were found.

Discussion

These findings provide evidence for our argument that understanding of scientific theories that involve unobservable variables is less likely to be attained by inquiry activities without further support. Rather, learners benefit substantially by being introduced to the theories developed by scientists. The finding that a summary of the same content as provided by prior expository instruction did not produce a lasting effect on the understanding of scientific theory suggests that the effect of prior expository instruction is not simply a matter of being told the right answers. An explanation could be that prior expository instruction about theories that cover phenomena observed during hands-on experimentation can lead to the application of these theories during inquiry activities, thereby yielding deeper theoretical understanding. Overall, the study supports the argument that elements of direct instruction might play an important role in inquiry learning (cf. Klahr & Nigam, 2004), while still highlighting the importance of phases of inquiry in which learners can apply the theories to be learned. Teachers implementing inquiry learning would be well advised to reflect about the chances their students actually have to find out by inquiry what they are supposed to learn, and provide targeted support.

References

- de Jong, T. (2006). Technological advances in inquiry learning. *Science*, 312, 532
- f.Klahr, D. & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science*, 12(1), 1-48.
- Klahr, D. & Nigam, M. (2004). The equivalence of learning paths in early science instruction: Effects of direct instruction and discovery learning. *Psychological Science*, 15(10), 661-667.

PAPER PRESENTATION

Interpersonal teacher behaviour: lesson associations with classroom social climate

Tim Mainhard, Utrecht University, Netherlands; Mieke Brekelmans, Utrecht University, Netherlands; Theo Wubbels, Utrecht University, Netherlands

The present study investigated whether the classroom social climate varies between lessons. Specifically, the within- and across-lesson associations of coercive and supportive teacher behaviour incidents with the classroom social climate were studied. Participants in the study were 48 Dutch secondary school teachers and their classes, that is, 1208 students. Multilevel process analyses showed that supportive behaviour incidents correlated with a positive social climate during the current lesson and the lesson a week later in terms of teacher interpersonal Affiliation. Supportive behaviour incidents did not, however, correlate with social climate in terms of teacher interpersonal Control. Coercive behaviour incidents correlated with disrupted teacher Affiliation during the current lesson and the lesson a week later, but did not virtually correlate to increased levels of a teacher's Control in the classroom.

How students perceive the classroom social climate, and especially the way students perceive their teachers interpersonally, is strongly related to student achievement and well-being (Davis, 2003; Wentzel 2002; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006). The more warm and supportive a teacher is, the more students report a sense of belonging and being engaged (Freeman, Anderman, & Jensen, 2007). On the other hand, if teachers are acting offensive and coercive learning is negatively affected, and students report more psychological and somatic complaints (Sava, 2002).

The aim of the present study is to examine how incidents of coercive and supportive teacher behaviour are associated with the variability of the classroom social climate teachers create. Studies which have investigated changes of the classroom climate (Mainhard, Brekelmans, Wubbels, & den Brok, 2010; Patrick, Anderman, Ryan, Edelin, & Midgley, 2001) have largely done so over rather extended periods of time (e.g., several months), thereby ignoring lesson-to-lesson variability. The present adds to the existing body of knowledge on classroom social climates by investigating these associations within (i.e., during a lesson) and across lessons; specifically, what is the association of coercive and supportive behaviour of a teacher with the classroom social climate one or two weeks later? Incidents of teacher coercion and supportive teacher behaviour may change classroom social climate temporarily or permanently.

Classroom Climate and teacher behaviour

In the present study, the social climate is conceived as the quality of social relations in classrooms. Collective students' perceptions of the teacher Control and Affiliation are utilized as an indicator of the climate. Building on a phenomenological point of view, students are considered as the most appropriate informants of their learning environment (c.f., Lýdtke, Robitzsch, Trautwein, & Kunter, 2009). Teachers with relative more Control and Affiliation provide, in terms of students motivation and learning outcomes, more effective classrooms (Brekelmans, Sleegers, & Fraser, 2000). The student Questionnaire on Teacher Interaction (QTI, Wubbels et al., 2006) was used to tap students' perceptions teacher Control and Affiliation (respectively: $\alpha = .80$ and $.93$; ICC1 = $.44$ and $.52$, ICC2 = $.93$ and $.95$).

Actions to gain control that students perceive as coercive negatively affect the social climate and student learning (Lewis (2001). Coercive discipline includes sarcasm, yelling in anger, embarrassing students, and punishment. On the other hand, using appropriate humour, providing clear and structured instruction, or undertaking activities students think are fun are factors that support a positive classroom social climate. A Teacher Behaviour Observation Checklist (TBOC) was developed, to collect student observations of teacher behaviour incidents (coercive: $\alpha = .81$, ICC1 = .58, ICC2 = .92.; supportive: $\alpha = .71$, ICC1 = .53, ICC2 = .91).

Hypotheses

In classrooms with more incidents of coercive teacher behaviour students perceive less Affiliation; teachers might gain Control because students comply with the teacher's display of power (Hypothesis 1).

Incidents of supportive behaviour positively correlate with students' perceptions of a teacher's Affiliation, but are also beneficial to the teacher's Control (Hypothesis 2).

Method

Participants and Procedure

48 Dutch secondary school teachers (26 females) and one of their classroom groups (1208 students, age $M = 14.09$, $SD = 1.47$). Teachers were asked to administered questionnaires on 9.31 ($SD = 2.35$) occasions during 4 month (i.e., 447 individual classroom lessons in total). Half of the students completed the QTI and the other students the TBOC. Thus, each time, a student focused on either teacher behaviour incidents or teacher Control and Affiliation to yield some independency in the applied measures.

Results

Multilevel process analysis was employed (van Doorn et al., 2008), which relates two or more simultaneously assessed concepts across time. This analysis is similar to multilevel modelling employing time varying covariates but without including a designated time variable as a predictor. Results are summarized in Table 1.

Discussion

Hypothesis 1

Frequently using coercive behaviour was associated with significantly lower teacher Affiliation. It immediately disrupted the social climate, and was associated with less Affiliation a week later. The use of coercive behaviour was associated with somewhat more Control in class, but acting coercively in two lessons in consecutive weeks occurred to counterbalance these associations.

Hypothesis 2

Frequent supportive behaviour was associated with more teacher Affiliation during the current lesson as was supportive behaviour one week earlier, but to a lesser extent. More frequent supportive behaviour however was hardly associated with teacher Control.

There were no differences found between classrooms in the associations between teacher behaviour and the social climate (i.e., random slopes). This suggests that the processes described here are comparable across classrooms.

Practical implications

Coercive teacher behaviour is very unlikely to go together with greater Control in the classroom. Teachers who engage in coercive behaviour may deliberately sacrifice Affiliation because they believe they will re-establish or consolidate their Control in the classroom. The present study shows that this assumption is not justified. Teachers should use small rather than intense corrections, behave as unaggressive as possible (Evertson & Weinstein, 2006), and should apply increased intensity of disciplinary actions only for intensified disruptive student behaviour (Cr   ton et al., 1989). Regarding supportive behaviour, although the effects we found were not substantial, we have shown that supportive behaviour pays off immediately and is an investment for the near future as well.

PAPER PRESENTATION

Dialogic interaction among primary pupils in a wiki-environment in science

Judith Kleine Staarman, University of Exeter, United Kingdom; Manoli Pifarre Turmo, University of Lleida, Spain

This paper describes the analysis of the collaborative process of a primary pupils' writing task with the aid of a Wiki environment. Students worked and contributed to the wiki in pairs. The aim of the project was to explore how a wiki may be used to support primary school pupils' collaborative interaction and to shed light on the complex process of collaboration and interaction, both in and around the Wiki environment.

Our study illustrates some of the challenges and the difficulties that students had to face in order to write a text collaboratively with a Wiki. We argue that students need to develop an intersubjective orientation towards others participants' perspectives, to be able to co-construct knowledge about a topic. For this purpose, the project utilised a "Thinking Together" – type approach to help students to develop an intersubjective orientation towards one another and to support the creation of a 'dialogic space' to co-construct new understanding.

We present our focus for the analysis of face-to-face students' interaction in order to contribute in the Wiki environment, which is based on a dialogic approach to collaboration. Our results illustrate how the thinking together approach became embedded in the Wiki environment and how in the context of a science project, it enabled the collaborative writing of a joint informative text about the science topic under investigation.

Our aim for this paper was to find out how, in a Wiki environment, students develop and maintain shared understanding of a science topic, and how students are taking each other's perspective into account. We also aimed to examine how the wiki environment itself may or may not support students in this process. To this end, we designed, implemented and evaluated a science project in which primary students used a Wiki environment, with the specific aim of establishing and supporting collaborative interaction, while engaging in a collaborative writing task. Students worked in pairs and also made their wiki contributions as pairs.

Our theoretical background is grounded in socio-cultural theory, which states that social interaction lies at the heart of all learning processes. From our perspective, participation in a collaborative activity requires that participants establish and maintain what Rogoff (1990) and Wertsch (1991) have termed intersubjectivity.

To enable and support collaborative learning, there are a number of particular relevant characteristics of wikis. First, wiki software enables the collaborative editing of texts and these texts are then available to the whole community of users. This means that the joint collaborative process and product is visible to all participants. Secondly, the wiki software allows two separate but related collaborative processes to happen simultaneously. The actual wiki content is written collaboratively on one page, while a tab leads to another page, in which participants may negotiate the actual content of the wiki. Thirdly, the collaborative writing process in a wiki environment is asynchronous, mediated and indirect, which gives participants the opportunity to reflect on what they read and write to respond/reply to their partners. And fourthly, all revisions to the wiki page are kept in the wiki history, enabling users to trace the development of the wiki and reflect on the changes in the collaborative work.

Although these features are characteristics of wiki design that may enhance the collaborative processes, it remains unclear which pedagogical approach could contribute most to successful collaborative learning processes using wikis and what difficulties and needs primary students would require in order to participate in the Web 2.0 global knowledge era.

The study took place in Lleida, Spain, in an urban primary school. Twenty-five 9-10 year old pupils participated in the study. Students worked together in pairs in the wiki environment to create a joint informative text about a science topic, together with 2 other pairs. We analyzed in depth the data collected during the seven wiki sessions. We video-taped, transcribed and analyzed face-to-face pairs' interaction while working in the wiki environment.

In this paper, we aim to answer the following research questions:

1. What type of peer's interaction occurs when they are working in a wiki environment? What features of dialogue are they using?
2. How does the face-to-face interaction of pupils support the interaction in the wiki-environment and the creation of a joint collaborative text.
3. What is the relationship between the pairs' collaborative communication and thinking as evidenced in their talk and their contributions in the wiki environment?

Our analysis approach has strong links with a methodological framework called Sociocultural Discourse Analysis (Mercer, 2005). The first stage of the analysis involved characterizing the type of interaction of students in and round the Wiki. The second stage of the analysis process consisted of searching for the presence of key words that may indicate reasoning and collaboration. For this reason, we used a computer-based concordance analysis programme (Wordsmith Tools).

For our analysis approach, we adopted a dialogic approach to studying the interaction of the students, and aimed to characterise the interaction process in terms of the students' intersubjective orientation. We based our analysis on the characterisation of talk in terms of Disputational, Cumulative and Exploratory, as proposed by Mercer and

colleagues (Mercer, Littleton and Wegerif, 2004). We argue that a dialogic approach such as this is needed to analyse interaction in a complex environment such as the one utilised in the current study, to be able to take into account the collaborative dimension of computer-supported collaborative learning.

Our data showed many episodes in which students presented a Disputational or more Cumulative orientation. The presence of these kinds of students' orientations could partially be explained in relation to the purposes of the task, it also indicates that the technology itself does not guarantee effective collaborative processes. It is therefore necessary to design an instructional approach that prepares students to use the wiki effectively and to develop students' awareness about thinking and working together in web 2.0 technologies. This result is line many voices that highlight students need a shift to a more participatory and collaborative culture of literacy practices (Wei-Ying, Hyo-Jeong & Seng-Chee, 2010). This shift needs also deep changes in the pedagogical practices that design the conditions to develop students' competences that eLearning 2.0 technologies require.

In contrast, our study also found episodes in which students presented a more Exploratory orientation. In the paper we will discuss what characteristics of the pedagogic design of the wiki environment used in our study might support students' joint interaction processes. Briefly, we stand out the next four. Firstly, the students' preparation to collaborate in a wiki environment using the "Thinking Together" approach was fruitful. Students used explicitly many of the features of the program in their collaborative talk. Secondly, every pair presented their own ideas in an initial text in the wiki environment, which was helpful in giving a 'voice' to all members of the group from the beginning of the collaborative work as it enabled all the pairs to be orientated to each other's ideas from the start. Thirdly, the students were all the time working with an artefact that was created as the product of their active participation. This may have encouraged users to examine others' opinions more closely, take them into consideration and increase their knowledge more deeply. Fourthly, the asynchronous nature of the collaborative processes in the wiki seems to have supported co-reflective processes about others' ideas, thoughts, arguments and information, which, in turn, lead to reconstruction and reorganization of experience.

PAPER PRESENTATION

Doing instructions. Exploring instructions in multilingual classroom interaction

Oliver St John, Orebro university, Sweden, Sweden, Sangeeta Bagga-Gupta, University of Orebro, Sweden

Doing instructions. Exploring instructions in multilingual classroom interaction

The aim of this study is to explore what might distinguish instructions from other kinds of classroom interaction in different classroom settings. Data is taken from video recordings of entire lessons in English, Home Economics, French and Maths as part of ethnographic fieldwork at an international secondary school in Sweden. CA analytic procedures have been adopted and developed. A complementary source of data is ethnographic field notes.

Preliminary findings suggest that instructions exhibit distinct features which participants orient to as instructions while relating them structurally to lessons as a whole. In doing instructions, teachers routinely mark their beginnings with 'openings' (e.g. calling the class to attention), sequence a variety of components (e.g. invoking past lesson activity) and conduct recurrent ways of bringing them to a close (e.g. giving a summary). Data makes evident certain kinds of boundary markers framing instructions as well as reinforced discourse, measured pace and the prominence of kinetic and gestural synchronized signals during such activity. A comparison of doing instructions across subjects suggests that the learning of any subject is, to a significant degree, language learning.

The pedagogic significance of such studies is to encourage investment in instructions as not simply communication for cueing other learning tasks, but as platforms for supporting task-related language learning, student engagement, the negotiation of common purpose, cohesion between different (parts of) lessons, the creation of meaningful entry points, etc. In short, an environment for co-constructing meaning and understanding for tasks.

Doing instructions. Exploring instructions in multilingual classroom interaction

The 's' on the end of 'instruction' indicates the distinction made in teaching methodology arenas between explaining subject content (instruction) and explaining what to do (giving instructions) (e.g. Kerry and Wilding, 2004). 'Instruction' has often been equated with learning (Säljö, 2005:13) while 'giving instructions' has been viewed as prior or incidental to learning per se, as an activity whose value is attached to the greater cause it serves. While the view that the main purpose of instructions is to prepare the way for forthcoming learning activity has some validity, it masks the complexity of the relationship between giving instructions and other teaching routines and activities that structure classroom lessons (see Richards & Lockhart, 1996). Views of learning as integral to social practice (Lave &

Wenger, 1991), as participation and acquisition (Sfard, 1998) and as interaction (Firth & Wagner, 1997; 2007) challenge an assumed distinction between a non-learning preliminary and learning proper as untenable.

The aim of this study is to explore what might distinguish instructions from other kinds of classroom interaction, such as transitions or teacher-presented instruction, in different classroom settings. Aspects which observations in this study have suggested may be relevant to the distinctive identity of 'giving instructions' include discursive composition, boundary markers, techniques used by participants to make meanings clear and constraints on or opportunities for interaction.

This study is part of a larger analysis of lesson phases using video documentation of eighth-grade lessons recorded during ethnographic fieldwork at an international secondary school in Sweden. Video data for the study has been selected from sixteen English, Home Economics, French and Maths lessons. In pursuit of an emic perspective, CA analytic procedures have been adopted and developed by amplifying CA transcript conventions in order to widen the aperture on some of the finely-tuned visually-mediated communicative moves configuring classroom interaction. This multi-track transcription system aims to make available for analysis not only speech, but the printed, written language, bodily conduct and positions in relation to artefacts and other environmental resources in the classroom (see Bagga-Gupta & St John, 2010, in preparation). As a complement to this fine-grained micro view, ethnographic field notes serve as a bridge to possible broader significations in the analysis.

Preliminary findings suggest that instructions exhibit distinct features which participants orient to as instructions while relating them structurally to lessons as a whole. In doing instructions, teachers routinely mark their beginnings with 'openings' when they call the class to attention, announce an imminent task or preview what the 'instructions' are intended to explain or achieve. After beginning, teachers sequence a variety of components including invoking past lesson activity, use of artefacts such as books and whiteboards, categorizing or labelling tasks, directives in steps or stages, prospectively projected sample utterances to illustrate specific activity, examples of task-related choices the students are to make and task assessment criteria. The data also indicates that teachers conduct recurrent ways of bringing instructions to a close, such as giving a summary, managing role distribution or delivering a directive to begin the task.

Data makes evident teacher use of oral expressions (e.g. ok) body movements (e.g. claps) and orientations to classroom artefacts (e.g. books) as boundary markers between instructions and other activities. Talk tends to be well reinforced by paraphrases, double-layered in some cases, while the pace tends to be more measured and the use of synchronized kinetic and gestural signals is a prominent part of the concerted communicative action.

Indeed it is evident that the internal structure of instructions bears many of the features related to the organization of a whole lesson. A picture of task instructions as a miniature model of a lesson suggests that learning has just as much chance to thrive during the doing of instructions as it might in any other component part of a lesson. Cross-subject comparisons of doing instructions showcase that the way language is used in classrooms provides a basis for relating lessons along language continua rather than separating some as 'language' lessons and others in terms of non-language learning lessons. Since the different subjects and disciplines of school are constituted by and generate their own vocabularies and conceptual lexical labels, the learning of any subject is, to a significant degree, language learning.

The pedagogic significance of such studies is to encourage investment in doing instructions as not simply communication for cueing other learning tasks, but as a platform for supporting task-related language learning, student engagement, the negotiation of common purpose, cohesion between different (parts of) lessons, the creation of meaningful entry points, etc. In short, an environment for co-constructing meaning and understanding for tasks. Such an investment will make better sense if giving instructions is viewed not as a set of directions or step-by-step guide, for example, on how to assemble a piece of furniture or operate an appliance, but as one of the steps integral to and inseparable from the process of realizing all the steps.

References

- Bagga-Gupta, S. & St John, O (2010). Making complexity invisible. (Article in preparation)
- Firth, A. & Wagner, J. (1997). On Discourse, Communication, and (Some) Fundamental Concepts in SLA Research. *The Modern Language Journal*, 81,285-300.
- Kerry, T. & Wilding, M. (2004). *Effective Classroom Teacher*. London: Pearson.
- Lave, J. & Wenger, E. (1991). *Situated Learning*. Cambridge University Press.
- Macaro, E. (1996). Teacher use of the target language. Part 1. In Roberts, T. (ed.) *Languages Forum* (5), 2-7, London: Institute of Education.
- Richards, J. & Lockhart, C. (1996). *Reflective Teaching in Second Language Classrooms*. Cambridge University Press.

- Sfard, A. (1998). On Two Metaphors for Learning and the Dangers of Choosing Just One. *Educational Researcher* 27 (2), 4-13.
- Säljö, R. (2005). *Lärande & Kulturella Redskap*. Norstedts Akademiska Förlag.
- Wong-Fillmore, L. (1985). When does teacher talk work as input? In S. Gass & C. Madden (eds.) *Input in Second Language Acquisition* (pp. 17-50). Rowley, Mass.: Newbury House.

PAPER PRESENTATION

Instructional Explanations When Introducing the Pythagorean Theorem: A Case Study

Daniela Jimenez, German Institute for International Educational Research, Germany; Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

Instructional Explanations in mathematics lessons remain a common practice and a typical discourse form though mathematics education has gone through dramatic changes in the last decades. The role of explanations seems to be particularly important when students are learning a new content, because explanations are a mean of conveying mathematical knowledge (Perry, 2000).

The aim of the present study is to characterize effective instructional explanations in videotaped mathematics lessons when introducing the Pythagorean Theorem. The case study was carried out in the context of a broader study including tests of mathematical understanding taken to the students immediately before and after the videotaped lesson unit. The 3 classes examined here were selected according to their learning outcomes under control of their previous knowledge. The results suggest that effective instructional explanations are based on concrete graphic support, showing flexibility in rewording and linking with previous knowledge. Besides, they include concrete applications of the Theorem and examples of its usefulness in everyday life. Even though these findings don't allow generalization, they could suggest that effective instructional explanations contribute to instructional quality.

Background and Aim of the Study One of the most important shifts in mathematics learning and instruction in the last decades has taken place in the conception of the subject matter, changing from a perspective of mathematics as composed of concepts and skills to be learned, to a new one emphasising the mathematical modelling of the reality (De Corte, 2004). This shift has had natural implications on classroom processes, and changed instructional settings and practices. In that landscape instructional explanations are an interesting topic, since they remain being a typical form of classroom discourse, especially when new contents are introduced to the students (Perry, 2000). Instructional explanations can be defined as pedagogical actions in response to implicit or explicit questions provided by teachers or students (Leinhardt, 2001). Their main purpose is the understanding of a portion of subject matter and can be accomplished in different ways, including diverse degrees and sorts of interaction between teacher and one or more students (Kiel, 1999). This means that instructional explanations can appear in several contexts and also take different shapes according with the instructional setting in which they occur.

On one hand instructional explanations have been conceived as a critical issue in understanding mathematical concepts since they are an important communication form of mathematical knowledge (e.g., Perry, 2000). Additionally, it has been argued, that since explanations are a form of oral communication, they offer the teacher the possibility to monitor the students' understanding and provide, if necessary, additional information or discuss possible misunderstandings immediately (Duffy et al., 1986). In contrast to that, Wittwer & Renkl (2008) indicate that explanations are often unnecessary, since they don't really promote understanding. A possible underlying reason is that while explanations occur, the learner assumes a passive role only listening to the teacher, instead of engaging actively in his own learning process. To sum up, there is agreement about considering instructional explanations as a frequent issue within lessons, but there are contradictory positions about whether and how they contribute to promote understanding. We would like to argue that whether instructional explanations promote understanding or not depends rather on elements of the way how explanations take place than to their frequency or duration. Consequently, the only possibility to assess whether instructional explanations are effective or not is regarding carefully the context in which they occur.

The present paper aims to shed light in aspects related to success and failure of instructional explanations in mathematics lessons when introducing the Pythagorean Theorem. More specifically following research questions will be examined, namely, what characterizes instructional explanations in lessons in which a high promotion of mathematical understanding takes place compared to lessons in which a low promotion of mathematical understanding occurs? **Method** The data source is the Chilean implementation of the core-design of the study "Quality of instruction, learning and mathematical understanding" designed and carried out originally in Switzerland and Germany (2000-2006) by the German Institute for International Educational Research and the University of Zurich. The complete Chilean sample consists of 21 mathematics teachers of 7th grade classes and their respective 784 students,

which participated in the investigation along one school year. In every class 3 consecutive lessons about the introduction of the Pythagorean Theorem were videotaped. Tests of mathematical understanding were taken immediately before and after the videotaped lesson unit. 3 of those teachers were chosen in order to carry out the present case study, according with the results of the post-test (under control of the pre-test). The analyses for the case study were based on the theoretical phases of the videotaped lessons and their respective transcripts. They included following dimensions of the instructional explanations, (1) use of graphic support, (2) explanations are repeated/modified, (3) Pupils' participation and contribution to explanations, (4) check for understanding, (5) link with previous knowledge, (6) abstraction and usefulness of the Pythagorean Theorem. Results The findings show differences in most of the dimension analyzed. Effective explanations about the Pythagorean Theorem were supported by hands-on activities, not only performed by the pupils, but also by the teacher or shared with the whole class. Besides, explanations' repetitions include often new information and there's some evidence of flexibility by rewording and going in depth. The teacher continuously checks for understanding while explaining and links the new contents with previous knowledge, not only mentioning it when a step is missing, but also using it as context to embed the new contents. Finally, effective explanations about the Pythagorean Theorem include concrete applications and examples of its usefulness in everyday life. In contrast to that, less effective explanations include graphic support, but just as context and not as a concrete tool. Repetitions occur frequently, tend to be rigid and don't incorporate new information. The teacher checks for understanding only few times along the lesson and often implicitly. New contents were linked with previous knowledge strictly when needed, for example to solve an exercise, but not really clarifying which is the link and why it is necessary. Only few or none concrete applications of the Pythagorean Theorem were presented and its usefulness was limited to mathematical contexts. It's interesting to note, that there were no differences regarding the participation opportunities given to the pupils, mainly answering dichotomous questions or only with one word.

Discussion

It is possible to characterize effective instructional explanations and distinguish them from less effective ones, regarding to what extent they promote mathematical understanding. In other words, even if we don't aim to assume that the improvement in learning outcomes is only attributable to the explanations examined here, these findings could suggest that effective instructional explanations contribute to instructional quality. These finding were obtained in a case study and don't allow generalization, besides they refer to an introductory unit in one curricular content, facts that allow a thorough examination. However, it would be interesting to investigate to what extent such characteristics can be applied to other teaching contents or whether it is possible to define features that allow their valid and reliable measure in bigger samples..

PAPER PRESENTATION

Experienced and non-experienced e-tutors in Europe: Differences in supporting online collaboration
Birgitta Kopp, Ludwig-Maximilians-University, Germany; Maria Cristina Matteucci, University of Bologna, Italy;
Carlo Tomasetto, University of Bologna, Italy

In this study, we investigated differences between experienced and non-experienced European e-tutors in their support of online collaboration in practice. Therefore, we developed a questionnaire European e-tutors had to fill in to evaluate specific collaborative activities and to answer yes/no-questions regarding their intervention to support these collaborative activities. In respect of these collaborative activities, we distinguished between cognitive and social activities which are relevant for effective online collaboration.

Overall, we received answers of 78 e-learning experiences from 17 different European countries. Cluster analysis was conducted to determine groups of e-tutors who answered similar regarding the response type across the various categories of support activities. To validate the cluster solution, we compared the resulting two clusters on the basis of the experience of e-tutors. The results indicate that e-tutors with experience evaluate relevant cognitive activities more important for collaboration than e-tutors without experience. Furthermore, e-tutors with experience intervene more often to foster cognitive and social activities. These findings show the importance of expertise in e-tutoring: It seems that e-tutors with experience consider the importance of specific cognitive activities for effective online collaboration and that they also are more familiar in detecting dysfunctional social phenomena and in adequately intervening to avoid such phenomena. Therefore, for daily practice it seems to be necessary to train e-tutors in sensitizing them to the problems and pitfalls of online collaboration.

Objectives

This study investigates how experienced and non-experienced e-tutors differ in supporting collaborative online learning in practice. E-tutors received a questionnaire evaluating specific online activities and answering yes/no-questions whether they practically gave online support for these specific activities in their e-learning experiences.

Theoretical framework

E-tutors are very important for the support of their learners, because virtual collaboration is often more demanding for learners as they mostly have no experience with this way of learning. E-tutors are defined according to their main function, which is to supervise and support learners.

When we look at the support of e-tutors, the question is which collaborative activities they specifically foster. There are especially cognitive and social activities important for collaboration. Cognitive activities are knowledge exchange, online discussion, argumentation, collaborative problem solving, and considering different perspectives. Regarding social activities, the focus is on the motivation of the group members, interpersonal interaction, social influence processes and information processing.

Regarding the daily practice of e-tutors, the question arises how e-tutors support collaborative online learning. As research on the topic of expertise shows that experts differ from individuals without expertise in their way how they deal with problems, the question remains whether such differences in problem-handling are true for e-tutorial support in collaborative online learning.

Research question

Do experienced and non-experienced e-tutors differ in supporting online collaboration? As experienced e-tutors already know how collaboration in virtual learning environments functions, the assumption is that experienced e-tutors differ in their support from non-experienced e-tutors in that way that experienced e-tutors support collaborative online learning to a greater extent than non-experienced e-tutors.

Method

Sample

The sample included seventy-eight e-learning experiences from 17 different European countries. All e-tutors completed an online questionnaire regarding their e-learning experiences with collaborative learning. Participants were instructed to complete one questionnaire for each e-learning course.

Design of the Study

The study was a survey for e-tutors regarding their experiences in providing and supporting virtual collaboration which took place in July 2007. All e-tutors received access to an online questionnaire in their language and were asked to answer this questionnaire for every e-learning experience they offered.

Data sources

The online questionnaire which was developed for this purpose included two main dimensions: cognitive activities and social activities. Regarding the cognitive aspects of collaboration, the questionnaire included five main activities: knowledge exchange, online discussion, argumentation, collaborative problem solving, and considering different perspectives. To gain deeper insights into these activities, the questionnaire asked e-tutors whether they intervened to foster the specific collaborative activity and if yes, how they intervened and if no, why they did not intervene. Based on theoretical assumptions, social activities were evaluated mainly according to four processes: motivation of the group members, interpersonal interaction, social influencing factors and information processing. Regarding motivational aspects, two dimensions were considered, namely different group goals (2 items) and dysfunctional competition. Interpersonal interaction included phenomena such as dysfunctional interpersonal conflicts, balanced participation, and diffusion/lack of responsibility. Social influencing factors are ignoring minorities and putting pressure on group members. Information processing included the following: superficial discussion to avoid conflicts and addressing the e-tutor rather than group members (2 items). In the questionnaire again, e-tutors were first asked whether they intervened to avoid a dysfunctional phenomenon. If they answered yes, they were asked how they intervened, and if no, why they did not intervene.

Data analyses

We used the TwoStep cluster methodology to explore the data. The algorithm selected the optimal number of clusters based on either the Schwarz Bayesian Information Criterion (BIC) or the Akaike Information Criterion (AIC). Once clusters were established, we used separate t-tests and chi-square tests on variable(s) not used to form the clusters to test the validity of the cluster solution. We compared the clusters based on their response type across the various categories of support activities in terms of past experience of e-tutors, feedback practices and intervention rate.

Results

The cluster analysis identified two clusters whose stability was ascertained until 75 % of the sample size. Using a theoretically meaningful distinction, we report the data on the cognitive and on the social activities. Cluster 1 (n= 51; 65.4%) comprised e-tutors who evaluated cognitive activities more important (mean between 4.90 and 5.47) than e-tutors included in cluster 2 (n =24; 30.8%) (mean between 4.08 and 4.83). Furthermore, e-tutors of cluster 1 intervened between 40 and 48 times to foster cognitive activities in online collaboration while e-tutors of cluster 2 intervened only 8 to 14 times. Regarding social activities, according to Chi-Square-Tests again e-tutors of cluster 1 intervened in 9 of 11 times significantly more often than e-tutors of cluster 2.

Validity of the two cluster solutions was evaluated by testing group differences on variables that were theoretically or empirically related to each cluster. In particular we used as cluster validation items concerning the past experience of e-tutors in designing and realizing online courses. We expected e-tutors with experience to be over-represented in cluster 1, which was confirmed by a chi-square analysis. The great majority of e-tutors with past experience in designing and realizing e-learning courses belonged to cluster 1, $\chi^2(1, n = 75) = 11.75, p$

Discussion

Cluster analysis has shown that our sample of e-tutors significantly differ in evaluating the importance ascribed and in intervention rate concerning specific cognitive activities which are relevant for online collaboration. Subsequent analyses confirm that e-tutors who intervened more frequently in respect of fostering cognitive and social activities in virtual collaboration are those with past experience. Even though, overall the intervention rate for social activities is much lower than for cognitive activities (overall less than 50 per cent), e-tutors with experience are more able to detect dysfunctional phenomena and thus support their learners in working effectively together.

Educational significance

This study shows that experience in supporting e-learning groups is an essential precondition for evaluating relevant collaborative activities higher and in adequately intervening for fostering the interaction between group members. As this study asked e-tutors concerning their daily practice, it seems essential to train e-tutors in considering and detecting specific dysfunctional phenomena which may otherwise inhibit effective group work.

PAPER PRESENTATION

Scaffolding self-regulated learning: implications for the design of CBLEs

Anneline Devolder, Ghent University, Belgium; Johan van Braak, Ghent University, Belgium; Jo Tondeur, Ugent, Belgium

Research has shown that in order to learn effectively in computer-based learning environments (CBLEs), students need to show sufficient self-regulated learning skills (SRL). Unfortunately, not many students possess these necessary skills, so support needs to be provided towards the students when learning in these environments. A specific type of support we focus upon in this study are scaffolds. Scaffolds are technology-mediated systems that support the learners when performing a task (Sharma & Hannafin, 2007). In the field of scaffolding, little conceptual clarity exists. Moreover, it was shown that some specific scaffolds are only effective for some specific processes of SRL (Schraw, 2007). The aim of this study was to create an overview that makes it possible to compare the effectiveness of the different scaffolding types in support of the different processes of SRL. Therefore, we extended a review study in search of which specific scaffolds are proven to be effective in supporting SRL processes when gaining scientific knowledge. In order to support educational practice in the decisional process of choosing the right scaffolds, the results of this study are presented in an integrated framework of SRL.

Framework Computer-based learning environments (CBLEs) are becoming ubiquitous and more extensively used in education [1]. CBLEs comprise systemic features (e.g. open-ended in structure, non-linear) that offer new possibilities for learning and instruction like direct visualization and manipulation of complex topics [6]. In order to learn effectively with CBLEs, learners will need to show skilful engagement which can be captured as self-regulated learning (SRL) [15]. Students are self-regulated to the degree that they are metacognitively, motivationally, and behaviourally active participants in their own learning process [16]. Unfortunately, many students do not possess the necessary SRL-skills [3]. Therefore, students need to be supported when learning with CBLEs. Research has shown that scaffolds can give the necessary support to students lacking SRL-skills [1]. Recently, scaffolding is being described as "...the provision of technology-mediated support to learners as they engage in a specific learning task" [12, p.29]. Studies have shown that different types of scaffolds provide effective support for different processes of SRL [4]. This means that when CBLEs are being developed, the types of scaffolds will need to be selected with care. **Purpose & Method** In order to support educational practice in this decision making process, the aim of our study is to synthesize and schematize research results on the effects of scaffolding on the processes of SRL when learning in CBLEs. To fulfil this purpose, a systematic literature review was conducted [8]. Some general criteria were set to mark out our search (e.g. studies published since 2000). Second, inclusion and exclusion criteria were defined. According to these criteria, the database

Web of Science was searched through using terms like scaffold*AND self-regulated learning/self-regulat*. This search resulted in 24 articles. To present these results clearly, they were placed in an integrated framework of SRL [5] that is designed based on some central models of SRL as well as more current research relating the specific context of CBLEs towards these central models [e.g. 9,2,14].

Results

The results of this are presented in Table 1. Table 1. An integrated framework for effective scaffolds in support of processes of self-regulated learning(p: primary education; s: secondary education, h: higher education) CognitionMotivationBehaviourPhase 1:Task definition&Planning Guiding questions(h) Concept-mapping task (s,h) Preset goal hierarchy & goalDescription(s) 'Plan ahead' prompts(s) Searching features(p) High-order questions(h) Phase 2: MonitoringDiagrams (h) Hints & cognitive feedback (p) Self explanation prompts, reason-justification prompts, cues (s) Written question prompts (s) Guiding questions(h) Phase 3:ControlMetacognitive feedback &Strategy prompt(h) Concept-map template(p) Spoken advice (prompts)(s,h) Generating prompts(s)Processing prompts(s) Worked-out examples(s) Organization feature(s) (headings and written)Question prompts(s) Organization feature(s),Collaboration features(p),Maintenance features(p) Self-explanation prompt & Worked-out example(u) Spoken advice(h)Worked-out examples(s) Saving/viewing features(p) Concept-map(h) Strategic prompts & Graphic advance organizers(h)Phase 4:Reaction & reflection'Look back' prompts(h) From the 24 retrieved studies, 16 of them proofed that the use of certain scaffolds were effective when gaining scientific knowledge. Most of the studies examined scaffolds that support processes of cognitive regulation.

Results indicate that especially prompts are effective scaffolds for this area. Little effective scaffolds were found in the area of motivation and behaviour. The area of context in this framework was deleted, because no effective scaffolds were found. Another remarkable finding is that a small amount of these studies focuses on primary education, although this is a category of students possessing the least SRL-skills. As it can be seen in the framework and is confirmed by the literature, some scaffolds provide effective support for multiple processes of self-regulated learning [10]. ConclusionOn the basis of the discussed theoretical framework and method, we were able to list up the effective scaffolds influencing self-regulatory skills of students when learning in CBLEs. In the presentation, we will focus on the meaning of these scaffolds towards the design of future CBLEs while bringing personal characteristics (e.g. prior knowledge) and contextual characteristics (e.g. task, peers) into account.

References

- [1]Azevedo,R. (2005). Computer Environments as Metacognitive Tools for Enhancing Learning. *Educational Psychologist*, 40(4), 193 - 197.
- [2]Azevedo,R. (2008). The role of self-regulated learning about science with hypermedia. In D.H. Robinson and G. Schraw (Eds.), *Recent innovations in Educational Technology that facilitates Student Learning* (pp. 140). Charlotte, NC: Information Age Publishing, Inc.
- [3]Azevedo,R.,&Cromley,J.G. (2004). Does Training on Self-Regulated Learning Facilitate Students' Learning With Hypermedia?. [Article]: *Journal of Educational Psychology* September 2004;96(3):523-535.
- [4]Dabbagh,N., & Kitsantas,A. (2005). Using web-based pedagogical tools as scaffolds for self-regulated learning. *Instructional Science*, 33(5-6), 513-540.
- [5]Devolder,A.,vanBraak,J.,&Tondeur,J. (2010). Supporting Self-Regulation in Computer-Based Learning Environments: A Systematic Review of the Impact of Scaffolding. Paper presented at the European Conference of Educational Research (ECER), Helsinki (Finland), 25-27 August.
- [6]Dignath, C., Buettner, G., & Langfeldt, H.-P. (2008). How can primary school students learn self-regulated learning strategies most effectively?: A meta-analysis on self-regulation training programmes. *Educational Research Review*, 3(2), 101-129.
- [6]Land,S.,&Hannafin,M. (2000). Student-centered learning environments. In D. Jonassen & S. Land (Eds.). *Theoretical foundations of learning environments* (pp. 1-23). Mahwah, NY: Erlbaum.
- [7]Petticrew,M.& Roberts,H. (2005). *Systematic reviews in the social sciences: a practical guide*. Malden, MA: Blackwell Publications.
- [8]Pintrich,P.R. (2000). The role of goal orientation in Self-Regulated Learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic Press.
- [9]Schraw,G. (2007). The use of computer-based environments for understanding and improving self-regulation. *Metacognition and Learning*, 2, 169-176.
- [10]Shapiro,A.M. (2008). Hypermedia design as learner scaffolding. *Etr&D-Educational Technology Research and Development*, 56(1), 29-44.
- [11]Sharma,P.,&Hannafin,M.J. (2007). Scaffolding in technology-enhanced learning environments. *Interactive Learning Environments*, 15(1), 27-46.
- [12]Steffens,K. (2006). Self-Regulated Learning in Technology-Enhanced Learning Environments: Lessons of a European Peer Review. *European Journal of Education*, 41(3), 353-379.

- [13]Winne,P.H.,&Hadwin,A.F. (1998). Studying as Self-Regulated Learning. In D.J. Hacker, J. Dunlosky, & A. Graesser (Eds.). *Metacognition in educational theory and practice* (pp. 277-304). Hillsdale, NJ: Erlbaum.
- [14]Winters,F.,Greene,J.,&Costich,C. (2008). Self-Regulation of Learning within Computer-based Learning Environments: A Critical Analysis. *Educational Psychology Review*, 20(4), 429-444.
- [15]Yelland,N.,&Masters,J. (2007). Rethinking scaffolding in the information age. *Computers & Education*, 48, 362-382.
- [16]Zimmerman,B.J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81(3), 329-339.

PAPER PRESENTATION

Understanding the online information seeking practices of young people

Rebecca Eynon, University of Oxford , United Kingdom

As the Internet and other new technologies become embedded within the lives of young people there is a growing interest in the extent to which new technologies can enhance informal and formal learning. Effective online information seeking forms a key part of many of these potential learning opportunities. Using nationally representative survey data of 1000 young people, this paper aims to add to existing research by providing empirical data on how and why young people in Britain use the Internet for information seeking outside formal educational settings for homework and everyday life. Using path analysis, this paper will provide an overview of the ways young people are using the Internet for information seeking and examine the individual (e.g. age and gender), skill and contextual factors (e.g. parent, school and friends use of technology) that help to explain this behaviour. It is hoped that these findings may assist in the development of policies and practice to support young people to make the most effective use of the Internet for information seeking as part of their learning in a global networked society.

As the Internet and other new technologies become increasingly embedded within the lives of young people there is a growing interest in the extent to which new technologies can enhance informal and formal learning opportunities (e.g. Becta, 2008). Effective online information seeking forms a key part of many of these potential opportunities both to support formal education (e.g. for homework) and to support informal learning through everyday life information seeking (ELIS) (Savolainen, 1995).

While relatively little is known about how and why young people access information online in their daily lives for these purposes, it is likely that there is significant diversity in what, how and why young people search for information online.

This paper aims to add to existing research by providing empirical data on how and why young people in Britain use the Internet for information seeking outside formal educational settings for homework and ELIS. The data is based on a nationally representative face to face survey of 1000 young people in Britain aged 8, 12, 14 and 17-19. The survey was conducted between December 2008 and January 2009 utilising a stratified sampling strategy. The survey formed part of the Learner and their Context study, commissioned by Becta, which explored young people's views and experiences of new technologies outside school and was designed to inform the UK's Harnessing Technology Strategy. Using path analysis, this paper will provide an overview of the ways young people are using the Internet for information seeking and examine the factors that help to explain this behaviour. Drawing upon the learning ecology approach (Barron, 2006) and in line with a range of theoretical frameworks that stress the importance of understanding both individual and environmental factors when exploring Internet use (e.g. LaRose et al., 2001; McHale et al., 2009) this paper will examine the importance of: 1) individual factors, specifically, age and gender (Livingstone and Helper, 2007), socio economic factors and quality of access (Facer, Furlong, Furlong, and Sutherland, 2003); 2) networks of support, specifically, peer use of technology (Ito et al., 2008), parental engagement / regulation (Livingstone and Bober, 2005) and the school environment; and 3) skills and confidence, that is, self concept in learning new things and confidence in online information seeking skills (Broos and Roe, 2006). Each of these three areas are hypothesised to contribute (both directly and indirectly) to online information seeking. The overarching research question for this study is: what are the direct and indirect effects of individual and contextual factors on online information seeking for homework and everyday life?

The initial analysis demonstrates that parent's involvement in their child's uses of technology and school uses of the Internet have no direct effect on online information seeking either for homework or everyday life. However, they do have a direct effect on learner self-concept and / or online information seeking ability which are of key importance in understanding both kinds of online information seeking analysed here. Furthermore, individual characteristics which reflect basic factors of digital inclusion (such as home access to the Internet and / or socio economic status) continue to play an important role in understanding online information seeking for homework and / or everyday life. The findings indicate that there is a need for researchers to explore both offline factors (e.g. SES and learner self concept)

as well as online factors in understanding Internet use; and highlights the opportunities open to educators to support young people more in using the Internet for information seeking. It is hoped that these findings may assist in the development of policies and practice to support young people to make the most effective use of the Internet for information seeking as part of their learning in a global networked society.

References

- Becta (2008). *Harnessing Technology: Learning Next Generation Learning 2008 - 2014*. Becta Report: Coventry.
- Barron, N. (2006). Interest and Self-Sustained Learning as Catalysts of Development: A Learning Ecology Perspective. *Human Development*, 49, 193–224.
- Broos, A and Roe, K (2006). The digital divide in the playstation generation: Self-efficacy, locus of control and ICT adoption among adolescents. *Poetics*. 43: 306-317.
- Facer, K, Furlong, J, Furlong, R, and Sutherland, R (2003). *Screenplay: Children and Computing in the Home*. London: RoutledgeFalmer.
- Ito, Mizuko, Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P., Pascoe, C.J. and Robinson, L. (2008). *Living and Learning with New Media: Summary of Findings from the Digital Youth Project*. The John D. and Catherine T. MacArthur Foundation Reports on Digital Media and Learning.
- LaRose, R, Mastro, D and Eastin, M (2001). Understanding Internet Usage: A Social-Cognitive Approach to Uses and Gratifications. *Social Science Computer Review*. 19(4): 395-413.
- Livingstone, S and Bober, M (2005). *UK Children Go Online. Surveying the Experiences of Young People and their Parents*. London: London School of Economics and Political Science.
- Livingstone, S and Helsper, E (2007). Gradations in Digital Inclusion: Children, Young People and the Digital Divide. *New Media and Society*. 9: 671-696.
- McHale, S, Dotterer, A and Kim, J (2009). An Ecological Perspective on the Media and Youth Development American Behavioral Scientist. 52(8): 1186 -1203.
- Savolainen, R. (1995). Everyday life information seeking: approaching information seeking in the context of 'way of life.' *Library & Information Science Research*, 17, 259-294.

PAPER PRESENTATION

Effects of constructivist teacher-led digital platform on learning achievement

Rosen Vigal, University of Haifa / Time To Know, Israel

This study explores the effects of a constructivist teacher-led one-to-one computing learning environment on elementary schools students' achievement in Mathematics and English Language Arts (ELA). The subjects were 59 4th grade students, who joined a Time To Know year-long program in Dallas, Texas and 68 4th grade students who learned in traditional settings. Findings indicated that learning with Time To Know program significantly enhanced students Mathematics and ELA achievements and contributed to development of Mathematics reasoning skills. In addition, the study showed that Time To Know program narrowed the gap between the low and high achievement students, as well as significantly promoted the academic outcomes of at-risk students, compared to the traditional settings. Overall, the findings indicated that intertwining digital content that is aligned with state standards and a constructivist-oriented teacher-led platform, enables a significant empowerment of teaching and learning processes.

Over past decade, there has been a growing interest in one-to-one laptop technology initiatives, whereby the teachers and the students have full access to a technology-rich learning environment (Bebbel, 2007; Gulek, & Demirtas, 2005; Jaillet, 2004; Lei & Zhao, 2008; O'Dwyer et al., 2008; Shapley et al., 2009; Silvernail & Gritter, 2005; Weston & Bain, 2010; Zucker & Light, 2009). The current study explores the effects of teaching and learning in the Time To Know program on Mathematics and ELA achievement of 4th grade students, compared to learning in more traditional setting.

Time To Know's teaching and learning environment is designed with a social-constructivist teacher-led approach to learning and teaching (Fosnot, 2005; Prawat & Folden, 1994; Roschelle, Pea, Hoadley, Gordin & Means, 2000; Von Glasersfeld, 1995). The program consists of five main components (Walters, Dede & Richard, 2009; Weiss & Bordelon, 2010): (a) Infrastructure: one-to-one laptop environment with a workstation for the teacher; (b) Interactive year-long core curriculum: Recommended sequences of interactive learning activities that are aligned with state standards. Teachers can modify these sequences by uploading their own "best practice" materials directly into the lesson flow; (c) Digital Teaching Platform (DTP): A platform that enables the teacher to conduct or plan a lesson, and to receive formative and summative assessment reports for data-driven instruction; (d) The platform also enables teachers to create their own content and adjust the recommended ready-made interactive learning activities to their teaching needs.; (e) Pedagogical support: Every teacher who joins the program takes part in comprehensive professional learning and ongoing guidance from an instructional coach.

The study addressed the following questions regarding the effects of the Time To Know program:

1. What is the impact of Time To Know program on reading, writing and Mathematics academic achievements, as measured by Texas Assessment of Knowledge Skills (TAKS) tests, compared to the traditional settings?
2. What is the impact of Time To Know program on academic achievements of at-risk students, compared to the traditional settings?
3. Do Time To Know students demonstrate greater Mathematics reasoning skills than control students?
4. Do lower performing Time To Know and control students (based on previous year TAKS scores) differ from higher performing students on Mathematics reasoning skills?

The study was based on the quantitative methodology using a quasi-experimental design (participation or non-participation in the Time To Know program). Pretest data were collected before the onset (April, 2009) of a Time To Know program, while post-test data were collected near the completion of the year-long school program (April, 2010). The study participants were 4th grade male and female students from four elementary schools from the Dallas-area district. Gender distribution was close to even. Two experimental schools were selected on the basis of two criteria: their participation in the Time To Know program and the same demographic background. Two control schools were purposively sampled to "match" the two Time To Know schools on the basis of known demographics (e.g., neighborhood characteristics, teacher characteristics, student characteristics). In all, there were 127 students who participated in the pre- and post-test data collection (59 experimental and 68 control students).

The instruments comprised on Mathematics, Reading and Writing and an adopted Mathematics reasoning test (HersHKovitz, in preparation). Mathematical reasoning refers to the ability to analyze mathematical situations and construct logical arguments (Francisco, & Maher, 2005; Stiff, & Curcio, 1999; Yackel, & Hanna, 2003). The Mathematics reasoning test was based on open-ended questions related to graphs and tables theme in 4th grade Texas curriculum that was taught in both the control and Time To Know classes.

The results indicated that participation in Time To Know (T2K) program contributed significantly to 4th grade students' academic outcomes in reading, writing and Mathematics, as measured by TAKS standardized tests. After controlling for gender, at-risk status, and 2009 reading TAKS scores (ANCOVA), the Time To Know students ($M=657.2$, $SD=88.3$) significantly outperformed the control students ($M=602.9$, $SD=104.4$) on the 2010 reading TAKS, $F(4, 95)=10.8$, p Time To Know students ($M=656.7$, $SD=83.0$) scored significantly higher than the control students ($M=625.1$, $SD=91.4$) on the Mathematics TAKS test, even after controlling for previous years TAKS scores (ANCOVA), gender, and at-risk status, $F(4,95)=6.5$, p

Although not significant, a trend was found in the context of at-risk students, showing that at-risk and non-at-risk students in the Time To Know classrooms score similarly. Whereas, in the control classrooms, the at-risk students Mathematics score much lower than the non at-risk population.

After controlling for students' third grade math TAKS scores, gender and at-risk status (ANCOVA), there was a statistically significant difference between the Time To Know and control students in the context of Mathematics reasoning (see Figure 9). Time To Know students ($M=35.7$, $SD=8.1$) far out-performed the control students ($M=24.3$, $SD=11.3$) on the Mathematics reasoning assessment overall ($F(4,95)=5.7$, p

Overall, the findings of the current study are showing the high potential of one-to-one computing learning environments, in which a comprehensive digital curriculum is combined with a constructivist-oriented teacher-led platform. Further research is recommended to examine qualitatively changes in teaching and learning practices underlie the effects of Time To Know program on academic outcomes, as well as the possible affective processes (i.e. engagement, motivation, self-regulated learning). In addition, given the relatively small sample, it is essential to conduct large-scale studies to examine the effects of comprehensive one-to-one laptop learning environments.

PAPER PRESENTATION

Effects of computer-based interventions to enhance the development of mental number representations
Andreas Obersteiner, Technische Universitat Munchen, Germany; Stefan Ufer, University of Munich, Germany;
Kristina Reiss, Technische Universitat Munchen, Germany

Cognitive psychological and neuropsychological research suggests two core cognitive systems of number processing, namely an object-file system for the exact representation of discrete objects and an analogue magnitude system allowing an approximate representation of quantities. In an intervention study we explored whether an exact or an approximate approach for fostering students' development of mental number representations was more successful. $N=46$ second grade students were tested in basic number processing (e.g., number comparison) before and after

seven computer-based intervention sessions. During the intervention students played one of two versions of a number game, requiring exact or approximate number processing. Results show that both the exact and the approximate condition led to improvements of basic number processing, without significant differences between these conditions. Process data revealed that both games were suitable for the students and did not differ in difficulty.

Theoretical background and aims

Cognitive psychological and neuropsychological research suggests that number processing relies on two “core systems” (Feigenson, Dehaene & Spelke, 2004), namely an object-file system for the exact representation of single objects and an analogue magnitude system for an approximate representation of quantities. Both systems seem to be innate and are responsible for early number learning. To enhance learning, mathematics education theories support the use of two kinds of manipulative materials representing exact numerosities using symmetric structures (e.g., a pegboard with two rows of ten pegs each) or analogue quantities (e.g., an empty number line). There is, however, no empirical evidence for the assumption that the use of such number representations has an effect on the development of students’ mental representations. The aim of our study is to explore whether an intervention using specific external number representations leads to improvements in basic number processing tasks, whether differential effects can be found for specific tasks, and whether computer games are an appropriate method for such an intervention.

Methods

In an intervention study with N=46 second grade students (mean age: 7;2 years) we used two different computer games (see Obersteiner, Ufer & Reiss, 2010). Both games were based on the “Number Race” (Wilson, Dehaene, Pinel, Revkin, Cohen & Cohen, 2006), an adaptive software with the aim of enhancing “number sense”. The two games were identical with respect to the overall conception. Depending on the level, the player had to solve number comparison tasks, calculation tasks, or number identification tasks with increasing task difficulty and time pressure. After each task, the player had to move his character on a game board by clicking on each square separately (“counting strategy”) or by clicking on the end square directly. However, the games differed in the way tasks were presented to the player. In the exact version numerosities were presented in symmetric structures and the tasks required exact number processing (e.g., exact calculation), while in the approximate version numerosities were presented without structures and the tasks required approximate number processing (e.g., approximate calculation). During the game, process data such as successful runs and number of clicks were logged. Before and after seven intervention sessions (30 minutes each) the students took a computer-based test of basic number processing (dot enumeration of structured and unstructured sets, number comparison, magnitude comparison, magnitude estimation, approximate calculation). Response times and accuracy rates were measured. Data from 3 students were excluded from further analysis due to absence in more than one intervention session.

Preliminary results

Both versions of the intervention program were suitable for the students and did not differ in general difficulty, as indicated by an equal mean number of games won by the students (22.1 for the exact version, 23.2 for the approximate version; $t(41)=-1.04$; $p=0.30$). Overall, students improved their number processing skills as indicated by reduced response times in all tasks of the post-test as compared to the pre-test. An analysis of variance with repeated measures showed that neither the differences between the two intervention groups nor the interaction terms with group reached significance for any task ($p>0.053$ for group differences, $p>0.108$ for interactions). Process data such as the number of clicks used to move the character on the game board revealed that students in the exact condition were more successful in directly clicking on the correct square as compared to students in the approximate condition (79% vs. 46% successful direct clicks; $t(41)=8.08$; $p<0.001$). This may reflect the successful use of structures by students in the exact condition.

Discussion

The two computer games were comparable in overall difficulty. They were an appropriate method to be used in an intervention study with an experimental design. Both games had positive effects on second grade students’ number processing abilities. However, as the present experiment was basically carried out to test the computer games, there was no control group, so that we do not know how specific these effects were. First results did not reveal group differences, indicating that both the exact and the approximate approach can be used to foster students’ number processing abilities. In the present study, we have tested a relatively small sample. After further developing the computer games we will test intervention effects in a larger sample of first grade students. So far, we have analysed differential effects on the group level only. In further analysis we will explore how individual factors such as working memory or visuo-spatial abilities may have influenced students’ test performances and their success during the intervention. A better understanding of such relations could help to develop individually tailored training for each individual student and is therefore of high relevance for mathematics education.

References

- Feigenson, L., Dehaene, S., & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences*, 87, 307-314.
- Obersteiner, A., Ufer, S., & Reiss, K. (2010). Fostering the development of mental number representations and arithmetic competencies in the first school year. Poster presented at the EARLI SIG22–Conference in Zurich, June 3-5. doi: 10.3389/conf.fnins.2010.11.00069.
- Wilson, A. J., Dehaene, S., Pinel, P., Revkin, S. K., Cohen, L. & Cohen, D. (2006). Principles underlying the design of "The Number Race", an adaptive computer game for remediation of dyscalculia. *Behavioral and Brain Functions*, 2, 19.

PAPER PRESENTATION

Students' use of tools in an undergraduate course: in search of tool-use patterns

Jan Elen, Katholieke Universiteit Leuven, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium;

Griet Lust, Katholieke Universiteit Leuven, Belgium

Research in controlled settings has revealed that students' tool-use behavior is a complex self-regulated behavior that cannot be taken for granted (Azevedo, 2004). It remains however unclear if these results are replicated in an ecological setting characterized by learning tasks integrated into the natural flow of the study, enough time to learn to use the tools and with long-time retention measurements (Grabinger, 2008). This contribution focuses on students' tool-use in an ecological setting. An undergraduate course was selected as object of research because despite the popularity of blended courses, as an integration of course management systems into the traditional constellation, there is little insight in how students behave in those environments. More specifically, the study investigates how students use the whole toolset at their disposal, whether user-profiles can be found and what the effects of students' tool-use on performance are. Cluster analysis reveals three distinct tool-use patterns or user profiles: the no-users, the intensive users and the incoherent users. Results from multiple analyses of variance reveal that those tool-use patterns affect the performance significantly. The results indicate that despite the benefits of blended learning environments as illustrated in literature, not all students seem to profit from the opportunities that are provided. Similar as in controlled settings, the results seem to indicate that students' tool-use cannot be taken for granted. Hence, they call for more research into the influencing variables, student-and context related, and the performance effects.

Research in controlled settings (e.g. review Alevén et al, 2003) underlines the fact that adaptive tool-use, as using tools in accordance with perceived learning needs, is a self-regulated activity that cannot be taken for granted (Azevedo, 2005). However, most of the research is done in a controlled setting characterized by non-embedded learning tasks and a focus on short-time learning effects (Grabinger, 2008). It remains unclear whether these results are replicated in an ecological setting. The current study puts the tool-use research in an ecological setting and more specific in an undergraduate blended course where learning is supported by various combinations of classical face-to-face initiatives (e.g. lectures, learning sessions) and digital devices as provided through the CMS (e.g. exercises, practice quiz, discussion board). Despite the fact that students, in most cases, have control in using these tools, there is little insight in how students' deal with this learner control i.e. how they use the tools and how that affects their performance.

First evidence in the Elis, Marcus and Taylor (2003) study indicates that coherently using the total tool-set cannot be taken for granted. Students were unsure of how to approach the online tools in ways that are likely to maximize the learning benefits in blended experiences. With respect to students' use of CMS tools, different studies reveal that students differ in how they approach a specific CMS tool (e.g. Grabe & Christopherson, 2005) or multiple CMS tools (e.g. Hoskins & Van Hooff, 2005) and this affects their performance for the course. The studies are however focused on one or multiple CMS tools without investigating how students use the tools all together, i.e. tool-use patterns.

The current study investigates students' tool-use in a blended undergraduate course. Based on evidence regarding students' use of CMS tools, it is expected that tool-use differences will exist and similar with evidence in controlled settings (e.g. Jiang, Elen & Clarebout, 2009) they will reflect distinct tool-use patterns among students. At least three tool-use patterns are expected: the no-users, the incoherent users and the intensive users.

Method

The sample

The study runs in a first year undergraduate course at the department of 'Educational Sciences' at the Katholieke Universiteit Leuven. It contains 91% of the course-participants (n=159). There are 152 women and 8 men. Most of the students were 18 years (72.3%).

The undergraduate course: toolset

Additional to the lectures, a CMS was provided and a team of support staff was at students' disposal. The support staff organized three learning support sessions and a feedback session that students could use voluntarily. The CMS was designed using Blackboard. The access and the use of the learning environment were under control of the student.

The tool-use behavior was captured through log-files. Table 1 presents the tools and the log indicators that were used in this study.

Indicators of learning

Students' course performance was assessed by an exam (consisting of factual items, comprehension items and application items) and an assignment for which students had to argue about an educational proposition.

Results

Students' tool-use behavior: tool-use patterns

K-means cluster analysis in Matlab was performed. K-means cluster solutions with two to ten clusters were fitted using 1000 restarts (for a discussion of the use of K-means cluster analysis, see Steinley, 2003). On the basis of a scree-test, the three-cluster solution was selected as optimal solution since a clear demarcation point is visible after three clusters.

One-way analysis of variance reveals that all the tool-use variables have a significant impact in defining the three clusters, $p = .000$. Post-hoc comparisons are illustrated in figure 1. As the figure illustrates, those three clusters represent different tool-use behavior among students, characterized by different tool-choices and distinct intensity in using them.

Fig 1. Tool-use patterns

Learning effects of the tool-use patterns

Multiple analysis of variance reveal a main effect of students' tool-use behavior on the five performance indicators, $F(5,150) = .139$, $p = .005$. More specific, students' tool-use behavior influences their total course grade, $F(2,154) = 5.056$, $p = .007$, and their assignment score, $F(2, 154) = 7.767$, $p = .001$. As for the assignment score, students in cluster 3, $M = .09$, $SD = .96$, and in cluster 2, $M = .31$, $SD = .78$, outperform students in cluster 1, $M = -.41$, $SD = .94$. For the total course grade, a significant difference exists between students in cluster 1 and cluster 2. Students in cluster 2, $M = .29$, $SD = .89$ outperform students in cluster 1, $M = -.25$, $SD = .81$.

Discussion and conclusion

In line with our expectations, three usage patterns were found. Students in cluster 1 reflect no users, they did not use the available face-to-face and CMS tools. Students in cluster 2 are intensive users, they used all the available tools. Students in cluster 3 are incoherent users, they used the face-to-face tools, the course material outlines and the learning support. The two latter CMS tools have a clear link with the face-to-face context. The outline notes referred to the face-to-face lectures and the learning support referred to the learning support sessions.

A significant difference was found between the no-users and the other patterns in performance on the assignment and on the total course grade. Surprisingly, no significant differences were found between intensive and incoherent users. This result raises questions with respect to the functionality of some CMS tools, the consistency in the intensive users group, possible mediating variables and possible influencing student variables.

[1] Duration and mean time were expressed in seconds.

PAPER PRESENTATION

Where's the math? Locations of mathematical activity in classes with handheld technologies

Thomas Hillman, University of Gothenburg, Sweden

This presentation will examine the locations of mathematical activity in classrooms where handheld digital technologies are used. By drawing on Actor-Network theory, it will discuss the interactions between humans and materials within the sociotechnical networks of mathematics classrooms as they form in relation to Texas Instruments' TI-Nspire™ graphing calculator. The findings indicate that while many individual elements and connections exist within classroom sociotechnical networks, they operate as a complex interconnected whole. In particular, they suggest that the ways technologies are configured in mathematics classrooms have a profound effect on the mathematical practices within them but also suggest that this is far from a one-way phenomenon.

In this presentation, I will examine the locations of mathematical activity in classrooms where handheld digital technologies are used. By drawing on Actor-Network theory, I will discuss the interactions between humans and

materials within the sociotechnical networks of mathematics classrooms as they form in relation to Texas Instruments' TI-Nspire™ graphing calculator. TI-Nspire™ and related technologies are broadly advocated in curriculum documents and guidelines for teachers (Ontario Ministry of Education, 2005; Qualifications and Curriculum Authority, 2007). In addition, a growing body of mathematics education research suggests that these technologies help learners make connections with and between mathematical concepts and enrich their mathematical thinking (Kaput & Schorr, 2008). Given this support for the use of digital handheld technologies, it is important to unpack the ways they change the geography of mathematical activity in classrooms. In this presentation, I will address these changes by examining the role of TI-Nspire™ as a location of mathematical activity in relation to other materials, teachers and students.

Theoretical Perspective

As a theoretical perspective, I draw on Shaffer and Clinton's approach to understanding the relationship between digital technology and learners in mathematics classrooms (2006). In particular, following their lead I draw on the Activity-Theory concept of learning as activity that always involves cultural tools. This notion suggests that understanding the mediation of tools including technologies is vital to understanding learning itself (Saljo, Eklund & Makitalo, 2006). While Activity-Theory foregrounds the important role of tools in human activity, it considers technologies and humans to have an asymmetrical relationship. In this relationship, humans are assumed to act as agents and technologies are not (Shaffer and Clinton, 2006). This assumption may obscure the important role that particularly complex digital technologies such as TI-Nspire™ can have in mathematical learning. To address this issue, I turn to Actor-Network theory to conceptualize the relationships between humans and technology as part of social networks of humans and non-humans all mediating each other's activity (Latour, 2007). Within these sociotechnical networks the relationship between actors, both human and non-human, are conceptualised in reciprocal terms offering the notion that when interacting the capacity to act cannot be located in either party but instead emerges from their interaction (Latour, 2007). Together the combination of Actor-Network theory and Activity-Theory provide a useful perspective for examining the mediation of mathematical learning within networks of humans and materials.

Method

I observed two ninth grade mathematics classes in the Canadian province of Ontario, spending a week video recording in each classroom. Augmenting this, I conducted a series of recorded interviews with the teachers that began with an in-depth session focused on their experiences teaching with technology. Continuing the interviews, the teachers participated in a retrospective debriefing interview following each observed class. In addition, I interviewed two students from each classroom about their experiences with TI-Nspire™.

Following data collection, all video-recordings, interview transcripts and collected artefacts were examined using Interaction Analysis (Jordan & Henderson, 1995) as an analytic approach to describing the complex activities and interactions within the networks of mathematical activity. As a tool for performing this analysis, the qualitative data analysis software Transana was used. This powerful and flexible software supported a detailed examination and interlinking of all collected data, including video, in a single environment.

Findings

The findings that I will present show the complex ways that the introduction of a digital handheld technology such as TI-Nspire™ changes the geography of mathematical activity in classrooms. They speak to the relationships between TI-Nspire™, teachers, students, and a wide range of materials such as the computer lab, paper/pencil, the blackboard, and interactive whiteboards. All these materials served as locations of individual and shared mathematical activity in the two observed classrooms. While no material replaced any of the others with the introduction of TI-Nspire™, the networks of humans and materials in each classroom reconfigured in different ways that supported different mathematical activity.

While many individual elements and connections exist within classroom sociotechnical networks, the findings of this study indicate that they operate as a complex interconnected whole. In the two observed classrooms, it was particularly evident that the effects of the teachers' decisions to include TI-Nspire™ as part of their instructional practices were not limited to, for instance, the local relationship between student and handheld technology while completing an activity. They were instead extremely broad, influencing practices as diverse as the use of the computer lab and whole-class discussion of homework. The findings of this study suggest, that the ways technologies are arranged in mathematics classrooms have a profound effect on the mathematical practices within them but also suggest that this is far from a one-way phenomenon. While teachers have enormous influence through their choices

of what technological arrangements to use, the technologies themselves along with other elements of the classroom geography mediate these configurations and are highly interrelated.

References

- Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, 4(1), 39-103.
- Kaput, J., & Schorr, R. (2008). Changing representational infrastructures changes most everything. In G. Blume & K. Heid (Eds.), *Research on technology and the teaching and learning of mathematics: Vol. 2. Cases and perspectives* (pp. 211-253). Charlotte, NC: Information Age Publishing.
- Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.
- Leont'ev, A. (1978). *Activity, consciousness, and personality* (M. J. Hall, Trans.). Upper Saddle River, NJ: Prentice-Hall.
- Ontario Ministry of Education (OME). (2005). *The Ontario curriculum grades 9 and 10: Mathematics revised*. Toronto: Queen's Printer for Ontario.
- Qualifications and Curriculum Authority (QCA). (2007). *The National Curriculum 2007*. London: Crown.
- Shaffer, D., & Clinton, K. (2006). Toolthoughts: Reexamining thinking in the digital age. *Mind, Culture, and Activity*, 13(4), 283-300.
- Saljo, R., Eklund, A.-C., & Makitalo, A. (2006). Reasoning with mental tools and physical artefacts in everyday problem-solving. In L. Verschaffel, F. Dochy, M. Boekaerts, & S. Vosniadou (Eds.), *Instructional psychology: Past, present, and future trends. Sixteen essays in honour of Erik de Corte*. (pp. 73-90). Amsterdam: Elsevier.

PAPER PRESENTATION

The Adoption of Technology Innovations

Charalambos Vrasidas, CARDET - University of Nicosia , Cyprus; Christiana Aravi, CARDET, Cyprus; Katerina Theodoriodu, CARDET, Cyprus; Petros Panaou, UNIC - CARDET, Cyprus; Anastasia Economou, CPI, Cyprus; Ireneos Pattis, UNIC - CARDET, Cyprus

The adoption of innovations and technology in teaching and learning has been studied extensively. This paper presents findings from 3 year program that focused on the development of case studies of the use of ICT in the classroom and results from large-scale evaluations of technology initiatives in Cyprus public schools. A large-scale survey was conducted and 30 case studies were developed in order to examine the use of ICT by teachers, the effectiveness of teacher professional development and the challenges faced by practicing teachers with respect to the integration of Information and Communication Technologies (ICT) in the curricula. This paper discusses findings from the large scale survey and enriches the findings with qualitative data from the ethnographic case studies to illustrate insights on effective practices of ICT adoption in Cyprus education.

Introduction

Attempts to integrate technology in education provoke a variety of responses from teachers that range from enthusiasm and skepticism to fear and uncertainty. A long history of technology use in education reveals that the first reaction is to use new technology in the same traditional ways as the old technology. Old curricula and pedagogical approaches should be reformed, and if necessary replaced, to take advantage of the affordances of the new media.

Context

During the last two years, we were involved in two large scale evaluations of the Cyprus Education system and 5 developmental research programs supported by the Republic of Cyprus, EU Structural Funds, and the European Commission. The focus of these projects was on the adoption of ICT by K12 teachers and the effectiveness of existing professional development programs offered. One of the key issues that came out was the importance of both formal and informal ways for teacher lifelong learning, and the role that online environments can play to support them. In this paper, we present the summary of findings from evaluation work conducted to investigate the adoption of ICT in Cyprus public schools. This paper discusses findings from the large scale survey and enriches the findings with qualitative data from the ethnographic case studies to illustrate insights on effective practices of ICT integration in Cyprus education.

Research Methods

Participants

For the ethnographic case studies part of the projects, a total of 30 K12 schools participated (10 high schools, 20 primary schools). From each school we had one teacher as a case study. Each teacher and his/her class comprised of one case study in a variety of subjects. Teachers were chosen by the Ministry of Education based on the following

criteria: teachers must have participated in some of the professional development programs, represent all counties of Cyprus (geographical distribution), and they must have expressed interest to participate in the case studies.

Setting and Procedures

The project research team that investigated and evaluated the case studies was led by the international Research Center CARDET. A total of 55 researchers were involved in the research. In order to achieve homogeneity and ensure consistency in data collection and analysis, four half-day workshops were held during which all researchers received appropriate training. The evaluation work span a period of 20 months.

Research/Evaluation Questions

The study investigated a series of questions. For the purpose of this paper we focus on the following:

1. What factors affect teachers' efforts in technology integration?
2. How do teachers use ICT?
3. What barriers do teachers face in using technology in the classroom?

Data Collection, Instruments and Analysis

Data for this project were collected and analyzed using both quantitative and qualitative methods. Data were collected from the following sources:

- . Pre-interviews conducted with each teacher on the planning process for the unit to be implemented and the teacher expectations
- . Observations of at least ten lessons implemented by each teacher, which integrated technology in the classroom over a period of 6 weeks.
- . Teacher self-reflective journals
- . A teacher post-interview
- . Interview with each teacher's technology advisor
- . Interviews with at least 3 students from each case (selected with the help of the teacher)
- . Student pre and post-tests.
- . A large scale survey administered to K12 school teachers.

For the purpose of this paper, we focus on the findings from the large scale survey. The main objective of the survey was to analyze how teachers use technology in the classroom and what challenges they face. In the discussion below, we enrich the findings of the survey, with qualitative data from the 30 case studies. In order to develop the 8-page instrument for the survey, we relied heavily on the findings from the qualitative data (e.g. interviews and observations). In addition, we reviewed other instruments, and consulted with experts in the field. A first draft instrument was developed and pilot-tested with 10 teachers and 4 experts. Following the pilot, we finalized the instrument and administered it to a sample of 1051 teachers using stratified sampling procedures. The total population of primary school teachers in Cyprus, during 2008-2009 was 4150. We ensured that all counties and regions of Cyprus were represented from both rural and urban settings. The response rate of the questionnaire was 50.5% (531 out of 1051).

Data Analysis

During data analysis, we followed the inductive and deductive stages used in interpretive and case study research. After we collected and organized all the data, we read through the data three times and generated assertions. Once we generated assertions from the data as a whole, we entered the deductive stage. In this stage, we engaged in detailed examination of the data corpus and looked for data to confirm or disconfirm our assertions. Moreover, statistical analysis of quantitative data included tables and diagrams, whereas authentic excerpts were extracted from the qualitative data.

Results

Even though the authors have studied all research questions related to this study, this section discusses only findings on the factors that affect teachers' efforts in technology integration and the challenges they face. The findings presented in this paper shed light to the complexities of integrating ICT in teaching and learning. The research reported is the first of its kind conducted in the Cyprus context. Findings reveal that teachers are willing to integrate technology into their teaching practices. However, even though they realize the benefits of ICT integration, a lot of teachers today seem resistant to integrating technologies. This is due to several factors that were revealed through the findings, such as lack of time, the ill-structured design of the school curriculum, and lack of infrastructure

PAPER PRESENTATION

Depiction of Theme in Graphics: Its Influence in Expository Text

Robert Danielson, California State University, Chico, United States; Neil Schwartz, California State University, United States; Stefan Krause, University of Koblenz-Landau, Germany; Marie Lippmann, University of Dresden, Germany; Sevil Gonen, California State University, Chico, United States; Maryam Fallahi, California State University, Chico, United States; Steven Caldwell, California State University, Chico, United States

It is well documented that when graphics are paired with textual material, recall is enhanced. However, not all graphics operate in a similar fashion. Previous research has indicated that decorative graphics provide little to the overall understanding of textual material, while representative graphics help learners construct a cognitive model of text content. Recently, decorative graphics have been found to be more effective than previously thought. Graphics which highlight the underlying themes present in a narrative, yield comprehension that is comparatively deep. This effect has been found both immediately after reading and one week later. In the present investigation, 80 volunteers read an expository text about the conflict in Darfur in the presence of a graphic depicting either the text theme of civil war or genocide, or they saw a graphic depicting the geographic region of the conflict, or no graphic at all. Results showed that the graphics, when they are metaphors of the underlying text themes, greatly enhance recall of the text when compared to either the non-thematic graphic or no graphic at all. Results are discussed in terms of the way decorative graphics can be used to influence deep learning.

Examples of text paired with graphics are prolific throughout textbooks and the web. It is well understood that when the two appear together, performance is consistently better than text alone (Carney & Levin, 2002; Schnotz, 2002; Schnotz & Bannert, 2003; Mayer, 2003; Mayer, Hagerty, & Mayer, 2005; Lewalter, 2003). However, not all types of graphics function in the same way, and specific text-graphic combinations lead to different performance outcomes. Schnotz & Bannert (2003) demonstrated that unique graphics, paired with identical texts, create different mental representations of textual information, and poorly selected graphics interfere with mental model construction (Schnotz & Bannert, 2003). Furthermore, some graphics are less reliable in their effect on learning from text, particularly when employed to decorate a page. Levin, Anglin, and Carney (1987), in a meta-analytic review, found moderate to strong effect sizes for graphics employed to inform text by representing all or part of text content, but weak to non-existent effect sizes for graphics used for decoration.

We contend that graphics used to adorn text serve more than a simple decorative function. Instead, they convey information about the theme of a text and influence a learner's cognitive interaction with a passage (Schwartz, Battinich, Lieb & Mortensen, 2008; Schwartz, Lieb, Battinich & Kuinke, 2007). Schwartz & Collins (2008) demonstrated that decorative graphics are capable of activating the prior knowledge of learners in idiosyncratic but reliably predictable ways. Mortensen & Schwartz (2009) found that thematically-related decorative graphics increased recall of both literal details and deeper level themes embedded in text-- immediately after reading the text two weeks later.

Unfortunately, Mortensen & Schwartz (2009) found effects with a narrative passage that, because of its ambiguous nature, may have contributed to the influence of the graphics. They also failed to test the effects against a non-thematic graphic condition. This investigation focused on expository text-- more common in textbooks and media, and tested the graphics against a non-thematic graphic condition.

Methodology

Design

The design was a 4 Metaphorical Graphic Theme (Genocide vs. Civil War vs. Geographic Location vs. None) x 3 Passage Theme Type (Genocide vs. Civil War vs. Neutral) fixed ANOVA, with repeated measures on the passage theme variable.

Participants

Eighty undergraduate volunteers (mean age = 23) were randomly assigned to experimental conditions in equivalent proportions of gender.

Materials

Experimental passage. The experimental passage was an 839-word expository text describing the current conflict in Darfur, written to reveal two socio-political themes— civil war and genocide. Overall, the passage contained a total of 80 idea units—40 neutral, 20 civil war, and 20 genocide. Neutral idea units provided contextual background of the conflict, geographic information, and a historical timeline. Civil war idea units consisted of rebel groups uniting against a corrupt government for representation. Genocide idea units consisted of a planned extermination or removal of a group of individuals. To ensure idea units were properly assigned to their corresponding themes,

sentences were randomly ordered, rated by a group of 40 undergraduates, and factor analyzed for the identification of evoked themes and emotional valence. Outliers were removed, and the passage was reconstructed as a cohesive unit.

Experimental graphics. Three metaphorical graphics were designed. The first graphic was a topographical representation of the region. The graphic depicting Civil War graphic consisted of two lions of similar color and size engaged in combat. The graphic depicting Genocide consisted of two lions of similar color and size devouring a third lion of a dissimilar color and size. Graphics were normed by a separate group of 40 undergraduates to ensure they elucidated the intended metaphor without evoking the alternate metaphors. (See Figure 1).

Experimental Website. An experimental website was designed to display the materials. The website consisted of 15 hypermedia pages; informed consent, general instructions, an essay prompt, and a demographic questionnaire. Prior knowledge of the conflict was assessed by embedding a 7-point Likert scale into the demographic questionnaire.

Procedure

Participants navigated the experimental website with the experimental text presented on the right half of the screen while one of three graphics (or no graphic) were randomly presented on the left. Participants were allotted six and a half minutes to comprehend both the text and the graphic. Participants were then allotted 15 minutes to write an essay containing as much information as they could remember, including any thoughts, feelings, or reactions to the text.

Data Source

Measures of comprehension were derived by scoring the essays for the number of three types of idea units—passage-neutral material and material related to the genocide and civil war themes. Two graduate students scored half the protocols in each between-subject group, and redundantly scored 20% of the total. Inter-rater reliability was $r = .90$.

Findings

Neutral-passage idea units recalled were analyzed across Metaphorical Graphic Theme (Genocide, Civil War, Location, No graphic) in a univariate ANOVA. Results yielded a significant effect between graphic conditions, $F(3, 76) = 3.495$, $p = .02$. Post hoc Tukey tests revealed neutral passage recall was highest ($M = 6.4$, $SD = 3.68$) in the presence of the metaphorical graphic depicting the theme of genocide. By contrast, recall was significantly reduced when the graphics contained no metaphor for theme (location, $M = 3.65$, $SD = 2.65$), and no graphic at all ($M = 3.68$, $SD = 2.63$). No relation was found between prior knowledge of the conflict and number of idea units recalled. (See Figure 2).

Theoretical and educational significance

These findings support Mortensen & Schwartz (2009), revealing that thematically related graphics increase recall of both deeper level themes and literal details from text. The results support those found by Mortensen & Schwartz (2009), but underscore the presence of the effect with expository text and test it against a thematically unrelated and absent-graphic condition. It is important to note that Mortensen & Schwartz (2009) found the largest effects when learners returned two weeks after reading. Delay condition data and the extent to which recalled is mediated by critical thinking skills will be presented and explained using the model proposed by Schnotz and colleagues (2003).

PAPER PRESENTATION

What do players have to say about informal learning through games?

Ioanna Iacovides, The Open University, United Kingdom; James Aczel, The Open University, United Kingdom; Eileen Scanlon, OU, United Kingdom; Will Woods, The Open University, United Kingdom

It has been suggested that digital games can be powerful learning environments that encourage active and critical learning, including participation within "affinity groups" and "semiotic domains" (Gee, 2004). However, there is still a need to provide further empirical evidence to substantiate these claims, especially if educators want to try to replicate people's enthusiasm for games within a formal educational context. By addressing the question "How do players describe learning in the context of gaming?" this study seeks to further our understanding of how and what people learn informally through playing games by first examining the player perspective. A set of learning categories, based on a series of email interviews with a range of adult games players, is identified along with some themes to consider in relation to players' views on learning within this context. The findings indicate the importance of considering more than just what occurs during play, because, for example, players often consult external resources for advice about what to do in the game world. It is also pertinent to note players' ideas about value and transfer of learning across

contexts. The research raises questions about the completeness and applicability of these learning categories, and about how these categories relate to motivations for playing games and engagement during play.

References

- Calleja, G. (2007) Digital Game Involvement: A Conceptual Model. *Games and Culture*, 2, 236-260.
- Gee, J.P. (2004). *What Video Games Have to Teach Us About Learning and Literacy*. New York: Palgrave Macmillan.
- Hamilton, R.J. & Bowers, B.J. (2006). Internet Recruitment and Email Interviews in Qualitative Studies. *Qualitative Health Research*, 16, 821-835.
- Howard-Jones, P.A. (2010). *The Teacher's Handbook of Twig: Minds, Brains and Teaching with Immersive Gaming*. www.lulu.com: NENet.
- Squire, K. (2002). Cultural Framing of Computer/Video Games. *Games Studies* 2(1). Retrieved October 15, 2010 from <http://gamestudies.org/0102/squire/>
- Richardson, J.T.E. (1999). The Concepts and Methods of Phenomenographic Research. *Review of Educational Research*, 69(1), 53-82.

PAPER PRESENTATIONS

Aligning Instruction to Individual Learning Needs in Adaptive Hypertext Learning Environments

Eniko Bezdan, Open University, Netherlands; Liesbeth Kester, Open University of the Netherlands, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Educational hypertext research on the effectiveness of pre-structured, static hypertext learning environments have greatly enhanced our understanding of how pre-structured hypertext environments affect navigation and learning outcomes. In particular, the effect of different types of graphic organizers have been extensively studied in the past two decades. In the meantime, however, the focus of hypertext and hypermedia design have moved on toward the development of ever more sophisticated adaptive techniques, yet empirical data about the cognitive effects of adaptive hypertext/hypermedia have been slow coming. The scarcity of research regarding the cognitive consequences of adaptive hypertext/hypermedia is somewhat surprising, as it has the potential to bring one of the longest standing ambitions in education one step closer: being able to provide instruction which is finely tuned to the learning needs of the individual learner. Knowledge accumulated about the learning effects of static hypertext environments, along with the results of studies about learner versus system control for task selection are examined, in order to outline possible future directions for adaptive hypertext/hypermedia research in an educational context.

When speaking of hypertext/hypermedia, the most basic kind of classification that can be made is between static and dynamic/adaptive. In static, more traditional, hypertext the sequencing of hyperlinks is fixed and the text content of the nodes remains unchanged. As the degree of interconnectedness via hyperlinks and the placement of hyperlinks between nodes determine the structure of hypertext (e.g., linear, hierarchical, network/semantic), navigation aids called spatial maps, graphical browsers or graphical organizers, depicting this structure of hyperlinks and nodes, are frequently used as a way of tackling the problem of disorientation (McDonald & Stevenson, 1998). Not surprisingly, one of the main themes of hypertext research in an educational context has been to examine the effects of different types of graphic organizers and its effects on navigation and learning outcomes (DeStefano & LeFevre, 2007).

Besides differences regarding their structure (e.g. linear, hierarchical, network), graphical organizers can also be divided into interactive and static. In the case of interactive organizers, the hypertext structure as defined by its hyperlinks, and the structure depicted in a graphic organizer need not be the same, as indeed they often are not. This is for example the case when nodes can be accessed directly by clicking on the concepts in the organizer. Once arrived at a textual node, there is only the option clicking on the back-button which leads back to the graphical organizer (e.g., Amadiou et al., 2009; Potelle & Rouet, 2003). Thus, a graphical organizer of this sort is not intended to describe the structure of the hypertext itself, as the lines drawn between the concepts in the graphical organizer do not correspond with the actual hyperlinks of the document. Consequently, it is almost certainly not the act of navigation (i.e. navigation here simply means clicking on concept in the organizer) which enhances learning, but the repeated viewing a representation of the relationships between the important concepts and of a knowledge domain.

Although in appearance similar to the interactive organizers described above, static graphic organizers usually have a different function. Static organizers can be a way of depicting the exact hyperlink structure of the hypertext document, as was the case in the study conducted by McDonald & Stevenson (1998). By visualising all possible pathways through the document, graphic organizers of this kind are navigation aids which could be said to convey a certain kind of spatial information. Thus, these are spatial maps which show how to get from a one text node to another, as well as the relative distance of textual nodes to each other as defined by the number intermediate steps

between them. What still remains unclear is, however, to what extent graphic organizers showing possible navigation paths engage same cognitive processes as graphic organisers in which the linkages (i.e. lines between concepts) do not correspond with the actual hyperlinks in the document. Besides the open questions remaining with regard to static hypertext, the cognitive effects of more complex, adaptive hypertext are largely unexplored. Today's learners encounter adaptivity on a daily bases when they for example use a search engine to browse the internet. Search engines make use of sophisticated algorithms analysing individual search histories in real time to select the hits in response of a search query, thereby adapting content presentation to the individual user. Yet, the widespread exposure to adaptive hypertext and hypermedia of the student population has so far sparked surprisingly little interest in educational research. Usability and user satisfaction studies are being carried out by the developers of adaptive hypertext/hypermedia, who come for the most part from the field of information and computers sciences. However, very little attention is paid in these studies to cognitive effects and learning outcomes (Brusilovsky, 2003).

The cognitive effects of adaptivity are being studied, however, in the specific context of adaptive task selection. Adaptations on task selection often focus on the degree of freedom the learner gets over task selection. The most common classification regarding the locus of control for the adaptations distinguishes between system controlled adaptation, user controlled adaptation, and shared control by the system and the learner (Corbalan, Kester, & Van Merriënboer, 2009). It could be argued that studies focusing on adaptive task selection, although mostly presented in hypertext/hypermedia format, are not representative of the hypertext/hypermedia that are typically encountered when browsing the web. Nevertheless, insights gained from these studies are still relevant for hypertext/hypermedia in a broader sense, as different levels of system and learner control can be incorporated and made adaptable in diverse hypertext/hypermedia formats. Utilising effectively the possibilities of adaptive hypertext and hypermedia could be the key to truly customising instruction to individual learning needs. But in order to do so, it is necessary to gain a better understanding about the extent the structural characteristics of navigation aids (e.g., graphic organizers) and hypertext structure as defined by its hyperlinks have differential effects on cognitive processes in the course of learning. Additionally, varying the locus of control in adaptive task selection is a good starting point to explore how shifting the control from the system to the learner and vice versa affects learning outcomes. There is also still much to be learnt about the possible objects of adaptive control, as the structure, content and the form and type of navigation aids in hypertext/hypermedia can all be made adaptable in a great number of ways. The focus of this paper is, therefore, to explore how adaptations regarding structure, content and navigability might interact with variations in the locus of control of these adaptations.

References

- Amadiou, F., Van Gog, T., Paas, F., Tricot, A., & Mariné, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load, and learning. *Learning and Instruction*, 19, 376-386.
- Brusilovsky, P. (2003). Adaptive navigation support in educational hypermedia: the role of student knowledge level and the case for meta-adaptation. *British Journal of Educational Technology*, 34, 487-497.
- Corbalan, G., Kester, L., & Van Merriënboer, J. J. G. (2009). Combining shared control with variability over surface features: Effects on transfer test performance and task involvement. *Computers in Human Behavior*, 25, 290-298.
- DeStefano, D. & LeFevre, J. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior*, 23, 1616-1641
- McDonald, S., & Stevenson, R.J. (1998). Navigation in hyperspace: An evaluation of the effects of navigational tools and subject expertise on browsing and information retrieval in hypertext. *Interacting with Computers*, 10, 129-142.
- Potelle, H., & Rouet, J. (2003). Effects of content representation and reader's prior knowledge on the comprehension of hypertext. *International Journal of Human-Computer Studies*, 58, 327-345.

Effects of Drawing and Diagram Selection on Learning from Multiple Representations in Biology

Carla Firetto, Pennsylvania State University, United States

Peggy Van Meter, The Pennsylvania State University, United States

Active processing of diagrams embedded in science text improves student learning. This study tests two manipulations intended to improve learners' processing of diagrams. All participants read a biology text that contained 25 diagrams. 7 of these 25 diagrams were removed in both active processing conditions. In the first of these, the Draw condition, participants constructed their own drawings to replace the missing diagrams. In the Select condition, participants selected the correct diagram from amongst a set of alternatives. These two conditions were compared to conditions in which participants studied the materials with all diagrams provided and a text only control. Learning outcomes were evaluated on a multiple-choice posttest that was divided into two subtests. One subtest tested knowledge that corresponded to content related to the 7 missing diagrams. The second subtest tested knowledge taken from other areas of the instructional material. Results show that participants who constructed drawings scored significantly higher on the correspondent subtest than did participants who studied either the text only or the text with the

provided diagrams. There were no differences between the selection condition and the provided diagram condition on this subtest nor were there differences between drawing and selection. On the subtest with non-correspondent items, all three conditions that received diagrams scored significantly higher than did participants in the text only condition. There were no differences found between these three conditions on this non-correspondent subtest, however.

Student-generated drawing is a strategy in which learners draw to depict instructional text (Van Meter & Garner, 2005). Although this strategy has been shown to increase learning (Van Meter, Aleksic, Schwartz, & Garner, 2006), other studies have failed to show strategy benefits (Leutner, Leopold, & Sumfleth, 2009). This study tests the drawing strategy by comparing learning outcomes for students who draw to those who were either provided diagrams or were forced to actively process provided diagrams. Forced processing was operationalized by requiring participants to select a correct diagram from amongst alternatives (Zhang & Linn, 2010).

Research hypotheses include:

Participants who actively process diagrams will acquire more knowledge than will participants who do not actively process diagrams.

Participants who construct drawings will acquire more knowledge than will participants who select diagrams.

The benefits of active diagram processing will be found on subtests that assess both correspondent and non-correspondent knowledge.

High prior knowledge participants will benefit from active processing of diagrams to a greater degree than will participants with lower prior knowledge.

Methods

Participants and Design

106 Educational Psychology students were randomly assigned to conditions. Conditions were text only (Text), text and provided diagrams (Provided), selection (Select), and drawing (Draw).

Materials

Instructional Materials. Participants studied a paper booklet describing muscle physiology. The text contained 1,780 words and 25 diagrams. Diagrams either depicted structures or were sequenced to depict processes.

Condition Manipulations. Participants in the Text condition studied booklets containing only text. In the Provided condition, booklets contained text and all diagrams were provided. Participants in the Select condition received booklets in which seven diagrams were removed. At these locations, participants selected the correct diagram from amongst a set of alternative diagrams. Missing diagrams were dispersed throughout the instructional material. Participants in the Draw condition also received booklets with missing diagrams. Booklets in this condition contained blank space and participants drew a diagram depicting the contents of the accompanying text.

Pretest and Posttest Measures.

Participants completed a pretest assessing prior biology knowledge.

The posttest was a multiple-choice test. This test was divided into two subtests. The first tested knowledge corresponding to the content that participants either selected or drew. The second tested knowledge taken from other areas of the instructional material. There were 17 correspondent items (C) and 25 non-correspondent items (NC). The alpha coefficient for the full test was .77.

Procedures.

Participants completed experimental sessions in a computer lab. Sessions were randomly assigned to condition. The experimenter explained instructions for each condition. Participants in the Select and Draw conditions were told of the missing diagrams and of the selection or drawing task, respectively. Participants completed the demographic survey, pretest, and posttest online; instructional materials were on paper.

Results

An extreme-groups split on the prior knowledge variable divided participants into high and low prior knowledge groups. 91 participants remained following this split.

Condition effects on the posttest variables were tested in a 2 (prior knowledge) X 4 (condition) MANOVA. The interaction between prior knowledge and condition was nonsignificant. Main effects for both prior knowledge and condition were significant; $F = 7.36$, $p < .05$; $F = 6.16$, $p < .05$, respectively. Univariate tests revealed a

significant main effect of prior knowledge for both NC and C subtests; $F = 11.09$, $p \leq .05$, $F = 10.52$, $p \leq .05$, $F = 10.23$, $p \leq .05$. High knowledge participants scored higher on both subtests than did low knowledge participants. There was also a significant main effect of condition found for both NC and C items; $F = 5.84$, $p \leq .05$; $F = 10.23$, $p \leq .05$. Tukey's HSD comparisons revealed that the pattern of these effects differed across the two subtests. For the NC subtest, the Provided, Select, and Draw groups all scored significantly higher than did the Text group. There were no significant differences across any of the three groups that received diagrams along with text. On the C subtest, each group that received diagrams again obtained higher scores than did participants in the Text condition. There were also differences amongst these three groups. The difference between Select and Draw was not significant, but students who drew did score significantly higher than participants in either the Text or Provided conditions. Participants in the Select condition did not obtain significantly higher C scores than did participants in the Provided condition.

Discussion

This study demonstrated that the drawing strategy can be effectively embedded into lengthy instructional materials. Participants in the Draw condition were required to construct 7 of the 25 total diagrams. We believe that the construction of some, but not all, diagrams was important to the success of the strategy. First, the diagrams that were available to Draw participants provided a necessary form of support (Van Meter & Garner, 2005) by illustrating key structures and spatial relations. Second, providing some diagrams may have reduced the cognitive load associated with the drawing strategy (cf. Leuntner et al., 2009). The differential pattern of performance on NC and C items suggests that the benefits of drawing are local. Drawing did show an advantage when the subtest assessed knowledge directly related to drawn content. When non-correspondent knowledge was tested, however, Draw participants did not obtain higher scores than did Provided participants.

This study also demonstrated that active processing of the diagrams alone, through the selection task, did not improve learning (Van Meter et al., 2006). It is possible, however, that the selection task was not sufficiently complex to support learning (Zhang & Linn, 2010).

We are currently analyzing qualitative characteristics of constructed drawings. Once this coding is complete, we will examine relationships between these characteristics and learning outcomes.

PAPER PRESENTATION

The role of teacher characteristics in promoting student engagement

Jolien van Uden, ROC van Twente/ Twente University, Netherlands; Henk Ritzen, Applied University Edith Stein, Netherlands; Jules Pieters, University of Twente, Netherlands

In this research the relationship between teacher characteristics, like their motives to become a teacher, their self-efficacy beliefs, competences and interpersonal teaching style, are examined in relation with student engagement. Disengagement is an important risk factor in the process of dropping out. Three types of engagement are being distinguished: behavioural, emotional and cognitive engagement. The relation between all three types of student engagement, and teacher characteristics are explored during a survey in vocational education and training centres in the Netherlands (VET Colleges). This survey consists of a teacher and a student questionnaire. The results of both questionnaires will be combined, so the engagement of the students can be linked to the characteristics of their teachers. The first student results show a relation between student engagement and interpersonal teaching styles. The results of the complete datasets are examined during the spring and will be presented at the Earli 14th Bienial Conference.

Theoretical framework Student drop-out is a hot item in the Netherlands (Researchcentrum voor Onderwijs en Arbeidsmarkt, 2009). From a pedagogical perspective drop-out is the result of a long term process of disengagement and withdrawal of a student from education. This process of disengagement starts during the early years of education (pre-school and primary education) and could result in dropping out of school in higher and vocational education (Dynarski, Clarke, Cobb, Finn, Rumberger & Smink, 2008; Hammond, Linton, Smink & Drew, 2007). Drop-out is not the result of one single factor, research confirms that different factors influence the decision to drop-out. These risk-factors are interrelated, interact with each other and have a cumulative effect on the decision to quit school (Dynarski et al, 2008). Among the important factors that influence drop-out of school is student engagement (Appleton, Christenson & Furlong, 2008; Fredricks, Blumenfeld & Paris, 2004). The expectation is that if student engagement has increased and other risk factors are offset by prevention activities or special student care programs like mentoring and individual coaching programs, the drop-out rate will decline. In this research we focus on what the teacher can do to improve student engagement. The concept of engagement is a multidimensional construct consisting of three components (Appleton et al., 2008, p.370):-

Behavioral engagement: a student is behavioral engaged if he participates in the lesson. The student is on time, concentrates on the assignments given, puts effort into these assignments and undertakes action if possible.- Emotional engagement: a student is emotional engaged if he is enthusiastic about school. He is interested in going to school, he can identify himself with school and demonstrates a positive learning attitude. –

Cognitive engagement: a student is cognitive engaged if he understands the importance of his education. He is able to formulate his own learning goals, disposes of self-regulating abilities and the extent to which he wants to put effort in receiving good learning results. According to Hattie (2003) the teacher accounts for 30 percent of the variance in the school success of students. The abilities of the student himself account for 50 percent of the variance. Other aspects, family, school and peers, explain five till ten percent of the variance. If school success is explained for 30 percent by the role of the teacher, could that mean that the teacher would have the same impact on student engagement? A lot of research has been conducted to examine the relationship between drop-out and engagement (e.g. Archambault, Janosz, Fallu & Pagani, 2009; Finn, 1989; Klem & Connell, 2004) while almost no research has been done to examine the way teachers can influence the engagement of students. In this research we examine what teachers can do to improve the engagement of students in lower educational tracks (assistant training level 1 and basic vocational training level 2). In this inquiry the teacher characteristics are limited to: The motives to become a teacher: A person can choose to become a teacher based on extrinsic, intrinsic or altruistic motives (e.g. Pop & Turner, 2009; Richardson & Watt, 2006). Which motives are important in stimulating student engagement? Competences: Teachers can develop three types of knowledge and competences: subject knowledge, didactical knowledge and pedagogical knowledge (e.g. Beijaard, Verloop & Vermunt, 2000; Borko, 2004; Darling-Hammond & Bransford, 2005). Which competences are related to higher student engagement of students in vocational education level 1 and 2? Personal characteristics: Literature suggests that students in the lower educational tracks are in need of social-emotional competent teachers. Interested, warm and careful teachers can make the difference in case of students at risk of dropping out (Jennings & Greenberg, 2008; Pianta & Allen, 2008).

A large amount of self-efficacy is related to educational innovation, good class management, offering suitable learning activities and taking responsibilities for students in need of special care. Furthermore teacher self-efficacy is associated with student's motivation and self-esteem and more positive attitudes towards school (Caprara, Barbaranelli, Steca & Malone, 2006). The motives to become a teacher, the competences and personal characteristics will probably result in specific behaviour in the class in interaction with the students. Wubbels, Créêton and Hooyman (1985) have adapted the 'Rose of Leary' for educational interaction. They call this adapted model 'Model for interpersonal behaviour' (MITB). This model distinguishes two dimensions: the amount of influence and the amount of proximity. A higher score on both dimensions correlates with better cognitive and affective results (e.g. Den Brok, Brekelmans & Wubbels, 2006; Van Petegem, Aelterman, Van Keer & Rosseel, 2008). We examine whether these results also apply for student engagement.

Research design

In this research we examine which teacher characteristics influence student engagement. Little research is done with respect to this subject, therefore we decided to start an explorative survey. This survey consists of two questionnaires, one for teachers and one for students. The student questionnaire is used to measure the student engagement (all three components) and will be correlated with the results of the teachers. We ask the teachers and students to fill in a short version of the questionnaire on teacher interaction (QTI) (Wubbels, Créêton & Hooyman, 1985). Besides the QTI teachers answer questions about their motives, competences and the mentioned personal characteristics. All teacher questionnaires will be linked to the results of their students. One completed teacher questionnaire needs at least ten completed student questionnaires to be included in the analysis. Results Several institutions of vocational education participate in the survey at this moment. The first student results (N = 370) show a relation between student engagement and the interpersonal teacher style (table 1). In the beginning of 2011 we will be able to analyze the teacher questionnaires in combination with the student questionnaires. We will present the results of those analyses at the Earli Conference in Exeter and answer the question which teacher motives, competences and personal characteristics.

PAPER PRESENTATION

Science and technology education for the future: needs of future employees
Professional Development, Science Education, Vocational education

Liesbeth Baartman, Eindhoven University of Technology, Netherlands

Koeno Gravemeijer, Eindhoven School of Education, Netherlands

Technological developments and computerisation influence many jobs. The goal of this study is to identify to what extent employees need an increased and/or different understanding of science and technology to function in their jobs than is currently taught in schools. Whereas previous research tended to focus on very general skills (e.g., problem solving, communication) or long detailed lists of content knowledge, the focus of this study is on competences such as modelling and visualising. Companies most influenced by technological developments were selected in cooperation with National Centres of Expertise on vocational education. They were asked in which companies (1) more and/or different scientific and technological competences, and (2) creativity and flexibility are required. We focused on jobs at the level of senior secondary vocational education, as these jobs are most prone to being outsourced or taken over by computers. Employees working in the different companies were asked what knowledge and skills they use during their work, for example when working with machines and computers. Preliminary results show the influence of technological developments on almost all jobs. Required knowledge and skills are for example: data-analysis, the use of graphs and thinking beyond one's own job. The need for flexibility, creativity and insight in 'black boxes' seems to depend on the level of education.

Theory and aims The increased use of information- and communication technology and the influence of scientific and technological developments have caused many countries to redefine the key competences for adequately functioning professionals. This study specifically focuses on the needs of future employees: what competences in the domains of science and technology do they need to function adequately in their jobs, now and the future? Previous studies tend to focus on very general skills such as problem solving and communication (e.g., Holbrook & Rannikmae, 2007), which do not provide any specification of what should be taught. Other studies provide long and detailed lists of content to be taught in schools (e.g., AAAS, 1993). These lists run the risk of quickly becoming outdated as the amount of technical information is doubling every two years (Binkley et al., 2010). This begs the question whether we can identify competences that are general in the sense that we may expect them to stay valuable for a long time, but at the same time not too general to offer directions for curricula. This study tries to answer this question by interviewing employees in companies that are subject to technological developments. In the literature, two domains provide input to this study. First, a number of studies focus on 21st century-skills, lifelong learning competences, or key skills. For example, Binkley et al. (2010) analysed curriculum and assessment frameworks around the world, and identified ten competences, including creativity, critical thinking and ICT literacy. Voogt and Pareja-Roblin (2010) and Dede (2009) reviewed different reports about 21st century skills, generally relying on private/business initiatives. These reports mention skills such as communication, ICT literacy, social awareness, and creativity. Problematic is, however, that explicit links to educational levels are missing and the educational community hardly participates in this debate. These reports thus provide little direction with regard to the content of education. Second, we reviewed the literature about knowledge and skills used in the workplace. Here, hardly any studies exist on the use of science and technology at the workplace. There are, however, studies on mathematics that are general enough to be useful for science and technology as well (e.g., Bakker et al., 2006; Pozzi et al., 1998). These studies show the importance of: (1) knowing what processes are 'hidden' in computers or machines, and (2) analysing relationships between variables, based on quantitative data.

Data and Methods **Participants** The context of this study was vocational education in the Netherlands, preparing students for a job at levels ranging from assistant worker to middle management. This middle-level job was chosen, as it is likely to be most affected by technological changes, while employees are not specifically educated in this domain (Levi & Murnane, 2005). To identify companies most influenced by technological developments, interviews were conducted with National Centres of Expertise, who develop national qualification profiles for the different branches. Six interviews were conducted with representatives from: animal and plant care, car mechanics, audician/optician, graphical design, commercials/presentation, and nursing/care. Seven interviews were conducted with employees of these branches: a farmer using robots, employees of Ford cards, a company developing logistical systems, an ICT desk, an outsourcing company, and an audician. In November/December 2010, more interviews will be conducted in different branches, and nursing specifically. **Interviews** Representatives of the branches were asked to describe developments with regard to: (1) the amount of science and technology, (2) the content of science and technology, and (3) flexibility and creativity needed to function on the job. Depending on their function, the employees were asked:- what kind of machines and computer programs they work with;- if they need to know the 'invisible processes' inside;- how they are trained to work with new machines and computers;- what they do in case of an unexpected outcome or problem. All participants were asked to describe job situations in which scientific and technological knowledge and skills are used. Preliminary results

Full results, including the remaining interviews and more examples from concrete job situations, are presented at the conference.

Required knowledge and skills: most employees need some basic knowledge of science and technology. For example, audicians need knowledge of the auditory organs.

Flexibility and creativity: at lower levels, employees are not expected to suggest improvements or solve non-standard problems. An exception is 'defence/tank' mechanics. They need to know the exact working of tank engines, enabling creativity in emergencies.

Insight in black boxes: opinions seem to differ here. In general, employees can work with machines without knowing 'what is going on inside'. For example, graphical designer can use software to make sketches without knowing how colours mix. Theoretical and educational

significance Most jobs seem to be influenced by computerisation and technology, leading to changed requirements in terms of knowledge and skills, creativity and insight in black boxes. The identification of these changed requirements could guide curriculum adaptations, better preparing young people for their future jobs. More research seems warranted on the use of science and technology at the workplace (following studies on mathematics). This study is a first step in this direction.

References American Association for the Advancement of Science (1993). *Benchmarks for Science Literacy*. New York: Oxford University Press. Bakker, A., Hoyles, C., Kent, P., & Noss, R. (2006). Improving work processes by making the invisible visible. *Journal of Education and Work*, 19, 343-361. Binkley, M., et al. (2010). White Paper 1. Developing 21st century skills. University of Melbourne: Assessment and Teaching of 21st Century Skills. www.atc21s.org. Dede, C. (2009). Comparing frameworks for 21st century skills. In J. Bellanca & R. Brandt (Eds.) *21st Century Skills*, pp. 51-76. Bloomington, IN: Solution Tree Press. Holbrook, J., & Rannikmae, M. (2007). The nature of science education for enhancing scientific literacy. *International Journal of Science Education*, 29, 1347-1362. Pozzi, S., Noss, R., & Hoyles, C. (1998). Tools in practice, mathematics in use. *Educational Studies in Mathematics*, 36, 105-122. Voogt, J., & Pareja Roblin, H. (2010). *21st Century Skills*. Discussion paper. Enschede, the Netherlands: University of Twente.

Using a Personal Development Plan for different purposes and its influence on learning & performance
Assessment methods, Assessment of Competence, Professional Development

Simon Beusaert, Maastricht University, Netherlands

Mien Segers, Maastricht University, Netherlands

Wim Gijssels, Maastricht University, Netherlands

Today, organizations are increasingly implementing assessment tools such as Personal Development Plans. Although the true power of the tool lies in supporting the employee's continuing professional development, organizations implement the tool for various different purposes, professional development purposes on the one hand and certification/selection/accountability purposes on the other (Smith & Tillema, 2001). The study presented here aims at a better understanding of how the purpose of the Personal Development Plan (PDP), as perceived by the employee, influences the extent to which s/he undertakes learning activities and consequently leads to improved performance. Data were collected from 286 employees working in a regional Dutch tax office and 81 experts from an international organization that is specialized in medical technology (n=367). Data were analyzed by conducting hierarchical regression analyses. Results indicate that perceiving the PDP either as a learning and development tool or as a certification and selection tool, positively predicts the undertaking of learning activities and the employee's performance. Follow-up regression analysis indicated that the most powerful predictor of undertaking learning activities and a high-quality performance is the extent to which employees perceive PDPs as serving learning and development purposes. The results of this study suggest that if an organization wants their employees to learn by undertaking learning activities and in turn perform better, the tool should in the first place be introduced and used as a learning and development tool.

1. Aim Today, organizations are increasingly implementing assessment tools such as Personal Development Plans (PDPs) to stimulate employees to intentionally undertake learning activities and in turn improve workplace performance (London, 1997; van de Wiel, Szegedi, & Weggeman, 2004). In general a PDP can be described as an assessment tool embedded in a larger assessment cycle of development and performance interviews; used to gather and document information about the competencies the employee worked on and is planning to further develop (Beusaert et al., 2010). It is argued that although there is a trend towards using the tool for performance appraisal (summative assessment), the power of the tool lies in supporting employees' professional development (formative assessment) (Darling-Hammond & Snyder, 2000; Smith & Tillema, 2003). Some authors even wonder whether a single assessment format such as a PDP can serve different purposes at the same time (Dochy & McDowell, 1997; Wolf & Dietz, 1998). For example, different authors question whether PDPs can be discussed in development interviews as well as in appraisal interviews, conducted by one and the same supervisor (e.g. Beck, Livne & Bear, 2005; Wolf & Dietz, 1998). When using the tool for both purposes at the same time, the purpose of the tool as well as the guidelines and the structure are not always clear (Smith & Tillema, 2003). In this respect, it is argued that one of the quality standards of assessment is making the purpose of the assessment clear (e.g. Tillema, 2003), especially in the case of PDPs because of the potential differences in content of and approach to the tool (Arter & Spandel, 1991). When it is not clear what the PDP strives toward, this jeopardizes the quality of the assessment practice. Employees' self-protection and fear of underachieving may lead to the collection of unauthentic evidence and the construction of

invalid PDPs, instead of PDPs that openly reflect on the employee's learning and development (Smith & Tillema, 1998, 2001). On the contrary, other authors believe that information gathered during the learning or development process can be very useful for summative evaluation (e.g. Snyder, Pippincott & Bower, 1998). Despite the many arguments elaborated upon in literature, there is hardly any evidence on the effect of implementing PDPs for different purposes. The study presented here aims to contribute to a better understanding of how the purpose of the PDP, as perceived by the employee, influences the extent to which s/he undertakes learning activities and in turn, leads to improved performance. Based on the aforementioned literature, the following hypotheses are formulated: H1. Perceiving the PDP as a (organizational and individual) learning and development tool predicts the employee's undertaking of learning activities and the employee's performance significantly positive. H2. Perceiving the PDP as a selection and certification tool predicts neither the employee's undertaking of learning activities, nor the employee's performance significantly positive. H3. In the case both learning/development and certification/selection goals are taken into account, perceiving the PDP as a learning and development tool is the most powerful predictor of the employee's undertaking of learning activities.

2. Method Two organizations participated in the research. Participants are 286 employees (response rate 20%) of a regional Dutch tax office and 81 employees (response rate of 41%) from an international organization that is specialized in medical technology. For an overview of the different measures, example items, and Cronbach's alphas, we refer to Table 1. Data analysis was done by calculating descriptives and conducting correlational and regression analyses. Table 1 Overview of the different scales and their descriptives

Scale	N	Alpha	Example items
The perceived nature of the goals			Indicate on a Likert scale going from 1 to 5 in which way your organization is striving for the following goals by implementing PDPs:
Personal learning and development goals	3.89		Stimulate reflection or learning.
Organizational learning and development goals	4.88		Stimulating collaboration with colleagues.
Certification and selection goals	4.76		To delivering evidence to my supervisor.
Outcome variables			
Undertaking learning activities	6.90		Because of using a PDP I look up things in books, journal or on the internet.
Performance	6.97		Since I am using a PDP and have related meetings, the quality of my work improved.

3. Findings The correlational analysis indicate that the three different goal components correlate significantly positive with Undertaking learning activities and Performance. To examine the independent effect of the three perceived goals components on the employee's undertaking of learning activities and performance, three hierarchical regression analyses were executed. The findings indicate that personal as well as organizational learning and development goals predict the employee's undertaking of learning activities ($b = .18$; $p = .02$; $p < .05$) and performance ($b = .35$; $p = .03$; $p < .05$) significantly positive, which confirm Hypothesis 1. In contrast to our expectations, the Certification and selection goals also predict the undertaking of learning activities ($b = .14$; $p = .04$; $p < .05$) and the employee's performance ($b = .29$; $p = .01$; $p < .05$) significantly positive, which is not in line with Hypothesis 2. However, in order to determine which goal component is the most powerful predictor of the employee's undertaking of learning activities and performance, we conducted subsequently hierarchical regression analyses. The results show that organizational learning and development goals is the most powerful predictor of undertaking learning activities ($b = .14$; $p = .04$; $p < .05$). Next, the performance of an employee is more likely to improve because of the PDP if s/he perceives the assessment tool as a learning and development tool (personal: $b = .17$; $p = .03$; $p < .05$) and not as a certification and selection tool (not significant).

4. Theoretical and educational significance of the research Theoretical significance. To our understanding this is the first quantitative study that researches the influences of the different perceived purposes of the PDP on the undertaking learning activities and performance in an organizational context.

Practical significance. This study has implications for human resource development in organizations. First, in order to stimulate employees to undertake learning activities and improve their performances by using a PDP, introducing and using the PDP as a tool for learning and development is the most effective. Second, this research leads to the question: How to balance between certification and selection purposes on the one hand and learning and development purposes on the other, knowing that learning and development purposes are stronger predictors of undertaking learning activities and performance? First, keep learning and development interviews separate from performance interviews and have them conducted by a different person. Second, make a distinction between the criteria used for discussing the PDP during the learning and development interviews and the criteria used during performance interviews.

Exploring new horizons: teacher professional development through networked learning
Continuing professional development in Teachers, Professional Development, Social interaction

Daniel Van Amersfoort, Open University, Netherlands

Monique Korenhof, Open University, Netherlands

Nienke Moolenaar, University of Twente, Netherlands

In educational practice and policy, teachers' professional development initiatives are catering to the notion that teacher learning is situated in a dynamic social context. One way in which teacher learning is shaped in practice is through networked learning. However, empirical evidence of networked learning as a means of teachers' professional development is scarce. The aim of the study was to examine teachers' perceptions of, and experiences with, networked learning to explore core concepts of teachers' networked learning in primary education. This article reports on an exploratory case study among primary school teachers of ten learning networks in two school districts in the Netherlands. We used constant comparative analysis in combination with an input-process-output approach to code the transcribed interviews on teachers' perceptions of networked learning. Findings indicated that teachers' perspectives on, and experiences with networked learning can be attributed to five main aspects referring to pre-conditions for networked learning (input), four main aspects related to the process of networked learning, and five main aspects pointing at output of teacher networked learning. Moreover, we found evidence of feedback loops connecting the input, process, and output stages. Insights from this study provide meaningful understanding of teachers' professional development through networked learning and the factors that constrain and support teachers' networked learning in daily practice. It is through these networked learning experiences that teachers' professional development will permeate teachers' daily practice and, ultimately, improve instructional practice.

References

- Coburn, C. E., & Russell, J. L. (2008). District policy and teachers' social networks. *Education Evaluation and Policy Analysis*, 30(3), 203-235.
- Earl, L. & Katz, S. (2007). Leadership in networked learning communities, *School Leadership and Management*, 27(3): 239-258
- Haythornthwaite, C. & De Laat, M.F. (May 2010). Social networks and learning networks: Using social network perspectives to understand social learning. *Proceedings of the Networked Learning Conference*, Aalborg, Denmark, May 2-3, 2010.
- Jones, C., Asensio, M., & Goodyear, P. (2000). Networked learning in higher education: practitioners' perspectives. *Journal of the Association for Learning Technology*, 8(2), pp. 18-28.
- Krackhardt, D. (1992). The strength of strong ties. In N. Nohria & R.G. Eccles (Eds.), *Networks and organizations: Structure, form, and action* (pp. 216-239). Boston, MA: Harvard Business School Press.
- McCormick, R., Fox, A., Carmichael, P., & Procter, R. (2010). *Researching and understanding educational networks. New Perspectives on Learning and Instruction*. New York, NY: Routledge.
- Moolenaar, N. M. (2010). *Ties with Potential: Nature, Antecedents and Consequences of Social Networks in School Teams*. Unpublished Doctoral Dissertation. University of Amsterdam, The Netherlands.

PAPER PRESENTATION

Languaging and identities in the construction and organization of 'Swedish for immigrants'.

Jenny Rosen, University of Dalarna, University of Orebro, Sweden; Sangeeta Bagga-Gupta, University of Orebro, Sweden

This study draws upon ongoing research in Project-KIK, Categorization of Identities and Communication. Project-KIK is interested in social practices in a tailored education for adult immigrants in Sweden and the discourses framing it. The theoretical framework employed approaches language policies in terms of a dialectical relationship between the policies (macro level) and the learning that takes place in the language classroom (micro level). Our empirical material consists of audio- and video recordings of everyday interactions at an institutional arena constituted under the name of "Swedish for immigrants (Sfi)".

Our preliminary analyses illustrate among other issues, how multilingualism and monolingualism in Sweden are reflected in and negotiated through everyday interaction and the social practices in classroom settings. By highlighting empirical examples from two separate language learning classrooms, we discuss how different learning environments are created in relation to how teachers and students negotiate their understandings of languages and identities. The

understanding of Swedish as the principal and only language used for communication in this institutional setting is challenged by the multilingual languaging practices that the students employ. As a result, different opportunities for the students (both in terms of learning as well as constructing and negotiating identities), are constituted.

The study presented here draws upon the ongoing work in project-KIK, Categorization of Identities and Communication. Project-KIK is interested in both the social practices and the discourses that frame a tailored education for adult immigrants in Sweden. It focuses on conceptualizations and the "doing" of languages and identities in the specific institutionalized arena that emerged in the post-world war II period with the intention of teaching Swedish language to adult immigrants in the nation-state of Sweden.

Research concerned with the language situation of adult immigrants in different European national contexts is not uncommonly founded upon an understanding of languages in terms of being standardized, static and with defined (often national) boundaries. For example, there is an established body of literature that focuses on language policy and politics at the societal (or macro) level, with an emphasis on the legal rights and policies in different nation states. Our interest in languages lies in their dynamic and fluid nature and embraces the theoretical perspective found in dialogism (e.g., Linell 1998, 2009). This entails that our approach to language policies is both multidimensional and complex.

The theoretical framework employed in the study that is presented here approaches language policies in terms of a dialectical relationship between policy (macro level) and the learning that takes place in the language classroom (micro level). The study presented here explores how policies regarding languages are reflected in the organization of language learning for adults. More specifically, we focus upon issues of multilingualism and monolingualism and show how these are oriented towards in the mundane, everyday social practices in classroom settings. The Swedish Language Act from 2009, maintains that 'Swedish is the principal language in Sweden', and that 'all residents of Sweden are to be given the opportunity to learn, develop and use Swedish'. The Act furthermore decrees that persons with "a different mother tongue" are to be 'given the opportunity to develop and use their mother tongue'. The tension between Swedish as the principle language on the one hand, and a recognition of multilingualism on the other, and which is reflected in such central policy documents, comes also alive in the language learning classroom.

Using empirical examples from our ongoing study, we show how questions regarding the status of Swedish and multilingualism are not only issues of debate on a macro level, but are (i) reflected in and (ii) discussed by the members of the language learning classroom and (iii) shape languaging activities there. KIK-project encompasses approximately 85 hours of audio and video materials and ethnographic field notes from five different classroom settings at an institutional arena that is called "Swedish for immigrants (Sfi)". Members in the typical Sfi classroom include 10-20 adult immigrants with diverse linguistic experiences and cultural resources. A variety of monolingual Swedish language textual materials are used in these classroom settings. The diversity of the students in the classroom with regards to their educational and linguistic experiences is understood, in the specific institutional setting of 'Swedish for immigrants', as a challenge for the organization of learning and instruction. In this presentation, we juxtapose empirical examples from two different types of classrooms: in the first, the institutional categorization of the students is done in terms of "limited educational background". Most of these students have at the time of the field study been enrolled in the educational program for one semester. In the second classroom, the students are categorized in terms of "long educational background" and the students in the project classroom had been enrolled from a period of a couple of weeks to approximately one year.

Through our analyses, we discuss how different learning environments are created following how teachers and students negotiate their understandings of languages and identities in the classroom. The understanding of Swedish as the principal and only language used for communication in this institutional setting is contrasted with more multilingual languaging practices that the students employ. Our analysis raises issues regarding different types of opportunities for the learning of Swedish as well as the ways in which identities are constructed and negotiated in the two different settings. In an environment, in which students multilingual resources are acknowledged and seen as a tool in the institutional target language learning, students are also given the opportunity to constitute a multilingual identity in their new country of residence. In contrast, when the students' use of their linguistic resources is subverted, students use resources to challenge the "Swedish only norm", rather than focusing on the language learning. Empirical examples will be used to illustrate these tensions.

PAPER PRESENTATION

Teachers' Mutual Understanding - A Systematic Analysis of Talk with Two Approaches

Inger Osterlund, Abo Akademi University, Finland; Varpu Tissari, University of Helsinki, Finland

Mutual understanding among teachers has an impact on development of school and students' success. The present study highlights the complexity in dialogues which signify the use of different approaches when analysing the data. The aim is to analyse teachers' mutual understanding during meetings by using different methods of analysis. This micro educational study on social interaction, analyse video records from teacher meetings, which are part of the data from two larger case studies. The first case study examines the multi-professional cooperation of an elementary school teacher and a subject teacher whilst they are planning a field visit to a nature school. The second case study investigates changes of codes in the collegial talk of secondary school teachers at a formal teacher meeting. Theoretically, the selected excerpts are examined from the sociocultural theories of learning, and from the sociolinguistic perspective. Methodologically, the excerpts are scrutinized by analysis of communicative functions, and according to the multimodal analysis. The results from the multimodal analysis point out a few utterances to the situated meaning that are accepted but not heard, or tolerated. The analysis of communicative function provides further insight on the thematically different communicative functions embedded in the interaction of teachers participating at the meeting. The results provide a diversity that indicates how a systematic outlining of the data varies. Thus, the study may stimulate networking of teachers both in virtual and face-to-face interaction.

Mutual understanding among teachers and between teachers and other professionals cooperating has an impact on development of school and students' success (Little, 2010; 1990; Willman, 2001; Fullan, 2002; Hargreaves, 2003). The ways in which such mutual understanding is constructed during teachers' talk vary and depend on which entries are chosen to explore talk.

In this micro educational study on social interaction, the authors analyse video records the teacher meetings, which are part of the data examined in two larger case studies (Yin, 2003). The first case study examines the multi-professional cooperation of an elementary school teacher and a subject teacher whilst they are planning a field visit to a nature school, in which the latter is working as a nature school teacher. The second case study examines changes of codes (Bernstein, 1990; Bourdieu & Passeron, 1990; Goffman, 1981; Goffman, 2000; ; Grenfell & Kelly, 1999; Lemke, 2007; Moore, 2006; Schiffrin, Tannen, & Hamilton, 2001; Tannen, 1998; Tannen, 2005) in the collegial cooperation of secondary school teachers at a formal teacher meeting.

The aim is to explore and analyse the construction of mutual understanding of teachers participating in the meetings, by using different perspectives and analysis methods. The objectives are to examine the teachers' talk in order to understand how teachers orchestrate their interaction with each other, and to analyse the obstacles and opportunities in such situations.

A sequence of the video data from both of the case studies is analysed by exploring the interaction and talk of teachers. Theoretically, the selected excerpts from the data from both case studies are examined from two perspectives. The first perspective draws on the sociocultural theories of learning (Packer & Goicoechea, 2000), and the second perspective draws on the sociolinguistic perspective using Bourdieu (Bourdieu & Nice, 1986) and with an interactional input from Gumperz (Schiffrin, 1994; Schiffrin, Tannen, & Hamilton, 2001) through Tannen (1989; 1998; 2005).

Methodologically, the excerpts from the data from both of the case studies are scrutinized by the analysis of communicative functions, and according to the multimodal analysis. The former sheds light on the thematic nature of interaction, and also on its moment-by-moment construction in the ongoing interactions (Kumpulainen & Wray, 2002; Kovalainen & Kumpulainen, 2005; Kovalainen, & Kumpulainen, 2007). The latter refers to the problematic in breaking up interaction into separate modes. This problem is overcome by looking at all the modes together at the same time, and examining how the modes interact in a small scale of data for a later exploration in the larger scale of data. (Jewitt, 2009; Bezemer & Jewitt 2010.)

The research questions are the following: 1. How mutual understanding is constructed during teachers' talk? 2. What may be the obstacles and opportunities for analyzing the talk with different methods of analysis?

The preliminary results from the multimodal analysis point out that the informing part of the meetings is dominating. However, when teachers' talk is addressed and when they form spaces for negotiations with arguments, the mutual understanding is shaped by cultural codes and quick changes of codes. A few utterances are left unnoticed which draws attention to the situated meaning as accepted but not heard, or as tolerated. The communicative functions provide insight on the thematically different communicative functions embedded in the interaction of teachers participating at the meeting. Both analysis methods are influenced by the debate of social relations in communicative practices that are in nature more for bringing in positive than negative influences.

Firstly, the results relate to the social capital and trustful networks within heterogeneous groups where both weak and strong ties (Coleman, 1990) are essential for mutual understanding. Secondly, non-verbal communication influence in the negotiations (Auer & Di Luzio, 1992; Duranti & Goodwin, 1992; Mercer, 2000; Tannen, 1989; Norris, 2004), and in the effort of finding a solution that is accepted or at least tolerated by the members (Firth, 1995; Naquin & Kurtzberg, 2009). Though the dialogues and utterances in the examples are chosen to explain the main objective of mutual awareness, it is impossible to generalize. Every speech event and utterance is strongly attached to the spatial and the contextual settings that are unique and will never occur again.

As a conclusion, the results of the analysis from different perspectives provide a diversity of systematically outlining the data. Therefore, the potential of teachers' talk and social interaction highlight differences either in the cultural sense, as different cultural codes, or in the subject, as differences in ontology and epistemology, even if the focus is the same. It is of significance to go beyond oneself, and extend the understanding even if the mutual understanding is not reached but only tolerated. Finally, the analysis in this study highlights the complexity in dialogues and multipart talk which signify the importance of the different approaches and data.

The paper argues for the essential to approach a problem, which is multifaceted, from different standpoints. The key elements (namely, talk, artefacts, gazes, gestures, etc.) in critical situations are paving the way to move forward. Therefore, the data is analysed first in a small scale, and later on in a large scale. Finally, the paper focuses on the critical situations in talk that may change overtime and space, to stimulate cooperation and networking of teachers both in virtual and face-to-face interaction.

PAPER PRESENTATION

"What's a Fourth? What's a Fifth? What's the Point?": Constructing Definitions in Scientific Inquiry

Leslie Atkins, California State University, Chico, United States; Irene Salter, CSU, Chico, United States

In a class for preservice teachers, undergraduate students observed and attempted to explain complex phenomena related to light and color. In doing so, they frequently invented terms which were negotiated and refined by the class, and some became precise, stable, and useful terminology. These include invented terms (e.g., "the seconds" and "kooshing") and everyday terms (e.g., "focus"). In this paper we provide an analysis of the evolution of one of these terms, "the seconds," and how demands of intersubjectivity, together with theory, observation, and utility, shape the evolution of the definition. In the analysis, we see not only improvements in students' understanding of light, but a shift towards academic discourse registers and a nuanced understanding of the role of definitions in science

Objectives

A debate regarding the definition of a "personal epistemology" recently appeared in the *Journal of the Learning Sciences* as Sandoval (2009) argued that clarity of definition is necessary for theoretical progress, while Elby (2009) countered that theoretical progress must precede the definition. "The scope of personal epistemology should not be decided entirely a priori," Elby claims, "it is more productive not to converge on a definition until further empirical and theoretical progress points us toward the best way to 'cut up [nature] ... along its natural joints'" (p. 64). We point this out not to make a statement regarding personal epistemology, but definitions. Many curricula take a "front end" approach: students are given precise definitions and they use these to enable progress on understanding key ideas. An alternative is an "iterative" approach: allow for students' inquiry to make theoretical and empirical progress before definitions reach scientific precision. There is little work, however, on how we might facilitate student inquiry to promote this iterative process, or even what such iteration might look like. The paper will describe the evolution of the definition ("the seconds") that undergraduate students constructed in a course on scientific inquiry, and addresses the question of how and why this term changes over time. We will argue that, through the communicative need to agree on a definition, theory and experiment are advanced, and students develop a shared understanding of characteristics of light, constructing a nuanced and scientific definition that balances pragmatic constraints with theoretical ideas.

Framework and methods

Two theoretical perspectives guide our interpretation of student ideas: idealized cognitive models and knowledge-in-pieces. Idealized cognitive models were introduced by Lakoff (1990), arguing that categories arise from cognitive models that carve out a space for terms. Such models vary in size and stability; they may be constructed on the fly (Barsalou 1983) and still maintain the structure characteristic of common categories. When analyzing student terminology and the stories that provide boundaries to those terms, we take a knowledge-in-pieces framework (diSessa 1988), interpreting utterances not as evidence of beliefs but stories constructed in the moment and sensitive to context. In approaching the question of how the terminology is shaped by student inquiry, we employ Interaction Analysis (Jordan and Henderson 1995) and recent work on intersubjectivity (Nathan, Eilam et al. 2007). Transcripts

are analyzed for evidence of repairs (Schegloff 1992), and how such repairs modify participants' initial descriptions. Data comes from a course, Scientific Inquiry, for undergraduate preservice elementary teachers. Every class session is videotaped, and digital copies of student work are kept, and our analysis focuses on identify events that cause shifts in terminology (here, the term is the "seconds").

Data

In the second week of the course, there are two competing ideas to explain the observation of "fuzziness" on the edge of a spot of light (Fig. 1): light "bends" around corners or "bounces" along walls. In a small-group conversation, Amanda terms these bounced rays "the seconds." The following day the whole class works to understand Amanda's idea. Below, we provide a few critical turns in the discussion of "the seconds" that foster evolution of the term.

4. Allie: [Fig. 2]...Whites are the firsts— they all get reflected...— pinks are the seconds... each time it hits a wall you add one, pretty simply.

5. Breanna: It's gonna get dimmer and dimmer...That's why we were talking about how it matters if it's a second or third or fourth. Because every time it hits something it's going to get dimmer. Other students disagree with their diagram and, by turn 30, students have noted several differences in their diagrams of "seconds," with one student (Dee) pressing for representational conventions. In time, her request is recast not as mere convention, and students identify empirical and theoretical work required to clarify the term:

31. Breanna: I don't think it matters what it hits off of as long as it hits off of something then it should be called a second. And if it hits something twice, it's a third...

40. Allie: ...the mirror makes a huge difference because the the mirror does not act like a wall. It reflects much differently. ...

52. Dee: So I guess the real question is: 'when it hits the mirror is any of the light absorbed.' Because to me the definition of a second is 'when it hits something, some of the light is absorbed so not all of it is coming back out.'

60. Steven: I think it's going to be extremely hard to differentiate what's a second, what's a third... what's the point? Might as well just break it down to 'primary light' and 'secondary light.' Like anything secondary and after will be obvious. ...We must have some agreement on definitions in order to communicate effectively, but the terminology must also agree with something useful - a 'carving at the joints' of things we wish to understand. Steven argues that distinguishing seconds from thirds is pointless for our activity: we can understand the "fuzzy edge" as being caused by light that bounced, regardless of how many times.

These interactions drive empirical investigations, which then inform the iterative development of the definition of the term, "the seconds." To create terminology, as Lakoff suggests, is to model: to construct a story that carves out relevant objects that are given names. The stories may be constructed on the fly, with terms that are provisional and contextual. These stories, however, have an audience, and the need to establish intersubjectivity with this audience drives the modification of stories; the group artifacts serve to drive stability of the stories, and, concomitantly, the terminology develops "hard edges." Over time, this interaction creates terminology that is increasingly stable, precise and clear.

This proposal highlights students' initial steps at constructing and refining terminology; a final paper will include a more complete story of the terminology that students ultimately constructed, the interplay of experiment and theory that, together with interactions, led to the final definition, and a more detailed description of methodology.

PAPER PRESENTATION

Newcomers' Learning in Communities of Practice

Julia Eberle, Ludwig-Maximilians-University Munich, Germany; Karsten Stegmann, University of Landau, Germany; Frank Fischer, Universität München, Germany

Learning in communities of practice is mainly informal without explicit learning goals. Newcomers start as peripheral members and become active members as their "community knowledge" grows. This process of newcomer's learning in communities of practice is only vaguely described as legitimate peripheral participation and hardly studied empirically. Thereby, it is hard for communities to support newcomers learning process: knowledge on effective means how to facilitate the integration of newcomers is lacking. Approaches from group research on socialisation tactics may fill the gap. Therefore, we investigated to what extent group size, time, and different socialisation tactics as an addition to the process of legitimate peripheral participation are related to the integration of newcomers in communities of practice. A correlation study on 16 German student associations with overall 223 members was conducted using social network surveys to measure the level of integration. In interviews with experienced community members, data about tactics to foster the integration of newcomers were collected. Five socialisation tactics could be identified. In a HLM analyses two of them (positive welcoming strategies and accessibility of knowledge) showed to be significantly related to the level of integration. In this model also group size was included, which was negatively related to the level of integration, while the factor time itself played no important role. Therefore, we assume that combining the concept of communities of practice and legitimate peripheral participation

with theories from group research is a promising approach for a better understanding of the learning process of newcomers in communities of practice.

Learning by working on a shared topic with a group of people, like on an open source software project, is mainly informal and explicit learning goals can hardly be defined. Groups of people who work together on a topic for some time have been conceptualised as communities of practice (CoP). Barab and Duffy (2000) define a CoP as an interdependent system that puts the individual into a larger context and provides meaning for being and acting, based on a common cultural and historical heritage of shared goals, understandings and practices among the members. Newcomers who are integrated in a CoP undergo a complex process of learning and enculturation that shapes their identity as an active member of a larger system. Lave and Wenger (1991) describe this process as legitimate peripheral participation (LPP), which seems mostly to be a matter of time that a newcomer spends in the CoP. However, this concept is so far not very well empirically investigated. Promising approaches to expand the understanding of the LPP process can be found in group research. Regarding socialisation of new employees in work groups, socialisation tactics have been found influential means (Saks, Uggerslev, & Fassina, 2006). Levine and Moreland (1991) collected important tactics, used by work groups to foster the socialization process of the newcomers; e.g. encapsulation describes activities in which older group members encourage newcomers to spend their time for the CoP and with its members. Positive welcoming strategies as another example are used, when groups try to welcome newcomers in a friendly way. In addition to this, group size has been shown to influence individual thinking and behaviour in (work) groups, e.g. voluntary turn-over rates (Hausknecht, Trevor, & Howard, 2009). This leads to the assumption that the size of a CoP could also influence integration processes of newcomers. So far it is unclear what factors structure, support or hinder the LPP process of newcomers in CoPs. We assume that the learning process is not only a matter of time, but that specific socialisation tactics are used by CoPs that shape this learning process.

Research Question

To what extent can group size, time, and the use of socialization tactics predict the integration of newcomers in CoPs? Method223 members of 16 student associations from the University of Munich participated in this study. They were chosen as an example for CoPs as they fulfil all three criteria defining a CoP mentioned above: they are an interdependent group with a shared cosmology and a reproduction cycle. The level of the members' integration in their CoP at a certain point in time was computed for every newcomer, based on data of a social network survey. In this survey all members were asked to indicate how intensively they had worked with each of the other members during the last three months. Additionally a semi-structured interview was conducted with an experienced senior member of every student association. In this interview participants were asked how their CoP had proceeded to integrate newcomers and were then asked about the socialisation tactics described by Levine and Moreland (1991). Via a content analysis a value for the use of the found integration mechanisms was then achieved for every CoP. An exploratory stepwise multi-level regression analysis (HLM) including the individual and the CoP level was applied to test the research question.

Results

Five socialisation tactics were found that the CoP members reported to use to foster the integration process of their newcomers: supporting legitimate peripheral participation, positive welcoming strategies, accessibility of community knowledge, encapsulation, and providing information about the CoP to potential newcomers before their entry. To explore which of those aspects are actually relevant to the process of newcomer integration the found tactics and the group size were step-wise included into a multi-level regression model which in the beginning only included time to predict the level of integration. In the final model the level of integration was negatively predicted by group size ($\beta = -0.139$) and positively predicted by positive welcoming strategies ($\beta = 0.716$). Time alone had no significant effect ($\beta = 0.025$), while it predicted the level of integration negatively in combination with positive welcoming strategies ($\beta = -0.118$) and positively in combination with accessibility of knowledge ($\beta = 0.047$). In short, newcomers are better integrated in smaller groups. They are integrated faster if the groups focus on knowledge access strategies. However, the explanation of the influence of welcoming strategies is more difficult: newcomers in groups that use this strategy are better integrated in general, but slower compared to groups that put less effort in positive welcoming strategies.

Conclusions

Our results provide evidence that combining the idea of LPP and theories from group research is a promising approach to a differentiated understanding of the underlying mechanisms of learning processes in CoPs. Five socialisation tactics have been identified in this study and for two of them a significant relation to the learning process in CoPs have been proved. This implies that it seems possible for community members to actively shape the learning process of newcomers and that not every tactic applied and widely used is really effective for learning.

Literature

- Barab, S. A., & Duffy, T. M. (2000). From Practice Fields to Communities of Practice. In D. H. Jonassen (Ed.), *Theoretical foundations of learning environments*.
- Mahwah, NJ: Erlbaum. Hausknecht, J. P., Trevor, C. O., & Howard, M. J. (2009). Unit-Level Voluntary Turnover Rates and Customer Service Quality: Implications of Group Cohesiveness, Newcomer Concentration, and Size. *Journal of Applied Psychology*, 94(4), 1068–1075.
- Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation*. Cambridge: Cambridge Univ. Pr.
- Levine, J. M. & Moreland, R. L. (1991). Culture and Socialization in Work Groups. In L.B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 257-279). Washington, DC: American Psychological Ass.
- Saks, A. M., Uggerslev, K. L., & Fassina, N. E. (2006). Socialization Tactics and Newcomer Adjustment: A Meta-Analytic Review and Test of a Model. *Journal of Vocational Behavior*, 70, 413-446

PAPER PRESENTATION

Meta-cognition

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature

Robert Cantwell, University of Newcastle, Australia; Janene Budd, University of Newcastle, Australia, Australia;
Jill Scevak, University of Newcastle, Australia

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature Janene Budd, Jill Scevak, and Robert Cantwell University of Newcastle, Australia A growing body of research has documented the affective, or emotional, demands associated with PhD candidature, which may include coping with social isolation and the fear of negative evaluation by significant others, such as supervisors, peers, or family, and dealing with uncertainty and intellectual change. Unfortunately, there has been a lack of research attention regarding how these affective experiences are interpreted and managed at the level of the individual PhD student, and the impact of this on persevering with doctoral candidature. To explore this issue, the results from the first phase of a large scale, mixed-methods longitudinal study investigating the metacognitive and affective profiles of over 1200 PhD students from across Australia are presented, and complemented with the results of a small-scale qualitative study of PhD students who were experiencing a 'crisis of persistence', and considering termination of candidature. Together, these findings suggest that although an affective response to the personal changes associated with the transformational nature of higher level intellectual development may be expected in doctoral study, misinterpreting this affective experience can have potentially serious consequences in terms of perseverance with PhD candidature, ranging from unnecessary attrition to suicidal ideation. The results of the two studies will be discussed in terms of the implications for doctoral pedagogy. In particular, we discuss the importance of, and strategies for, helping students to more comprehensively understand and manage the affective experiences associated with doctoral learning, and identify areas requiring further research.

"I didn't expect to feel like this" – Affect management and perseverance in doctoral candidature Janene Budd, Jill Scevak, and Robert Cantwell University of Newcastle, Australia Various aspects of doctoral candidature have attracted much research attention since the recognition of the high attrition and slow completion rates that occur across institutions internationally. The background to this paper is the growing body of research documenting the affective, or emotional, demands associated with PhD candidature, which may include coping with social isolation and the fear of negative evaluation by significant others, such as supervisors, peers, or family, and dealing with uncertainty and intellectual change. Although it is generally agreed that intellectual development is expected to occur during the doctoral research process (e.g. Batchelor & Di Napoli, 2006; King & Kitchener, 2002), Stevens-Long and Barner (2006) have noted that the management of affective experiences accompanying intellectual development in higher education has been largely ignored in the literature. More importantly, there is a lack of understanding of how these affective experiences are interpreted and managed at the level of the individual PhD student, and the impact of this on progressing through doctoral candidature. To address this issue, an ongoing, large-scale, mixed-methods design study is investigating the affective and metacognitive profiles of over 1200 PhD students from universities across Australia, to provide both cross-sectional and longitudinal data regarding the management of affect during candidature. The study is underpinned by a constructivist learning theory framework, and assumes that there will be individual differences in the application or experience of a variety of metacognitive, affective, and personality factors as students seek to manage the intellectual and other demands of doctoral learning.

The study consists of three components: 1) comprehensive online surveys assessing metacognition, affect and personality, along with demographic and candidature data, conducted at baseline and with a 12 month follow-up, 2) brief online 'journey tracking' surveys conducted monthly for 12 months, and 3) two series of telephone or email interviews. The focus of this paper is an exploration of individual differences in 'perseverance' as a personality trait, based on the initial stages of data collection. While dispositional perseverance was one of many factors assessed in

the baseline survey, during the first series of telephone and email interviews for the study it was also identified by the majority of interviewees as a personal quality or characteristic that is central to success in PhD candidature. As a measure of dispositional 'perseverance and passion for long-term goals', the Short Grit Scale (Duckworth and Quinn, 2009), was employed to examine how self-reported perseverance might be related to various demographic or candidature factors, as well as to a number of different measures of metacognition and affect.

The baseline survey data indicated that mean perseverance scores for participants in this study were relatively high compared to the populations of 'high achievers' studied by Duckworth and colleagues (2007, 2009). Consistent with Duckworth, Peterson, Matthews and Kelly's (2007) findings with the original Grit scale, was the positive trend, evident via ANOVA and Scheffe analysis, between perseverance and age. There were no significant differences associated with stage of candidature. Strong and significant positive correlations were found between perseverance and a number of metacognitive measures, most notably with indicators of a student's sense of hope, agency and self-efficacy. To further investigate the responses to the Grit questionnaire, this paper draws on the findings of a small-scale qualitative study undertaken to explore and describe how PhD students discuss the experience of what could be termed a "crisis of perseverance" – a time of intense uncertainty and distress regarding whether or not to persist with the PhD (Budd, Scevak, and Cantwell, 2010). In an approach enabling a more immediate insight into this experience than that offered by retrospective reflections from attrited PhD students, and enhanced ecological validity through the preservation of participant anonymity, a number of public domain online forum discussions for PhD students were analysed to learn more about the factors at play at the time when quitting was considered.

An analytical approach based on grounded theory (Corbin & Strauss, 2008) was used. The findings of the public forum study identified that, at least for these students, uncertainty about their ability or willingness to persevere with the PhD was often associated with a sense of disappointment that the student's expectations of the PhD and of themselves as PhD students were either unmet or mismatched. Many observed in themselves a change from confident and successful graduate, to depressed, lonely, and uncertain PhD student. There was a dissonance between their expected and actual affective experience of themselves as PhD students, an uncertainty about what this meant, and a waning of motivation. Clearly, the students' decisions about perseverance in doctoral study were closely related to their interpretation of the affect associated with the PhD process. Further, these findings suggest that while such affective dissonance may be a common experience among PhD students, it is not well understood. For example, while this type of affective response and personal change may be associated with the transformational nature of higher level intellectual development usually expected in doctoral study, a lack of awareness of this possibility may result in the interpretation of this experience as indicating a lack of personal ability or suitability for the PhD process. The latter certainly appeared to be the assumption on which many students' discussion comments were based.

Analysis of these online discussions highlighted how misinterpreting this affective dissonance can have potentially serious consequences in terms of perseverance with PhD candidature, ranging from unnecessary attrition to suicidal ideation. The results of the two studies will be discussed in terms of the implications for doctoral pedagogy. In particular, we discuss the importance of, and strategies for, helping students to more comprehensively understand and manage the affective experiences associated with doctoral learning, and identify areas requiring further research.

PAPER PRESENTATION

Creating metacognitive environments in primary Religious Education lessons

Shirley Larkin, University of Exeter, United Kingdom

This paper focuses on the RE-flect project. RE-flect was a collaborative mixed methodology research project designed to create metacognitive learning environments in primary year 5 classrooms. Participants were 10 state run primary schools from one UK local education authority area. In total 10 teachers and 250 pupils age 9-10 years took part in the year long project. The aims of the project were to develop activities to enable pupils in RE year 5 primary classrooms to reflect on and consider their own ontological positions in relation to others; create metacognitively-oriented classroom environments and improve attainment in RE; support teachers in developing their own metacognition in order to reflect on their own ontological positions.

The project draws on theories of metacognition and metacognitively oriented learning environments. The paper provides findings from the quantitative pre and post test measures of attainment in RE and from a scale, REMOS designed to measure pupils' perceptions of their learning environment. An illustrative case study of one school in the project suggests the systemic and local obstacles teachers and pupils face in creating metacognitive environments in religious education lessons.

This paper describes a year long collaborative project between a team of university researchers and ten primary school teachers. The project, RE-flect, was designed to create metacognitive environments in year 5 primary religious education lessons. The guidelines for Religious Education in English Schools: Non-statutory Guidance 2010 (DCSF, 2010) are challenging, suggesting that RE should cover a wide range of goals from provoking questions about the meaning and purpose of life and what it means to be human; to encouraging pupils to explore their own beliefs as well as contributing to community cohesion by promoting tolerance. School inspectors and professional inter-faith groups have criticised the provision of RE in primary schools (Ofsted, 2007). In particular it was found that pupils do not gain a secure conceptual framework within which to fit their learning and teachers lack confidence in teaching a subject in which they are not specialists. It has been suggested that pupils cannot engage with others without first understanding their own beliefs and values ((Inter Faith Foundation, 2006). Without developing the skills to reflect on their own thinking pupils often view RE as simply a "matter of opinion" (Freathy & Aylward, 2010) and thus oversimplify the nuances of difference within faiths as well as the complexity of identity and culture more generally. Baumfield has suggested that the study of pedagogy in RE is "underdeveloped" (Baumfield, 2010). This paper argues that there needs to be a shift in emphasis away from research on content (Hayward, 2006; Rymarz, 2007) or the extent to which the representation of religious traditions may be considered truly authentic (Everington, 1996; Greaves, 1998) or representative (Jackson, 2004; Nesbitt, 2004) towards an emphasis on the pupils' "response, thinking and critical self-awareness" (van der Zee, Hermans, & Aarnoutse, 2006). The RE-flect project seeks to address these specific issues through supporting teachers in creating metacognitive environments.

Metacognition

Metacognition can be defined as everything we know and believe about our own and others' cognitive processes and the regulation and control of our own thinking (Flavell, 1979). Flavell suggested metacognition enables us to "make wise and thoughtful life decisions" (ibid pg910). This project views metacognition as enabling self understanding through a reflection on one's own thinking, beliefs, epistemological stance and values. In this way, metacognition prioritises knowledge of self before engagement with the other. Research indicates that it is not enough to train teachers to facilitate metacognition (Zohar, 2006). Teachers need to develop their own metacognition (Duffy, Miller, Parsons, & Meloth, 2009). It is plausible that some of the difficulties encountered by non-specialist teachers of RE are linked to a lack of metacognition.

This project aimed to provide teachers with a framework for developing activities, pedagogy and classroom environments to support the development of metacognition. There is a focus on metacognitive orientation. Metacognitive orientation refers to the extent to which psychosocial conditions that are known to enhance pupils' metacognition are evident within classrooms. The characteristics of metacognitively-oriented learning environments (Thomas, 2003; Thomas & Mee, 2005) suggest that the beliefs and practices of the communities within which students learn to learn and reason strongly influence their metacognition; that specific language plays a key role in relation to communication regarding thinking and learning processes to and between pupils, and that pupils require particular encouragement if they are to reflect on, critique and possibly alter their thinking processes.

Participants

250 pupils aged 9-10 years in 10 different state run primary schools from one UK education authority
10 teachers with a responsibility for teaching religious education in these schools.

Research Aims to:

develop activities to enable pupils in RE year 5 primary classrooms to reflect on and consider their own ontological positions in relation to others; create metacognitively-oriented classroom environments and improve attainment in RE support teachers in developing their own metacognition in order to reflect on their own ontological positions.

Methodology

This is a collaborative project with a mixed methodology design. Pre and post quantitative measures are illuminated by qualitative data collected during the project. Individual case studies of classes within the project provide detail of the classroom practices developed during the project.

Data Collection and Analysis related to the above aims

1. Pupils create "world view profiles" during the project – analysed qualitatively with a focus on ability to express thinking; ability to reflect on ideas and sophistication of ideas expressed
2. Pre, predicted and post level of attainment in RE using standard UK assessment Pre and post scores on REMOS a scale developed to measure pupils' perceptions of the metacognitive orientation of their classroom environment Pre and post semi-structured interviews with 6 focus children in each class 3x10 semi-participant classroom observations,

including video capture of the lesson and activities - data analysed qualitatively using NVIVO and related to a theoretical framework of metacognition

3. 3 methods of developing teacher metacognition – repertory grids, reflective diaries and on-line discussion - data analysed using content analysis, concordance analysis and discourse analysis

EthicsBERA ethical guidelines were adhered to. Special consideration was given to ethical issues surrounding using reflective diaries as data and to supporting participants through the processes of producing repertory grids and reflecting on thinking.

Findings

The paper presents headline findings from the pre and post measures along with an illustrative case study which illuminates the way teachers and pupils worked together to create metacognitive environments in one RE classrooms. Preliminary data is showing that teachers face a number of system level challenges to creating such environments, these are connected to UK policy on religious education in primary schools and to wider educational factors such as whole school attainment targets. The project ends in July 2011 when the quantitative data will be available.

Discussion and ImplicationsThe paper will discuss the findings in relation to theories of metacognition and the creation of metacognitive environments. Implications for teacher development will be drawn and suggestions for future research made. It is not possible to detail these implications until the project ends.

PAPER PRESENTATION

Rethinking the scope of Metacognition: a multi-dimensional account

Robert Cantwell, University of Newcastle, Australia; Jill Scevak, University of Newcastle, Australia; Sid Bourke, University of Newcastle, Australia; Krystyna Cholowski, University of Newcastle, Australia

In this paper, we report on a study of metacognition in PhD students, examining the possibility that identified individual differences may well reflect variations at an epistemic rather than componential level. Following Veenman et al. (2006), we speculate that the scope of metacognitive knowledge includes more than strategic regulation. We suggest metacognitive knowledge also provides a higher order, multi-dimensional dispositional framework that guides the affective, intellectual and contingency appraisals individuals must make in generating regulatory decisions.

263 PhD students completed measures relating to the management of intellectual, affective and contingency demands in candidature. A two-step cluster analysis discriminated two groups differing significantly across all measures. Factor analysis identified three dimensions to the responses: "Coping" with the intellectual, affective and contingency response demands of learning; "Naivety" in conceptualising the intellectual demands coupled with a diminished sense of competence and commitment; and "Disengagement", through diminished understanding of the intellectual demands combined with an abrogation of responsibility for progress. Third, analysis of variance indicated that Cluster 1 members more highly Coping, Cluster 2 members more highly on Naivety and Disengagement.

We interpret these results as evidence of the multi-dimensional nature of metacognitive knowledge. The differences in the strength and direction of affiliation with the three factors (Coping, Naivety and Disengagement) by the two groups suggest differences in the qualities of the active metacognitive knowledge base driving engagement with the doctoral task. Such differences in epistemic metacognitive frameworks have the potential to provide explanations of problematic candidature and inform developments in supervisor pedagogy.

Traditionally, metacognitive research has focused on self-regulatory capacities and their relationships to planning, monitoring and evaluative behaviours. More recently, research has begun to extend the remit of metacognition in learning to minimally acknowledge the relationships between regulatory decision-making and other, perhaps more general, domains of individual differences. Veenman et al., (2006) gave impetus to this process by identifying the need to examine metacognition in the context of other individual differences, although they did not extend this to suggest a more general unified metacognitive construct to account for individual differences in learning. Nonetheless, there has been some movement in extending the scope of explanation of effective metacognitive activity. A recent special issue of the journal "Metacognition & Learning" (April, 2010), for example, considered the relationships between epistemology and metacognition. For many of the contributors, the link between epistemic beliefs and metacognitive behaviours was emphasised, giving rise to at least some degree of a recognition of the potential mutuality between epistemological and metacognitive beliefs (see Mason et al, 2010; Richter & Schmid, 2010; Muis & Franco, 2010; Bromme, Pieschl & Stahl, 2010). It is our position that this observed link represents only one of many potential associations between domains of individual differences and regulatory behaviour (see Veenman et al. 2006) and that the aggregate of these potential associations may provide evidence of a more generalisable model of metacognition that explicitly acknowledges the interdependence of a multitude of potential sources of individual differences in explaining how specific regulatory decisions are derived and acted upon.

In this paper, we report on a study of metacognition in PhD students. We see the PhD as a useful medium through which the nature of metacognition can be explored. The PhD is first and foremost difficult, requiring candidates to manage intellectual tasks ranging from the basic technical through to those requiring mastery of quite high levels of complexity and abstractness. The PhD also requires completion of a multitude of (related) tasks over an extended time period. Thus the regulatory demands of the PhD exist at many levels, and require maintenance over an extended period of time. Moreover, the PhD is not only about regulation of intellectual activity: it also involves the regulation of affective responses which over time will be as many and varied as evident in the intellectual demands. Finally, as a function of both difficulty and extended time, the PhD also involves the ongoing management of the potential challenges and difficulties in candidature: how the student responds to contingency is also an issue of regulation.

In this study, 263 PhD students completed a battery of instruments relating to the management of intellectual demands (Need for Cognition, Metacognitive Awareness, Epistemological Beliefs), affective demands (Efficacy, Coping) and contingency demands (Volition, Responsibility, Procrastination) of candidature. The analysis focused on three questions: a) whether, as an elite cohort, doctoral students could nonetheless be discriminated on the basis of responses to these questionnaires, b) whether there was an underlying dimensionality to the responses to the questionnaires, and c) whether identified groupings within the cohort differed in their level of affiliation with identified dimensions in the responses. In relation to the first question, a two-step cluster analysis identified two clusters differing significantly across all measures. In relation to the second question, factor analysis identified three dimensions to the responses: "Coping" with the intellectual, affective and contingency response demands of learning; "Naivety" in conceptualising the intellectual demands coupled with a diminished sense of competence and commitment; and "Disengagement", through diminished understanding of the intellectual demands combined with an abrogation of responsibility for progress. In relation to the third question, analysis of variance indicated that Cluster 1 members identified more closely with the Coping factor, while Cluster 2 members identified more closely with the Naivety and Disengagement factors.

We interpret these results as providing evidence for the possibility of a multi-dimensional account of metacognitive knowledge. In the first instance, the cluster analysis provided evidence of heterogeneity within the doctoral cohort. Because the differences between the cluster groups were both significant and spread across all measures, and because these differences were consistently in the appropriate direction, we concluded that the students comprising Cluster 1 had a broader and more strongly internalised base upon which to generate appropriate regulatory interventions. That is, this group likely had, at an epistemic level, a more functional metacognitive framework with which to manage the intellectual, affective and contingency demands of candidature, a framework that included not only the basic self-regulatory skills of conventional descriptions of metacognition, but also the broader epistemological, efficacy, coping and volitional dimensions that provide the conditions for effective regulation to occur. The results of the factor analysis and subsequent ANOVAs gave support to this interpretation. The differences in the strength and direction of affiliation with the three factors (Coping, Naivety and Disengagement) by the two cluster groups suggests differences in the qualities of the active metacognitive knowledge base driving engagement with the doctoral task. Such differences in epistemic metacognitive frameworks, we argue, have the potential to provide explanations of problematic candidature and inform potential developments in supervisor pedagogy.

PAPER PRESENTATION

A New Framework for the Conceptualization of Epistemic Cognition

Clark Chinn, Rutgers University, United States; Luke Buckland, Rutgers NJ, United States; Ala Samarapungavan, Purdue University, United States

In previous work (Authors et al., 2010a, 2010b) we have considered how ideas prevalent in the philosophical literatures of analytic epistemology and the philosophy of science might be used to extend and improve educational research on epistemic cognition. Research on epistemic cognition examines cognitions, especially beliefs, about knowledge and the conditions and processes of attaining knowledge (e.g. Hofer and Pintrich, 1997). Our expanded framework for models of epistemic cognition includes five categories: (1) epistemic aims and their interactions with non-epistemic aims, (2) the structure of knowledge, (3) the certainty, sources, and justification of knowledge, (4) epistemic virtues and obligations, and (5) the reliable processes by which knowledge is achieved. These categories capture many epistemic topics and concepts that feature in the philosophical literatures, but which have not yet featured in extant educational research. In this paper we further elaborate the framework, and provide a more detailed analysis of how philosophers have elaborated on the topics within these five categories. We also develop systematic analyses of the ways in which educational researchers' conceptualizations of epistemic topics diverge from those of philosophers. We argue that an expansion of the dimensions of models of epistemic cognition provides psychologists and educators with rich theoretical resources that can better explain students' thinking and learning.

A New Framework for the Conceptualization of Epistemic Cognition

Goals

Epistemic cognition refers to cognitions about topics such as knowledge and how people come to attain knowledge. The most prominent framework for conceptualizing epistemic beliefs in current educational research derives from the landmark work of Hofer and Pintrich (1997) which characterizes these cognitions in terms of four dimensions: (1) the degree to which knowledge is viewed as simple versus complex, (2) the degree of certainty of knowledge, (3) the sources of knowing, and (4) the justification of knowing. In this paper we aim to expand on this seminal framework by drawing on philosophical work to identify additional topics that educational researchers could investigate.

Method

We have extensively reviewed two philosophical literatures that discuss epistemological topics: analytic epistemology and the philosophy of science. We analyzed epistemological topics and subtopics covered in 150 significant contemporary philosophical books as well as numerous articles from prominent philosophical journals. From these sources, we developed a list of significant topics related to epistemic cognition. As a result of our analyses, we argue that epistemic cognition should be viewed in a more expansive manner than educational researchers have done. We argue specifically that important topics for researchers of epistemic cognition fall into at least five distinct categories, which we briefly describe below.

A Philosophically-Grounded Framework for Conceptualizing Epistemic Cognition

In previous work (Authors et al., 2010a, 2010b), we have provided a broad overview of the five categories of epistemic topics. In the paper for EARLI, we will provide a much more detailed analysis of how philosophers have elaborated on the topics within these five categories, and we will provide a new, systematic analysis of the differences in the frameworks of educational researchers, on the one hand, and philosophers, on the other. Given the space limitations of this proposal, we can here provide only a brief introduction to topics in these five categories. In our paper and presentation, we will provide elaborated analyses of important topics within each of these categories as well as a detailed analysis of the ways in which educators' conceptualizations of epistemic topics diverge from those of philosophers. We will argue that philosophical work suggests many new issues that could be productively addressed in future educational research. The five categories are as follows:

1. Epistemic aims and their interactions with non-epistemic aims. Philosophers have extensively investigated different kinds of epistemic aims (e.g., acquiring true beliefs, avoiding false beliefs, developing powerful explanations, and so on). They have asked what kinds of knowledge people value and thus what epistemic aims they adopt (e.g., do people seek knowledge for its own sake, or knowledge because it is useful in helping them achieving other aims such as wealth or happiness). We will summarize a broad range of issues relating to epistemic aims that philosophers have viewed as important to understanding epistemic cognition. We argue that educators have seldom addressed what epistemic aims students adopt or what their beliefs are about what kinds of aims should be adopted.

2. Structure of knowledge. Current psychological and educational research on epistemic cognition has addressed the complexity versus simplicity of knowledge. Philosophical work suggests the need to investigate more than just this one aspect of the structure of knowledge. As one of many examples we will provide, EC researchers could also examine the degree to which knowledge is viewed as universal (i.e., knowledge applies very broadly) versus contextually (i.e., knowledge is very specific to particular situations).

3. The certainty, sources, and justification of knowledge. Our third category encompasses the certainty, sources, and justification of knowledge. (We include certainty within this category because philosophers treat certainty as a function of the strength of the justification of knowledge, so that degree of certainty is closely tied to strength of justifications.) These are categories that have been explored by many educators. However, philosophers identify many specific issues within these broad categories that have been unexplored by psychologists and educators.

4. The ethics of knowledge: epistemic virtues and obligations. Epistemologists extensively investigate epistemic virtues such as intellectual honesty, intellectual courage and open-mindedness. They also address issues of epistemic obligations—an example of this is the extent to which one is obligated to seek out information on different kinds of questions, such as the extent to which one is obligated to have a certain level of economic knowledge when voting on economic issues. EC researchers have addressed a few epistemic virtues, especially open-mindedness. Philosophical research suggests many other virtues that could be investigated, and we will present a taxonomy of these virtues. Philosophical research also suggests new avenues of research on epistemic obligations, which have not yet been investigated by psychologists or educators.

5. Reliable and unreliable processes for achieving knowledge. Epistemologists and philosophers of science intensively study processes by which knowledge is reliably produced. For philosophers who focus on these reliable processes, a belief is justified (roughly speaking) if it results from a reliable belief-forming process (or set of processes). Philosophers who address these processes ask questions about the conditions under which different

processes do and do not promote knowledge. For example, philosophers may ask questions such as these about social processes of knowledge production in the mass media: What media processes promote societal knowledge, and which do not? Under what conditions do particular media processes (such as televised debates between experts) promote knowledge? Under what conditions do such debates promote knowledge in society, and under what conditions do they not? We think that there is little research by EC researchers on students' beliefs about reliable and unreliable processes for achieving any epistemic aims, including true beliefs. We will present an analysis of the many types of reliable processes that philosophers have examined as important to epistemic cognition.

In this proposal, we have provided a brief overview of our philosophically-grounded framework for epistemic cognition. In the full paper, we elaborate on the specific issues that philosophers have addressed, and we show by expanding the issues included under epistemic cognition, psychologists and educators will gain theoretical resources that can better explain students thinking and learning. We will show how this framework can be applied in educational research.

References

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67, 88-140.

PAPER PRESENTATION

Young Children's Experiences through Transition between Preschool and Primary School in Chile

Daniela Jadue Roa, University of Cambridge, United Kingdom; David Whitebread, University of Cambridge, United Kingdom

Full Title: Young Children's Experiences through Transition between Preschool and Primary School in Chile and its Relation with their Developing Resilience and Sense of Agency. Abstract: This paper discuss the preliminary findings of an ongoing PhD research in its last phase. This research was carried out in a State school in Santiago de Chile, with 16 young children aged 5 to 6 years during their transition between preschool and primary school. The research design is a multiple-case study within a bio-ecological perspective (Bronfenbrenner, 2005) and therefore, data was gathered from children, their parents and their practitioners. Video-recording, photograph interviews (book-making and poster-making), were carried out with children; the 'Children's Independent Learning Development (CHILD 3-5)' Checklist (Whitebread, Coltman, Anderson, Mehta, & Pino-Pasternak, 2005) was applied by practitioners and semi-structured interviews supported by a questionnaire (Dockett & Perry, 2000a, 2000b, 2000c, 2000d) were carried out with practitioners and parents or caregivers. The purpose of this study is to explore the transition process that Chilean young children experience between preschool and primary school and its relation with their developing resilience (Cefai, 2008; Dunlop, 2003c) and sense of agency along this period (Bandura, 1982, 1993; Bruner, 1996). This study was organized in two phases (before and after transition) and it was developed between September 2009 and August 2010.

The present study was inspired by the proposal of 'The Mosaic Approach' (Clark, 2005; Clark & Moss, 2001); by the research carried out in Australia by Dockett's and Perry's (2007) the 'Starting School Research Project'; and by Dunlop's (2003a, 2003b, 2003c) research study carried out in Scotland. Accordingly, the present study aims to explore young children's experiences in the context of an early transition between preschool and primary school in Chile, and how these experiences relate to their developing resilience and sense of agency within an educational context. Hence, this research intends to answer the following research questions:

Main question: How do young children's experiences of transition between preschool & primary school in Chile relate to their developing resilience and sense of agency?

- Further questions:
- a) How do young children experience transition between preschool & primary school in Chile?
 - b) How do parents experience young children's transition between preschool & primary school in Chile?
 - c) How do practitioners experience transition between preschool & primary school in Chile?
 - d) How do young children's resilience and sense of agency develop during their transition between preschool & primary school in Chile?

To answer these questions, the research was designed with a multiple case study approach within a bio-ecological perspective (Bronfenbrenner, 2005). Taking this into account the research methods are child-centred and seek to

gather young children's perspectives on their own experiences. Therefore, visual and participatory methods such as photography, video recording, book-making and poster-making were used (Clark, 2005; Clark & Moss, 2001, 2005; Jones, 2004; Veale, 2005). In addition, and with the aim of acknowledging the social constructivist perspective of the research design proposed, data was also gathered from adults involved with the young children participating on this study. Practitioners used the 'Children's Independent Learning Development (CHILD 3-5)' Checklist (Whitebread, et al., 2005) to assess young children's self-regulatory skills; and practitioners and parents or caregivers participated in semi-structured interviews guided by the Questionnaire developed by Dockett & Perry in their 'Starting School Research Project' (Dockett & Perry, 2000a, 2000b, 2000c, 2000d). In other words, this design aims to acknowledge young children's voices and agency through their learning and developmental processes. Young children's voices are reflected in this research project by the recognition of their agency and by the inclusion of them as valid informants and active participants in research concerning their experiences (Cousins, 1999; UNICEF, 1989). Taking into account that the school year in Chile goes from March to December and the characteristics of the study, the data collection process was organised in 2 phases: (1) Phase One, from September 2009 till December 2009; and (2) Phase two, from March 2010 till August 2010.

Phase one considered a familiarisation time, video-recording of classroom activities (with a special focus in the classroom interactions); the application of the 'Children's Independent Learning Development (CHILD 3-5)' checklist (Whitebread, et al., 2005); photographs interviews with the book-making activity; and semi-structured interviews with adults participants. The purpose of selecting the book-making session as the first photograph interview was to help young children to engage with the researcher and to help them being confident to share their experiences and reflections on kindergarten. During Phase two the same data collection process was repeated, however, photograph interviews involved the poster-making activity. The purpose of doing a poster in this second phase is to help young children with reflecting about things that have changed in first grade. They are invited to think about what young children need to know about primary school, and to discuss why; also what can schools, teachers and families do to help children who are starting primary school (Margetts, 2006). All these questions are also explored with adults involved in the semi-structured interviews carried out with them.

The data analysis has had as a main purpose the co-construction of meaning with young children's perspectives and adults involved in their experiences. Therefore, data has been coded grounded in what the data reveals and supported with the theoretical framework presented for the present study. Two main coding schemes have been developed: one regarding young children's perspectives on transition; and a second one related with their expressions of resilience and developing sense of agency. In order to ensure that during this process the focus is young children's voices and the construction of meaning, the following principles for listening to young children developed by Clark and Moss (2001, 2005) have been acknowledged: . 'it is an active process of communication involving hearing, interpreting and constructing meanings . Not limited to the spoken word . A necessary stage in participation in daily routines . Participation in wider decision-making processes' (Clark & Moss 2005, p. 8) In sum, this paper invites to a discussion about preliminary findings of young children experiences in their transition and their demonstrated resilience and sense of agency. Present findings can be discussed in the light of the outcomes of previous research carried out in the field and its contributions to further research in this context are considered. Lastly, this paper aims to reflect upon the contributions of visual methods in participatory research with young children, their effectiveness in helping the researcher to listen to young children's perspectives and, particularly, young children's perspectives in the context of an early transition in Chile.

Young Children's Perceptions of the Nature and Functioning of Artifacts with Adaptive Behaviour

David Mioduser, Tel Aviv University, Israel; Asi Kuperman, Tel-Aviv University, Israel

This study examines the effect of experimenting with advanced-robotic technological systems on young children's perceptions of the Nature and functioning of controlled artifacts with adaptive behavior. 10 kindergarten children performed a series of explanatory and programming tasks of increasing complexity, in terms of the expected robot's adaptive behavior. The research questions focused on: (a) children's perceptions of behaving artifacts, whether these reflect a psychological/behavioral or a technological/functional perspective, and (b) children's ability to program behaving artifacts focusing on the representational structures used for expressing the robot's behavior (e.g., scripts or rules) and on the troubleshooting processes (debugging). Findings are indicative of young children's (both "explainers" and "programmers") ability to conceptualize the robot's behavior using a technological perspective. As well, the results convincingly show "programmers" ability to construct complex robot behaviors. Moreover, we observed children's ability to use generalizable, a-temporal and abstract representations of the desired behaviors (e.g., rules), seemingly a serious challenge for kindergarten children according to existing literature. It seems that the interaction

between the concrete (the physical robot and its actual functioning) and the abstract (the symbolic interface for constructing and debugging the control program) supported children's performance at sophisticated cognitive levels.

Kindergarten Children's Perceptions of the Nature and Functioning of Artifacts with Adaptive Behavior David Mioduser, Asi Kuperman Tel-Aviv University Children are exposed nowadays from a very young age to controlled technological systems. A visit to the nearest supermarket introduces them to automatic doors, barcode readers or controlled conveyor belts. Many toys they play with are programmable? and at home they interact with complex devices such as controlled appliances, mobile phones and computers. In recent years, children from a kindergarten in central Israel have been exposed to experiences with simple robots as part of the implementation of a curriculum focused on technological thinking. The curriculum has been developed upon the idea that technological thinking integrated into the kindergarten's culture will stimulate the children's curiosity and will support, and even demand, the use of high-order thinking, analytic capabilities, abstraction and problem solving, laying out the road to meaningful knowledge building processes. Such technological-thinking related skills are not part usually of the curriculum in kindergartens.

This study examines the influence of experimenting with advanced-robotic technological systems on children's perceptions of the Nature and functioning of controlled artifacts with adaptive behavior. The main goal was to explore how kindergarten children perceive and program the behavior of an adaptive robot.

Method

The population included 10 kindergarten children aged 5-6 (chosen randomly from a group of 25). Data was collected using observations and interviews. A qualitative research paradigm was chosen for the study, due to the small sample. Two types of tasks were implemented: (a) explanatory tasks in which children were requested to describe and explain the observed behavior of a robot, and (b) programming tasks of a robot's adaptive behavior. The tasks were built as a progression of increasing complexity, defined by the number of program components (e.g., rules, routines) required for generating the robot's behavior. The programming environment, "RoboGan", was developed for kindergarten children. It is icon-based, enabling to define the control rules in intuitive manner not requiring reading or writing code. The research questions addressed in this presentation focus on: (a) children's perceptions of behaving artifacts: whether these reflect a psychological/behavioral or a technological/functional perspective. (b) children's ability to program behaving artifacts, focusing on the representational structures used for expressing the robot's behavior (e.g., scripts or rules) and on the troubleshooting processes (debugging).

Findings

On children's perception of the robot's behavior Findings indicate that the children referred unevenly to the robot as a behaving artifact from psychological/behavioral and technological/functional perspectives. The utilization of anthropomorphisms (as indicator of a psychological perspective) was not dominant, compared to usage of technological language (Figure 1). When used, it was mostly due to the linkage made by the children to the task's underlying story, thereby recurring to the usage of anthropomorphisms, e.g.: "walking on the bridge", "careful not to bump into an obstacle", "getting the goal". In contrast, the technological perspective, and the usage of technological language, was dominant. This finding emphasizes the children's ability (both "explainers" and "programmers") to conceptualize the robot as functioning artifact. Figure 1: Children's perception of the robot's behavior as a function of task complexity A decrease in the use of anthropomorphisms as the task's complexity increases was observed both amongst the 'explainers' and the 'programmers'. This indicates that in more complex tasks children describe what they see or do in more "professional" terms. Thus for complex behaviors, anthropomorphism is not sufficient - when children understand the connection between the task, the robot and the interface, they perceive the robot from a technological/functional perspective. This indicates also children's ability to establish the linkage between the robot as concrete artifact and the programming environment as abstract or symbolic space. This abstraction is evident in the children's explanations, in their analysis of the robot's behavior and in the capabilities they exhibit in the programming process.

On children's ability to program the robot's adaptive behavior Among alternative constructs used for representing a device's behavior, in this study we focused on three: episode (description of a one-time event), script (a sequence of events in a temporary structure and re-usable as routine) and rule (general and a-temporal construct, using condition/action terms such as "if... then..."). Findings indicate that children were able to use all three constructs, as required by the programming tasks (Figure 2). Usage of rules indicates the ability of kindergarten children to generalize and use a-temporal abstract representations, something seemingly beyond the capabilities of kindergarten children according to existing literature. Additional support to this claim in the findings is the relatively low usage of episodic descriptions. The programmers seldom used concrete terms for describing the robot's behavior, and were

inclined to use the more complex structures (i.e scripts and rules). Figure 2: The robot's behavior representation as a function of task complexity

Regarding troubleshooting and problem solving, different strategies were used by the children until satisfactory completion of the task was reached, e.g. deleting the whole program and starting over, or replacing one command at a time till the expected behavior was observed. In summary, technological thinking entails an important, interesting and unique experience which has the potential to contribute to young children's conceptual understanding, problem solving and learning of complex phenomena in the everyday environment. Kindergarten children are at a stage in which their curiosity is at its peak. They ask, examine and try to discover the world in which they live in, hence meaningful authentic and relevant experience leads to learning. The tasks they were exposed to were real: they were required to learn and to use their acquired knowledge to fulfill tasks in the real world: programming a functioning artifact in the real world. These conclusions encourage the need for further studies focusing on implementation of technological thinking in the kindergarten curriculum as well as on additional questions beyond the scope of this study, e.g. the importance of adult mediation, mental models developing from these experiences, educational tools which may be developed following the study's findings, and naturally, the collaborative learning taking place in technological thinking-based group activity.

PAPER PRESENTATIONS

Teacher's talk about toddler's early literacy experiences at preschool

Sara Hvit, Jonkoping University, Sweden; Polly Bjork-Willen, Linkoping University, Sweden

Early literacy experiences are important parts of toddler's literacy development at preschool. The importance of children's literacy is also emphasized in the new Swedish preschool curriculum. Kress (1997) points out, that a literary sign is a combination of meaning and form, and that the meaning making should be seen in a social and cultural context as well as an activity. From this point of view young children's literacy does not consist of reading and writing only. It also includes all visual information that communicates to the children in their everyday world. The present paper aims to explore how teacher teams at 10 diverse preschools during focus group interviews, talk about and discuss toddler's literacy experiences. Detailed analyses of the interviews are made. The analyses show that three main areas of toddlers' literacy are highlighted in the talk; 1) toddlers' own manifestation of literacy, 2) how to work with toddlers' literacy, and 3) what characterizes the literacy environment. However, the majority of the teams were not used to verbalize and openly discuss toddlers' literacy and its implication on the preschool practice. The latter finding is a challenge for the teacher education and the implementation of the new curriculum.

Aim and theoretical background. In Sweden most children begin preschool at the age of one, and 80 % of the children between one to three years old go to preschool for education and care on a daily basis (Skolverket, 2009). Hence, the way the curriculum is implemented is of great importance for the children's learning and development, particularly when the youngest children aged one to three (named toddlers in the present paper) are concerned. In the new curriculum for the Swedish preschool there are clarifications in the area of language and communication. Language and communication are described as inextricably connected with children's identity and understanding of self and others (Ministry of Education, 2010). Furthermore the curriculum calls attention to the fact that language environment in preschools should offer children opportunities to explore and use written language. The conclusion drawn from the curriculum outline above is that the expectations laid on the preschool teachers' way of realizing a 'good' language environment are very high.

The focus of this paper is to investigate the language environment for toddlers at preschool, and the study takes its theoretical starting point from Barton's (2007) ecological view of literacy. It also uses a multimodal approach of children's meaning making in different modes (Kress, 1997, 2010). Consequently, to understand toddlers' intentions in literacy events, it is important to pay attention to their verbal as well as non verbal way of expressing themselves and to create meaning (Lökken, 2006, 2009). More specifically the aim is to explore how literacy is talked about and discussed by teacher teams working with toddlers.

Method

In the present study focus group interviews with ten teacher teams are analyzed in detail with respect to the teachers talk about literacy events with toddlers. Each team was interviewed at two distant occasions, hence the data includes in total 20 interviews. The interviews originate from a larger corpus of interview data and this in turn is a part of a comprehensive study that investigates preschool as a context for children's language development at 60 preschools, being equally distributed over three communities in Sweden. As the literacy of toddlers is the focus of the present study, only interviews with teams working solely with toddlers were selected. The interviews were transcribed, and a collection of sequences including the teachers' talk and discussions about literacy and literacy events were selected

for the analysis. Transcriptions were prepared using conversation analytic notations (cf Hutchby & Wooffitt, 1998). The sequences of talk were analyzed in detail with a participant-oriented perspective on interactional conduct (Schegloff, 1999). All names of persons and places have been changed to preserve participants' anonymity.

Preliminary findings

Preliminary findings indicate that literacy is defined and discussed in most varying ways between the teams, but also within a team. To verbally express what signifies toddlers' literacy seemed to be an unusual issue for many of the teams. Although, the areas that gradually became emphasized were 1) toddlers' own manifestation of literacy, 2) how to work with toddlers' literacy and 3) what characterizes the literacy environments. When literacy was described from the perspective of the child, a common description in the interviews were how toddlers use books, and how obvious it is that toddlers identify themselves as readers as well as writers. For example it was described how the children read for each other and for the dolls, and that they turn the pages and sounds like reading. The toddlers also encourage their listeners to be really quiet and listen carefully (c.f. Björk-Willén & Cromdal, 2009). However, most of the teams declare that they oppose to teach toddlers reading and writing. They preferred methods that are embedded in everyday practice, and that literacy should be highlighted in situ, for instance asking a child "do you want to read for me or do you want me to read?", or "what are you writing? ". One of the teachers points out that "the physical language environment in total aims to learn them (the children) to read and write, but we do not coach them to read and write". The environment and the pedagogic material are not referred to as an isolated unit, but the connection between physical aspects of the environment, language and teaching attitudes are often discussed in the interviews. So is the kind of artifacts and its locations that are used to improve toddlers' literacy.

Theoretical and educational significance of the research

The teachers' talk and discussions about toddlers' literacy strengthens the way of viewing toddlers style (i.e. Lökken, 2006, 2009) and their manifesto of literacy (Björklund, 2008). The discussions about the language environment also have a clear multimodal approach to small children's literacy (see Kress, 2010). However, the teacher's talk about toddlers' literacy was unreflecting and based more on experiences than theory. The talk also derives from a play based rather than a teaching view of toddlers' early literacy.

References

- Barton, D. (2007). *Literacy: An introduction to the ecology of written language*: Malden MA:Blackwell.
- Björk-Willén, P& Cromsal J. (2009). When education seeps into 'free play': How preschool children accomplish multilingual education. *Journal of Pragmatics* 41: 1493-1518
- Björklund, E. (2008). *Att erbjuda litteracitet: Små barns kommunikativa möten med berättande, bilder, text och tecken i förskolan*. Göteborgs universitet.
- Hutchby, I & Wooffitt, R. (1998). *Conversation analysis: principles, practices and applications*. Cambridge: Polity Press.
- Kress, G. (1997). *Before writing: Rethinking the paths to literacy*. London: Routledge
- Kress, G. (2010). *Multimodality a social semiotic approach to contemporary communication*. London:Routledge.
- Lökken G, Haugen S, Røthle, M & Trädgårdh, E. (2006). *Småbarnspedagogik: fenomenologiska och estetiska förhållningssätt*. Stockholm:Liber.
- Lökken, G. (2009). The Construction of 'Toddler' in Early Childhood Pedagogy. *Contemporary Issues in Early Childhood* 10 nr 1:35-42.
- Schegloff, E. A. (1999). 'Discourse, Pragmatics, Conversation, Analysis', *Discourse Studies* 1: 405-435.
- Skolverket. (2010). *Statistik: Förskola-barn och Grupper. Barn och grupper i förskolan 15 oktober 2009. Riksnivå: Tabell 1B. Uppdaterad den 30 mars av Utbildningsenheten*. Skolverket. (2010). *Läroplan för förskolan Lpfö 98: reviderad 2010*: Skolverket

PAPER PRESENTATION

Early development of self-regulation and the use of communicative signs in educative interactions

Marisol Basilio, Universidad Autonoma de Madrid, Spain; Cintia Rodriguez, Universidad Autonoma de Madrid, Spain

From a socio-cultural approach, the role of language as a tool to support the self-regulation (SR) of physical and cognitive activity has been widely studied, yet there is little evidence on the role of pre-linguistic semiotic systems in the early development of self-regulatory skills. By extending Vygotsky's hypothesis on the development of SR to a pre-linguistic level, the purpose of the study is to analyze the transition from other-regulation to SR through mediated activity. We observed four children longitudinally at 11, 13 and 15 months old in triadic interaction (child-adult-object) with one of their parents. The object for the interaction was a toy which conventional use requires the understanding of rules, the execution of successive sequences of actions and the use of a hammer as an instrument. We coded for parents' use semiotic utterances to scaffold the object's conventional uses to their children, (i.e verbal utterances, demonstrations, ostensive signs, pointing gestures, etc), and for children's use of signs related to their activity

(ostensive gestures, pointing gestures, vocalizations). Parents used complex semiotic mediators during the interaction, and children engaged in progressively more complex conventional uses of the object over time. We identified 44 events in which children used pre-linguistic signs with a self-regulatory function (4, 4 and 36 at 11, 13 and 15 months old respectively). We analyzed and classified these events according to their semiotic modality and their function. We present qualitative observations that illustrate these categories.

A global networked society means fast changes that demand for the ability to adapt to new circumstances. Supporting children to become self-regulated independent learners is probably one of the most important goals of education in this context. During the last decades, the awareness of the importance of quality Early Years Education especially during the 0-3 period has increased. From a vygotskian perspective, the role of language as a tool to support self-regulation (SR) has been widely studied (on children older than 3 years old, Winsler, 2009)) and numerous educative tools have proven to effectively promote SR. However, there is little evidence on the role that pre-linguistic semiotic systems might play in the early development of self-regulatory skills (i.e. Rodríguez & Palacios, 2007, Valloton, 2008, Delgado, Gómez y Sarriá, 2009).

This study aims to address this gap in the literature. We aim to understand when and how do children start using semiotic tools with a self-regulatory purpose. Understanding the early development of SR and its relation with non-linguistic semiotic tools, has great implications for early years education. The questions of the study are: (1) what kind of communicative semiotic tools do parents use to regulate the children's behavior? (2) Do children use similar communicative semiotic tools (ostensive gestures, pointing gestures, vocalizations) to regulate their action, either directed towards the adult, or to themselves?

Four infants and one of their parents were videotaped at their homes while interacting with a complex object during five minutes. The object of the interaction is described in Basilio & Rodríguez (in press) It is a wooden toy with different parts: a box with three holes on the top, three balls that fit in the holes, but they do not fall inside the box unless they are pushed down. There is a hammer to hit the balls and push them down and make them fall. The bottom of the box is inclined so the balls exit through a hole in one side of the box (Figure 1). Parents were told to "Play with their babies as they would normally do".

We conducted a microgenetic analysis of interactions from a semiotic-pragmatic perspective of development and objects (Rodríguez and Moro, 1999). We coded for parents use semiotic utterances to scaffold the object's conventional uses to their children, (verbal utterances, demonstrations, ostensive signs, pointing gestures, symbolic gestures), and for children's use of signs related to their activity (ostensive gestures, pointing gestures, vocalizations). We identified 44 events in which children used pre-linguistic signs with a self-regulatory function (4, 4 and 36 at 11, 13 and 15 months old respectively). We analyzed and classified these events according to their semiotic modality and their function. We present qualitative observations that illustrate these categories. We describe the categories used to characterize these behaviours (both, used in previous studies and developed in this study) and we analyze observations that illustrate them. The following is an example.

Observation 4. duration: 28 seconds.

C1 (Child 1, girl) 15 months old; A (Adult, father)

Indexical sign, Ostensive gesture and vocalization; requesting specific help to the adult.

C1 hammers the balls that she has placed in the holes previously. A encourages her action saying "Very good, very good, very good, another one, come on!". C1 hammers over the box, but does not aim at any specific ball, so she just manages to introduce partially the three of them, but none of them would fall inside the box. C1 stops hammering and tries to take out one of the balls. A grabs the child's hand holding the hammer and says "it's about to fall, it's about to fall. Once again, once again, hit it one more time", directing her arm so that the hammer is over a ball, and making the movement up and down, like hammering but not hitting the ball. Then A, holds N1's arm higher and says "come on, you hit it!" letting her arm go, so when it falls it hits the ball with the hammer and makes the ball fall into the box. A celebrates saying "Good!". After this immediate demonstration. N1 takes the ball from the exit hole, she places it again and hammers three times, but doesn't manage to hit the ball. A says "Come on, hit it harder". Then C1, points at the ball with the hammer, she looks at her father's hand and still holding the hammer, she shows him her wrist and vocalizes "hmm", requesting for his help to hammer. A grabs her hand and says "Do you want me to help you? Come on" and guides her hand hammering with her until the ball falls into the box.

In this observation the child has the goal of hammering the ball, but she is not succeeding. After trying by herself, she asks the father to help her. She manages to communicate him what she wants without words, using an indexical sign (when she points toward the ball using the hammer) an ostensive sign (when she shows her wrist with her hand holding the hammer) and a vocalization. The father understands her intention and helps her, so she succeeded in her

goal. This behaviour indicates that the girl, as young as 15 months old is capable of: - holding a goal in mind, - she understands the sequences of actions necessary to complete the goal, - she knows that her father can help her, - and she communicates effectively what she wants. In this case, she is not yet capable of achieving the complete use of the object but herself, but instead of giving up and do something else, or instead of giving the hammer to the father for him to do it, she keeps the hammer, and request for help in the specific part of the action where she has difficulties. We conclude that sensitive microgenetic analysis of triadic interactions allows to evidence that children develop self-regulatory skills even before they learn to use language, non-verbal communicative tools also fulfil a self-regulatory function from early in life.

PAPER PRESENTATION

Antecedents and consequences of initial and sustained interest during a learning task

Anna Tapola, University of Helsinki, Finland; Marjaana Veermans, University of Turku, Finland; Markku Niemivirta, University of Helsinki, Finland

In two related studies, the change in students' on-task interest was examined as a function of individual and task characteristics. Elementary school students worked in two groups with a different simulation task type to learn the basics of electricity. Students' personal goal orientations and interest in math and science were measured before the task. Pre- and post-tests were used for measuring relevant content knowledge on the subject. On-task interest was recorded repeatedly in different phases of the task. The results of Study 1 (n=52) were tested for replication and extended with measures on students' self-reported use of motivational regulation strategies in Study 2 (n=120). Repeated measures ANOVA and partial least squares method were used for analysing the data. The role of task characteristics in students' on-task interest was reflected in the results showing, first, that the general level changes in on-task interest were different in the two simulation task groups. Second, the learning outcomes seemed partly to depend on the changes in students' on-task interest, in favour of the task group where an increase in on-task interest was observed. On the other hand, students' initial interest at the beginning of the task depended on their individual characteristics. Time sequenced on-task interest ratings also strongly predicted one another, regardless of the task condition. Students' self-reported tendency to use motivational regulation strategies was related to their on-task interest throughout the task. Discussion focuses on the importance of acknowledging both individual and situational factors in the development of students' on-task interest.

Summary

Introduction

In order to cope with a learning task, students need a sufficient level of initial motivation to get started, as well as maintained motivation to perform it (Sansone & Thoman, 2005). To better understand the formation of this 'motivational chain', integrated knowledge on the factors affecting students' motivational state at the very beginning and during the learning task is needed. The separate roles of various antecedents and consequences of motivational states have been studied within different research traditions. However, there have been only a few attempts to integrate distinct motivational constructs from different theoretical frameworks (Harackiewicz et al., 2008). Also studies that would have examined the dynamic changes of motivation over the course of a learning task are scarce. Objectives Consequently, two related studies were conducted to address these shortcomings. Central concepts of goal orientation and interest theory were used to study the dynamics, as well as the antecedents and consequences of students' on-task interest during a learning task. More specifically, we wanted to know 1) how students' on-task interest change in the course of a learning task, 2) how students' individual and task characteristics affect students' on-task interest, and 3) which factors predict students' learning outcome measure.

Method

In order to examine of the role of task characteristics, a condition comparison was created. Elementary school students (10 to 12 years old) worked either with a semi-concrete or concreteness fading simulation task to learn the basics of electricity. Before the simulation task, students' personal goal orientations and subject-specific interest in math and science were measured. Taking into account the dynamic nature of on-task interest (Ainley & Hidi, 2002), repeated measures in different phases of the task were used. Students' prior knowledge on the subject (pre-test) was measured before, and learning outcomes (post-test) one day after the simulation task. The change in students' on-task interest was analysed using repeated measures of ANOVA. Partial least squares (PLS) path modeling was used to examine the effects of antecedents and consequences of on-task interest.

Results

In Study 1 (n=52), the simulation task condition had an effect on the way students' on-task interest changed during the learning task. Students' level of interest increased among those who were working with the semi-concrete

simulation type, while a decrease in interest was found in concreteness fading condition. However, students' initial on-task interest was dependent on their interest in science and math, which, on their part, mediated the effects of mastery-intrinsic and avoidance orientation on initial on-task interest. It was also found that independently of the task condition, the effects of time sequenced interest measures on one another were notably strong. Further, our results gave indications that the changes in students' motivational state were reflected in their learning outcome measure after the task. At the group level, students who experienced an increase in their interest during the task also performed better in the post-test. In Study 2 (n=120) the same design was replicated with slightly revised methodology and a larger sample. We also wanted to gain more knowledge of the factors related to the development of students' interest during the task. It has been suggested that students' tendency to use motivational regulation strategies affect whether the initial level of motivation will be sustained (Wolters, 2003). We used a modified questionnaire developed by Wolters (1999) to measure students' self-reported use of motivational regulation strategies after the learning task. Thus, we were able to examine students' on-task interest also from the perspective of their self-regulatory tendencies.

The preliminary results of the Study 2 indicated that, as in Study 1, there was an increase in students' level of on-task interest in the semi-concrete simulation condition. In the concreteness fading condition, on-task interest maintained at the same level throughout the task. The effect of mastery-intrinsic orientation, mediated by students' interest in math and science, on initial on-task interest was replicated. Like in Study 1, repeated on-task interest measures strongly predicted one another. Students' tendency to use motivational regulation strategies was related to their personal goal orientations (except avoidance orientation) as well as on-task interest measures.[1]

Conclusions

Although acknowledged in theory, there is a lack of empirical studies concerning the changes in motivational states during a learning task. The results of the two studies reported here illustrated the dynamic nature of students' on-task interest. The differences found in the two task conditions showed, first, that besides maintaining students' interest, task characteristics may have the potential to even enhance it. Second, although the level of students' interest was rather high in both conditions throughout the task, it was the positive change that seemed to matter when considering students' learning outcomes. While the general level changes could partly be attributable to the differences in task conditions, the results showed that students entered the task situation with different motivational backgrounds which affected the level of their initial on-task interest. The importance of the initial interest at the beginning of the task was highlighted in its predictive effect on subsequent interests during the task. Further, as shown in Study 2, students who reported having used motivational regulation strategies more often during the learning episode were also more interested throughout the task. The results of the studies speak in favour of acknowledging individual factors that affect, not only the initial level but also the maintenance of students' transient motivational states. Consequently, besides considering the "interestingness of the environment", the influence of students' motivational background should be taken into account in study designs as well as in practical implications.

References

- Ainley, M., & Hidi, S. (2002). Dynamic measures for studying interest and learning. In P. R. Pintrich, & M. L. Maehr (Eds.), *Advances in motivation and achievement: New directions in measures and methods*, Vol. 12 (pp. 43-76). Amsterdam:
- JAI. Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink Garcia, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, 100, 105-122.
- Sansone, C., & Thoman, D. T. (2005). Interest as the missing motivator in self-regulation. *European Psychologist*, 10, 175-186.
- Wolters, C. A. (1999). The relation between high school students' motivational regulation and their use of learning strategies, effort, and classroom performance. *Learning and Individual Differences*, 3, 281-299.
- Wolters, C. A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist*, 38(4), 189-205.[1] As the analyses are still in progress, a more detailed examination of motivational strategies as well as the effects of pre- and post tests will be included in the final version.

PAPER PRESENTATION

Motivational approaches to the study of theology in relation to theology students study path

Laura Hirsto, University of Helsinki, Finland

The aim in this study is to explore the relationships between motivational approaches to the study of theology and theology students' curricular choices during their study path. Relationships were explored through follow-up data. During their first year, they completed a questionnaire which included motives for studying theology. On the third and fifth year they were asked to respond to questions concerning their curriculum choices. There are empirical

indications that spirituality is one of the determinants of career behavior (Lips-Wiersma, 2002): it influences career purpose, sense-making and coherence. Duffy and Blustein (2005) argue that individuals who have a strong spiritual relationship with a higher power and are religious through intrinsic motivation tend to be more confident in their ability to make career decisions and are more open to exploring a variety of career options. The theological studies provided an interesting context to investigate religious and spiritual aspects of motivation, for those aspects usually are more detectable in choices of theology students compared to university students in other fields. According to preliminary results, certainty of curriculum choice, curriculum choices and reasons given to them were significantly related to the motivational approaches for the study of theology reported in the beginning of university studies. However, the pattern was different when third and fifth year relationships were compared.

Aims The aim in this study is to explore the relationships between motivational approaches to the study of theology and theology students' curricular choices during their study path. Vocational psychologists have conducted a great deal of research into the effect of contextual variables on career development, but have yet to explore adequately the role of spirituality and religiousness (Duffy & Blustein, 2005, p. 431-432). Theoretically, religious questions are intertwined in the personal worldviews (cf. Hirsto, 2001) and values of students and affect motivational constructs. Spirituality and religiousness can provide people with an ultimate sense of purpose (Emmons, 1999; McIntosh, 1995). There are also empirical indications that spirituality is one of the determinants of career behavior (Lips-Wiersma, 2002): it influences career purpose, sense-making and coherence. Duffy and Blustein (2005) argue that individuals who have a strong spiritual relationship with a higher power and are religious through intrinsic motivation tend to be more confident in their ability to make career decisions and are more open to exploring a variety of career options.

The theological studies provide an interesting context to investigate religious and spiritual aspects of motivation for those aspects usually are more detectable in choices of theology students compared to university students in other fields. Faculties of theology in Finland offer a general theological education and the education required to become a teacher of religion, as well as qualifications for students wishing to become pastors in the Evangelical-Lutheran church. It could be assumed that more students in these faculties than in higher education in general have some sort of spiritual motivations for their study. However, the teaching at these faculties is non-confessional and students come from various Christian spiritual traditions. Studies on motives for studying theology have produced some classifications: a spiritual calling, the instrumental approach, the scientific approach, self-fulfilment, a helping orientation, being assured of a place to study, and other people's influence (Niemelä, 1999; Baylis, Cargas, Hartley, Rowland, Sabri, Stavrakopoulou and Wyatt, 2004). The relationships with motivational approaches and curricular choices will be explored through the following questions: How are the motives in the beginning of the theological studies related to a) certainty of curriculum choice b) curriculum choices, and c) reasons given for the choices in the third and the fifth year of university studies?

Methodology

This is a follow-up study among theology students. During their first year, they completed a questionnaire which included motives for studying theology. On the third and fifth year they were asked to respond to questions concerning their curriculum choices. The response rates were 70.4 % in the first year, 41.8 % in the third year and 25.9 % in the fifth year. Missing data-analysis will be reported in this presentation.

Findings

In the beginning of the university studies similar factors of motivational approaches were found compared to earlier research (c.f. Hirsto & Tirri, 2009). Of the third year students, 79.9 % reported to be certain of their choice of the curriculum, while in the fifth year 85.7 % were certain. The distribution of the choices in third and fifth year represented very well the distribution of the graduating Masters' of Theology. According to preliminary analysis, experienced spiritual calling is related to the certainty of curriculum choice in the third year of the university studies ($t=2,540$, p In addition to certainty of curriculum choice, also the actual curriculum choices were investigated in relation to motives to start to study theology. Of the motivational approaches in the beginning of the university studies, spiritual calling, a helping orientation, assuring a place to study, other people's influence were significantly related to the curriculum choices students had made in the third year of their theological studies. Also, uncertainty of career choice was significantly related to curriculum choices. In the fifth year spiritual calling and a helping orientation in the beginning of the theology studies were related to curriculum choices in the fifth study-year. Also, in the fifth year, uncertainty of career choice in the beginning of the studies was related to curriculum choices. The contents of the reasons students gave for their curriculum choices were qualitatively analysed and classified. Top level categories were named: calling or certainty, exclusion and other. However, the nature of the explanation differed according to curriculum choices, which students had made. Therefore, the relationships of these curriculum choice bound explanations were investigated further. This revealed interesting significant relationships and variety of the motivational approaches of the students following different curriculum paths. The study path of religion teachers and

pastors seems to be somewhat coherent, but students' in general theological education curriculum seems to have more or less dissonant approach to their studies.

Theoretical and educational significance of the research

This study sheds light to university students study paths in a specific context of theological education. The findings will be discussed in terms of the theoretical background, self-regulation (e.g. Pintrich, 2004; Zimmerman, 2002; Boekaerts & Cascallar, 2006) and curriculum development. Through this empirical starting point, implications are discussed also in terms of more general academic education. This research contributes to the understanding of how motivational approaches in the beginning of university studies may affect the choices later in the study-path. It seems that spiritual calling, which, in case of other curriculum choices except that of becoming a pastor, seem to take a form of unquestioned certainty, plays an important role in certainty of choices during university studies. More generally, results also suggest that there are students trying to progress in their university studies, but who may not have a very clear vision of their goals. If this lack of perspective is persistent, which it seems to be according to these results, this phenomena would need more intensive elaboration in developing higher education curricula.

PAPER PRESENTATION

Achievement Goals Over Time: How Changes in Mastery and Performance-Approach Predict Deep Knowledge

Daniel Belenky, University of Pittsburgh, United States; Timothy Nokes, University of Pittsburgh, United States; Matthew Bernacki, University of Pittsburgh, United States

The current study examines two factors that are critical to understanding the role of achievement goals in classroom learning; how goals change over time and the relation between those goals and what is learned. Students' achievement goals were measured in relation to three exams completed during a Cognitive Psychology lecture course (N = 154). The exams included items that assessed different kinds of knowledge including factual, conceptual, and application based understanding. Performance on the initial exam was predicted by student performance-approach goals, while performance on the third exam was predicted by mastery-approach goals. Moreover, a positive change in mastery-approach goals from Exam 1 to Exam 3 led to increased performance on the third exam, while a positive change in performance-approach goals led to decreased performance. This effect was driven by an advantage for mastery-approach goals on the application-based items. These results indicated that mastery-approach goals may be particularly important for the development of deeper forms of understanding, and that movement towards such goals over the course of a semester may be a pedagogically important aim for instructors.

The relationship between achievement goal orientations and academic performance is mixed (see Linnenbrink-Garcia, Patall, & Tyson, 2008). In some cases, mastery goals predict achievement, while in others, performance goals are better predictors. In the current study, we focus on two factors that may be contributing to the conflicting findings in the literature; the type of knowledge being measured on achievement tests, and how goals change over time. Specifically, we analyzed exam items, differentiating between fact-based, concept-based, or application-based questions. We test the hypothesis that advantages observed for performance-approach goals reflect performance on items that assess a fact-based understanding, while advantages for mastery-approach goals reflect deeper forms of understanding as measured by concept- and application-based items (see Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). Furthermore, we examined how achievement goals change over the course of a semester, and how these changes influence exam performance.

Methodology:

Participants were students in a Cognitive Psychology course at the University of Pittsburgh (N = 154). Students completed questionnaires at four time points throughout the semester; on the first day, before the first exam (5 weeks in), before the second exam (9 weeks), and before the third exam (14 weeks). Questionnaires assessed a range of motivational and self-regulatory variables. For the purposes of this paper, we focus on achievement goals and their relationship to exam performance. We measured mastery-approach, performance-approach, and performance-avoidance goals using three 7-point Likert scale items for each construct (1 = Strongly Disagree, 7 = Strongly Agree) from the Achievement Goal Questionnaire – Revised (Elliot & Murayama, 2008).

For each multiple-choice exam, the percentage of total items correct was calculated to measure overall performance. The items on each exam were analyzed and coded into sub-categories of fact-based, concept-based, or application-based items by two raters ($\kappa = 0.94$, $n = 125$, $p < .05$). Fact-based items assessed the direct recognition of information from the course, concept-based items required students to reason with concepts and theories covered in the course, and application-based items required students to apply knowledge to a given scenario or analyze given information in light of particular concepts or theories.

Findings:

Mean values for each goal score at the first and third exam are given in Table 1. Each construct showed a decrease in endorsement of these goals across time points.

To analyze the effect of achievement goals on Exam 1 performance, the three achievement goal constructs were entered as predictors into a linear regression predicting exam scores. Overall performance was not predicted by any achievement goal. However, when examining the subscales, we found that performance-approach was a marginal predictor of factual and applied item performance ($B = .27, p = .07$ and $B = .28, p = .06$, respectively), performance-avoidance goals negatively predicted performance on the applied items ($B = -.31, p < .05$), and mastery-approach goals did not predict any subscales. In contrast to the first exam, mastery-approach goals predicted performance on the third exam ($B = .25, p < .05$). When looking at subscales, mastery-approach predicted performance for factual and applied ($B = .26, p < .05$ and $B = .31, p < .05$, respectively) and was marginally predictive of performance on conceptual items ($B = .16, p = .10$). Neither performance goal was predictive of subscale scores at Exam 3.

The effect of mastery-approach at the third exam is particularly interesting in light of the fact that, as a whole, the class reported less mastery-approach goals at the third exam than at the first (see Table 1). To examine the effect of this change on an individual basis, we calculated a difference score for each student by subtracting goals at Exam 1 from goals at Exam 3. This resulted in a "change score" value for mastery-approach, performance-approach, and performance-avoidance goals. A negative change score indicates that the student decreased in their endorsement of that particular goal. These change scores were entered into a regression predicting performance on Exam 3. Mastery-approach change scores positively predicted exam performance ($B = .23, p < .05$), while performance-approach change scores negatively predicted exam performance ($B = -.24, p = .05$). Looking at the subscales, we see that performance on applied items is positively predicted by changes in mastery-approach goals ($B = .33, p < .05$), but marginally negatively predicted by changes in performance-approach goals ($B = -.22, p = .08$). Increases in mastery-approach goals promoted deep understanding, while increases in performance-approach goals inhibited the development of such understanding.

Summary:

Exam 1 performance was positively predicted by performance-approach goals but not mastery-approach goals. However, at Exam 3, mastery-approach goals positively predicted performance whereas performance-approach goals did not. Furthermore, changes in these goals over time predicted exam performance. Students who became more mastery-oriented had higher Exam 3 scores, while those who became more performance-approach oriented had lower scores. These changes were especially strong for the applied items that required a deeper understanding of the material.

Theoretical and Educational Significance:

In order to shed light on inconsistent findings in the literature on the relationship between achievement goals and achievement we focused on how student goals change over time and the types of measures used to assess achievement. We found that an increase in mastery-approach goals over time leads to better performance on measures of deeper understanding. In contrast, increases in performance-approach goals were associated with lower performance on such measures. Focusing attention on variation of achievement goals across time and context may improve our conceptualization of how achievement goals positively influence students, and how educators can maximize these benefits.

References:

- Elliot, A.J., & Murayama, K. (2008). On the measurement of achievement goals: Critique, illustration, and application. *Journal of Educational Psychology*, 100, 613-628.
- Harackiewicz, J.M., Barron, K.E., Pintrich, P.R., Elliot, A.J., & Thrash, T.M. (2002). Revision of achievement goal theory: Necessary and illuminating. *Journal of Educational Psychology*, 94, 638-645.
- Linnenbrink-Garcia, L., Tyson, D.F., & Patall, E.A. (2008). When are achievement goal orientations beneficial for academic achievement? A closer look at main effects and moderation factors. *International Review of Social Psychology*, 21, 19-70.

PAPER PRESENTATION

Longitudinal relationships between achievement goal orientations, well-being and educational choice

Markku Niemivirta, University of Helsinki, Finland; Katariina Salmela-Aro, Helsinki Collegium for Advanced Studies, Finland; Heta Tuominen-Soini, University of Helsinki, Finland

The purpose of this study was to examine the developmental characteristics of secondary school students' achievement goal orientations, and, especially, the relative benefits of adopting either mastery vs. performance-

focused goal orientations in terms of students' subjective well-being. The participants were of 549 secondary school students of whom 176 (42% females) chose the vocational track and 373 (52% females) chose the general academic track after the ninth grade. The design included four measurement points, two before and two after the transition from lower secondary to upper secondary education. All students completed a questionnaire with scales assessing achievement goal orientations, self-esteem, depressive symptoms, and satisfaction with educational choices. Latent growth curves were estimated for each type of achievement goal orientation. Later ratings of self-esteem, depressive symptoms, and satisfaction were regressed on the trajectories of change in achievement goal orientations, while controlling for the effects prior level of self-esteem, frequency of depressive symptoms, and school performance. The results showed some systematic changes in achievement goal orientations over time, which, to some extent, were moderated by the educational context. Changes in achievement goal orientations independently influenced the students' later well-being. The patterning predictive effects showed that positive changes mastery tendencies were related to parallel changes in well-being, whereas increases in performance-focused tendencies, especially in performance-avoidance orientation, were associated with decreases in well-being. The findings of this study contribute to our understanding of the long-term changes in students' academic motivation during the transition from lower secondary to upper secondary education.

Achievement goal orientations refer to individuals' tendencies to strive for certain outcomes and to favor some types of goals over some others. Much of the recent research on achievement goal orientations has focused on their achievement-related antecedents and outcomes (for a review, see Kaplan & Maehr, 2007). Fairly little attention has been paid on the developmental aspects of different orientations and how changes over time in them relate to some personal factors other than achievement, such as subjective well-being. Quite lively debate has also focused on the relative benefits of adopting either mastery tendencies (i.e., striving for gain in competence) vs. performance-related tendencies (i.e., striving for the demonstration of competence), although the criteria for evaluating such adaptiveness have mostly revolved around achievement-related indicators (Midgley, Kaplan, & Middleton, 2001). The main objective of this study was thus to contribute to the current discussions by examining the developmental characteristics of secondary school students' achievement goal orientations, and, especially, whether the striving for some types of goals in the long run proves to be more beneficial in terms of subjective well-being than striving for some other types of goals.

The few studies available addressing the linkage between achievement goal orientations and well-being suggest that tendencies reflecting the strive for self-improvement and growth (i.e., mastery focus) are related to more adaptive socio-emotional functioning and more positive self-evaluations, whereas the tendency to validate and demonstrate one's personal qualities (i.e., performance focus) is associated with adjustment problems and socio-emotional vulnerability (e.g., Sideridis, 2005; Tuominen-Soini, Salmela-Aro, & Niemivirta, 2008). In this study, we expected to find similar relationships between achievement goal orientations and subjective well-being in a longitudinal setting. That is, we assumed that changes over time in different types of achievement goal orientations were predictive of later well-being in such a way that increases in mastery-focused tendencies were associated with higher well-being, and increases in performance-focused tendencies were related to lower future well-being.

The participants were of 549 secondary school students of whom 176 (42% females) chose the vocational track and 373 (52% females) chose the general academic track after the ninth grade. The design included four measurement points, two before and two after the transition from lower secondary to upper secondary education. All students completed a questionnaire with scales assessing different achievement goal orientations (e.g., mastery, performance-approach, and performance-avoidance orientations) and two important aspects of general well-being, self-esteem and depressive symptoms. Also, students' ratings reflecting their satisfaction with their educational choices were assessed at time 4. Within the structural equation modeling framework, latent growth curves were estimated for each type of achievement goal orientation. Later ratings of self-esteem, depressive symptoms, and satisfaction were regressed on the trajectories of change in achievement goal orientations, while controlling for the effects prior level of self-esteem, frequency of depressive symptoms, and school performance.

The results showed an increase in mastery goal orientation over time, whereas no change was detected in performance-approach and performance-avoidance orientations. The trajectories of change were moderated by educational track so that stronger increase in both mastery and performance-approach tendencies were evident for vocational students. When examining the predictive effects of growth trajectories of achievement goal orientations on well-being, the results showed that later self-esteem was predicted by lower initial level of performance-avoidance orientation as well as by increases in mastery orientation and decreases in performance-avoidance orientation. Depressive symptoms were influenced by both prior school performance and increases performance-avoidance orientation. The initial level of mastery orientation as well as increases in mastery orientation and decreases in performance-avoidance orientation had an effect on students' satisfaction with their educational choices.

The findings of this study suggest some systematic changes in achievement goal orientations over time, which, to some extent, are moderated by the educational context (i.e., educational track). Changes in achievement goal orientations also seem to independently influence the students' later well-being. The patterning predictive effects further show that positive changes mastery tendencies appear to be related to parallel changes in well-being, whereas increases in performance-focused tendencies, especially in performance-avoidance orientation seem to contribute to decreases in well-being. The findings of this study add to understanding of the long-term changes in students' academic motivation during the transition from lower secondary to upper secondary education. The results also importantly contribute to the recent debate on the benefits of adopting either mastery-focused or performance-focused achievement goal orientations in school settings.

References

- Kaplan, A. & Maehr, M. (2007). The contributions and prospects of goal orientation theory. *Educational Psychology Review*, 19, 141-184.
- Midgley, C., Kaplan, A., & Middleton M. J. (2001). Performance-approach goals: Good for what, for whom, under what circumstances, and at what cost? *Journal of Educational Psychology*, 93, 77-86.
- Sideridis, G. D. (2005). Goal orientation, academic achievement, and depression: Evidence in favor of a revised goal theory framework. *Journal of Educational Psychology*, 97, 366- 375.
- Tuominen-Soini, H., Salmela-Aro, K. & Niemivirta, M. (2008). Achievement goal orientations and well-being: A person-centred analysis. *Learning and Instruction*, 18, 251-266.

PAPER PRESENTATION

Mathematics with eyes wide shut: Facing challenges and overcoming barriers

Claudia Ventura, Faculdade de Ciencias e Tecnologia da Universidade Nova de Lisboa, Portugal; Nuno Santos, Escola Secundaria de D. Dinis, Lisboa, Portugal; Margarida Cesar, Universidade de Lisboa, Instituto de Educacao, Portugal

In Portugal, students categorised as presenting Special Educational Needs attend mainstream classes (ME, 2008). Mathematics presents high levels of rejection and low achievement (Céêsar, 2009). Considering mathematics knowledge as socially constructed, giving a meaning is an essential step to access mathematical tools (Vygotsky, 1934/1962). Representing mathematical objects is a barrier blind students experience. Braille writing specific features must be considered when teachers talk about mathematics in classes including blind students (Santos & Céêsar, 2007). They need a thick descriptive discourse and language adapted to Braille writing. In a mainstream classroom teachers must consider the blind student(s) and the non-impaired students, facilitating all students' participation. Communication plays an essential role in students' mathematical knowledge appropriation (Sfard, 2001). Collaborative work can be used as a mediator of students' learning (Céêsar, 2009). This study belongs to the Interaction and Knowledge project whose aims were to study and promote collaborative work in formal educational scenarios. We assume an interpretative approach and an action-research design. The main participants are the students (N=190) from classes including blind students (N=11), two teacher/researchers and a psychologist. The data collection instruments are: observation, questionnaires, documents, informal conversations and students' protocols. Inductive categories emerged from the content analysis (Hamido & Céêsar, 2009). We analyse some examples of students' solving strategies and social interactions illuminating teachers' role in blind students' learning process and the particularities of mathematics Braille. They also illustrate the importance of the communicative processes due to the use of mathematical Braille, particularly differences among blind and non-blind students.

The Salamanca Statement (UNESCO, 1994) symbolises a rupture: changing from the integration into the inclusion paradigm. In the integration paradigm, schools and society looked for students' normalization. After the Salamanca Statement students' characteristics are respected and teachers try to potentiate them (Céêsar & Ainscow, 2006). In the Portuguese curriculum mathematics is a compulsory subject until the 9th grade (14/15-year-olds). It is one of the most selective, as many jobs and university courses ask mathematics as a condition to be admitted (Céêsar, 2009). Failing in this subject puts students' school path and professional life at risk. Mathematics is one of the subjects that more often contribute to early school dropouts. Therefore, it is crucial to promote all students' access to mathematics achievement, particularly blind ones. Mathematics uses abstraction, an ability that is more difficult to develop when students use a symbolic system (Braille) different from the one used by non-impaired students. This is a barrier blind students need to overcome in order to mobilize/develop their mathematical abilities and competencies (Santos & Céêsar, 2007). Communication is also very important to a blind student because s/he does not have access to the information captured through sight. Thus, we need alternative forms of communication that can surpass this problem. A mathematics teacher of a mainstream class with blind student(s) must adapt his/her practices to each student, including the blind one(s). A way to include every student in the mathematical activities is through the promotion of peer social interactions. Social interactions play an important role in students' socio-cognitive and emotional

development (Vygotsky (1934/1962) and in giving students a voice (Wertsch, 1991). Collaborative work in mathematics classes is a way to promote peer and dialogical social interactions (Céêsar, 2009). The problem that originated this research was the difficult inclusion process experienced by many blind students in a mainstream mathematics class. We aim to understand the sort of communication that is established between mathematics teachers and blind students included in mainstream classes, the adaptations that can be observed in the practices developed by teachers and the interactive patterns between students (blinds and non-blind).

The research questions we address are:

- (1) Which are the facilities and the difficulties that blind students experience to have access to the cultural mathematical tools?
- (2) What can be done to facilitate their access to them?

This study is part of Interaction and Knowledge (IK) project. Its main aims were to study and to promote collaborative work in formal educational scenarios, contributing to a more inclusive and intercultural education (Hamido & Céêsar, 2009). This research project lasted 12 years (1994/95 to 2005/06), included 69 mathematics teachers and more than 600 mathematics classes. We focus in those attended by blind students (N=11) included in mainstream schools. We assume an interpretative approach (Denzin, 2002) and developed action-research projects (Mason, 2002). The participants were these blind students (7th to 12th grades – 12 to 18 years old), their classmates (N=190), their mathematics teachers, a psychologist and significant others (colleagues, friends, families, other educational agents).

During the first week of the school year (September), students answered to a questionnaire, a task inspired in projective techniques and an instrument to evaluate abilities and competencies. They also answered two other questionnaires in the begging of the second term (January) and the end of the school year (June). Participant observation (registered in teacher/researchers' diaries, audio/video taped, photos), informal conversation, documents and students' protocols were collected during all school year. Data treatment and analysis is based in a narrative content analysis (Clandinin & Connelly, 1998) from which inductive categories emerged (Céêsar, 2009) illuminating empirical evidence.

We analyse some examples that illuminate teachers' adaptations to practices and to the communication with blind students. We also present some examples of solving strategies and mathematical thinking, discussing the particularities of the Braille writing. This analysis illuminated that there were complements of verbal information to respect the blind students' characteristics. Some complementary information was presented through movement, touch and materials adapted to befit their needs. But teachers also performed some adaptations to the tasks to allow the blind students to participate in the same mathematical activities as their peers. Thus, the results illuminate how dialogical social interactions can contribute to a more inclusive mathematics education and facilitate blind students' access to the cultural tools of mathematics.

References

- Céêsar, M. (2009). Listening to different voices: Collaborative work in multicultural maths classes. In M. Céêsar, & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 203-233). Rotterdam: Sense Publishers.
- Céêsar, M., & Ainscow, M. (Eds.) (2006). *European Journal of Psychology of Education*, XXI(3).
- Clandinin, D. J., & Connelly, F. M. (1998). Personal experience methods. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 150-178). Thousand Oaks, Sage Publications.
- Denzin, N. (2002). The interpretative process. In A. Haberman, & M. Miele (Eds.), *The qualitative researchers companion* (pp. 349-366). Thousand Oaks: Sage Publications.
- Hamido, G., & Céêsar, M. (2009). Surviving within complexity: A meta-systemic approach to research on social interactions in formal educational scenarios. In K. Kumpulainen, C. Hmelo-Silver, & M. Céêsar (Eds.), *Investigating classroom interaction: Methodologies in action* (pp. 229-262). Rotterdam: Sense.
- Mason, J. (2002). *Researching your own practice: The discipline of noticing*. London: Rand Falmer.
- Ministério da Educação (ME) (2008). Decreto-Lei nº 3/08, de 7 de Janeiro, Diário da República – I Séérie, N.º 4. Lisboa: INCM.
- Santos, N., & Céêsar, M. (2007). Eu não vejo como tu... mas podemos falar de matemática. In E. C. Martins (Ed.), *Cenários de educação/formação: Novos espaços, culturas e saberes*. Castelo Branco: SPCE. [CdRom]
- Sfard, A. (2001). There is more to discourse that meets the ears: Learning from mathematical communication things that we have not known before. *Educational Studies in Mathematics*, 46, 13-57.
- UNESCO (1994). *Final report. World conference on special needs education: Access and quality*. Paris: UNESCO.
- Vygotsky, L. S. (1934/1962). *Thought and language* (Myshlenie I rech' Trans.). Cambridge MA: MIT Press. [Original work published in Russian, in 1934]

Wertsch, J. (1991). *Voices of mind. A sociocultural approach to mediated action*. Hemel Hempstead: Harvester Wheatsheaf.

PAPER PRESENTATION

The relationship between naming-speed and spelling in dyslexia

Erlijn van Genuchten, Knowledge Media Research Center, Germany; P. C-H. Cheng, School of Informatics, University of Sussex, United Kingdom; Paul A. Kirschner, Open Universiteit, Netherlands; Paul Leseman, Utrecht University, Netherlands

Literature about dyslexia proposes two competing theories. The phonological deficit theory holds that people with dyslexia have problems with their phonological representations, whereas the double deficit theory holds that people with dyslexia show an additional naming-speed deficit that is claimed to be equally important in causing reading problems. Research on the relationship between naming-speed and reading has shown that reading problems are related to the commonalities between phonological processing and naming-speed, which supports the phonological deficit theory. However, research on the relationship between naming-speed and spelling has shown that naming-speed remains a significant predictor for spelling when phonological problems are controlled, which supports the double deficit theory. A problem with studies relating naming-speed to spelling is that they use the standard naming-speed test used in reading research. In this test, individuals have to verbally name letters, instead of presenting them graphically. Also, this test does not distinguish between information processing speed and pronunciation speed. To this end, we implemented an adapted naming-speed test — measuring the speed of retrieving a letter from memory during writing — to investigate the relationship between naming-speed and spelling. The results confirm previous findings that naming-speed and spelling are unrelated. Our findings imply that future studies should use adapted naming-speed tests to shed light on why the phonological deficit theory explains the relationship between naming-speed and reading and the double deficit theory the relationship between naming-speed and spelling.

Literature about dyslexia proposes two competing theories. One, the phonological deficit theory, holds that people with dyslexia have problems with their phonological representations affecting performance on any task requiring phonological processing (Pennington, Cardoso-Martins, Green, & Lefly, 2001). The other, the double deficit theory, holds that people with dyslexia show an additional naming-speed deficit that is claimed to be equally important in causing reading problems (Vaessen, Gerretsen, & Blomert, 2009).

The phonological deficit is defined as difficulties in storing and/or retrieving words and in processing information in working memory, whereas the naming-speed deficit is defined as the inability to rapidly retrieve phonological codes from memory (Vellutino, Fletcher, Snowling, & Scanlon, 2004). Although many studies have shown that people with dyslexia indeed have phonological processing problems (e.g., Pennington et al.), it is still unclear whether naming-speed is a separate problem or a problem caused by phonological processing weaknesses.

Research on the relationship between naming-speed and reading has shown that reading problems are related to the commonalities between phonological processing and naming-speed (e.g., Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002), which supports the phonological deficit theory. However, research on the relationship between naming-speed and spelling has shown that naming-speed remains a significant predictor for spelling when phonological problems are controlled (e.g., Savage, Pillay, & Melidona, 2008), which supports the double deficit theory. A problem with studies relating naming-speed to spelling is that they use the standard naming-speed test used in reading research. This test measures the time individuals take to encode and verbally name a series of letters (Denckla & Rudel, 1976). In contrast, letters are decoded and presented graphically during writing. Another problem is that the time needed to utter the name of a letter is included in the measured time. However, as people with dyslexia have problems with rapid naming, it is more relevant to examine how long they take to retrieve a letter name from memory. To this end, we implemented an adapted naming-speed test—measuring the speed of retrieving a letter from memory during writing—to reinvestigate the relationship between naming-speed and spelling. **Method** Participants were 95 Dutch children (Mage = 8.28 years, SD = .64), namely 29 grade 3 children with dyslexia (DYS), 33 grade 3 chronologically age matched (CA) children without dyslexia, and 33 grade 2 reading age matched children (RA) without dyslexia. Children wrote four types of sentences (N = 24) from memory. In familiar sentences (e.g., Have go hungry), syntactic, semantic, and phonologic support facilitated remembering. In jumbled sentences, syntactic support was removed by presenting words in random order (e.g., You the dog). In sentences containing language-like non-words (e.g., Rummer hoat barden), semantic support was removed by presenting non-existing words that sounded Dutch.

Finally, in sentences containing language-unlike non-words (e.g., Knuk greupeg), phonological support was removed by presenting non-existing words that did not sound Dutch. Children also wrote their first names, which served as a writing baseline. To evoke pauses between letters, children wrote sentences on a piece of paper attached to a graphics tablet containing horizontal rows of rectangles. They wrote one letter in each rectangle (Figure 1). Naming-speed was measured as pause lengths by gauging the time that the pen was lifted from the paper between writing two consecutive letters.

Figure 1. Example sentence. After the experiment, we counted the number of phonological spelling errors. These errors were marked when a word sounded completely different than the stimulus (e.g., 'knuf' instead of 'knuk'). Results We predicted naming-speed or the number of phonological spelling errors with type of sentence, group and writing baseline simultaneously in a regression analysis. This analysis revealed that CA children exhibited shorter pause lengths and made fewer phonological spelling errors than RA and DYS children. RA and DYS children did not differ in pause lengths; however DYS children made more spelling errors than RA children. A second regression analysis testing whether pause length mediated the effect of group on spelling errors yielded no significant results.

Discussion

The double deficit theory was confirmed by two findings. First, DYS children lagged behind in their spelling development compared with their peers; this disadvantage was clearer for phonological processing than for naming-speed problems. This supports the double deficit theory as a similar pattern would be expected for similar deficits. Second, the finding that naming-speed did not mediate the effect of group on spelling errors also confirmed that the naming-speed and phonological processing deficits are independent. These results are in line with previous studies on the relationship between naming-speed and spelling. These findings imply that future studies should use adapted naming-speed tests?measuring time to retrieve a name from memory instead of total performance time?to shed light on why the phonological deficit theory explains the relationship between naming-speed and reading and the double deficit theory the relationship between naming-speed and spelling.

References

- Denckla, M., & Rudel, R. G. (1976). Rapid "automatized" naming (RAN): Dyslexia differentiated from other learning disabilities. *Neuropsychologia*, 14, 471-479.
- Pennington, B. F., Cardoso-Martins, C., Green, P. A., & Lefly, D. L. (2001). Comparing the phonological and double deficit hypotheses for developmental dyslexia. *Reading and Writing: An Interdisciplinary Journal*, 14, 707-755.
- Savage, R., Pillay, V., & Melidona, S. (2008). Rapid serial naming is a unique predictor of spelling in children. *Journal of Learning Disabilities*, 41(3), 235-250.
- Schatschneider, C., Carlson, C. D., Francis, D. J., Foorman, B. R., & Fletcher, J. M. (2002). Relationship of rapid automatized naming and phonological awareness in early reading development: Implications for the double-deficit hypothesis. *Journal of Learning Disabilities*, 35, 245-256.
- Vaessen, A., Gerretsen, P., & Blomert, L. (2009). Naming problems do not reflect a second independent core deficit in dyslexia: Double deficits explored. *Journal of Experimental Child Psychology*, 103, 202-221.
- Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry*, 45(1), 2-40.

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PAPER PRESENTATION

Dyslectic trainee teachers' views of their educational trajectory and their future vocational role

Lena Ivarsson, Mid Sweden University, Sweden; Ulla Damber, Mid Sweden University, Sweden

The objectives of this study was to explore how Swedish dyslectic trainee teachers view their past educational trajectory, their present studying situation, their adjustment to university studies, and their future vocational role. To get an inside perspective of the students' perceptions, in-depth interviews were chosen as method of inquiry. As the conditions for dyslectic students in school have changed according to different policy documents over time a life history perspective was employed in the interviews. This was made in order to get a full description both of the individual experiences and the conditions provided by the school environment. Even though all ten students have a diagnosis of dyslexia, a majority of them were not diagnosed until they were in upper secondary school or even at the university. One major finding was that no extra support was given until the diagnoses were made. The students perceived that their university studies required rigorous planning and lots of time, and they claimed that the compensatory support they had been given was crucial to them to meet the academic demands. In describing their Future Time Perspective the students emphasized their ability to understand and help children with special needs.

This was a major driving force for them to apply to become trainee teachers. A major implication of these findings is that dyslectic children are not identified so that remedial assistance can be brought in as early as possible. Secondly, these students' capacities and strengths should earn more attention both in practice and research.

The overarching objectives of this study were to explore how Swedish dyslectic trainee teachers view their past educational trajectory, their present studying situation, their adjustment to university studies, and their future vocational role. The study was conducted in Sweden at a small university, predominantly carrying out distance education. A substantial part of the student body has a working-class background. The informants, all women, were varying in age from twenty to fifty. The distribution of the sexes reflects the fact that the majority of the trainee students are women. To get an inside perspective of the students' perceptions, in-depth interviews were chosen as method of inquiry. The student counselor, who was the contact person for dyslectic students, distributed invitations to the students to participate in the study. This procedure was chosen to guarantee the students' anonymity in case they rejected the invitation. In order to get a picture of the compensatory support the students were offered at the university, the student counselor was also interviewed. The theoretical framework is based on a social cultural view of the individual and his/her learning (Wertsch, del Rio, & Alvarez, 1995).

We aimed to employ a broad perspective on the students' life situations, including their social, cultural, and historical background, and not only their clinical background. The social, cultural, and historical perspective also encompasses the view of learning employed in the study. As the conditions for dyslectic students in school have changed according to different policy documents over time, a life history perspective was employed in the interviews (Goodson, 1994), together with a Future Time Perspective (FTP), as FTP is an important predictor of school investment and academic success (Peetsma, 2000). A simplified version of the Zimbardo time perspective inventory was employed in the student interviews (Zimbardo & Boyd, 1999). The life history perspective was chosen in order to get an extended description both of the individual experiences and the conditions provided by the school environment. Even though all ten students have a diagnosis of dyslexia, a majority of them were not diagnosed until they were in upper secondary school or even at the university. In Sweden children are seldom diagnosed with dyslexia in elementary school. It seems like the students were able to handle the rather simple texts, often fictional, used in early reading instruction. In the students' narratives it is clear that the problems with reading got more apparent when they encountered more abstract and complex non-fictional texts in upper secondary school and, above all, at the university level.

Most students were diagnosed with dyslexia as upper secondary school students or as university students. The student narratives revealed that the need for support was clearly manifested in upper secondary school, but no support was offered. One major finding was that no extra support was given until the diagnoses were made. Even those students, who had an earlier diagnosis, were dependent on the help each individual teacher could or would offer. Some students reported that their self-esteem suffered a lot as they linked their reading problems to a view of themselves as "being stupid". In particular, for those students, the diagnosis of dyslexia was a relief. At university level the students perceived that their studies required rigorous planning, a lot of time, and many hours of reading. They claimed that the compensatory support they had been given, was crucial to them to meet the academic demands. The compensatory actions will be described in the presentation. In describing their Future Time Perspective the students emphasized their ability to understand and help children with special needs. This was a major driving force for them to apply to become trainee teachers. Firstly, a major implication of these findings is that dyslectic children are not identified so that remedial assistance can be set in as early as possible. Secondly, it is obvious that the condition of dyslexia, in these students, is not only linked to the problems associated with reading, but also to a strong Future Time Perspective and ability to large investments in their studies. Our conclusion is that these students' capacities and strengths should earn more attention both in practice and research.

PAPER PRESENTATION

Academic self concept in children with special educational needs attending different school types

Dietmar Grube, University of Oldenburg, Germany; Lieselotte Scheewe, University of Bremen, Germany;

Julia Nicklaussen, Carl-von-Ossietzky Universitat Oldenburg, Germany; Susanne Mayer, Carl von Ossietzky University of Oldenburg, Germany

Some children with a mild intellectual disability or with socio-emotional problems visit classes at special schools, some others are integrated within classes in regular elementary schools. The academic self-concept is an important variable for life-long learning. From the theoretical view of the big-fish-little-pond-effect (Marsh, 1987) lower self-concept scores can be predicted in children that are integrated in classes at regular schools than in children instructed in special classes.

The present study is aimed at testing this hypothesis. Self-concept and other school related variables were collected from 13 children attending special classes and from 13 children attending regular classes. All children had been diagnosed as needing special educational help. The children attending schools in the rural regions of Germany were matched for age (about 9 years) and sex. For reasons of statistical control individual reading, arithmetic and working memory were assessed. Each child completed a questionnaire regarding emotional and social school experience ("Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen", FEES 1-2; Rauer & Schuck, 2004). The groups of children differed significantly regarding academic self-concept, attitude toward school and enjoyment to learning with children educated in special classes showing more advantageous values than children integrated within regular elementary schools. An analysis of covariance showed that the significant differences were saved after controlling cognitive variables.

Findings

Show that self-concept of children with special needs is at risk if the children are schooled within regular schools. A disadvantageous self-concept seems to reduce the attitude toward school and the enjoyment to learning.

Children who fail to profit from regular instruction at school in the long term may be categorized as children with special educational needs. Some children with a mild intellectual disability or with socio-emotional problems visit classes at special schools, some others are integrated within classes in regular elementary schools. In former times, special classes were arranged in order to give special instruction to children with special needs and in order to save them from learning standards they can't reach. Nowadays, directed by the Convention on the Rights of Persons with Disabilities (2006), more and more children with special needs receive their special education while attending regular schools.

Children with special educational needs should be encouraged regarding both, cognitive and socio-emotional aspects. On the socio-emotional side, the academic self-concept is an important variable. In this theoretical context the well known big-fish-little-pond-effect (Marsh, 1987) predicts a disadvantageous self-concept in children with classmates whose mean capability is much higher than their own. Therefore one could predict lower self-concept scores in children that are integrated in classes at regular schools than in children instructed in special classes. On the other side, teachers of regular classes that integrate children with special needs should be well trained and prepared to be conscious of the big-fish-little-pond effect and to fight against it. From this point of view one should predict no differences between the two groups of children educated in different contexts.

The present study is aimed at investigating the self-concept of children with special educational needs attending special classes compared to children attending classes in regular schools. Self-concept and other school related variables were collected from 13 children attending special classes (four girls, nine boys, mean age = 9;0 years, SD = 0;3) and from 13 children attending regular classes (four girls, nine boys, mean age = 9;1 years, SD = 0;4). All children had been diagnosed as needing special educational help. The children attending schools in the rural regions of Germany were matched for age and sex. For reasons of statistical control individual reading and arithmetical skills as well as working memory were assessed. Each child completed a questionnaire regarding emotional and social school experience ("Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen", FEES 1-2; Rauer & Schuck, 2004) that gives information about the following seven variables: social integration, class climate, academic self-concept, attitude toward school, effort tendency, enjoyment to learning, feeling to be accepted.

Simple t-tests ($\alpha = .05$) did not show significant differences between both groups of children regarding reading and arithmetical skills and working memory. However the groups of children differed significantly regarding academic self-concept ($d = 1.04$), attitude toward school ($d = 0.92$) and enjoyment to learning ($d = 0.99$) with children educated in special classes showing more advantageous values than children integrated within regular elementary schools. For the other socio-emotional variables analyses did not show any significant differences. Because there were tendencies toward better cognitive skills in children attending special classes an additional analysis of covariance was carried out. This analysis showed that the significant differences found for socio-emotional variables were also significant after controlling reading skills, arithmetical skills and working memory.

These findings show that the self-concept of children with special educational needs is at risk if the children are schooled within regular elementary schools. A disadvantageous self-concept seems to reduce the attitude toward school and the enjoyment to learning. Consequently, teachers instructing children with special needs within regular schools have to take the risk for the self-concept of the children into account. Educational research has to yield further knowledge and schools of education have to impart the knowledge about how to save the self-concept of students from being damaged by the context of more capable peers.

PAPER PRESENTATION

The role of text production processes in the development of understanding through writing

Veerle Baaijen, Center for Language and Cognition Groningen, Netherlands; David Galbraith, Staffordshire University, United Kingdom; Kees de Glopper, Faculty of Arts, University of Groningen, Netherlands

Writing is often used as a tool for learning in schools. Current theories of writing, however, have different conceptions of the processes responsible for its epistemic effects. The knowledge-transforming model (Bereiter and Scardamalia, 1987) attributes it to deliberate planning designed to satisfy rhetorical goals. By contrast, the dual-process model (Galbraith, 2009) claims that it depends on the spontaneous formulation of thought during dispositionally-guided text production. Two groups of writers - high self-monitors, whose writing is assumed to be directed towards rhetorical goals, and low self-monitors, whose writing is assumed to be dispositionally-guided - were asked to write an article for the university newspaper. Half the participants were asked to make an outline before writing (outline planning); the other half were asked to sum up their main point before writing (synthetic planning). All participants were asked to rate their understanding of the topic before and after writing, and, in order to assess the extent to which content was modified during text production, keystroke logs were collected. The results are broadly compatible with the dual-process model: (i) writers reported significantly more development of understanding after synthetic than after outline planned writing; (ii) low self-monitors writing synthetically planned text showed much higher levels of text modification during writing; (iii) developments of understanding within the synthetic planning condition were significantly related to the extent of text modification during writing. Alternative explanations for the findings, and their implications for designing school writing tasks, will be discussed.

Writing is often used as a tool for learning in schools. However, there are contrasting conceptions about what is responsible for the epistemic effect of writing. Problem solving models of writing (e.g. Bereiter and Scardamalia, 1987) attribute the development of understanding through writing to deliberate planning designed to satisfy rhetorical goals. By contrast, Galbraith (2009) claims that the development of understanding depends on the extent to which text production is dispositionally driven. This paper focuses on the fundamentally different role that these two theories attribute to text production processes. For the problem solving models of writing, text production is a passive process of translating thoughts into words, whereas the dual process model (Galbraith, 2009) suggests that text production is an active knowledge constituting process in its own right. 42 high self-monitors (whose writing is assumed to be directed towards rhetorical goals) and 42 low self-monitors (whose writing is assumed to be dispositionally driven) were asked to plan and write an article for the university newspaper. Half the participants were asked to make an outline before writing (planned text production) while the other half were asked to write down a single sentence summing up their overall opinion (non-planned text production). We used the latter as a control planning condition, which we defined as synthetic planning.

To assess the development of understanding, participants were asked to list ideas and to rate their understanding of the topic both before and after writing. To assess the extent to which content was modified during text production, keystroke logs were collected during writing (Leijten & Van Waes, 2006). In order to capture text production processes we used a simple indicator of content modification during text production, which we will label as the text modification index. The text modification index is the number of process words registered by Inputlog as a proportion of words in the final text. This index is taken as the extent to which text is modified during writing. Because only the dual process model attributes an active role to text production processes we will take the perspective of the dual process model to state the predictions. If the dual process model is right then the text modification index should be at a maximum when low self-monitors write synthetically planned texts, since it is assumed that low self-monitors' writing is dispositionally driven and that outline planning reduces the extent to which text production is spontaneous. Furthermore, if the dual process model is right, high levels of text modification should also be associated with increases in subjective understanding.

This experiment showed three important results. First, writers reported significantly more development of understanding after synthetic than after outline-planned writing. Secondly, low self-monitors writing synthetically planned text showed much higher levels of text modification during writing than the high self-monitors writing outline planned texts. Third, developments of understanding within the synthetic planning condition were significantly related to the extent of text modification during writing. Taken together, the latter two results suggest that dispositionally-driven (i.e. low self-monitors') writing leads to more modification of thought during text production than writing that is directed towards rhetorical goals (high self-monitors), and this is associated with the development of writers' subjective understanding. This effect is reduced when writing is outline planned. These results are, therefore, compatible with the main claims of Galbraith's dual process model. However, a key question that remains is the nature of the process by which text modification occurs during writing. Is it a consequence of the spontaneous formulation of thought in language, or of a more deliberate planning and rhetorical evaluation of sentences as they

are produced? In order to examine this, a further, more detailed analysis of the key-stroke logging data is currently in progress. To date, this analysis has supported the assumption that the text modification index is a valid measure of differences in the number and nature of production and revision phases during writing. More detailed analyses of these findings will be reported in the paper, in addition to the data described above. These results have potentially important implications for the way that writing is taught in schools. Outline planning is one of the most common writing strategies taught in schools, and this is often accompanied by a focus on the rhetorical goals of different forms of writing. Our results suggest that, at least so far as learning is concerned, more exploratory, less structured forms of writing, may be equally important.

PAPER PRESENTATION

Bursts of written language production increase across the initial years of schooling

Rui Alexandre Alves, Universidade do Porto, Portugal; Ilda Jesus, Universidade do Porto, Portugal

Writers compose in bursts, that is, texts are produced by adding up stretches of words, which in adults have an average length of about nine words (Kaufer, Hayes, & Flower, 1986). How do writers progress to achieve this length? Do children readily start by adding up segments of about nine words? Likely not. Here we report a study conducted with Portuguese children that we set up to find if burst length develops throughout the initial four years of schooling. To test this, we formed groups of first, second, third, and fourth graders ($N = 166$). The children handwrote narratives (elicited by a cartoon like drawing) into a digitizing tablet that recorded pauses and bursts. Regarding pauses, we found that its duration decreased from 1st to 4th grade. Regarding bursts, we found a steady increase in burst length from 1st to 4th grade, the average burst size for the four groups were, respectively: 1.84, 3.53, 5.26, and 7.86 words. This result shows for the first time that burst length heightens during the initial years of schooling. Overall, across grades the picture that emerges from this study is one of writing becoming progressively more efficient, as reflected by decreasing pause duration, and increased burst length. These results are of educational relevance, because online measures of writing, such as pauses and bursts, can be thought as markers of writing efficiency, thus teaching us more about identifying and promoting writing skills in the initial years of schooling.

Writers compose in bursts, that is, texts are produced by adding up stretches of words, which in adults have an average length of about nine words (Kaufer, Hayes, & Flower, 1986). How do writers progress to achieve this length? Do children readily start by adding up segments of about nine words? Likely not, because several studies have already shown that in adults burst length is affected by several factors including domain expertise (Kaufer et al., 1986), language skill (Chenoweth & Hayes, 2001), available working memory capacity (Chenoweth & Hayes, 2003), and transcription skill (Alves, Castro, Sousa, & Stromqvist, 2007; Alves, Olive & Castro, 2010). Since many of these skills show developmental trends with age and schooling, it is likely that in children they might contribute to a steady progression of burst length. Nevertheless, bursts of written language production have been seldom studied in children (but see, Alves, Branco, Castro, & Olive, in press), and this topic is unexplored. Here we report a study conducted with Portuguese children that we set up to find if burst length develops throughout the initial four years of schooling.

The first scientific report that writers compose in bursts was made by Kaufer et al. (1986). They compared expert to novice writers, and showed that the experts had larger bursts and wrote generally better texts. For many years this topic of research was overlooked, but has recently seen a handful of studies. Chenoweth and Hayes (2001) compared undergraduates writing two texts, one in their native language (L1), the other in their second language (L2). As predicted, they found that writers were more fluent and had larger bursts in L1 than in L2. Also in a sample of adult writers, Chenoweth and Hayes (2003) have further shown that reducing verbal working memory capacity by articulatory suppression (saying “tap, tap, tap...” to a metronome) decreased both writing fluency and burst length. Two recent studies by Alves and colleagues have argued that automatizing transcription leads to larger bursts. Alves et al. (2007) asked low and high skilled typists to compose written narratives from a set of pictures. They found that the later group used larger bursts. In an experiment, Alves et al. (2010), randomly assigned undergraduates to one of four conditions resulting from the crossing of output modality (handwriting vs. typing) and transcription skill (low vs. high). They have shown that, irrespective of modality, the high skilled groups composed in larger bursts.

All the skills just discussed have typical progresses during the first years of schooling, thus it is reasonable to expect that they might contribute to more efficient bursts from first to fourth grade. To test this, we formed groups of first, second, third, and fourth graders. The mean ages, size of the groups and gender distributions were, respectively, as follows: $M = 6.4$ years old, $n = 30$, 20 girls; $M = 7.5$ years old, $n = 47$, 20 girls; $M = 8.4$ years old, $n = 48$, 24 girls; and $M = 9.5$ years old, $n = 41$, 24 girls. These groups were asked to write a narrative from a simple line drawing depicting a child strolling with a balloon. The children handwrote the stories into a digitizing tablet, that was controlled by an E-Prime script programmed to measure pauses and bursts of language production.

Two-way Gender X Grade ANOVAs were computed on the means of pause duration and burst length. Regarding pause duration, main effects of both gender, $F(1, 158) = 5.42, p < .05, \eta^2 = .03$, and grade, $F(3, 158) = 7.71, p < .01, \eta^2 = .13$, were found. No interaction was found in this analysis. Girls made shorter pauses than boys. Pause duration decreased from 1st to 4th grades, which is compatible with more efficient composing processes. Regarding burst length, main effects of gender $F(1, 158) = 7.70, p < .01, \eta^2 = .05$, and grade, $F(3, 158) = 40.15, p < .01, \eta^2 = .43$, were found. Also, the interaction between gender and grade was significant, $F(3, 158) = 4.22, p < .01, \eta^2 = .07$. While there were no gender differences in the initial two years of schooling, girls in the 3rd and 4th grade showed larger bursts than boys. A similar gender advantage has been reported before in fourth graders (Alves et al., in press), and seems to be accounted by an early advantage of girls in transcription skills (Berninger & Fuller, 1992). As expected, a steady increase was found in burst length from 1st to 4th grade, the average burst size for the four groups were, respectively: 1.84, 3.53, 5.26, and 7.86 words. This result shows for the first time that burst length increases during the first years of schooling. Overall, across grades the picture that emerges from this study is one of writing becoming progressively more efficient, as reflected in decreasing pause duration, and increasing burst length. These results are of educational relevance, because online measures of writing, such as the one studied here, can be thought as markers of writing efficiency, thus teaching us more about identifying and promoting writing skills in the initial years of schooling.

References

- Alves, R. A., Branco, M., Castro, & Olive, T. (in press). Effects of handwriting skill, composition mode and gender of fourth graders on pauses, written language bursts, fluency and quality. In J. Hayes, M. Fayol, P. Boscolo, & V. Berninger (Eds.), *Past, present, and future contributions of cognitive writing research to Cognitive Psychology*. New York: Psychology Press.
- Alves, R. A., Castro, S. L., & Olive, T. (2010). Transcription skill constrains bursts of language production. In M. Torrance (Ed.), *Learning to write effectively: Current trends in European research*. Brussels: OPOCE.
- Alves, R. A., Castro, S. L., Sousa, L., & Stromqvist, S. (2007). Influence of typing skill on pause-execution cycles in written composition. In M. Torrance, L. van Waes & D. Galbraith (Eds.), *Writing and cognition: Research and applications* (pp. 55-65). Amsterdam: Elsevier.
- Berninger, V. W., & Fuller, F. (1992). Gender differences in orthographic, verbal, and compositional fluency: Implications for assessing writing disabilities in primary grade children. *Journal of School Psychology Review*, 30, 363-382.
- Chenoweth, N. A., & Hayes, J. R. (2001). Fluency in writing. *Written Communication*, 18, 80-98.
- Chenoweth, N. A., & Hayes, J. R. (2003). The inner voice in writing. *Written Communication*, 20, 99-118.
- Kaufer, D. S., Hayes, J. R., & Flower L. S. (1986). Composing written sentences. *Research in the Teaching of English*, 20, 121-140.

PAPER PRESENTATION

Instruction as Mediated Practice: a critical analysis of an intervention study

Susan Jones, Exeter University, United Kingdom; Debra Myhill, Exeter University, United Kingdom

Abstract

This paper will present qualitative findings from a nationally-funded study measuring the impact of contextualized grammar teaching. This study was designed in response to calls for a Randomised Control Trial to establish 'if grammar teaching works', but the trial itself was embedded within a qualitative framework. The focus of this paper is the qualitative data, including teacher interviews and observation data. Both the observations and the interviews were coded using a grounded approach employing NVIVO software to facilitate the coding process. The RCT revealed a positive effect of 1.53 for those classes being taught explicit grammar. However the classroom observations and interviews with the teachers reveal that the pedagogic materials used in the intervention were mediated differently by different teachers and key themes informing these differences were linguistic subject knowledge and beliefs about the value of explicit grammar teaching. This presentation seeks to show the different and nuanced ways in which an intervention shown to be effective, is realised in the classroom context.

Introduction

The study from which this data is drawn aimed to measure the impact of contextualized grammar teaching. The term 'contextualized' was used to indicate that grammar features were taught at the point of writing, as a set of linguistic choices the students might employ for purposeful rhetorical reasons. The research took place against a contested background regarding the value of explicit teaching of grammar (Gordon 2005). As a consequence of this debate there had been calls for a Randomised Control Trial to establish empirically 'if grammar teaching works' (Andrews et al 2006) This study employed an RCT but embedded the trial within a qualitative framework. It is this qualitative data that reveals that while there was a positive effect for those classes being taught explicit grammar, the pedagogic

materials were mediated differently by different teachers. Thus it is argued that a simple 'what works' approach to educational research misrepresents the complexity of classroom contexts; the aim here is to reveal some of this complexity through a presentation of the findings from the teacher interviews and classroom observations.

Methodology

32 schools were recruited and randomly assigned to intervention and comparison groups. Both groups were taught three types of writing, Fictional Narrative, Argument, and Poetry Writing, through the year, employing schemes of work designed by the research team. In both conditions the learning focus, period of study, resources and learning objectives were the same; however, the intervention group received detailed lesson plans and a day's training in their use and a pedagogic rationale for the teaching. This rationale was informed by a view of grammar teaching that promoted the exercise of informed choices regarding the multiple possibilities of linguistic expression, rather than the teaching of grammar knowledge for its own sake. The comparison group received medium term plans but no pedagogic support or training and taught in their usual manner. Both groups completed pre and post test writing assessments which were scored by an independent organization responsible for marking the National Key Stage tests in the UK. However informed by a belief that 'to undertake a trial of an educational or social intervention without an embedded qualitative process evaluation would be to treat the intervention as a black box, with no information on how it worked, how it could be improved, or what the crucial components of the intervention were.' Moore, Graham and Diamond (2003) the RCT was embedded within a qualitative design. The qualitative data included teacher and student interviews, observation data and examples of student writing. Contextual data relating to individual teachers such as length of service, academic background and linguistic subject knowledge, together with the demographics of the schools were also collected.

Findings

The headline findings of the study indicated a positive effect size of 1.53 for the intervention group. However, the RCT does not provide a simple answer to the question 'does grammar teaching work.' Embedded within the data are the complexities of the classroom context and the differential ways by which the schemes of work were taught and understood. Both the observations and the interview analysis reveal teachers adapting the schemes of work to accommodate either the teachers' own practice and approach, or to avoid areas that challenged their own subject knowledge. In the interviews the teachers frequently air their own concerns about their lack of linguistic subject knowledge. The teachers also reveal their own beliefs about students' ability to engage with grammatical concepts and the pedagogic decisions that resulted from these beliefs. More positively however, there are also examples of teachers being surprised by unexpected outcomes, experimenting with linguistic possibilities and making connections between the schemes of work and pedagogic practice.

Conclusion

While the headline findings indicate the efficacy of contextualized grammar teaching, the qualitative data reveals that this is mediated in different ways by different teachers. The effectiveness of the teacher is informed by a complex set of understandings and skills of which subject knowledge is only part of the equation (Phelps and Shilling 2004). Schulman (1986) speaks of pedagogic content knowledge as the integration of subject knowledge with pedagogy such that the teacher needs to translate what they know into a form that can be taught to others. What is revealed in this data is the struggle to make this translation. At the same time teaching as a profession is the focus of competing discourses whereby both what is taught and how it is taught is a contested agenda frequently aired in professional, research and social contexts. The place of grammar; the role of the teacher and the purpose of writing instruction have all been subject to significant pedagogic shifts. This ranges from progressive approaches to a more prescriptive skills-based curriculum and more recently, attempts to reduce centralised strategy making, returning autonomy to teachers and schools. This shifting pattern and the tensions created are also articulated by these teachers and visible in their pedagogic decision making. This presentation seeks to show the different and nuanced ways in which an intervention shown to be effective, is realised in the classroom context.

References

- Andrews, R. Torgerson, C. Bevertson, S. Freeman, A. Locke, T. Low, G. Robinson, A and Zhu, D. (2006) The effect of grammar teaching on writing development. *British Educational Research Journal* 32 (1) 39-55
- Gordon, E (2005) Grammar in New Zealand Schools: Two Case Studies *English Teaching: Practice and Critique* 4 (3) 32-47 48-68
- Moore, L. Graham, A. and Diamond, I. (2003) On the Feasibility of Conducting Randomized Controlled Trials in Education *British Education Research Journal* 29 (5) 673-689
- Phelps, G., & Schilling, S. (2004). Developing measures of content knowledge for teaching reading. *Elementary School Journal*, 105, 31-49.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15, 4-14.

PAPER PRESENTATION

A new perspective into writing regulation: Regulation Episodes in expert research article writing

Anna Inesta, ESADE Business School, Spain; Montserrat Castello, Universitat Ramon Llull, Spain

The present study tests a new unit of analysis, the Regulation Episode, with the objective of identifying patterns in the writing regulation activities implemented by 2 expert writers while producing a research article in Spanish as their L1 in ecological conditions. Qualitative analysis of video-recorded writing sessions (Writer 1: 660 hours in 11 writing sessions; Writer 2: 1016 hours in 12 writing sessions), all produced drafts (Writer 1: 14; Writer 2: 13) and writing diaries (Writer 1: 11; Writer 2: 15) showed that Regulation Episodes took place along the writing processes. Two morphological factors were found to characterize Regulation Episodes: explicitness/implicitness (whether or not Episodes appeared after writers' challenge declaration) and continuity/discontinuity (whether or not Episodes required more than one session to solve the challenge). Also, explicit Episodes focused on molar challenges while implicit episodes focused on local, especially those related to the construction of their authorial voice.

We understand by Regulation Episode the sequences of actions that authors strategically implement with the objective of solving a difficulty or challenge identified during the writing process. We expected that this unit of analysis would allow us to approach the regulation of a challenging task such as research article (RA) writing in a comprehensive way and find meaningful writing strategy patterns in ecological conditions.

Participants were two experienced researchers in the field of psychology, who decided to write a RA in Spanish as their academic writing L1[1] in co-authorship conditions. For the purpose of research, Writer 1 and Writer 2 accepted to work separately on the whole article to compare their versions and negotiate a joined one for submission. Writer 1 devoted 660 hours distributed in 11 sessions to write the RA while Writer 2 devoted 1016 hours distributed in 12 writing sessions.

Two independent judges participated in the categorization of the data at two different levels of analysis. Macro-level analysis involved distinguishing the objectives, challenges, solutions as declared in the writing diaries participants were asked to fill in for every writing session, as well as in the process and retrospective interviews. Micro-level analysis, on the other hand, involved analyzing the transcripts of the researchers' video-recorded writing activity (for each of the writing sessions) to identify the actions implemented while working on the RA as well as infer the intentionality underlying these actions.

Results obtained through macro-analysis confirmed the existence of Explicit REs in the writing process of both participants, which were found to be either continuous (challenge and solutions are cited and implemented in one same writing session) or discontinuous (challenge and solutions are cited and implemented in different writing sessions). Finally, micro-level analysis showed evidence of intentional challenge resolution that had not been explicitly identified by the writers. We considered this to be evidence of implicit Regulation Episodes, which we defined as those sequences of actions of at least 10 bursts[2], some of which are aimed at reformulating or adjusting various elements of the sentence, showing an intention to address a challenge, despite not having made any explicit reference to it during the writing process. Examples of these two kinds of Regulation Episodes will be shown in the session.

[1] In the context of the study there are two official languages, Spanish and Catalan, and while the writers considered Catalan to be their first language, they considered Spanish to be their first language for academic writing purposes.

[2] We use the unit of burst in the same way as Chenoweth & Hayes (2001, 2003) or Beare & Bourdages (2007).

PAPER PRESENTATION

Professional Development through Reflection. A Video and Interview based Analysis.

Corinne Wyss, Educational University Zurich, Switzerland

The conventional Universities of Teacher Education in Switzerland, as well as in the surrounding countries are in a changing phase. Teacher education is part of a critical and controversial discussion and new methods and criteria for teacher education are being looked for. With the definition of standards, the quality of teacher education and the teaching competencies of the students should be secured.

One outcome of these discussions about teacher education and professional career is the image of the teacher as "reflective practitioner". The reflecting competency of a teacher is assumed to be an important factor for professional learning and development. Further more, it is the basis for teaching progression and qualitative instruction. But, there is little known about the reflecting competency of teachers and their reflecting practices.

This study tries to find some evidence by questioning novice and expert teachers with different methods and instruments. The analysis is proceeding on the basis of videotaped lessons which are taken at the beginning and at the end of the job entry phase. The longitudinal study reveals how the reflecting competencies are changing in the first year on the job. The coeval study identifies differences between the novice teachers and the expert teachers.

Affiliation

This paper is written within a national project of the Universities of Teachers Education of St. Gallen and Zürich called "Assessing Standards of Teaching Competency in Initial Teacher Training and in the Job Entry Phase".

PAPER PRESENTATION

Reflecting on Reasoning by Studying Videos

Carolyn Maher, Rutgers University, United States; Cindy Hmelo-Silver, Rutgers University, United States; Marjory Palius, Rutgers University, United States; Robert Sigley, Rutgers University, United States

This study examines the features identified by teachers studying videos of children's mathematical reasoning in an online environment. Analysis of small group discourse about the videos indicate that teachers related the video to their own and classmates problem solving, identified connections to other videos, indicated the enjoyment of studying the videos, and related the videos to opportunities to improve their own teaching. Also, teachers made key connections of the videos to assigned and non-assigned readings. Significant findings are (1) that the video offered a context to discuss the undiscovered potential for reasoning in children and (2) that assigned and other readings were introduced by teachers to support the ideas that were offered.

Aims:

When learning is viewed as a process in a social context, it is crucial to consider ways in which technology influences how students engage in building new knowledge (Collins & Halverson, 2009; Peters & Slotta, 2010). Researchers have argued that technology can serve as cognitive and metacognitive tools that extend classroom experiences beyond the physical classroom to enable learning in virtual spaces (Azevedo, 2005; Lajoie & Derry, 1993). The view that such tools can change the nature of teaching and learning as students enable new forms of activity requires study. It is important to understand how learners develop and deepen their understanding through interactions with each other and with computer tools. Asynchronous discussions offer opportunities to students to be more reflective than they might be in face-to-face groups that call for immediate feedback. They also provide instructors a window into the development and extension of knowledge, offering formative assessment and facilitation of multiple groups (Andriessen, 2006; Bonk et al., 1998). It is claimed that student reflection about their learning is essential in order think about the broader contexts in which they might apply their knowledge (Etkina et al., 2010; Salomon & Perkins, 1989). Opportunities to reflect and revisit ideas, and discuss them within a community of learners, have shown to be especially powerful in the development of mathematical reasoning (XXX, 2010). Blending asynchronous online discussion with access to electronic resources, particularly videos, suggests a potent model for catalyzing learning among mathematics teachers.

The Study:

This research examines online discussions of groups of teachers enrolled in a technology-enriched, hybrid course in mathematics education. A goal for the instructional intervention is that teachers learn to recognize children's reasoning as presented on video clips that come from a seminal collection on children reasoning in mathematics being preserved for worldwide accessibility. Setting/intervention: The intervention model involves studying videos of students across K-12 grades as they engage in cognitively challenging mathematical tasks and providing explanations of children's justifications for their solutions. We analyze online discussion within a course management system, where four groups of about 6-7 teachers engage in conversation about their mathematical problem solving. The data source include postings from a group of seven students, over a three day period, coded for Unit 8, five weeks into the strand. Full paper data will be expanded to all four groups.

Research Questions:

The questions that guide the study are: (1) How, if at all, does discussion of studying of videos contribute to knowledge of children's reasoning; and (2) What are indicators of contributing factors? Data Source: A unit over two weeks involved teacher problem solving in class, and online discussions about a video and related readings. The video involved 5 tenth graders, working in groups of two and three working on the following problem: How many different block towers can be built selecting from three colors of blocks such that the towers have at least one of each color? For the online portion, teachers were asked to describe tenth grader Romina's solution to the problem, indicate whether it is convincing and why or why not. They also were asked to compare Romina's solution strategy with those that emerged in class, and to comment on how explaining and justifying contribute to learning mathematics.

Results:

Data emerging from online discussion were coded with time stamp and for initial (I) and response (R) posts. The categories that evolved from the assignment related the videos to: problem solving (VP), value of the video (VA), examples of student reasoning (VR), and examples from the literature (VL). Teacher postings about connections of the readings to practice were also coded (RP). Studying video proved to be a strong catalyst, with 76% of the reasoning related the video and 24% related to the paper. Teacher comments reflected acknowledgement of Romina's proof as correct, clever, convincing, elegant, impressive, similar/different than that of their/other class members, to the way other members of their class solved it, similarity in notation, cleverness in notation, personally insightful, brilliantly represented, etc. The full paper will elaborate on these results, reporting on all four groups and blending quantitative analysis with qualitative evidence in the form of examples of postings made by the teachers.

Implications:

Understanding what a knowledge community looks like in practice is important for advancing our understanding of how to create and facilitate collaborative knowledge building on line and how carefully selected videos made available globally can enhance collaborative learning. Attention to student reasoning is an important aspect of mathematics teaching that can be enhanced through studying videos and thinking deeply about them.

Andriessen, J. (2006). Collaboration in computer conferencing. In A. M. O'Donnell, C. E. Hmelo-Silver & G. Erkens (Eds.), *Collaborative learning, reasoning, and technology*. Mahwah, NJ: Erlbaum.

Azevedo, R. (2005). Computers as metacognitive tools for enhancing learning. *Educational Psychologist*, 40, 193-197.

Bonk, C. J., Hansen, E. J., Grabner-Hagen, M. M., Lazar, S. A., & Mirabelli, C. (1998). Time to "connect": Synchronous and asynchronous dialogue among preservice teachers. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 289-314). Mahwah, NJ: Erlbaum.

Collins, A., & Halverson, R. (2009). *Rethinking Education in the Age of Technology: The Digital Revolution and Schooling in America*. New York: Teachers College Press.

Etkina, E., Karolina, A., Ruibal-Villasenor, M., Rosengrant, D., Jordan, R. & Hmelo-Silver, C. (2010). Using design and reflection to help students develop scientific abilities. *Journal of the Learning Sciences*, 19,

Lajoie, S. P. & S. Derry (1993). *Computers as cognitive tools*. Hillsdale, NJ: Erlbaum.

Peters, V., & Slotta, J. D. (2010). Scaffolding knowledge communities in the classroom: New opportunities in the web 2.0 era. In M. J. Jacobson & R. P. (Eds.), *Designs for Learning Environments of the Future: International Perspectives from the Learning Sciences*, (pp. 205-232). New York: Springer.

Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanisms of a neglected phenomenon. *Educational Psychologist*, 24, 113-142. XXX. (Eds.), (2010). *Combinatorics and reasoning: Representing, justifying and building isomorphisms*. New York: Springer.

PAPER PRESENTATION

Adaptive Teaching Strategies in German Primary Schools

Jasmin Warwas, German Institute for International Educational Research (DIPF), Germany; Andju Sara Labuhn, German Institute for International Educational Research, Germany; Silke Hertel, German Institute for Internat.Educational Research, Germany; Eckhard Klieme, Deutsches Institut fur Intern. Padagogische Forschung, Germany; Marcus Hasselhorn, DIPF, Germany

Dealing with students' heterogeneity and providing individual support to students in classroom instruction are key to teachers' work in every day school life, and are important demands of educational policy. To reach this goal, teachers can make use of several adaptive teaching strategies such as individualised worksheets and expert groups. When investigating classroom practices, teachers' beliefs play a major role. The aim of our study is to investigate what adaptive strategies teachers use, and which role both the heterogeneity of students and the teachers' beliefs play for their use. Teachers in German primary schools (N=26) reported their use of adaptive teaching strategies and their constructivist beliefs. To measure heterogeneity, we assessed the variability of grade level 3 students' (N=469) competencies in reading comprehension and mathematics in each class. Using linear regression analyses, we could not confirm a relationship between the heterogeneity of students' competencies and the self-reported use of adaptive teaching strategies. Furthermore, teachers holding a constructivist view reported a more frequent use of individualised worksheets, but they did not report to prefer expert groups. Additionally, we found significant interaction effects between the teachers' constructivist view and the heterogeneity of students' competencies regarding the self-reported use of adaptive teaching strategies. The present study reveals important implications for the development of intervention studies designed to provide individual support to students, and for implementing adaptive teaching strategies in teachers' classroom instruction.

Dealing with students' heterogeneity and providing individual support to students in classroom instruction are key to teachers' work in every day school life, and are important demands of educational policy. To this end, Corno and Snow (1986) defined adaptive teaching as "teaching that arranges environmental conditions to fit learners' individual differences" (p. 621). To reach this goal, teachers can make use of several adaptive teaching strategies such as individualised worksheets and expert groups. The former emphasise students' individual learning strategies and are quite popular in German classroom instruction. The latter is a cooperative learning method assigning students to "expert" roles, as the Jigsaw method does (Aronson et al., 1978). A large body of research shows cooperative learning methods to be effective for dealing with heterogeneity and fostering the students' achievement (e.g. Cohen, 1994; Johnson, Johnson, & Stanne, 2000). When investigating classroom practices, teachers' beliefs play a major role. Here, a direct transmission view is contrasted with a constructivist view (see Peterson, Fennema, Carpenter, & Loef, 1989; Staub & Stern, 2002). According to a direct transmission view, teachers are transmitters of knowledge. Within a constructivist framework, students are active constructors of knowledge and teachers support students' self-regulated learning strategies. Therefore, the aim of our study is to investigate what adaptive strategies teachers use, and which role both the heterogeneity of students and the teachers' beliefs play for the use of these strategies.

Hypotheses:

We hypothesize that (1) teachers use individualised worksheets as an adaptive teaching strategy in primary schools more frequently than expert groups, (2) teachers use adaptive teaching strategies particularly in classes with high heterogeneity, (3) teachers with a constructivist view use adaptive teaching strategies more frequently, and (4) teachers with a constructivist view use adaptive teaching strategies more often when they are teaching in classes with high heterogeneity.

Methods:

Teachers (N = 26) in German primary schools completed a questionnaire about their adaptive teaching strategies (e.g. 'How often do you use expert groups as an adaptive teaching strategy in your current classroom instruction?' 1 = never to 4 = in every lesson) and their beliefs (e.g. 'Students should create new ideas on their own and use individual learning strategies.' 1 = I disagree to 4 = I totally agree; three-item scale measuring a constructivist view; Cronbach's alpha = .80). Teachers were predominantly female (89%) and about a half of them had professional experience of more than ten years. Furthermore, we assessed their students' (N = 469) competencies in reading comprehension and mathematics using German standardized diagnostic instruments, such as Wuerzburg Silent Reading Test (Kuespert & Schneider, 1998) and German Mathematics Test (Hasselhorn, Marx, & Schneider, 2004). About half of these students in grade level 3 were female (52%) with a mean age of 8,8 years. To assess heterogeneity, we used the variability of students' competencies in reading comprehension and mathematics in each class. We conducted pairwise comparisons of the self-reported use of two adaptive teaching strategies: individualised worksheets and expert groups. Using stepwise multiple linear regression analyses, we tested main and interaction effects of (a) the heterogeneity of students' competencies for each class, and (b) the teachers' beliefs on the use of these strategies.

Results:

In line with our first hypothesis, a comparison of mean values revealed that teachers reported they used individualised worksheets more often than expert groups ($t(1,24) = 4.63$, $p < .05$, $R^2 F(2,22) = 7.55$, $p < .05$, $R^2 F(2,22) = 7.04$, $p < .05$, $R^2 F(3,21) > 6.95$, $p < .05$, $R^2 = .50$) or in mathematics ($F(3,21) > 10.70$, $p < .05$, $R^2 = .61$). Regarding the self-reported use of expert groups, we found a significant interaction effect between teachers' beliefs and heterogeneity of students' reading comprehension ($F(3,21) = 3.18$, $p < .05$, $R^2 = .31$), whereas the interaction between teachers' beliefs and heterogeneity of students' competencies in mathematics did not reach significance ($F(3,21) = 1.99$, $p > .05$, $R^2 = .22$). However, the significant regression weight for the interaction term ($b = 0.41$, $SE = 0.29$, $p < .05$).

Conclusion and further discussion:

In our study, the heterogeneity of students' competencies within classes was not directly related to the self-reported use of adaptive teaching strategies. However, heterogeneity in a classroom can stem from different reasons and can also be assessed in other ways, such as socioeconomic background or migration status. Also, the direction of the effects found in our explorative study should be confirmed in longitudinal studies. Furthermore, previous research shows social learning arrangements such as expert groups to be a teaching strategy dealing with students' heterogeneity as well as fostering the students' achievement. Nevertheless, this adaptive teaching strategy is quite rarely used in German primary school classroom instruction. Most likely, teachers report to use this strategy when holding a constructivist view and facing the challenge of teaching students with comparatively heterogeneous competencies. In this study, we aimed to investigate the relationship between self-reported teaching strategies and beliefs, and the heterogeneity of students' competencies. For implementing adaptive teaching strategies in teachers' work in every day school life, it is necessary to examine the teachers' current practices. Thus, the present study

reveals important implications for the development of intervention studies designed to provide individual support to students.

PAPER PRESENTATION

Effects of experience and kind of information in making achievement judgments in schools

Assessment of Competence, Cognitive Skills, Continuing professional development in Teachers; Julia Herfordt-Stopel, University of Luxembourg, Luxembourg; Sabine Krolak-Schwerdt, University of Luxembourg, Luxembourg

In a series of experiments, judgment biases and their formation in teachers' assessment of students' performance were investigated. These experiments focused on specific student attributes which, in general, should not influence the achievement assessment, e.g. socioeconomic status or migration background. Previous experiments have provided evidence that experienced teachers are less influenced by these characteristics, especially when the accountability for their decision is high (cf. Krolak-Schwerdt & Rummer, 2005). The difference between experienced and inexperienced teachers might be that they process students' characteristics in a different way. The ability of experienced teachers to ignore irrelevant student characteristics was the focus of three experiments involving different types of participants representing different career levels (experienced teachers as experts, student teachers as novices, and students as laypersons). In these experiments, a special paradigm (Mouselab; cf. Payne, Schkade, & Bettman, 1986) was used. The Mouselab paradigm makes it possible to specify which information is retrieved in what order and which information is ignored when participants search for information about students. The kind of student information which was retrieved in our experiments differed among the three groups. Experts preferred information on achievement characteristics, whereas laymen and novices favored information more connected to person evaluations in daily life. Furthermore the reproduction of the students' attributes was more correct for experienced teachers when the accountability for their judgment was high, than for laymen or novices. For the laymen, no such differences could be shown, whereas, the effects for novices were inconclusive.

Theoretical background Assessment of students is an important task for teachers. However, this assessment may be influenced by student attributes that are not achievement characteristics, such as migration background or socioeconomic background. Until now, it is not known which kind of information (grades, information about solved tasks, additional personal information, etc.) is integrated in what way into judgments. The continuum-model (Fiske & Neuberg, 1990) may help in modeling such judgments. The continuum-model distinguishes two kinds of judgment strategies.

The first strategy is the category based strategy. In this strategy, an activated category (e.g. one based on socioeconomic background or migration background) is used to judge a student. To apply the category based strategy, only low cognitive and motivational effort is needed. For this reason, the category based strategy is used for most judgments, especially when the accountability for the judgment is low. When the accountability for a judgment is high, the second strategy, the attribute based strategy, is used. In this strategy, any available information about the student is integrated into a judgment. This strategy requires much more cognitive effort but leads to less biased judgments. Beyond this, previous research has provided evidence that experienced teachers are less affected by these additional characteristics than inexperienced teachers (Krolak-Schwerdt & Rummer, 2005). This supports the assumption that certain level of expertise is needed to switch between the two strategies (Krolak-Schwerdt & Rummer, 2005), and suggests that not only the amount of information used for the judgment differs with differing levels of expertise, but also the kind of information used.

Methods

In a series of three experiments, the study tested how experts (experienced teachers), novices (student teachers), and laymen (students) search and discern information about students. For these experiments, a special paradigm, Mouselab (cf. Payne, Schkade, & Bettman, 1986) was used. By using Mouselab, it was possible to measure which kind of information (grades, sample tasks, additional information like manners or social behavior) was used to evaluate students. In Mouselab, it is not only possible to record which information is read by the participants but also the length of time and order in which information is viewed. In these experiments, half of the participants were instructed to form an impression (low accountability) while half were asked to predict the future development of a specific student (high accountability). After the instruction, participants read information about students presented in form of the Mouselab paradigm. After they were informed about a student, the participants had to give a description of that student. Furthermore, the novices took part in a special condition involving retrospective thinking aloud. Research questions and hypotheses

When the goal impression formation is activated, experts encode the student information in a category based manner. Therefore, their reproductions are biased by the activated category and they should produce more inferences. The processing data (Mouselab data) should show that participants retrieve less information under the impression formation goal. In contrast, when the goal for the experts is to give a prognosis of the students' academic development, they should integrate all information about the student in an attribute based manner. In this case, experts are expected to produce much more correct reproductions and fewer inferences. The processing data should show that experts search for more information when accountability is high.

For laymen, we expect no effects of the induced goal, because the continuum-model would predict that they are not able to switch between the two different goals. Furthermore, we believe that not only information processing itself, but also the kind of information used differs between experts and laymen. Experts should retrieve more information associated with achievement, as they are trained to do, whereas laymen should concentrate more on additional information resembling that used in daily life. For the novices, no concrete research questions were formulated. Their judgment process was only observed in an explorative manner.

Results

Concerning the recognition data, experts made more correct reproductions when they worked under the instruction to give a prediction (high accountability). Furthermore, experts made more inferences when they reported their first impression of a certain student (low accountability). For the laymen, no such differences could be shown. The novices showed no effect for the correct reproductions. However, they showed a marginally significant effect for inferences in the same direction as experts. Concerning the information which was used for judgment (Mouselab data), experts revealed a preference for information related to a students' achievement, while novices and laymen preferred information more connected to daily life (e.g. manners).

Discussion

This series of experiments gives evidence that experience is a crucial factor in making achievement judgments. For laymen and experts (experienced teachers) the expected effects on memory could be shown. Furthermore, these experiments support the assumption that information processing between experts and laymen is different and that the two groups base their judgments on different kinds of information. In summary, these results indicate the progression from laymen to experts and give important insight into the search and processing of student achievement information. On a further level, these results may help in developing training programs for student teachers. A very important point which is suggested by these experiments is that student teachers must be trained to concentrate on the important information (achievement information) and to screen out other information (migration background).

References

- Fiske, S. T. & Neuberg, S. L. (1990). A continuum of impression formation from category-based to individuating processes: Influence of information and motivation on attention and interpretation. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 23, pp. 1-74). New York: Academic Press.
- Krolak-Schwerdt, S. & Rummer, R. (2005). Der Einfluss der Expertise auf den Prozess Der schulischen Leistungsbeurteilung. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 37, 205-213.
- Johnson, E.J., Payne, J. W., Schkade, D. A., & Bettman, J. R. (1986). Monitoring information processing and decisions: The mouselab system. Unpublished manuscript, Center for Decision Studies, Fuqua School of Business, Duke University.

PAPER PRESENTATION

Assessing ck, pck- and pk-components of prospective teachers' diagnostic competence

Claudia von Aufschnaiter, Institute of Physics Education, Germany

Among the competences outlined to be relevant for pre- and in-service teachers, assessment and diagnosis is frequently mentioned. Teachers need to be able to identify students' conceptions and their learning outcomes and they have to monitor students' learning trajectories in order to design instruction accordingly. Even though such diagnostic competence plays an important role in teachers' professional knowledge it is yet rarely explicitly addressed in educational research. Using the distinction between content knowledge (CK), pedagogical content knowledge (PCK) and pedagogical knowledge (PK) we have set up a model to describe diagnostic competence. The model serves as a framework for both, the development of a pre-service curriculum that establishes this competence and the evaluation of prospective teachers' professional competences. Research reported focuses on first results for CK, PCK, and PK which were gathered on prospective teachers of science and mathematics. These prospective teachers demonstrate middle or high knowledge of science content and science methods but show difficulties in diagnosing students'

competences. Furthermore, no interrelation was identified between assumed moderating factors, such as attitudes or reported motivation, and the prospective teachers' PK.

Theoretical Framework and Research Aims

During the last couple of years, an increasing number of research projects have addressed teacher profession. Shulman's distinction between subject matter/content knowledge (CK), pedagogical content knowledge (PCK), and pedagogical knowledge (PK) (e.g., Shulman, 1987, see also Park & Oliver, 2008) is often used to describe teachers' professional knowledge. Even though knowledge about students' learning and methods by which this knowledge can be achieved are considered to be important aspects of professional competences, typically these are not addressed in detail in current research projects. In particular, a coherent model to describe diagnostic competence on which the design and evaluation of curricula in teacher education can be built can hardly be found in current frameworks. In order to establish and evaluate prospective teachers' diagnostic competence at university level, we have developed a framework aiming to model subject-matter related diagnostic competence (Figure 1). The framework draws on Shulman's distinction and identifies facets of (subject-matter) diagnostic competence in all three areas (CK, PCK, PK). These facets are either a prerequisite of assessment (such as content specific knowledge about the topic/subject that is to be diagnosed) or refer to the methods and results of diagnosis (such as questionnaires to assess students' prior conceptions). Furthermore, we have included competences which refer to making use of methods and results of assessment for the design of instruction. For each facet, several standards are developed which describe related competences.[Figure 1. Model for diagnostic competence]In our project, the model serves as a heuristic for two research aims. First, it informs us about the design of a curriculum which aims to establish prospective teachers' diagnostic competence. Second, the model provides the frame of reference for assessing prospective teachers' competences and the development of these competences during university training.

Procedure, Sample and Methods

The project lasts for four years (10/2008-09/2012) and comprises two cohorts of prospective teachers (at the beginning typically about 20 years old) who are monitored through their university education (which takes about 3-4 years). Cohort 1 has started in 2008, cohort 2 in 2009. All prospective teachers are included who have chosen either two sciences as subjects or a science subject and mathematics. The number of participants in each cohorts are calculated for each subject individually, numbers vary from roughly 50 (physics) to roughly 140 (biology). For educational psychology all prospective teachers are included who study for a teacher exam (N roughly 800 per cohort).In each subject and for educational psychology the prospective teachers' competences are assessed about once a year. Early in their education, the focus is on CK-components shifting slowly to increasing complex PCK-components; anchor items are included in all tests. Instruments are based on established questionnaires and tests used, for instance, in German research on teacher profession. Sample items for CK, related PCK and PK are presented in Figures 2a-c. Assessments in educational psychology also include items focusing on the assumed influencing factors (Figure 1). [Figures 2a-c. Sample items of CK-, PCK- and PK-tests aiming to assess diagnostic competence (based on Halloun et al., 1995; Riese, 2009)]In addition to summative assessments, formative assessments take place in physics and biology education. Here, the prospective teachers are videoed while working on CK- or PCK- tasks. Videos are then analyzed using surface and deep level coding procedures. These analyses have recently begun so that we cannot yet report sound results but will have those ready for the conference.

Results

During their first year of university education, our prospective teachers demonstrate similar subject matter learning difficulties than pupils do. However, the prospective teachers seem to have a good understanding of Nature of Science and science methods. Our hypothesis that a limited understanding of the content also limits the prospective teachers' ability to diagnose students' learning opportunities and difficulties seems to hold true for the majority of our population. However, some of the students (about 30%) either demonstrate high CK but low PCK or, more surprisingly, low CK and high PCK. It has to be stressed that these results are gained with relatively small sample sizes of physics students and without controlling that the level of difficulty for CK- and PCK-tests is similar. Our first analysis of participants' videos indicates that CK is important for PCK: For CK-tasks the prospective teachers rarely discuss PCK-aspects whereas for PCK-tasks a noticeable amount of time is spent on discussing the science content. The final grade in school and gender have the largest impact on prospective teachers' PK but regression analysis indicates that moderating factors for CK are different than those for PK. Those prospective teachers who hold a higher tolerance regarding bad exams show less achievement. During one year, the prospective teachers' self-evaluation of their educational skills has significantly increased even though their educational training is at the beginning.

Conclusions and Implications

The project is novel in its emphasis on trying to model and identify diagnostic competence and its development in prospective teachers. It can be expected that the model itself and results gained in the project contribute to research

on teacher profession. Even though the project is explorative in its nature, it can reveal as to whether prospective teachers will establish competences we consider to be relevant, how long such a process takes (even though it might become shorter with better learning opportunities) and what kind of learning difficulties prospective teachers encounter.

References

- Halloun, I., Hake, R. & Mosca E. (August, 1995). Revised version of the Force Concept Inventory. <http://modeling.asu.edu/R&E/Research.html> [01.08.2009]
- Park, S., & Oliver, J. S. (2008). Revisiting the conceptualisation of Pedagogical Content Knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research of Science Education*, 38, 261-284.
- Riese, J. (2009). *Professionelles Wissen und professionelle Handlungskompetenz von (angehenden) Physiklehrkräften*. [Professional competence of (prospective) teachers.] Berlin: Logos.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.

PAPER PRESENTATION

Surprising differences, hidden difficulties: findings from a teacher education pilot

Christopher Deneen, Hong Kong Institute of Education, Hong Kong; Ronnie Shroff, Hong Kong Institute of Education, Hong Kong

In the last several years, Hong Kong has undergone significant changes in quality assurance and enhancement at the tertiary level. Within this context, the Hong Kong Institute of Education, the region's largest teacher education provider has conducted an exploration of an outcome-based approach to course design, implementation and assessment within teacher education programs.

This paper reports findings from an institute-wide pilot study on OBL, implemented in 2009-2010. Pilot aims included trialing of teacher education course modifications across all undergraduate departments, analyzing and comparing students' and tutors' perceptions of the trial courses, identifying challenges within the trial process, generating evidence-based recommendations to the Institute for larger-scale implementation, and providing evidence-based findings towards to the larger teacher education community on issues of quality assurance and enhancement.

35 instructors and 672 students across 12 departments participated in the pilot. Survey, interview, focus group and related data were collected and analyzed using both quantitative analysis (item/factor scoring, ANOVA, factor analysis) and qualitative analysis (modified grounded theory). Findings include significant discrepancies between instructors' and students' perceptions of course design, assessment and implementation elements. Data analysis also revealed the significance of hidden barriers at multiple levels to change implementation. Theoretical and practical implications for institutions of teacher education contemplating or engaging in quality assurance and enhancement are discussed.

Context

In the last several years, Hong Kong has undergone significant changes in quality assurance and enhancement at the tertiary level (Kennedy, 2008; 2009). One manifestation of this has been the Hong Kong University Grants Committee's (UGC) suggestion that regional universities adopt an outcome-based learning (OBL) approach (Ewell, 2006). The Hong Kong Institute of Education is a tertiary institution serving over 7000 students. The principal focus of the Institute is teacher education. In 2007, the Institute began an exploration of OBL as a means to learner-centered quality assurance and enhancement. This paper reports on findings from the second institute-wide pilot study (Pilot II) on OBL, implemented in 2009-2010.

Aims

Five principal aims of Pilot II:

1. Within an OBL paradigm, enact a trial of teacher education course improvements across all undergraduate departments
2. Analyze and compare students' and instructors' perceptions of trial courses
3. Identify challenges within the trial process
4. Generate evidence-based recommendations to the Institute for larger scale implementation
5. Generate evidence-based findings that may inform the larger teacher education community on issues of quality assurance and enhancement

Methodology

Sample

35 instructors and 672 students participated across 12 departments.

Data collection

Two survey instruments were developed, an Instructor Survey Instrument and a Student Survey Instrument. Instruments were constructed from the same item matrix, which allowed for comparisons in response between instructors and students. Both instruments used a positively-loaded six-point scale (Lam & Klockars, 1982), and open-response items. Qualitative data was collected through instructor professional development sessions, instructor group sharing sessions, and student focus groups. Ethnographic interviewing techniques (Spradley, 1979) and Morgan's (1997) focus group protocols were utilized.

Data Analysis

Data was subjected to qualitative and quantitative analysis. Confirmatory Factor Analysis (CFA) was used on student survey data. CFA was not used with instructor survey data due to sample size restrictions. Analysis of mean, mode, standard deviation, was applied to both instructor and student survey data as well as ANOVA. Qualitative data was coded using a modified Grounded Theory technique (Strauss & Corbin, 1990).

Findings

Factor Analysis

CFA demonstrated the existence of five factors. Inter-correlation values and fit statistics indicated that respondents saw these factors as separate but related components of the pilot course:

1. Course Intended Learning Outcomes (CILOs)
2. Planning, design and alignment
3. Learning and teaching activities
4. Course assessment
5. Feasibility/Comparison

Findings from the fifth factor have been integrated into the discussion of the four course planning and implementation factors.

CILOs

Students evaluated this factor quite highly; CILO factor mean on the student survey was 4.31. Mean factor score on the instructor survey was 4.42, indicating strong parity between students' and instructors' evaluation of CILOs. This factor represents the area in which there was greatest course change as seen through analysis of professional development and sharing session data. Student-generated data reinforced the above findings; students perceived CILO-specific differences from other courses they had taken. Data indicated students placed a high value on outcomes that that were practice-oriented.

Planning, design and alignment

This factor received positive ratings from both students and instructors. However, there were concerns as to whether this factor was conceptualized similarly by students and instructors. CFA analysis of the student survey revealed a strong (.97) inter-correlation between this factor and the factor, learning and teaching activities of the course." Fit statistics revealed that despite this inter-correlation, a model with separate factors was more viable. One hypothesis to explain this finding is that students viewed course planning and design differently than instructors. Qualitative and quantitative data from instructors support the hypothesis.

Learning and teaching activities

This factor received highest overall evaluation by students. Factor mean was 4.33. Qualitative data supports this positive impression. However, student ratings negatively correlate to year in degree program. This finding held across the first four factors but it was most pronounced within learning and teaching. One hypothesis is that students' evaluative criteria become more refined as they progress in the degree program. This interpretation is supported by related research into variance in SET scores by student characteristic (Sailor, Worthen, & Shin, 1997).

Course assessment

Students evaluated this factor category lowest out of all four impact categories. Factor mean was 4.08. This factor category yielded the greatest variance between student and instructor evaluation. Assessment factor mean on the tutor survey was 4.82. Larger-scale analysis of data suggests that classroom assessment was the area of least change within Pilot II. Findings suggest this lack of change was due to multiple factors including administrative barriers and participating instructors' response to change initiatives.

The subset of instructors and students who did make/experience changes in course assessments experienced significantly different results. Open-ended survey responses as well as interview data yielded strong positive response from both groups.

Theoretical and educational significance

Pilot II had strong interaction with unanticipated context issues, such as institutional policy and procedures. Impact was especially pronounced in assessment findings. Attention within the paper is given to understanding these interactions and how findings could be of significance to institutions engaged in quality assurance and enhancement.

Understanding the significant aggregate gap between instructor and student evaluations of classroom assessment has theoretical significance in relation to an emerging field of inquiry: stakeholder conceptions of assessment (Brown, 2006; 2009; 2010). The subset of courses where there were changes to assessment produced significantly different results. The paper discusses theoretical implications and practical possibilities for fostering change in course assessment and addressing challenges to implementation and adoption.

Findings related to planning and teaching are of special significance to teacher education and the preparation of student teachers in the practice of course planning and teaching. Designing transparency into courses is discussed, both as a design element within teacher education courses and as a skill to be taught to student teachers.

The paper also discusses findings on teaching and learning in relation to strategizing student engagement according to progress within degree programs. Implications for teacher education program design are discussed, in terms of outcome development, course leveling, and course mapping/sequencing.

PAPER PRESENTATION

Personalisation in (Initial) Teacher Education

Christian Kraler, Teacher Education and School Research, Austria

Globalisation influences teacher education in Europe especially since the introduction of the Bologna process. This forces governments and universities to reform their teacher education programs. Competence-oriented programs imply the chance to plan initial teacher education outcome oriented and at the same time to increase the process specific flexibility for the course of education of individual students. Thus the idea is to develop a flexible curriculum matrix for a teacher education program with regard to the objective profession-specific course of education defined by competencies and the individual, personal course of education concerning choices, prevailing conditions and other biographical aspects.

In this talk the main findings of a study based on interviews with graduates of a competence oriented teacher education curriculum, a curriculum analysis and quantitative context data will be presented. The research question of the study is: "What are student based developmental tasks during a competence oriented teacher education program?" One result is that we do have two different only partially overlapping cultures of initial teacher education. Based on the concepts of developmental tasks and personalised learning we try to integrate the different approaches into the design of a flexible curricular matrix for initial teacher education with regard to the findings of the study and the existing literature.

One of the effects of the technology-based globalisation of markets is the current status of the individual. The logic behind this seems to be that everything is potentially available at any time for anybody. The responsibility is delegated to the individual. On the other hand, we find that institutions or governments control processes of all kinds increasingly by prescribing detailed structural and content-specific standards for the individual's actions. The same, at least in the German speaking countries, goes for educational systems and especially for teacher education. The modularisation of teacher education programs at universities initiated by the Bologna process (following the logic of global or continental markets) has led to more choice and flexibility for students. Yet on the curriculum level we now find a higher fragmentation of contents. This probably makes the essential profession-specific task of integrating the different elements of initial teacher education for both, the individual teacher student and teacher educators, more challenging than before.

On the other hand, the consequences of this global thinking can be a big chance for teacher education and in particular for the very specific, traditionally government controlled and inflexible teacher education systems in Austria and Germany. The changing framework forces governments and universities to reform their teacher education programs. Thus the internationalisation of teacher education and the necessary governmental reaction to the big international student assessments has led to the implementation of competence-oriented teacher education curricula. As the increasing research literature on this topic since the turn of the century shows, the definition of profession-specific competencies at least improves transparency regarding the efficacy of the teacher education system. Curricular competencies and Bologna modules would offer a profession-specific raster for the individual

teacher education student. Carefully implemented, such curricula for teacher education imply the chance to plan initial teacher education in view of the outcome (what are minimum requirements for beginning teachers?) and at the same time increase the process-specific flexibility for the individual course of education. Students have more choices with regard to their individual strengths and weaknesses.

The study presented moves within this context. The underlying question is this: How can a competence-oriented university-based teacher education program be developed further into a profession-specific, personalised course of education?

The theoretical framework of our research into teacher education at the University of Innsbruck is threefold. The starting point is Kant's pedagogical question: How can I cultivate freedom under constraint? Based on this question we adapt Havighurst's concept of developmental tasks (cf. Trautmann 2004), the concept of the course of education (Meyer M. 2007) and put it in the context of personalised learning (Des 2006). The idea is that teachers need to experience successful ways of teaching for our changing society during their own professional education at university that implies personalised learning and an individual course of education. Taking into account institutional limits and reasonable common standards for beginning teachers a matrix of curricular modules and profession-specific competencies might lead to a flexible set of specific developmental tasks for students. Personalisation would imply that not all these tasks need to be taken on by every student and that the order must remain flexible.

The University of Innsbruck has implemented a competence-oriented, portfolio-supported teacher education program in 2000 (Kraler 2008). It is based on curricular developmental tasks for every academic year (e.g. 1st year: trial identification, self-assessment, shift in perspective from pupil to teacher, introduction & fit). After ten years of experience we get positive feedback from schools and school authorities. But at the same time an ongoing evaluation study has shown that the students view their education as too inflexible and rigid. The next logical step for program development was to systematise the feedback and the student experiences (Kraler 2009). So the central research question of the study is: What are student-based developmental tasks during a competence-oriented teacher education program? The objective, ultimately, is to develop a flexible curriculum matrix for our teacher education program with regard to the objective profession-specific course of education defined by competencies and the individual course of education concerning choices, prevailing conditions, etc. In the context of our personalised concept we used a qualitative approach and held 25 profession-specific biographical interviews, on a voluntary basis, with graduates of our teacher education program. The interviews covered questions from the origin of the idea of becoming a teacher, the school career, the experiences at university, familial and private influences, up to next steps after graduation. The average duration of the interviews was between 1h20min and 2 hours. In keeping with our gender distribution, there were 7 male and 18 female interviewees. In addition to the interviews we could analyse the portfolios of the interviewees and, as a quantitative element, take into account all the students' grades. The data analysis was done computer-supported (MaxQDA), using a combination of grounded theory, metaphor analysis and hierarchical content analysis. The grades contextual biographical data were analyzed with SPSS. We also analysed the curriculum (18 different subjects), focusing on the description of competencies.

The main findings are:

Prescribed program/curriculum-based developmental tasks: - Trial identification - Understanding fundamental ideas of the relevant subjects - Teaching internships to test out acquired competencies - Readjustment & amendment (based on the experiences from the internship) - Diploma certification Student-based developmental tasks (interviews, portfolios): - Role allocation: growing into the role of the student - Relations: disengaging from the parental home, relationship/new friendships/old friendships sustained, students studying together - Dealing with frustration concerning course organisation and specific contents - Subject-specific socialisation (faculty culture) - Change of perspectives through periods spent abroad (especially when studying languages) - Earning money (subject-related, e.g. tutoring, or non-subject-related, often also just to get a change) The last part of the presentation will deal with our first approaches to designing a flexible curricular matrix for initial teacher education based on the findings of the study mentioned.

PAPER PRESENTATION

Wisdom-related competence in teacher education - an adapted model of psychological wisdom research

Robin Stark, Saarland University, Germany; Miriam Hoffmann, Saarland University, Germany

Wisdom-related competence supports effective action in complex social situations as for example in an educational setting. Our concept of wisdom-related knowledge postulates 14 knowledge and attitude categories which constitute wisdom-related competence. We distinguish wisdom-relevant and wisdom-specific knowledge and attitude dimensions. In order to investigate the level of wisdom-related competence in teacher candidates, we generated

complex scenarios situated in an educational context. 49 teacher candidates processed these scenarios in two different learning conditions: problem-based learning (n=24) and analysis of erroneous examples (n=25), plus a control group of n=9. In the pretest, we assessed "wisdom" through the three-dimensional Wisdom Scale (3d-WS) and the Self-Assessed Wisdom Scale (SAWS) and tolerance of complexity through the Tolerance of Complexity Scale. We performed a content analysis on the written answers of pre- and posttests using a specific coding manual and the software MaxQDA. Means were higher in the post- than in the pretest but still at only 35% (problem-based condition) resp. 36% (erroneous example condition) of the theoretical maximum. There were no significant differences between experimental conditions, but both experimental conditions outperformed the control group. A significant predicting factor for posttest achievement proved to be the prior level of wisdom-related competence as assessed in the pretest. Posttest total scores' correlations to the three additionally implemented scales missed statistical significance, whereas posttest scores of some wisdom-related dimensions correlated at least partially to the 3d-WS, SAWS and the Tolerance of Complexity Scale.

Aims: Based on the Berlin Wisdom Paradigm (e.g. Staudinger & Baltes, 1996a) and the Balance Theory of Wisdom (Sternberg, 2001), our model of wisdom-related competence distinguishes 14 wisdom-relevant and wisdom-specific knowledge and attitude dimensions (Hoffmann & Stark, 2009), the first being necessary, but not sufficient prerequisites for the development of wisdom whereas the latter describe aspects characteristic for people whose actions could be considered to be "wise".

We tried to reveal the level of wisdom-related competence in teacher students as we consider everyday school life as a highly complex and very dynamic working environment where dealing with wisdom can provide valuable "orientation knowledge" (Staudinger & Baltes, 1996a) in order to facilitate complex problem-solving.

We investigated whether wisdom-related competence can be fostered by a short scenario-based learning environment with either a problem-based learning approach or by processing erroneous examples.

In order to validate our wisdom model respectively our coding system, we compared the results of our assessment method to two existing wisdom scales (3dWS, Ardel, 2003; and SAWS, Webster, 2003) and a scale for assessment of tolerance of complexity (Radant & Dalbert, 2006).

Methodology

Sample

Participants were teacher students (n=63, 40 female, 23 male), between 19 and 36 years old (M=22.13; SD=3.80), who during their studies underwent a practical training of five weeks. They all participated in the pre- and posttest; the two experimental groups worked with a learning environment in the problem-based learning (n=24) or the erroneous example (n=25) condition.

Scenarios

We developed four scenarios dealing with problematic situations in everyday school life. Two of them were used in the pre- and/or post tests, two only in the experimental conditions.

Problem-based learning vs. Learning from erroneous examples

In the problem-based learning condition, participants had to process a scenario and compare their own answer to a sample solution given by a fictitious psychologist.

In the erroneous example condition, the erroneous example consisted of a given answer by a fictitious laymen. This erroneous example had to be compared to the sample solution.

Coding manual

The coding manual comprises 14 categories (Hoffmann & Stark, 2009). Answers are coded according to their congruence with an ideal answer on a 7-point-scale.

Wisdom Scales

3d-WS: This scale by Ardel (2003) consists of 39 items belonging to either the cognitive, affective or reflective subscale, each item is rated on 4- resp. 5-point Likert scales.

SAWS: The SAWS (Webster, 2003) comprises 40 items belonging to one of the five subscales "Experience", "Emotional Regulation", "Reminiscence/Reflection", "Humour" and "Openness" with a 6-point Likert scale.

Tolerance of Complexity Scale: This scale (Radant & Dalbert, 2006) assesses tolerance of complexity in three subscales ("Challenge", "Pressure" and "Necessity") of 20 items each on a 6-point Likert scale.

Findings

Concerning pretest performance and tolerance of complexity, learners of the three groups did not differ significantly. Total scenario scores (theor. max.: 98 points) in the posttest ranged from 21 to 56 points in the erroneous example condition ($M=35.72$; $SD=9.14$; 36% of theor. max.), from 14 to 49 points in the problem-based learning condition ($M=34.58$; $SD=10.81$; 35% of theor. max.), and from 17 to 35 points in the control group ($M=26.67$; $SD=5.96$; 27% of theor. max.). There were no significant differences between the two experimental groups. Both experimental groups clearly outperformed the control group. For all groups, pretest scores were strong predictors for posttest performance. There was no interaction between pretest scores and experimental condition. Correlations between posttest results and the Tolerance of Complexity Scale, 3d-WS and SAWS missed statistical relevance. Tolerance of Complexity correlated with "domain-specific background knowledge" ($r=.29$, $pr=.29$, $pr=.27$, $pr=.29$, $pr=.27$, $pr=.34$, $pr=.27$, $pr=.30$, p

Theoretical and educational relevance

On an abstract level, results indicate an existing deficit in teacher candidates concerning wisdom-related competence. More concretely, our results show that aspects of wisdom-related competence can be fostered effectively and economically by a scenario-based learning environment. Similar results can be achieved by problem-based learning and learning by erroneous examples. However, they also show that both approaches are not effective enough to develop wisdom-related competence. We suppose that in order to come closer to this goal, both approaches have to be implemented for a longer period. They should be combined with additional instructional support, e.g. innovative feedback methods. Based on findings by Staudinger & Baltes (1996b), we propose that these methods could be realized by implementing forms of cooperative learning (e. g., reciprocal teaching; Palincsar & Brown, 1984). The correlations between aspects of wisdom-related competence assessed by our coding procedure and the two wisdom scales can be interpreted in terms of first indicators for convergent validity.

References

- Ardelt, M. (2003). Empirical assessment of a three-dimensional wisdom scale. *Research on Aging*, 25(3), 275-324.
- Hoffmann, M.C. & Stark, R. (2009). Weisheitsbezogene Kompetenz im medizinischen Kontext. *GMS Zeitschrift für Medizinische Ausbildung*, 26(4), Doc41.
- Maercker, A. (1995). Existentielle Konfrontation: Eine Untersuchung im Rahmen eines psychologischen Weisheitsparadigmas. Unpublished doctoral dissertation, Max-Planck-Institut für Bildungsforschung, Berlin, Germany.
- Palincsar, A. S., & Brown, A. L. (1984). Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities. *Cognition and Instruction*, 1(2), 117-175.
- Radant, M., & Dalbert, C. (2006, September). Dimensionen der Komplexitätstoleranz: Ergebnisse einer Synopse von Persönlichkeitsstrukturen. Paper presented at the 45th Congress of the Deutsche Gesellschaft für Psychologie (DGPs), Nürnberg.
- Staudinger, U. M., & Baltes, P. B. (1996). Interactive minds: A facilitative setting for wisdom-related performance? *Journal of Personality and Social Psychology*, 71(4), 746-762.
- Staudinger, U. M., Smith, J., & Baltes, P. B. (1994). Handbuch zur Erfassung von weisheitsbezogenem Wissen. Materialien aus der Bildungsforschung Nr. 46. [Handbook for the assessment of wisdom-related knowledge. Educational research materials No. 46.] Berlin: Max-Planck-Institut für Bildungsforschung.
- Sternberg, R. J. (2001). Why schools should teach for wisdom: the balance theory of wisdom in educational settings. *Educational Psychologist*, 36(4), 227-245.
- Webster, J. D. (2003). An Exploratory Analysis of a Self-Assessed Wisdom Scale. *Journal of Adult Development*, 10(1), 13-22.

PAPER PRESENTATION

Model Competence in Biology Education – Evaluation of a Theoretical Structure Using Open-Ended Tasks

Juliane Gruenkorn, Freie Universitaet Berlin, Germany; Dirk Krueger, Freie Universitaet Berlin, Germany

Various studies have shown that most of the students' conceptions of models differ from scientific conceptions (e.g. Grosslight et al. 1991). Students reflect little on their thinking in and handling of models and are not aware of the role models play in an epistemological process (e.g. Grosslight et al. 1991; Trier & Upmeyer zu Belzen 2009).

If teachers know about students' conceptions, they can provide adequate support for learning about models. In the long term, diagnostic instruments have to be designed. Upmeyer zu Belzen and Krueger (2010) have developed a model of model competence that could serve as a theoretical basis for such instruments. However, first this theoretical structure needs to be evaluated empirically.

The aims of this research project are to operationalize and evaluate this theoretical structure. 25 open-ended tasks were designed and tested for understandability and consistency with the theoretical structure on a sample of 1059 students. The data were analyzed by qualitative content analysis (Mayring 2003). The analysis of the student answers showed few difficulties to understand the tasks. Difficulties mainly occurred with the instruction and certain biological topics e.g. genetics. The majority of the student answers are consistent with the theoretical structure. But additional facets such as the uniqueness of models need to be considered. Results of the study will be presented at the EARLI 2011.

PAPER PRESENTATION

Conditions and Consequences of Assessment Practices and Judgment Accuracy

Anika Buergermeister, DIPF, Germany; Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

Assessment processes are prominent in instruction and teachers devote a substantial amount of time to measure, evaluate and report on students' performance. For that reason, the present contribution addresses two main issues concerning classroom assessment, namely assessment practices and accuracy of assessment, as correct and precise judgements are demanded, in order to adequately plan and enhance instruction. The focus is on effects of different assessment practices as well as on conditions for assessment accuracy. More precisely, the study (N = 46 teachers, N = 950 students; 9th grade secondary school) investigates three research questions: Do different classroom assessment practices (grade-centred, verbal, participatory) in mathematics instruction impact students' motivation and performance (1)? Findings reveal that a grade-centred assessment practice in mathematics instruction, in which students are not actively involved in the assessment process, is negatively correlated with students' motivation as well as students' test performance. To which extent do teacher variables (2) and classroom assessment practices (3) have an effect on teachers' judging accuracy? Results prove that a higher knowledge concerning the aspect of assessment, more experience in teaching the students as well as a participatory assessment practice cause a higher, while a grade-centred assessment approach leads to a lower judging accuracy. In sum, findings suggest, that classroom assessment is a crucial element of instruction and may be relevant on the one hand for students' learning process and on the other hand for teachers' ability to evaluate their students' achievement and as a result appropriately plan instructional processes.

Background

Teachers spend a substantial amount of time carrying out activities in order to assess students' performance and achievement in instruction (Stiggins & Conklin, 1992). Assessment, which Hattie and Timperley (2007) define as activities that provide teachers and/or students with feedback information [...] can be seen as an essential instructional tool by providing accurate and important information on student learning and its progress. This information from ongoing classroom assessment is essential for instructional decisions and classroom management (Begeny et al., 2008). Additionally, researches have proved an impact of assessment practices themselves on students (e.g. Brookhart, 1997). Bol et al. (1998) found that the use of various assessment strategies as well as alternative forms of assessment (e.g. portfolios) have a positive effect on students' motivation and performance. In this context, the importance of actively involving students in the assessment process is emphasized in several studies (Stiggins & Chappuis, 2005). It is assumed, that giving students an active role in monitoring and reflecting their own level of achievement as well as their strengths and weaknesses may positively influence their learning process (e.g. van Gennip, 2010).

Besides the effect of assessment practices, the teachers' ability to precisely assess students' achievement is a relevant issue in the context of classroom assessment. Only by accurately judging students' performance, teachers are able to adequately adapt their instructional processes and methods to students' needs and requirements. However, to what extent teachers are able to give exact judgments can vary considerably (Hoge & Coladarci, 1989; Perry & Meisels, 1996) and may depend for example on students' characteristics or teacher and classroom variables (Bates & Nettelbeck, 2001; Hurwitz; Demaray & Elliott). In this context, Martínez, Stecher and Borko (2009) claim that different assessment methods of students' performance lead to different accuracy in judging this performance.

Aim of the study

The present study aims at investigating the two outlined aspects of classroom assessment, namely consequences of classroom assessment practices and conditions of judgment accuracy in mathematics instruction. It is intended to explore the impact of classroom assessment practices (grade-centred, verbal, participatory) on students' motivation, effort and performance (1). Moreover the study focuses on teachers' judgment accuracy in assessment processes. Concerning this aspect we aim at investigating conditions of teachers' judgment accuracy. More precisely it will be

examined, in what way teacher variables (2) and classroom assessment practices (3) may influence the assessment accuracy of students' mathematical competence.

Method

The sample consists of 46 mathematics teachers and their 950 students. The students, attending the ninth grade of the middle school, worked on a mathematics test which contained tasks referring to the area Theorem of Pythagoras and Linear Equations, covering either technical (knowing and using formulas and definitions, calculating) or modelling competence (translating a real-world problem into a mathematical problem).

In addition, we measured students' test motivation and effort by implementing a questionnaire. As we consider reference norms to be an important aspect of assessment processes, students were also asked to report on their teachers' reference norms used in assessment processes.

The teachers completed a questionnaire focusing on the one hand on the use of classroom assessment practices. Here we distinguished a grade-centred assessment form which mainly contains an explicit assessment, implemented by the teacher, which is essentially realized by giving grades, from a participatory assessment practice which includes, that students are actively involved in the assessment procedure (self- & peer-assessment, portfolio). Furthermore we measured how often teachers use a verbal kind of assessment practice, which mainly involves a verbal feedback for the students and the oral explanation of common mistakes or misunderstandings.

On the other hand the questionnaire measured teachers' ability to accurately judge students mathematical competences. Teachers were asked to estimate each student's technical and modelling competence.

Furthermore, we asked for the teachers' demographic characteristics such as gender, age, experience in teaching this class in mathematics and moreover measured their self-reported knowledge concerning the issue of assessment. As our data is characterized by a multi-level-structure, we conducted multilevel – multiple - regression - analysis.

Results

Analysing the first research question, results reveal, that a grade-centred assessment approach is negatively related to students' motivation ($b = -.10^*$) as well as to students' test performance in technical ($b = -.11^*$) and modelling tasks ($b = -.16^{**}$). Beyond, if students perceive an individual reference norm in their teachers' assessment activities it indicates a positive link to their motivation ($b = .13^{**}$), effort ($b = .10^{**}$) and performance ($b = .13^{***}$).

Concerning the second research question, we found, that teachers' knowledge about assessment positively moderates the association between students' performance in technical items and teachers' judgment ($b = .07^*$). Furthermore it is proved, that the experience in teaching this particular class in mathematics positively moderates the accuracy of teachers' prediction of students' performance (technical competence: $b = .13^{**}$, modelling competence: $b = .11^{**}$). Findings referring to our third question reveal that a grade-centred approach negatively moderates the accuracy of teachers' assessment (technical competence: $b = -.12^{**}$, modelling competence: $b = -.08^*$). In contrast, a participatory assessment form seems to positively influence the accuracy of judging students competences (technical competence: $b = .08^*$, modelling competence: $b = .08^*$).

Discussion

Findings support existing assumptions (Stiggins & Chappuis, 2005; Rodriguez, 2004) that assessment strategies may affect students' motivational and cognitive characteristics. As expected, taking individual improvements and differences in assessment processes into account, positively influences students' motivation. The negative effect of a grade-centred approach might be due to the fact, that grades are perceived as controlling and therefore negatively affect students' intrinsic motivation and performance (Butler, 1988).

Concerning the aspect of judgment accuracy in assessment processes it seems to be important that teachers have knowledge about assessment and experience in teaching the students.

It is to be concluded, that classroom assessment is not only important for measuring students' skills and achievement, but also needs to be seen as an essential tool, which may influence students' learning process and teachers' judging accuracy.

PAPER PRESENTATION

Modelling item position effects and students' individual persistence in standardized assessments

In standardized educational assessments, performance of students can decrease with long tests due to fatigue or declining motivation, i.e. the position of an item within a test has an effect on item difficulty. The present paper aims to analyze these item position effects within the PISA 2006 science assessment to obtain knowledge about the general size of these effects (how much does performance decrease in the course of the assessment) and about individual differences in item position effects, i.e. the students' persistence during the assessment. Furthermore, the correlation between the students' performance level and their persistence is analyzed. The analyses make use of the published science assessment data from the PISA 2006 study consisting of data from $N = 397.920$ students from 57 countries. Responses to 103 science test items were used in the analysis. All effects of interest were analyzed separately for each country, allowing to compare the effects across countries. A small effect of item position on item difficulties was found consistently across all countries, regardless of their national performance level. The individual differences in persistence were relatively small in all countries, but more pronounced in countries with low performance levels than in high performing countries. Students' performance level is practically uncorrelated with persistence in high performing countries, while it is negatively correlated within low performing countries.

In standardized educational assessments, performance of students can decrease with long tests due to fatigue or declining motivation, i.e. the position of an item within a test has an effect on item difficulty. An examination of these effects is interesting for several different reasons: For example, if item position effects are known, the maximum test length that can be administered to students without overly impairing the assessed performance can be determined. More importantly, if item difficulties are used to describe test scores by construct maps (e.g., Wilson, 2005), effects of item positions should be separated from differences in item difficulties due to item content. In addition to the main effects of item positions (e.g. a general increase in item difficulty), students may also differ individually in item position effects. The performance of some students may remain stable even across long tests, while the performance of others may decrease faster. To analyze individual differences in item position effects is appealing as these individual differences reflect the individual tendency to change (and most probably decrease) performance in the course of an assessment. This individual tendency can be interpreted as a student characteristic of its own right, providing additional diagnostic information over and above the individual performance level. Within this paper, we will refer to the individual effect of item positions as persistence: low individual persistence means decreasing performance, high persistence means stable or even increasing performance throughout the assessment.

In tests with fixed item orders, however, the difficulty of the actual item content and effects of the item position within the test cannot be separated since every item is always presented at the same position, e.g. at the beginning or the end of the test. Therefore, neither effects of item position nor individual differences in persistence can be estimated. Only if item position and item content are not confounded, the general examination of item position effects as well as of respective individual differences between students is possible. This is the case in data from large scale studies that implement balanced booklet designs, as in the OECD Programme for International Student Assessment (PISA) or the Trends in International Mathematics and Science Study (TIMSS).

Aim of the Study

The present study examines general item position effects and individual differences in persistence using public data from the PISA 2006 science assessment. The first aim is to assess the size of a general item position effect and the consistency of this effect across countries with different national performance levels. Second, variances in students' persistence are estimated and compared between countries. Finally, the correlation between students' performance level and persistence is estimated for different countries. A positive correlation implies that the performance of low performing students decreases faster in the course of the assessment, whereas a negative correlation indicates that higher performing students tend to decrease their performance.

Method

The analyses make use of the published science assessment data from the PISA 2006 study (OECD, 2010) consisting of data from $N = 397.920$ students from 57 countries. Responses to 103 science test items were used in the analysis. In PISA 2006, items were presented in a completely balanced booklet design with each booklet consisting of four blocks of items. Each item was presented equally often at all of the four possible block positions within the booklet, i.e. item position and item content were varied independently. The item responses were analyzed using a logistic multilevel model treating responses as level one variables nested within students. With only fixed effects for item difficulties, this model is equivalent to the Rasch model which was originally used to analyze the PISA data. In addition to the effects of item content (i.e., the item difficulties) the model was extended to include the main effect of the item position within the booklet and an associated random effect to capture individual differences in persistence. The

model allows an estimation of (1) the general effect of the item position, (2) the amount of variance in persistence, and (3) the correlation between the performance level and the persistence. The three effects were estimated separately for each country.

Results

A small effect of item position on item difficulties was found consistently across all countries, regardless of their national performance level. For example, the percentage of correct responses decreases from 35% to 29% from booklet position one to four in Brazil and from 59% to 55% in Finland. The individual differences in persistence were relatively small in all countries, but more pronounced in countries with low performance levels (e.g. Brazil and Turkey) than in high performing countries (e.g. Finland and Korea). The most striking difference between countries was found with respect to the correlation between students' performance levels and persistence. In high performing countries, item position effects were practically uncorrelated with the performance level (e.g. $r = ?0.032$ for Finland or $r = ?0.019$ for Korea). In low performing countries, however, the performance level is negatively correlated with the individual item position effect (e.g., $r = ?0.367$ for Brazil, $r = ?0.388$ for Tunisia or $r = ?0.399$ for Thailand. This means that particularly the higher performing students in these countries tend to decrease their performance in the course of the assessment.

Implications

The general effect of item position confirms the already known negative effect of test length on performance. However, the effects are relatively small and do not indicate that the two-hour testing session for PISA 2006 was too long. The negative correlations between performance level and persistence in the low performing countries indicate that one (although small) contribution to these countries' test results may be that higher performing students aren't able to keep up their performance level across the whole assessment. Finally, the analyses demonstrate that item position effects as well as individual differences in these effects can conveniently be analyzed in a standard multilevel framework.

OECD (2007). PISA 2006 Science Competencies for Tomorrow's World. Paris: OECD.

Wilson, M. (2005). Constructing measures. An item response modelling approach. Mahwah: Lawrence Erlbaum Associates.

PAPER PRESENTATION

Students' Test Motivation in PISA

Therese Nerheim Hopfenbeck, University of Oslo, Faculty of Education, Norway; Marit Kjaernsli, ILS, University of Oslo, Norway

Abstract

There is an ongoing discussion as to whether large scale assessment studies such as the Programme for International Student Assessment (PISA) have biased test scores due to students' lack of test motivation (Baumert and Demmrich 2001). One of the main concerns is that low-stake assessments, having little consequence for students, teachers or schools underestimate students' ability (Holliday and Holliday 2003; Sjöberg 2007). If lack of test motivation is not measured and controlled for, it might be a threat to the validity of the interpretation and use of test scores (Eklöf 2010). Despite these concerns, there is a lack of empirical research regarding students' test motivation in large scale assessment studies. This paper will present two studies conducted in Norway which investigated students' test motivation while participating in the PISA test. Questionnaire data ($N = 4600$ students) will be presented together with interviews of Norwegian students who participated in the PISA study in 2006 ($N = 22$) and 2009 ($N = 11$). The preliminary findings show that students report to have been fairly motivated despite the low-stake testing of PISA.

Aims

This paper will present two studies conducted in Norway which investigated students' test motivation while participating in the PISA test. Questionnaire data ($N = 4600$ students) will be presented together with interviews of Norwegian students who participated in the PISA study in 2006 ($N = 22$) and 2009 ($N = 11$).

After the PISA 2003 cycle, results showed that overall, students answered that they would have put more effort in the test if it would have influenced their school marks, but it was also found that the expenditure of reported effort by students were fairly stable across countries (Butler and Adams 2007).

In Germany a study was conducted with the aim to investigate whether teachers coaching of PISA items would influence the achievement scores in mathematics and reading. Overall, the researchers did not consider pretesting and coaching a threat to the validity of the PISA study (Brunner, Artelt et al. 2007). In the United States another study

investigated monetary incentives when using released TIMSS mathematic items on a test. The experiment did not show any improvement of the performance, and the speculations about the lack of test motivation in American students as a cause of the poor results on the TIMSS study were rejected (O'Neil, Abedi et al. 2005).

The two studies presented in this paper draw upon this previous research, in addition to research conducted in Sweden (Eklöf 2006; Eklöf 2007) and the United States where researchers have developed and validated a questionnaire measuring students' test motivation; the Student Opinion Scale and the Motivational Scale (Wolf and Smith 1995; Sundre and Moore 2002; Sundre 2007).

Methods

In order to further explore students' test motivation on the PISA test, seven items were developed and used as national options in the student questionnaire booklet in the spring of 2009. A sample of 4600 students reported their test motivation on this instrument. The items build upon the work described by Eklöf and her work on TIMSS students in 2003. In addition, we have adapted some of the items from the Student Opinion Scale and the Test Motivation Scale to measure Effort and Importance. Following the research of Sunder and More (2007) we conducted reliability tests and based upon these analyses, we decided upon a four-item motivation construct for use in the PISA 2009 test. Eleven students were interviewed to investigate item understanding and to learn more about students' responses. The interviews were semi-structured, and based on an interview guide used in a previous study of how students experienced the PISA 2006 test (Hopfenbeck 2009). Students' were asked how the school had been preparing them for the test, how they experienced the test and whether they believed they were able to do their best.

Findings

The preliminary findings show that students report to have been fairly motivated despite the low-stake testing of PISA. Complete results will be published in December 2010 together with the PISA 2009 findings.

Significance

This paper is a contribution to the ongoing discussion as to whether large scale assessment studies such as the Programme for International Student Assessment (PISA) have biased test scores due to students' lack of test motivation (Baumert and Demmrich 2001). One of the main concerns is that low-stake assessments, having little consequence for students, teachers or schools underestimate students' ability (Holliday and Holliday 2003; Sjöberg 2007). If lack of test motivation is not measured and controlled for, it might be a threat to the validity of the interpretation and use of test scores (Eklöf 2010). Despite these concerns, there is a lack of empirical research regarding students' test motivation in large scale assessment studies.

References

- Baumert, J. and A. Demmrich (2001). "Test motivation in the assessment of student skills: The effects of incentives on motivation and performance." *European Journal of Psychology of Education* XVI(3): 441-462.
- Brunner, M., C. Artelt, et al. (2007). "Coaching for the PISA test." *Learning and Instruction* 17(2): 111-122.
- Butler, J. and R. Adams (2007). "The Impact of Student Effort on the Outcomes of International Studies." *Journal of Applied Measurement* 8(3): 279-304.
- Eklöf, H. (2006). Student motivation on low-stakes tests: An example from TIMSS 2003, Umeå University: 1-14.
- Eklöf, H. (2007). "Self-Concept and Valuing of Mathematics in TIMSS 2003: Scale structure and relation to performance in a Swedish setting." *Journal of Educational Psychology* 51(3): 297-313.
- Eklöf, H. (2010). "Skill and will: test-taking motivation and assessment quality." *Assessment in Education: Principles, Policy & Practice* 17(4): 345-356.
- Holliday, W. G. and B. W. Holliday (2003). "Why using international comparative math and science achievement data from TIMSS is not helpful." *The Educational Forum* 67 (Spring): 250-257.
- Hopfenbeck, T. N. (2009). Learning about Students' Learning Strategies. An empirical and theoretical investigation of self-regulation and learning strategy questionnaires in PISA. Faculty of Education. Norway, University of Oslo. PhD: 314.
- O'Neil, H. F., J. Abedi, et al. (2005). "Monetary Incentives for Low-Stakes Tests." *Educational Assessment* 10(3): 185-208.
- Sjöberg, S. (2007). PISA and "Real Life Challenges": Mission Impossible? PISA according to PISA. S. Hopman.
- Sundre, D. L. (2007). The Student Opinion Scale (SOS) A measure of examinee motivation Harrisonburg, VA, The Center for Assessment and Research Studies: 6.
- Sundre, D. L. and D. L. Moore (2002). "The Student Opinion Scale: A measure of examinee motivation." *Assessment Update* 14: 8-9.
- Wolf, L. F. and J. K. Smith (1995). "The consequence of consequence: Motivation, anxiety, and test performance " *Applied Measurement in Education* 8 (227-242).

PAPER PRESENTATION

Two Deaf students participating in a mainstream mathematics class

Ines Borges, Universidade Nova de Lisboa, Faculdade de Ciencias e Tecnologia, Portugal; Margarida Cesar, Universidade de Lisboa, Instituto de Educacao, Portugal

National and international policy education documents stress the need to provide an inclusive education (ME, 2008; UNESCO, 1994), but students categorised as presenting special educational needs still face many barriers in their access to achievement (Cesar & Ainscow, 2006). In Portugal, Deaf students experience different forms of school and social exclusion, like higher underachievement in many subjects such as mathematics (Borges, 2009) and lower percentages concerning the attendance of the university (Almeida, 2009).

We focus on the participation in mainstream mathematics classrooms of two profound and severe Deaf students. They were pre-lingual, oralist and attended the 12th grade. Assuming an interpretive approach (Denzin, 2002), we developed two intrinsic long-term case studies (Stake, 1995), one for each Deaf student. We consider these participants: the two Deaf students, their classmates, mathematics and special education teachers. The data collecting instruments were the observation (recorded in the researcher's diary and audio-taped), interviews, informal conversations, students' protocols and documents. The data treatment was based in a narrative content analysis (Clandinin & Connelly, 1998) from which inductive categories emerged (Cesar, 2009).

Through the analysis of some episodes and empirical evidence we address adaptations made by their teacher that helped Deaf students to give a meaning to mathematics (Bakhtin, 1929/1981), learn it and become legitimate participants (Cesar, 2009). We also acknowledge the five interactive patters we identified in these mathematics classes (Borges, 2009) and how they facilitated students' transitions (Zittoun, 2006), namely from the mainstream culture and knowledge to the Deaf culture and these students' daily knowledge.

Schools are multicultural settings (Abreu & Elbers, 2005; Cesar, 2009). National and international policy education documents suggest a more inclusive schooling (ME, 2008; UNESCO, 1994). But opening the mainstream classrooms to students categorised as presenting special educational needs (SEN) is not enough. Classroom practices must befit students' needs, characteristics and interests. In Portugal, this need is more urgent in mathematics as this subject is often associated with underachievement, rejection, low positive academic self-esteem and poor engagement in classroom activities (Cesar, 2009; Cesar & Santos, 2006). Moreover, there is a lack of studies regarding advanced mathematics learning and Deaf students (Borges, 2009). Thus, teachers claim they have no data illuminating how to improve Deaf students' learning processes. As stated by Sfard (2001, 2008), learning and thinking is communicating. The barriers Deaf students face when communicating with the mainstream hearing community shape their school and social paths (Freire & Cesar, 2003; Sim-Sim, 2005). At Lisbon University Deaf students present the lowest percentage of attendance among SEN cases (Almeida, 2009). In order to include Deaf students in mainstream classes teachers have to facilitate the establishment of a shared communication system, allowing every student to participate in the classroom interactions and activities (Borges, 2009).

The barriers in the communication and in their access to the school mathematical tools experienced by Deaf students included in mainstream classes are the problem that originated this study. We focus on three research questions: (1) What adaptations in classroom practices are performed by this teacher in this 12th grade class that includes Deaf and non-impaired teenagers?; (2) What adaptations are performed by the non-impaired students in their communication while working and interacting with these two Deaf students?; and (3) How do these two Deaf students construct their access to the cultural tools of school mathematics?

We assumed an interpretative approach (Denzin, 2002) and an intrinsic long-term case study design (Stake, 1995). These Deaf students were oralist, pre-lingual and profound and/or severe and they attended the same 12th grade mainstream class. They were considered academic successful cases as each one of them had only doubled one school year. We chose these characteristics intentionally as disclosing successful cases promote the development of a more inclusive education (Armstrong, Armstrong, & Barton, 2000; Cesar & Santos, 2006). Besides these Deaf students, the participants we focus in were their classmates, their mathematics and special education teachers. We focus on the data collected in the first year of this research: from November (middle of the first term) to June (end of the school year) using informal conversations, observation (recorded in the researcher's diary and sometimes audio taped), students' protocols and documents. Interviews were conducted in November and April (Deaf students, mathematics and special education teachers). The data treatment and analysis was based in a narrative content analysis (Clandinin & Connelly, 1998), from which inductive categories emerged (Cesar, 2009), illuminating these Deaf students school paths.

Through the analysis of empirical evidence we address adaptations made by their teacher that facilitated mathematics learning and allowed these students to give a meaning to mathematics (Bakhtin, 1929/1981). We acknowledge five interactive patterns we identified in these mathematics classes (Borges, 2009) and how they facilitated students' transitions (Zittoun, 2006), namely from the mainstream culture and knowledge to the Deaf culture and these students' daily knowledge. The adaptations made by their mathematics teacher and classmates helped these Deaf students becoming more included in their class, among their peers group and in the school community. The results illuminate a well-accomplished inclusion process, where these Deaf students became legitimate participants (Cesar, 2009). Both hearing and Deaf students emerged from this experience as more inclusive and aware future citizens.

References

- Abreu, G. de & Elbers, E. (Eds.) (2005). *European Journal of Psychology of Education*, XX(1).
- Almeida, A. N. de (2009). *Os estudantes a entrada da universidade de Lisboa: 2008/09*. Lisboa: OPEST – Universidade de Lisboa. [Unpublished document]
- Armstrong, F., Armstrong, D. & Barton, L. (Eds.), (2000). 'Vive la Difference?' Exploring context, policy and change in special education in France: Developing cross-cultural collaboration. London: David Fulton.
- Bakhtin, M. (1929/1981). *The dialogical imagination* (M. Holquist, Ed.) (M. Holquist, & C. Emerson, Trans.). Austin: University of Texas Press. [Published in Russian, in 1929]
- Borges, I. (2009). *Alunos Surdos e a matematica: Dois estudos de caso, no 12.º ano de escolaridade do ensino regular*. Lisboa: APM. [Master thesis]
- Cesar, M. (2009). Listening to different voices: Collaborative work in multicultural maths classes. In M. Cesar & K. Kumpulainen (Eds.), *Social interactions in multicultural settings* (pp. 203-233). Rotterdam: Sense.
- Cesar, M. & Ainscow, M. (Eds.) (2006). *European Journal of Psychology of Education*, XXI(3).
- Cesar, M. & Santos, N. (2006). From exclusion into inclusion: Collaborative work contributions to more inclusive learning settings. *European Journal of Psychology of Education*, XXI(3), 333-346.
- Clandinin, D. J. & Connelly, F. M. (1998). Personal experience methods. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 150-178). Thousand Oaks: Sage.
- Denzin, N. (2002). The interpretative process. In A. Haberman, & M. Mieses (Eds.), *The qualitative researchers companion* (pp. 349-366). Thousand Oaks: Sage.
- Freire, S., & Cesar, M. (2003). Inclusive ideals/inclusive practices: How far is dream from reality? Five comparative case studies. *European Journal of Special Needs Education*, 18(3), 341-354.
- Ministerio da Educacao (ME) (2008). Decreto-Lei n.º 3/08, de 7 de Janeiro, *Diario da Republica – I Serie*, N.º 4. Lisboa: INCM.
- Sfard, A. (2001). There is more to discourse than meets the ears: Learning from mathematical communication things that we have not known before. *Educational Studies in Mathematics*, 46, 13-57.
- Sfard, A. (2008). *Thinking as communicating*. Cambridge: Cambridge University Press.
- Sim-Sim, I. (2005). O ensino do portugues escrito aos alunos surdos na escolaridade basica. In I. Sim-Sim (Ed.), *A crianca surda: Contributos para a sua educacao* (pp. 15-28). Lisboa: Fundacao Calouste Gulbenkian.
- Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: Sage.
- UNESCO (1994). *Declaracao de Salamanca e enquadramento da accao na area das necessidades educativas especiais*. Lisboa: UNESCO.
- Zittoun, T. (2006). *Transitions: Development through symbolic resources*. Greenwich: Information Age Publishing.

PAPER PRESENTATION

Teaching children to read the clock: a matter of time?

Elise Burny, Ghent University, Belgium; Ningning Zhao, Ghent University, Belgium; Martin Valcke, Ghent University, Belgium

Considering the fact that many primary school children experience difficulties in the acquisition of clock reading skills, the present study scrutinizes the Flemish curriculum for clock reading, assessing the extent to which it effectively promotes children's acquisition of clock reading skills. By comparing Flemish students' outcomes to the clock reading abilities of Chinese children, who are taught to read the clock according to a different curriculum, the developmental sequence in clock reading that was defined in previous research, is reexamined. The results of this study indicate that children's development of clock reading skills is subject to both instruction and maturation. Based on the current results, it seems that the Flemish curriculum is geared to children's capabilities and needs and that an acceleration in the teaching of clock reading skills is not advisable. However, further research on the effect of instructional strategies is necessary in order to optimize the teaching of clock reading skills in primary education.

Learning how to tell time is an important subject in primary school mathematics that is addressed in nearly every grade of primary education. This is not surprising, as the ability to read the clock appears to be a very complex concept that takes teachers years to teach to their pupils and at the same time presents itself as a fundamental life skill that allows us to plan our daily activities, to get organized and to function in a society that is driven by time (Bock, Irwin, Davidson, & Levelt, 2003; Friedman & Laycock, 1989). Nevertheless, there has been little research upon the pedagogy of time in general, and clock reading in specific. As previous studies showed that children's ability to read the clock develops in an age-related manner, starting with hour times at the age of six, and followed by half hour times in second grade (age 7), five minute time in third grade (age 8-9) and eventually one minute clock times in grade four (age 9-10) (Andersson, 2008; Boulton-Lewis, Wilss, & Mutch, 1997; Case, Sandieson, & Dennis, 1986; Friedman & Laycock, 1989; Griffin, Case, & Sandieson, 1992), the curriculum for clock reading in most Western countries reflects this developmental sequence. However, as Hodkinson (2004) pointed out that we have continuously underestimated what young children can do and learn with regard to the concept of historical time and that the English curriculum for history is not adapted to children's capabilities, it is worthwhile to reexamine the mathematics curriculum in order to find out whether clock reading abilities are currently taught in the most effective way.

In order to define whether the present curriculum for clock reading is geared to young children's capabilities and needs, the present study compares the outcomes of two distinct curricula: (1) the Flemish curriculum, that builds upon the developmental sequence as suggested in previous research, and (2) the Chinese curriculum, that suggests to teach all clock reading skills in first grade of primary school. By means of the test results of 10959 Chinese and 784 Flemish primary school children in grades one to six, clock reading skills were compared for both countries, showing that Flemish children indeed acquire clock reading according to the previously described developmental sequence. Despite the different curriculum in China, Chinese children do not acquire clock reading skills at a younger age than Flemish children. Moreover, Chinese children's accuracy in clock reading gradually improves between grade two and five, without any additional instruction or practice after first grade. This implies that the developmental sequence, as described in previous research, is not primarily influenced by the curriculum but seems rather universal and that children's acquisition of clock reading skills is at least partially subject to maturation. Based on the current results, it seems that the present curriculum for clock reading is geared to children's cognitive development and should not be changed. However, a closer analysis of instructional strategies and classroom practices is necessary in order to define the impact of instruction on children's acquisition of and accuracy in clock reading.

References

- Anderson, U. (2008). Mathematical competencies in children with different types of learning difficulties. *Journal of Educational psychology*, 10, 44-66.
- Bock, K., Irwin, D. E., Davidson, D. J. & Levelt, W. J. M. (2003). Minding the clock. *Journal of Memory and Language*, 48, 653 – 685.
- Boulton-Lewis, G., Wilss, L. & Mutch, S. (1997). Analysis of primary school children's abilities and strategies for reading and recording time from analogue and digital clocks. *Mathematics Education Research Journal*, 9, 136-151.
- Case, R., Sandieson, R. & Dennis, S. (1986). Two cognitive developmental approaches to the design of remedial instruction. *Cognitive Development*, 1, 293–333.
- Friedman, W. J. & Laycock, F. (1989). Children's Analog and Digital Clock Knowledge. *Child Development*, 60, 357-371.
- Griffin, S., Case, R. & Sandieson, R. (1992). Synchrony and asynchrony in the acquisition of children's everyday mathematical knowledge. In R. Case (Ed.), *The mind's staircase*. Hillsdale, NJ: Erlbaum

PAPER PRESENTATION

Junior high-school students' meta-emotional knowledge during mathematical problem solving

Erik De Corte, University of Leuven, Belgium; Peter Op 't Eynde, University of Leuven, Belgium; Fien Depaepe, University of Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Over the past decade researchers in the field of mathematics education have become more and more interested in the study of motivational and emotional besides cognitive aspects of mathematics learning. With regard to emotions it is of special importance that students are able to control their emotions during learning and problem solving (De Corte, Op 't Eynde, Depaepe, & Verschaffel, in press; Durlak et al., in press). In this respect research suggests that similar to metacognition, the self-regulation of emotional processes requires students to acquire emotional knowledge and skills that will enable them to become aware of their emotions and to actively regulate them. However, so far research has paid scarce attention to students' awareness and mastery of relevant meta-emotional knowledge and skills. This paper will report an investigation that attempts to analyze students' awareness and identification of their emotions during mathematical problem solving. Sixteen junior high-school students solved 4 complex mathematical problems. They were asked to think aloud during the solution process that was videotaped. Immediately after solving a problem a video-based stimulated recall interview took place. A cyclical procedure of data

analysis took place based on the thinking aloud protocols, the videotapes and the interview transcripts, and resulted in the identification of students' knowledge of emotions. The results that will be presented reveal that students possess some meta-knowledge that enables them to identify and describe their emotions. But the findings show also that they are often not immediately aware of the emotions they are experiencing.

Theoretical background and objective

Over the past decade researchers in the field of mathematics education have become more and more interested in the study of motivational and emotional besides cognitive aspects of mathematics learning. With regard to emotions it is of special importance that students are able to control their emotions during mathematical learning and problem solving (De Corte, Op 't Eynde, Depaepe, & Verschaffel, in press; Durlak et al., in press). In this respect research suggests that similar to metacognition, the self-regulation of emotional processes requires students to acquire emotional knowledge and skills that will enable them to become aware of their emotions and to actively regulate them. However, so far research has paid scarce attention to students' awareness and mastery of relevant meta-emotional knowledge and skills. This paper will report an investigation that attempts to analyze students' awareness and identification of their emotions during mathematical problem solving.

Method and data sources

Sixteen Flemish junior high-school students (age 14 years) of 4 classes in different schools were asked to solve in each of 4 consecutive lessons a complex realistic mathematical problem. They were asked to think aloud during the problem-solving process that was videotaped. Immediately after finishing a problem, a video-based stimulated recall interview took place (Prawat and Anderson 1994). In phase 1 of the interview the student and the researcher watched the videotape and the student was asked to recall what he did, thought, and felt while he was solving the problem, especially during those episodes that he was not thinking aloud. After the student had described in his own words his complete problem-solving story, the interviewer asked questions for clarification in phase 2. Episodes that seemed to be emotionally loaded were played back on the video. In view of the identification of emotions a stepwise technique of questioning was used. The researcher would first repeat the open question of phase 1. If the student's answer was not explicit enough in relation to possible emotions experienced, the researcher would explicitly ask "How did you feel?". If there was still no clear labeling of the emotion experienced, the researcher would proceed and check his own interpretation, asking, for example, "Did you feel angry?". A cyclical procedure of data analysis took place based on the thinking aloud protocols, the videotapes and the interview transcripts, and resulted in the identification of students' knowledge of emotions through a triangulation of the following data: facial expression, bodily actions, vocalizations observable in the videotape, and interpretations and appraisals explicated in the interviews. ResultsThe main findings summarized here below will be discussed in more detail during the presentation at the conference. Students experienced different emotions during problem solving. They felt at times annoyed, frustrated, angry, nervous, worried, anxious, relieved, happy, confident. Emotions were usually experienced at moments that students were unable to solve a problem as easily or fluently as they anticipated. Experiencing the inadequacy of cognitive strategies used, is apparently as much an emotional as a (meta-)cognitive process (see also Mandler 1989). However, students usually had a hard time in clearly describing the emotions they experienced. From the emotions observed in the episodes that were explicitly discussed with students in phase 2 of the interview, the large majority was not immediately and clearly identified by them. Only "relief" and "nervous" are emotions that - when experienced by students - were easily recognized and identified (resp. in 50% and 45% of the cases). The emotions "happy", "annoyed", "angry", "worried" and "anxious" were mostly only acknowledged and identified by students when they were explicitly asked to tell how they felt in an episode. Finally, "confident" and "frustration" were in respectively 83% and 60% of the episodes concerned only labeled by the students in confirmation of the interpretation of the researcher, and thus not spontaneously mentioned previously in the interview.

Conclusion, discussion, and direction for continued research

This study shows that students possess some meta-emotional knowledge during mathematical problem solving in the classroom. However, one can question if they are really aware of the emotion when they encounter it and act mindfully upon it. Indeed, in very few emotionally loaded episodes students described immediately the emotions experienced. Of course, it is possible that some students were aware of their emotions, but did not mention them by themselves in the interview. Also, one might argue that some students were possibly prompted to identify a selected episode as emotional because of the questions asked. We were well aware of these possible biases and, therefore, we presented only episodes to the students that indicated an emotional loading based also on other criteria than what the student said (e.g., facial expression, vocalizations, bodily gestures). However, in view of solving these methodological problems, an important challenge is to develop more sophisticated research methods that combine the use of psychophysiological and interpretative methods. Implications for educational practiceThe study documents that students do not acquire thorough meta-emotional knowledge spontaneously. Taking this into account but also the fact that appropriate self-regulation of emotions is a characteristic of productive learning and problem solving, it is

a challenge for mathematics education to foster in students identification and awareness of their emotions. Therefore, it is important that during the mathematics lessons teachers help students from time to time to develop meta-emotional knowledge and thus to become aware of their emotions in view of being able to regulate them constructively. In fact this also constitutes an issue for further inquiry, but some relevant ideas for educational practice have already resulted from research on the impact of social and emotional (SEL) programs (see Durlak et al., in press).

Rational number and proportional reasoning in Year 7 classrooms: Why dialogic teaching may not always contribute to student learning

Christine Howe, University of Cambridge, United Kingdom; Stefanie Luthman, University of Cambridge, United Kingdom; Riikka Hofmann, University of Cambridge, United Kingdom; Kenneth Ruthven, University of Cambridge, United Kingdom

Covering four key topics in mathematics and science, the ESRC-funded epiSTEMe project aims to promote student attitudes and achievement during Year 7 of the UK education system. This paper focuses on the trialling in six classrooms of a six- (optionally eight-) lesson module on one of the topics, rational number and proportional reasoning. Attitudes were assessed via post-module questionnaires, and were positive. Achievement was assessed via pre-tests before the module and post-tests immediately and four-weeks afterwards: pre- to immediate and immediate to four-week progress both occurred (unlike control classes taught by traditional methods where post-test scores were equivalent to pre-test). The positive results were consistent across the six classes, despite considerable variation in the implementation of the dialogic teaching methods that are central to the epiSTEMe approach. This has significant implications for how dialogic teaching should be theorized.

Located within the ESRC's Targeted Initiative on Mathematics and Science, the epiSTEMe project (Effecting Principled Improvement in STEM Education) seeks to promote student attitudes and achievement during Year 7 of the UK education system. Covering mathematics and science, the project emphasizes dialogic teaching methods, while also calling upon cognitive research into the development of reasoning. It began in 2008, will end in 2012, and comprises three main phases. The key activities for Phase 1 involve collaboration with teacher co-researchers from a small number of schools to devise a teaching intervention, which is grounded in four topic modules: a) fractions, ratios and proportions; b) probability; c) forces and proportional relations; d) electricity – electrical circuits. In Phase 2, the focus is upon classroom implementation by the teacher co-researchers, with results evaluated and modules refined. Phase 3 revolves around scaled-up implementation of the modules with a large sample of teachers who are new to the project, and controlled comparison with the established practices of a comparable group of teachers.

This paper focuses on Phase 2 implementation of the fractions, ratios and proportions module. The module is designed to occupy six 50-minute lessons (with an optional further two lessons), and has many features that differentiate it from standard Year 7 teaching. Unusually with this age band, the module uses proportional reasoning to contextualize the teaching of rational number (decimals and percentages as well as fractions and ratios). At the same time, it emphasizes equivalences across decimals, percentages, fractions and ratios as much as equivalences within these differing types of number, e.g. between simplified and non-simplified fractions. Current and historical events are used to highlight the topic's relevance to everyday life. Finally, the module employs an integrated series of small-group and whole-class activities, all of which emphasize the articulation, justification and resolution of contrasting viewpoints in a dialogic environment.

Six classes were involved in Phase 2 implementation of the fractions, ratios and proportions module. All classes involved Year 7 students of approximately 12 years of age. Four classes were located in English secondary schools and were streamed by mathematical ability (top to middle sets), and two classes were located in Scottish primary schools and were mixed ability. In all cases, the students: a) took a pre-test during the first lesson; b) proceeded through the lessons (observed and/or video-recorded while they did this); c) took an 'immediate post-test' during the final lesson and completed a 'learning perceptions' questionnaire to indicate their attitudes towards the module; d) (in four classes) took a 'deferred post-test' four weeks later. Pre- to immediate post-test gain occurred in all six classes, and additional immediate to deferred post-test gain occurred in three of the four classes to complete both tests. The extent of gains was consistent across classes. The gains contrasted with results obtained from two control classes, who studied fractions, ratios and proportions using traditional methods: here post-test scores were equivalent to pre-test scores. In addition, the students in the six Phase 2 implementation classes expressed generally positive attitudes in response to the learning perceptions questionnaire.

While it was encouraging to witness pre- to post-test gains with all six Phase 2 implementation classes, the consistency of these gains across the classes was in some respects surprising. This is because classroom observations

indicated marked variation in how effectively the dialogic component was implemented. At one extreme, research literature ideals were reached; at the other extreme, dialogic interaction was virtually non-existent. A possible interpretation is that in these six classes, talk was not regarded as the locus of teaching; the focus was on module materials, and it was these materials that promoted learning. One general implication would be that good dialogue alone is insufficient for effective teaching; the relevance of dialogue also needs to be highlighted for students. This carries an important message for both the implementation of dialogic methods and for the criteria by which good practice is identified during teaching observation.

PAPER PRESENTATION

The development of critical thinking in first year educational sciences students

Sigrid Francois, KULeuven, Belgium; An Verburgh, Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium

Critical thinking is an important aim in higher education. This is also the case for higher education in Flanders (Belgium). Despite its importance, empirical data on students' growth in critical thinking are mainly limited to the Anglo-Saxon area. Data on the development in continental Europe are scarce. To gain insight in the situation in Belgium, a study was conducted among a cohort of 171 first year bachelor students in an educational sciences programme. A test constructed with items from both the Halpern Critical Thinking Test in Everyday Situations and the Cornell Critical Thinking test was administered twice: a first time at the beginning (November) and a second time at the end (May) of the academic year. A paired sample t-test shows a significant growth in critical thinking between the first and the second administration of the test. Furthermore, students with a higher first time score show less growth in critical thinking than their peers with a lower first time score. In addition the relation between growth and the option followed in secondary education was looked at. Results of this analysis show students who choose stronger options during their prior education tend to score higher for critical thinking. In the paper these results are discussed from a methodological and theoretical perspective and suggestions for future work are made.

Introduction and aims

Worldwide, the development of critical thinking is acknowledged as an important aim of higher education (King & Kitchener, 2004). Also in Flanders (Belgium), policy documents as well as empirical data indicate that the development of critical thinking is an important objective. Verburgh, Schouteden and Elen (2009) showed that the development of critical thinking is the most frequently mentioned course and programme goal. Their study indicated however that it was a vexed educational goal, difficult to grasp its meaning and unclear how it relates to other goals. Studies on critical thinking performance show (1) differences in students' critical thinking skills between the start and the end of their undergraduate studies, and (2) overall students often do not reach highest levels of critical thinking (Astin, 1993; Giancarlo & Facione, 2001; Miller, 1992). Empirical data are mainly based on Anglo-Saxon students and studies on the Belgian/ Flemish students are lacking. This study investigates first-year students' growth with respect to critical thinking among students in an educational sciences bachelor programme at a Belgian university. It analyses differences in critical thinking performance between the beginning (November) and the end of the academic year (May). Critical thinking performance is expected to grow between the beginning and the end of the academic year.

Methodology

In the study, an online-test is used consisting of translated items of two different critical thinking tests (the Halpern Critical Thinking Assessment (Halpern, 2007) and the Cornell Critical thinking test, level Z (Ennis, Millman, & Tomko, 1985)). The selection of the items is based on a factor analysis and on content validity (for more information: see X). The test consists of 17 situations, followed by an open and/or closed question about that situation. In order to answer the question, critical thinking is required. The test consists of 34 items. Most open questions are subdivided in two parts (e.g.; 1. What is the best evidence provided that supports the director's claim? 2. What is the best evidence to refute the claim?). The maximum score is 95. One cohort of first year students, in the bachelor educational sciences of the K.U.Leuven filled out the test twice, once in November '09 and once in May '10, as a compulsory part of a course. The test was administered collectively. In November 171 students filled out the test, in May there were 158 students, of which 153 students were the same students as in November. All open questions were independently scored by two raters. The agreement between these two raters on the different parts of the questions is acceptable to almost full agree (only one question lower than 70% agreement (i.e. 62%), 5 subquestions between 70 and 80%, and the 19 others 80% or higher. All different scores were discussed until agreement was reached. The reliability of the test is acceptable for a complex construct such as critical thinking (Cronbach alpha= .65).

Findings

A paired-sample t-test was conducted to evaluate students' growth in critical thinking. There was an overall statistically significant increase in critical thinking performance between November ($M=57.86$, $SD=7.67$) and May

($M=61.69$, $SD= 8.07$, $t=-6.27$; $df = 152$; p . To gain insight into the relations between growth, November-score and May-score Pearson-product correlation coefficients were calculated. November and May-scores are positively correlated ($r=.54$). Growth is negatively correlated with critical thinking performance in November ($r=-.44$). The higher students score in November, the less they grow. Growth is positively correlated with critical thinking performance in May ($r=.52$). To investigate the relationship between critical thinking performance and secondary education, a mixed between-subjects analysis of variance was conducted, with November and May-scores as within-subject variables (time) and type of secondary education as between subject factor (very strong option in secondary education, a strong option and a option in human sciences. There is significant growth between November and May, $F(1, 141)=38.92$, p Theoretical and educational significance of the findings. This study is one of the first to explore growth in critical thinking in a non-Anglo-Saxon area. The findings demonstrate that Belgian first-year university students in educational sciences grow in their critical thinking performance. In addition, evidence was found that students who score weaker in the beginning show more growth. We also found that the option followed in secondary education at least partially explains differences in critical thinking between students, but it does not explain their growth in critical thinking during their first year at university. The findings confirm earlier research in Anglo-Saxon countries which demonstrate growth in critical thinking (e.g. Giancarlo & Facione, 2001). Test -retest effects are rather unlikely because students who only participated in May do not strongly differ from the others. More probably, the educational setting stimulates students to develop their critical thinking ability, because the setting has characteristics that were identified in previous research to elicit development in critical thinking, such as discussing in groups, write assignments, essay exams... (e.g.; Tsui, 1999) However, further work is still needed to clarify what factors in the educational setting contribute to growth in critical thinking in higher education and to explain why there is a smaller growth in high-achievers. In order to do so, future studies need to take more programmes and students in different stages in their programme into account, along with a fine-grained analysis of the educational settings in these programmes. A longitudinal design, over different years would shed light on the actual development over different years. The current research shows this test is suitable for such a purpose because there is ample space for growth.

PAPER PRESENTATION

Epistemic beliefs of high school students: "Can we trust the news about Haiti?"

Florian Feucht, The University of Toledo, United States; Nathan Ziegler, The University of Toledo, United States; Lauren Maziarz, The University of Toledo, United States; Susan Hany, The University of Toledo, United States

Over the last decade, technological advancement has made global news more accessible for learners than ever before. Despite this accessibility, students are not provided with a framework to critically analyze the news, especially on a global scale. The capacity of teenagers to form opinions and make decisions about the news does not come naturally, nor does their appreciation of the cognitive labor involved in these processes. Hence, there is the need for teenagers to acquire the skills for and value of being critical global news consumers. This research study explored the news seeking behavior of teenagers ($n = 60$; mean age 17.6, $SD 0.76$) applying a combination of interview and observation techniques. Twelve participants were interviewed specifically about the earthquakes in Haiti and their news seeking behavior in this context (i.e., espoused beliefs). Then, they were asked to assess the credibility and quality of several newspaper clippings on the earthquake of Haiti (i.e., enacted beliefs). Results showed that more than 60% of the students were not able to apply criteria and strategies to assess the quality and credibility of the news clippings. Essentially, young adults should be cognizant of criteria and strategies to assess global news, be able to form their own opinions, and be able to verbally argue for their opinions. Results demonstrate the need for educators to develop educational materials and interventions to improve the skills necessary to critically analyze global news in addition to improving opinion forming skills related to these issues.

Introduction

Students in the 21st century have access to more information than any generation before them. Often, they are confronted with news from online news sources, social networking sites (i.e., Facebook, Twitter), the television, newspapers, magazines and the radio. Even though there is a plenitude of news sources, students often confront very contradictory information from these sources. Since news is always streaming from multiple sources simultaneously, students need to possess the skills to critically analyze the news media and make informed decisions about the content. For example, what were the students' understandings of the earthquakes in Haiti? How did students analyze the different news articles and sources and form an opinion? Did the students find an article that matched their existing beliefs and schemas and believe that this article was providing factual information? The answers to these questions are increasingly pertinent to education, and with the growing connectedness in today's global society, students need to be inclined to critically analyze news media. Thus, this study explored high school students' epistemic beliefs on an a priori news issue: the earthquakes in Haiti.

Theoretical Framework

Epistemic beliefs can be defined as subjective theories a person holds about the nature of knowledge and knowing (e.g., Hofer, 2001). These beliefs revolve around certainty of truth, origins and sources of knowledge, and ways of justifying knowledge claims. Epistemic beliefs unfold along a developmental progression, ranging from naïve beliefs to sophisticated beliefs (e.g., Kuhn, 1999). Research has shown that sophisticated epistemic beliefs have a positive influence on reasoning skills, critical thinking skills (e.g., Kuhn, 1999) strategy use and ethical and intellectual development (e.g., Schommer, Crouse & Rhodes, 1992). Furthermore, Kuhn (1991) and Weinstock and Cronin (2003) found that people with sophisticated beliefs are more likely to identify evidence in written accounts, to analyze argumentations, and take less extreme positions. These findings align with Kuhn's (1999) developmental framework for critical thinking. For this study, we adapted Kuhn's (1999) framework by focusing it on "news" as a specific knowledge source rather than "knowledge" in general.

Research Questions

The directing research questions were: What are the epistemic beliefs of high school students about news, specifically to the earthquake in Haiti? What criteria and strategies do students state they would apply when analyzing the quality and accuracy of written news? What criteria and strategies do students actually apply when analyzing the quality and accuracy of written news articles?

Methods

Sixty high school students from a rural Midwestern high school in the United States were interviewed. Participants were drawn from 11th and 12th grade classrooms with an even gender distribution. The materials encompassed a set of semi-structured interview questions and a sorting task. The semi-structured interview targeted beliefs about news quality, strategies, and criteria used to evaluate news in general. More specifically, a group of students were interviewed about the devastation that struck Haiti in early 2010. In the sorting task participants were asked to read, sort, and categorize five news clippings about Haiti. The clippings differed in perspective and degree of providing facts, opinions, and formatting. The researchers pulled students from their classroom for one-on-one data collection in the school library, and lasted approximately 40 minutes. The method of qualitative content analysis was used to summarize, explicate, and structure the qualitative data. The software, Atlas.ti, was used in this process.

Results

Preliminary analyses of data identified discrepancies between what students say (interview) and do (sorting task). Some students mentioned strategies and criteria but were not able to apply them while others were able to apply criteria and strategies but were not cognizant about them. More than 60% of the students were not able to apply criteria and strategies to assess the quality and credibility of news clippings about the earthquakes in Haiti. From an educational standpoint, young adults should be cognizant of criteria and strategies to assess scientific and environmental news, be able to form their own opinions, and to verbally argue for their opinions. Most high school students did not trust the news as a source of knowledge. They believed its primary goal was to manipulate facts in order to influence public opinion.

Conclusion

Based on our results, it is evident that there needs to be more focus on developing students' epistemic beliefs so that they are able to critically analyze the news media. As research has shown (e.g., Kuhn, 1999), critical thinking skills do not develop naturally. Students must be scaffolded to more sophisticated levels of thinking and must be provided with a framework from which they can analyze the news media. Even though our results are not generalizable across a large population, we believe that this study offers insight into the nature of high school students' epistemic beliefs, their beliefs about news media, and their understanding of global issues such as the earthquakes in Haiti.

References

- Hofer, B. K. (2001). Personal epistemology research: Implications for learning and teaching. *Journal of Educational Psychology Review*, 13, 353-383.
- Kuhn, D. (1991). *The skills of argument*. New York: Cambridge University Press.
- Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher*, 28(2), 16-26, 46.
- Schommer, M., Crouse, A. & Rhodes, N. (1992). Epistemological Beliefs and Mathematical Text Comprehension. *Journal of Educational Psychology*, 84(4), 435-443.
- Weinstock, M. & Cronin, A. (2003). The everyday production of knowledge: individual differences in epistemological understanding and juror-reasoning skill. *Applied Cognitive Psychology*, 17(2), 161-181.

PAPER PRESENTATION

Learning about the Equal Additions strategy for subtraction by Year 5/6 students

Jennifer Young-Loveridge, University of Waikato, New Zealand

The purpose of the study was to investigate interactions between teachers and their students during a mathematics lesson designed to teach the Equal Additions strategy for subtraction. Nine teachers (7 females and 2 males) and a total of 64 Year 5/6 students (9- to 11-year-olds) participated in the study. The language of the teachers and those students closest to them were audio-recorded and observational notes made of non-verbal information. The transcripts for the Equal Additions lesson were analysed both quantitatively and qualitatively. Two teachers (C and G) appeared to be particularly effective in teaching the Equal Additions strategy, and they each had two students who used the strategy during written assessment. What distinguished these two teachers from the others was their understanding of the purpose of the lesson and the strong conceptual understanding of mathematics that was clearly evident during their interactions with the students. The results reflect the challenges of bringing about deep and lasting change in the ways that mathematics is taught and learned, when there is a strong emphasis on building students' conceptual understanding rather than simply training them in mindless procedures and skills.

The purpose of the study was to investigate interactions between teachers and their students during a mathematics lesson designed to teach the Equal Additions strategy for subtraction (see Ministry of Education, 2008a, Book 5, pp. 38-39). The lesson was the second of three lessons taken from the resource materials of New Zealand's Numeracy Development Project, a major initiative designed to raise students' achievement in mathematics (see Ministry of Education, n.d.). Nine teachers (7 females and 2 males) and a total of 64 Year 5/6 students (9- to 11-year-olds) participated in the study. Each teacher chose the instructional group for which the three lessons seemed most appropriate in terms of their current stage on the New Zealand Number Framework (Ministry of Education, 2008b). The lessons were designed to consolidate students' understanding of number properties within the domain of addition and subtraction (stage 6 Advanced Additive Part-Whole thinking). Instructional groups ranged in size from 5 to 10 students. Prior to the first lesson and after the third lesson, students were given a brief paper-and-pencil assessment that asked them to show their solution strategy for each answer. On the post-test, only 8 of the 64 students used the Equal Additions strategy to solve a problem. Two of the teachers (C and G) had more than one student in their group that used the strategy (4 others had one student each). During the lessons, each teacher wore a portable digital audio-recorder attached to a flexible belt, with lapel microphone to record his/her language (and that of students who were close to teacher). The researchers observed the lesson and noted non-verbal (contextual) information that could assist with the interpretation of the transcripts of audio-recordings.

Although the first lesson, Saving Hundreds, is not the focus of this paper, the experience of working with missing addend problems such as $\$287 + ? = \400 the previous week, helped to familiarise the students and their teacher with being observed and recorded by the researchers. Saving Hundreds also introduced the use of paper money (in denominations corresponding to place value units), an important component of the Equal Additions lesson. Another key aspect of the Saving Hundreds lesson was the experience of exchanging ten \$1 notes for one \$10 note, and vice versa, and this provided an important introduction to the contexts used for the Equal Additions lesson.

In the Equal Additions lesson, the first problem is a comparison problem, as follows:

Problem: "Debbie has \$445 in her bank account, and her younger sister Christine has \$398. How much more money does Debbie have?"

Make piles of \$445 and \$398. "Now suppose that Grandma gives Christine \$2 to give her a 'tidy' amount of money. To be fair, Grandma gives Debbie \$2 also." Discuss why $445 - 398$ has the same answer as $447 - 400$ and then record $445 - 398 = 47$ on the board or modelling book.

The teacher's book then presents other problems to be solved using materials (eg, paper money).

The transcripts for the Equal Additions lesson were analysed both quantitatively and qualitatively. Using the approach of Mercer and Littleton (2007), the frequencies of particular "indicator words" (why, how, which, what, cause, think, agree, if) were calculated for each teacher. Although frequencies for each of these words varied, neither Teacher C nor Teacher G differed notably from the other seven teachers in their use of these words. The transcripts of teachers C and G were examined closely, along with the observational records. What distinguished these two teachers from the others was their understanding of the purpose of the lesson and the strong conceptual understanding of mathematics that was clearly evident during their interactions with the students. For example, they both understood that the purpose of adding an equal quantity to both the minuend (larger number) and the subtrahend (smaller number) was to "tidy" the subtrahend up to a round number that could be easily subtracted from the minuend. Some other teachers were not aware of this and encouraged their students to "tidy" whichever number they preferred. When students tried to "tidy" the minuend, it did not make the calculation any easier. In post-lesson interviews, the teachers all expressed confidence that their students had understood the Equal Additions strategy. However, the researchers were not convinced that the students really understood the strategy. Teachers C and G appeared to be the most successful teachers. Although the teachers asked their students to explain their solution strategies, they accepted these explanations very readily, without pressing students to prove why the strategy worked. Students were not asked

to compare the Equal Additions strategy with other popular strategies for subtraction such as Rounding and Compensating, Bridging Through Ten/s, Reversibility, or the standard written algorithm so students were not aware of the elegance and efficiency of this particular strategy. Most teachers were committed to enhancing conceptual understanding but seemed unaware that their approaches were quite procedural. It was interesting to note that none of the teachers drew students' attention to different problem structures for subtraction, or contrasted the use of subtraction to calculate difference rather than to "take away." The findings have some important implications for the field of conceptual change, specifically students' understanding of mathematics, as well as teachers' content knowledge and pedagogical content knowledge for mathematics. The results reflect the challenges of bringing about deep and lasting change in the ways that mathematics is taught and learned, when there is a strong emphasis on building students' conceptual understanding rather than simply training them in mindless procedures and skills. The findings are considered in relation to constructivist and socio-cultural theories.

References

- Mercer, N. & Littleton, K. (2007). Dialogue and the development of children's thinking: A sociocultural approach. Abingdon, Oxon, UK: Routledge.
- Ministry of Education (n.d.). <http://www.nzmaths.co.nz/numeracy-projects>
- Ministry of Education (2008a). Book 5: Teaching addition, subtraction and place value. Wellington, NZ: Author.
- Ministry of Education (2008b). Book 1: The number framework: Revised edition 2007. Wellington, NZ: Author.

PAPER PRESENTATION

Effects of instruction considering individual students' conceptions of vision and perception

Sarah Dannemann, Freie Universitat Berlin, Germany

Many studies have determined the importance of students' conceptions for learning (c.f. the bibliography of students' and teachers' conceptions, Duit 2003). However, it is not enough to know about the various students' conceptions that exist. Knowing about the individual conceptions of students in class opens up the opportunity to use them as anchors for a specific and individual learning. The aim of this research project is to determine if learning can be advanced when teachers consider individual students' conceptions explicitly in class, and if this kind of learning has a lasting effect in terms of conceptual changes. To test this, an intervention study (N = 215) with three conditions is conducted: one intervention group in which individual students' conceptions were considered and two control groups. In the first control group all students get the same material as the intervention group but teaching is not considering their individual conceptions. The second control group is not instructed. All groups are tested three times with a diagnostic computer program for students' conceptions of vision and perception (Dannemann & Krýger 2009, 2010). In the intervention group, epistemic and metaconceptual conceptions were also addressed and discussed. Preliminary results show that students whose individual conceptions are explicitly considered in class are modifying their everyday conceptions significantly more often.

Students' conceptions are mentioned as one of the most important factors of learning. In many studies students' conceptions were analyzed and described for different topics using interviews, group discussions or open-ended questionnaires (e.g. Guesne 1992; Gropengießer 2001 concerning vision and perception). Different learning arrangements and guidelines were created (e.g. Gropengießer 2006; Duit, Treagust & Widodo 2008). However, it is not enough simply to know students' conceptions concerning one topic. What is helpful for one student can consolidate everyday conceptions of others. Therefore, it is important to know the individual students' conceptions and to teach them accordingly.

The aim of this study is to determine if learning can be advanced when teachers consider individual students' conceptions explicitly in class, and if this kind of learning has a lasting effect in terms of a conceptual reconstruction. In recent years, emphasis was laid on the role of epistemic beliefs and metaconceptual conceptions that contribute to the process of learning (Murphy 2007; Vosniadou 2007). Therefore, epistemic beliefs and metaconceptual aspects are also included in the learning arrangements.

This study is based on moderate constructivist epistemology (Reinmann & Mandl 2006). Learning arrangements are created in a way that they summon students to become aware of their initial conceptions and to reflect them and discuss them with others.

The framework of this study is the Model of Educational Reconstruction (Kattmann 2007). Students' and scientific conceptions are seen as equally valid and useful sources of individual sense making.

The theory of Conceptual Change describes processes in which students' understanding is modified or refined so that students' conceptions are approximating scientific conceptions (Strike & Posner 1992). To point out that students' conceptions do not change in learning processes but get modified the term 'conceptual reconstruction' is used in this study (Krýger 2007). As Vosniadou (2007) points out, not isolated misconceptions need to be reconstructed but domain-specific theories based on everyday experience.

This study focuses on these main research questions:

- To what extent does (constructivist oriented) instruction that explicitly considers individual students' conceptions support learning processes of vision and perception?

Hypothesis 1: The students of the intervention group will acquire scientific conceptions more often and will be more sure about them than students that have not been taught accordingly to their individual conceptions.

- To what extent does this way of learning has a lasting effect?

Hypothesis 2: The students of the intervention group are able to create metaconceptual awareness, so they should be able to use their scientific conceptions in adequate contexts even after some time has passed.

The study is designed as a pre-post-follow-up-testing. Three different learning environments are compared:

Group I: The identified individual students' conceptions of the intervention-group were considered, giving them learning material that referred explicitly to their individual conceptions, and discussing different coexisting conceptions and metaconceptual aspects.

Group II: Students of this control-group learned with material that did fit to their individual conceptions just by chance. All students got material that was created for the most common conceptions. Besides, the individual students' conceptions are not known by the teacher.

Group III: The second control-group was not instructed on vision and perception.

Each learning environment was tested in three classes (8th and 9th grade (N = 215)).

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To determine students' conceptions, a diagnostic inventory for conceptions of vision and perception was used (Dannemann & Krýger 2009, 2010). It is designed as a computer program with 17 tasks in a multiple-choice-format. The tasks include different themes e.g. the role of light, the eyes, and the brain in the seeing process, image formation and even epistemic conceptions of everyday realism or constructivist ideas of oneself and the external world. For each conceptions students are classified either as 'sure', 'not sure', or 'rejecting'. Reading competence (LGVT 6-12, cf. Schneider et al. 2007), motivation concerning biology as a school subject and concerning the topic of vision and perception (PISA 2006-scales, cf. Prenzel et al. 2007) were tested as additional variables, and some personal data (grades, methodical skills) were collected.

Group I and group II were instructed for four lessons, mainly conducted in rotation work in groups of 3 to 4 students with similar conceptions. At the end of each lesson, students' ratings of features of constructivist instruction (Urhahne et al. 2010) were determined.

The presented results are preliminary because the complete data is not evaluated yet.

Table 1 shows the results of the pre- and the post-test of three classes for the conception "instruction" which means the scientific idea of "light reflects from the object into the eye". Only students who changed or refined their conception after the treatment are mentioned. Some students had instructionist ideas before and retained them (group I: 7 students (n = 24); group II: 4 students (n = 21); group III: 5 students (n = 22)). The others had everyday conceptions before and after the treatment.

Table 1. Students who changed their belief in the conception "instruction" from the pre- to the post-test in group I (Int.), group II (Contr. 1) and group III (Contr. 2); * = significance with 0,05.

Please insert table 1.

9 students out of the intervention group have changed from an everyday conception to the scientific one, 1 student is not sure. In the first control group, only three students reconstructed their everyday conceptions and in the second control group just one person is not sure about "instruction" in the post-test. The differences between intervention group and control groups are significant. This result supports hypothesis 1.

These results show that students of the intervention group have modified their conceptions of this theme significantly more often than students of both control groups. Concerning the epistemic conceptions the results are not as clear.

Most students are keeping their former concepts or are just changing from 'sure' to 'not sure'. Epistemic ideas might need more time to be modified. There might be a bigger effect in the follow-up-test. The complete results of this study will be available at EARLI 2011.

PAPER PRESENTATION

Visual carbon cycle narratives in diagram form have translation traps

Simon Gates, University of Exeter, United Kingdom

The visual literacy of narratives for the carbon cycle topic in secondary school science in England, as displayed in diagrams, was investigated in an interpretive study. A selection of diagrams was used by informants at interview. Published instructional diagrams were also evaluated: 43 diagram designs were of interest. In all, the creations of over 200 educators were inspected. The study uncovered a widespread occurrence of diagrams with visual literacy faults, both in school texts and exam papers in England, over the last 40 years: evidence that they did not have visually-literate makers. Little has been reported in the literature about the visual literacy, narrative version, diagram form, or accuracy of these diagrams. It seems to be assumed, wrongly, that published diagrams will have accurate content and be visually literate; that teachers and pupils will use them without difficulty. The findings presented here show that although these diagrams can be made so they translate precisely into speech and written English, informants did not do this easily. The results revealed a number of translation traps. These, and the evidence for them, are presented in detail. They inform strategies for using diagrams in ways that avoid them, are introduced.

The aim of this qualitative research has been to explore, with educators, issues of visual literacy, design, content and use of diagrams available to teach the carbon cycle topic to secondary science pupils aged 14-16 in England, as part of our National Curriculum. Research questions were general: How do educators see and use carbon cycle diagrams? What do they notice, like and dislike about them? How do they use their own, and how would they use ones made by others?

The methodology for this empirical, interpretive-constructivist study, (Schwandt, 1994), was modelled on a naturalistic approach, and contained elements of multiple case studies (Bassey, 1999). Two instruments were used. First, semi-structured interviews with an opportunistic selection of educators, focused on tasks set with carbon cycle diagrams selected from textbooks and exam papers. This was followed by an archival survey of the content, structure, and accuracy of carbon cycle diagrams published in textbooks and exam materials. Its focus was informed by the first instrument. The informants, and the outputs of other diagram makers, together, provided evidence about carbon cycle narratives produced by over 200 education professionals, most in the UK; others in Europe and the USA. Informants were asked to evaluate carbon cycle diagrams, carry out tasks with them and say how they might use them in their own teaching. Informant talk, recorded at interview, the transcripts, and diagrams the informants made, were coded for themes. These were collected into categories, and then transformed and evaluated to present the findings. A number of criteria were used to provide reliability, and generalizability (Taylor and Wallace, 2007). Importantly, each of the two instruments did provide evidence which reinforced and complimented the findings of the other.

Findings

In general, informants preferred diagrams which contained naturalistic depictions. They commented on surface features, not those to do with narrative version, accuracy of content, the visual conventions used, or form and its implications for using these visual narratives with pupils. Many flaws in design or content went unremarked. They disliked exam diagrams, which had little supporting text to aid translation of the processes linking the entities, and had narrative versions and forms with which they were unfamiliar. Carbon cycle diagrams can translate precisely into speech and formal writing, but informants did not translate them into speech easily. Indeed, some had limited experience of using published diagrams. In particular, the strategies informants used for translating process arrows in these diagrams exposed translation traps for teachers, writers of text matching or using diagrams' visual narratives, and for pupils. These are presented and discussed in detail, with the aid of a reference model of a carbon cycle narrative. To avoid these traps, teachers need to see diagrams in particular ways, use the right strategies to translate them into speech, and instruct pupils how to translate between visual narratives and speech or writing. Educational significance. No direct reference is made to this problem in the literature, but the way some writers construct expository text for pupils indicates they are aware of it (See Mackean 1978, for example). The presentation will show that exposing the problems informs a useful training specification to provide for accuracy and fluency in the visual literacy required for more effective instruction with carbon cycle diagrams, a topic which is of interest to all of us, now that we are confronted with changing carbon dioxide levels and their consequences (Fýssel, 2009). These diagrams can also be used to make accurate templates to teach other cycles: water, nitrogen, and oxygen, for example. More generally, Avgerinou gives a current perspective on the universal importance of visual literacy. Pauwels describes what we need for practical, everyday, 21st century 'visuality'. This study provides a case in point. Without it, we cannot

teach, learn, or function adequately in or out of school, in our contemporary, global, visual culture. Visual literacy is a fundamental requirement for unambiguous communication using any and every medium in a globally networked world.

References

- Avgerinou, M. D. (2009). Re-viewing visual literacy in the "bain d'image" era. *TechTrends*. 53, 2, 28-34.
- Bassey, M. (1999). *Case study research in educational settings*. Maidenhead, England: Open University Press.
- Fussel, H.-M. (2009). An updated assessment of the risks from climate change based on research published since the IPCC Fourth Assessment Report. *Climatic Change*, 97, 469-482.
- Mackean D. G. (1978). *Introduction to biology*. (Colour edn.) London: John Murray National Curriculum. (1999). London: Department for Education and Employment.
- Pauwels, L. (2009). Visual literacy, visual culture and visual scholarship: Adjusting a distorted picture. In *Engaging creativity & critical thinking: Selected readings of the International Visual Literacy Association* (pp. 19-24). Loretto, PA: Saint Francis University.
- Schwandt, T. A. (1994). Constructivist, interpretivist approaches to human inquiry. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd edn.). (pp. 118-137) Thousand Oaks, CA: Sage.
- Taylor, P. C., and Wallace, J. (2007). *Contemporary qualitative research: Exemplars for science and mathematics educators*. (pp. 45-57). Dordrecht, The Netherlands: Springer.

PAPER PRESENTATION

The Impact of Feedback on Mathematical Competencies

Birgit Harks, German Institute for International Educational Research, Germany; John Hattie, The University of Auckland, New Zealand; Katrin Rakoczy, German Institute for International Educational Res, Germany; Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

The powerful impact of feedback on learning has been demonstrated in many studies. However, to date, only few researchers have dealt with the influence of feedback on mathematical achievement in secondary school. In the present study we compare the effects of two kinds of feedback on mathematical competencies of secondary school students and take a closer look on how these effects come about by investigating the role of motivational, cognitive, and meta-cognitive mediating variables. Our research questions are: (1) What impact does process-oriented feedback in comparison to social-comparative feedback have on the development of mathematical competencies? (2) Do motivational, cognitive and meta-cognitive variables mediate the impact of process-oriented vs. social-comparative feedback on the development of mathematical competencies? To investigate these questions a laboratory experiment with a one factor, bivariate design was conducted. 97 students were assigned to either process-oriented or social-comparative feedback. Mathematical competencies were assessed with tests, mediating variables were measured by questionnaires. Results of path analysis show that (1) process-oriented feedback has a stronger impact on the development of mathematical competencies than social-comparative feedback. (2) This comparatively positive impact of process-oriented feedback on mathematical competencies is mediated via cognitive, but not via motivational or meta-cognitive variables.

Theoretical Background & Aims

Since international comparative studies such as PISA (OECD, 2004) revealed low levels of mathematics achievement in secondary school students in many Western countries, educators, policy-makers, and researchers are faced with the challenging task of finding ways to enhance students' mathematical achievement. Latest research suggests that one important way of promoting students' learning is to provide students with feedback (e.g., Hattie, 2009). However, so far, most researchers have studied the impact of feedback by using tasks (like abstract memory or problem-solving tasks) which have little relation to the learning contents at school. The impact of feedback on mathematical achievement in secondary school has rarely been investigated (e.g., Rakoczy et al., 2008).

Feedback researchers argue that especially feedback which (1) uses an individual frame of reference (e.g., Shute, 2008), (2) provides information about task performance, process of understanding or self-regulation, and (3) helps to reduce discrepancies between current performance and learning goals (e.g., Hattie & Timperley, 2007) is beneficial for learning. However, a lot of feedback information actually given in mathematics classrooms, is neither individual-referenced – but social-comparative – nor elaborated in terms of directing students towards their learning goals. Considering these findings, one aim of our study is to compare the impact of elaborated and individual-referenced feedback (process-oriented feedback) with the impact of non-elaborated, social-comparative feedback (social-comparative feedback) on the development of mathematical competencies of secondary school students. With regard to mathematical competencies we focus on technical competence (competence to use knowledge about

mathematical facts and skills) and modelling competence (competence to transform a real world problem into a mathematical problem and vice versa).

A second aim of our study is to gain a deeper understanding of how different kinds of feedback affect the development of mathematical competencies. Cognitive, meta-cognitive and motivational variables have been identified as central components in the process of learning (e.g., Boekaerts, 1999). Butler & Winne (1995) point out that feedback can influence each of these components. As few empirical studies have investigated this assumption so far, we analyse the role of motivational, cognitive, and meta-cognitive variables in mediating the feedback effect on the development of mathematical competencies.

In summary, our research questions are (1) What impact does process-oriented feedback in comparison to social-comparative feedback have on the development of modelling and technical competence? (2) Do motivational, cognitive and meta-cognitive variables mediate the impact of process-oriented vs. social-comparative feedback on the development of modelling and technical competence?

Methods

A laboratory experiment with a one factor, bivariate design was conducted. 97 ninth graders from 55 classes in 23 German schools (intermediate secondary school track) were individually tested. Students were assigned to two feedback conditions. In the social-comparative feedback condition, individual achievement was compared with a social frame of reference by reporting the individual grade, the average grade and the overview of grades of a social reference group. In the process-oriented feedback condition, an individual frame of reference was used and information about strengths and weaknesses (regarding task performance, process of understanding or self-regulation) were given. Additionally, learning aids and strategies were provided to help students move towards their learning goals.

Modelling and technical competence were measured before and after the feedback. As an indicator of the development of modelling respectively technical competence (dependent variables) the difference between post- and pretest WLE-parameters for modelling respectively technical competence were used. Modelling competence and technical competence items covered a broad scope of content domains of mathematics instruction and were partly derived from the German national standards and partly developed in the context of the Co2CA-project (Conditions and Consequences of Classroom Assessment). Modelling and technical competence scales consisted of 15 pretest and 6 posttest items each (modelling competence: EAP-reliability = .67, technical competence: EAP-reliability = .71).

Motivational, cognitive and meta-cognitive mediating variables were measured by amotivation (4 items, e.g., "This test was a waste of time.", Cronbach's α = .70), behavioural adaptivity (5 items, e.g., "Feedback helps me to see where I can improve", Cronbach's α = .81), and accuracy of self-evaluation (amount of difference between a self-evaluation judgment on the overall test performance and the actual test performance).

After pretesting modelling and technical competence, feedback was given. Subsequently students' behavioural adaptivity, amotivation, self-evaluation, modelling and technical competence were assessed.

Data were analysed with path analysis using MPlus. We applied a model with feedback (process-oriented vs. social-comparative feedback) as a dummy coded predictor, behavioural adaptivity, amotivation and self-evaluation as mediators, and modelling and technical competence as criteria. Effects of feedback on the three mediators and effects of the three mediators on modelling and technical competence were specified. Additionally, an effect of behavioural adaptivity on amotivation was modelled. Total, direct and indirect effects were estimated.

Results

The path model yields a good fit to the data. Results reveal a total effect of feedback on modelling competence, not on technical competence. Furthermore, there is a direct feedback effect on behavioural adaptivity, but not on self-evaluation or amotivation. Behavioural adaptivity in turn has a direct effect on modelling competence, technical competence and amotivation. In contrast, neither self-evaluation nor amotivation influence modelling or technical competence. Accordingly, an indirect effect of feedback via behavioural adaptivity on modelling competence, technical competence and amotivation is shown. There is no indirect effect via amotivation or via self-evaluation.

Discussion

We conclude that: (1) Process-oriented feedback has a stronger impact on the development of modelling and technical competence than social-comparative feedback. (2) The comparatively positive impact of process-oriented feedback on modelling and technical competence is mediated via behavioural adaptivity, but not via amotivation or self-evaluation. Students who receive process-oriented feedback show a higher behavioural adaptivity than students

who receive social-comparative feedback. An increased behavioural adaptivity, in turn, leads to a greater development in modelling and technical competence and to a decrease in amotivation.

This study reveals that a shift in the existing feedback culture – in terms of providing more individual-referenced and elaborated feedback on strengths, weaknesses and learning aids – could be beneficial in helping secondary school students to enhance their mathematical competencies.

PAPER PRESENTATION

How Do Vocabulary Interventions Affect Young At-Risk Children's Word Learning: A Meta-Analytic Review

Loren Marulis, The University of Michigan, United States; Susan Neuman, The University of Michigan, United States

This meta-analysis examines the effects of vocabulary interventions on at-risk preschool and kindergarten children's oral language development. The authors quantitatively reviewed 39 studies and 112 effect sizes to better understand the impact of training on word learning. Results indicated an overall effect size of 0.94, $SE=0.10$ $CI95=0.74, 1.14$, $p<.01$, indicating, on average, a gain of nearly one standard deviation on vocabulary measures. Moderator analyses reported greater effects for trained adults in providing the treatment, combined pedagogical strategies that included explicit and implicit instruction, studies who targeted specific vocabulary words in advance of instruction and author-created measures compared to standardized measures. Middle- and upper-income at-risk children were significantly more likely to benefit from vocabulary intervention than those students both at risk and poor. These results indicate that although they might improve oral language skills, vocabulary interventions are not sufficiently powerful to close the gap—even in the preschool and kindergarten years.

Vocabulary at age 3 is strongly associated with reading comprehension at the end of grade 3, and predicts the trajectory of word acquisition that impacts future academic learning (Hart & Risley, 1995). However, there are significant differences in vocabulary knowledge among children from different socioeconomic groups beginning in toddlerhood (Hoff, 2003).

To date, previous studies have provided limited information about the effectiveness of training on the improvement of young, at-risk children's early vocabulary. Our goal was to examine not only how instructional practices affect at-risk child outcomes but also whether the effects of instruction differentially affect various types of at-risk children. Specifically, our meta-analysis addressed the following questions: 1) To what extent are vocabulary interventions an effective method for at-risk children prior to conventional reading instruction? 2) What factors are associated with significant word learning gains for children at-risk? 3) (How) are various risk populations differentially affected? 4) How do cumulative risk factors affect children's vocabulary gains?

In addition to an electronic database search, we contacted experts in the field for published and unpublished studies. Our searches produced 3,584 relevant papers. Four University graduate students coded a training set of studies (Fleiss' Kappa = .96) and then individually coded the remaining papers; thirty-six met all study inclusion criteria.

Effect sizes were expressed as Hedges' g and weighted by the inverse of their error variances. We examined publication bias using the classic fail-safe N test, which indicated that we would need to be missing 5,538 studies to invalidate our results. None of our effect sizes were outliers.

Our sample comprised 36 individual papers yielding 39 studies and 112 effect sizes resulting in an overall effect size of 0.94, $SE=0.10$ $CI95=0.74, 1.14$, $p<.01$. Our sample was largely heterogeneous thus we conducted moderator analyses to explain variance / examine which factors of instruction were related to child outcomes. We found no significant difference between the gains received by kindergarten ($g=1.13$, $SE=.17$, $CI95=.80, 1.46$) or preschool ($g=.80$, $SE=.13$, $CI95=.56, 1.05$) at-risk children, $Qb(1)=2.46$, $p=.12$.

The figure in Appendix images includes details of all findings. The only significant difference found for type of risk factor was SES. At-risk children with low-SES status ($g=.80$, $SE=.12$ $CI95=.58, 1.03$) received gains that were significantly lower than middle to high SES at-risk children ($g=1.50$, $SE=.25$, $CI95=1.01, 1.98$), $Qb(1)=6.32$, $p=.01$; Middle to high SES children who had at least one risk factor gained more than low-SES children with at least one additional risk factor. Dosage of the intervention on its own was not significantly related to child outcomes and no significant difference was found between interventions given individually ($g=.97$, $SE=.18$, $CI95=.61, 1.33$), in small groups of five or less ($g=.95$, $SE=.18$, $CI95=.61, 1.30$), or in large groups of six or more ($g=1.17$, $SE=.35$, $CI95=.49, 1.86$), $Qb(2)=.32$, $p=.85$. Interventions conducted by child care providers who were non-certified/non-degreed ($g=.23$, $SE=.11$, $CI95=.02, .44$) were significantly less effective than those conducted by parents ($g=.71$, $SE=.26$, $CI95=.21, 1.22$), experimenters ($g=.95$, $SE=.24$, $CI95=.48, 1.42$), or certified teachers ($g=1.25$, $SE=.19$, $CI95=.89, 1.62$), $Qb(3)=25.91$, $p<.001$. Explicitly

taught word learning interventions had significantly higher gains ($g=1.01$, $SE=.16$, $CI95=.71, 1.32$) than implicit / incidental word learning interventions ($g=.57$, $SE=.13$, $CI95=.33, .82$), $Qb(1)=4.78$, $p=.03$. Interventions that combined explicit and implicit instruction ($g=1.52$, $SE=.17$, $CI95=.1.18, 1.85$) were significantly more effective than either explicit alone. Studies whose experimenters specifically selected target words prior to the intervention ($g=1.22$, $SE=.16$, $CI95=.90, 1.54$) had significantly higher effect sizes than those who did not ($g=.73$, $SE=.12$, $CI95=.49, .97$), $Qb(1)=5.80$, $p<.05$. Lastly, interventions assessed with author-created tests ($g=1.37$, $SE=.20$, $CI95=.98, 1.76$) had significantly higher effect sizes than those assessed with standardized measures ($g=.68$, $SE=.11$, $CI95=.46, .91$), $Qb(1)=8.91$, $p=.003$.

Our results provide strong evidence for the overall effectiveness of vocabulary interventions for young, at-risk children. The effect sizes obtained are considered both educationally significant (Lipsey & Wilson, 1993) and large (Cohen, 1988). This is tempered by the fact that 69% of the studies' participants scored at or below the 16th percentile at pretest. Thus, even a large gain may not be enough to narrow the achievement gap for at-risk children. In addition, children living in poverty with at least one other risk factor received the smallest gains and tended to have the lowest baseline scores. In essence, interventions would have to accelerate, rather than merely improve, children's vocabulary development, to narrow the achievement gap. In addition, standardized measures alone may be too obtuse to detect nuanced growth and conceptual changes in vocabulary learning suggesting the addition of more sensitive author-created tests for assessing vocabulary growth in at-risk children.

Our findings suggest that more powerful interventions than have generally been conducted are needed for at-risk children related to the type of intervener, the explicitness of instruction, and whether specific words are targeted prior to the intervention. The study that produced the largest effect size (Coyne et al, 2007; $g=2.13$) provided embedded explicit teaching of words targeted in advance, with 'interactive opportunities..to interact with and discuss target words in varied contexts beyond those offered in the story' (p. 77). This exemplified instruction powerful enough to narrow the achievement gap. Neither the dosage nor the group size of the intervention were related to the magnitude of the child outcome suggesting that policy efforts focus on the quality of instructor and instruction, particularly for the at-risk children in poverty who may have the most limited access. Altogether, our meta-analysis provides some promising recommendations for classroom settings for at-risk children.

References

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Coyne, M. D., McCoach, D. B. & Kapp, S. (2007). Vocabulary intervention for kindergarten students: Comparing extended instruction to embedded instruction and incidental exposure. *Learning Disability Quarterly*, 30, 74-88.
- Hart, B. & Risley, T. (1995). *Meaningful differences*. Baltimore, MD: Brookes.
- Hoff, E. (2003). The specificity of environment influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74, 1368-1378.
- Lipsey, M. W. & Wilson, D. B. (1993). The efficacy of psychological, educational, and behavioral treatment: Confirmation from a meta-analysis. *American Psychologist*, 48, 1181-1209.

PAPER PRESENTATION

Mental representation of diagrams: An investigation using free writing and correspondence analysis

Emmanuel Manalo, Waseda University, Japan; Yuri Uesaka, The University of Tokyo, Japan; Yuichiro Wajima, Tokyo Institute of Technology, Japan; Yoshio Yano, Ishikawa Prefectural University, Japan

The use of diagrams is generally considered to be efficacious in a wide range of settings. However, a number of problems relating to student use of diagrams have been identified in both research and applied educational settings, including inappropriate choice of diagrams to use and lack of spontaneity in use. Previous research findings, that student views and perceptions influence their spontaneity in using diagrams, suggest that understanding how students mentally represent diagrams could help towards understanding and addressing problems about their use. However, the question of how people might normally represent diagrams in their minds had not been previously addressed in research. Thus, the present investigation was an attempt to answer this question. The participants of the study were 129 undergraduate university students in Japan who were asked to free write for 3 minutes on the topic of "diagrams". The free writing data were put through morphological and correspondence analyses, which enabled the proximity between words (nouns, verbs, and adjectives used) to be calculated and plotted on a two-dimensional grid. This plot revealed three main clusters pertaining to words that denote where diagrams are used, words that indicate the functions of diagrams, and words that describe specific kinds of diagrams – with the first two clusters appearing to lie along a possible "depth-of-processing" continuum. The words proximity plot suggests that diagrams may be mentally represented along two dimensions, one pertaining to their entity (i.e., what diagrams are) and the other to their purpose (i.e., what diagrams are for).

Introduction

Diagrams are used in a wide variety of fields (Blackwell & Engelhardt, 2002) and are considered as facilitative of efficiency in computational processes (Larkin & Simon, 1987), including problem solving (e.g., Hembree, 1992; Pedone et al. 2001). Various problems, however, have been identified in their use, including the necessity of prior knowledge for their effective use (Grawemeyer & Cox, 2008) and students' general lack of spontaneity in using them (Dufour-Janvier et al., 1987; Uesaka et al., 2007). Thus, despite their apparent usefulness, many students may fail to benefit from diagrams use.

The majority of studies on diagrams have focused on their effects and functions (e.g., Ainsworth & Th Loizou, 2003; Cheng, 2002, 2003; Mayer, 2003), with very few addressing issues about user problems. One study that falls into the latter category is Uesaka et al. (2007): their key finding was that lack of confidence and perceptions of difficulty in diagram use, and failing to view diagrams as part of their own personal repertoire of learning strategies, were deterrents to students' spontaneous use of diagrams. This finding suggests that understanding how students mentally represent diagrams could be key to understanding and addressing problems about their use.

There is, however, not a lot of research that has been undertaken about how people mentally represent diagrams. Studies have looked at the differences between and effects of active and passive diagrammatic representations (Stern et al., 2003), and the categorizations that people use when asked to sort depictions of different kinds of diagrams (Cox & Grawemeyer, 2003), but the question of how people might normally represent diagrams in their minds had not been addressed. This therefore was the objective of this study.

Method

The participants were 129 undergraduate students (mean age = 19.75 years, SD = 1.57; females = 61, males = 68) in a university for teacher training in Japan. They were administered a questionnaire in three parts. The first part asked them to free write for 3 minutes about "diagrams". The second part sought their opinions about diagrams, and the third part required participants to solve three problems. In this summary, only findings relating to the free writing task will be reported.

Free writing is a technique that has been used to facilitate participants' articulation of their beliefs and ideas about target concepts (see, e.g., free writing uses in Curtis & Millar, 1988; Knobloch-Fedders & Knudson, 2009). Participants' articulations can provide insights into their cognitive structures about target 'objects' (i.e., through the definitions, categorizations, connections, and elaborations they articulate, the structural properties of their cognition can be inferred). The technique was considered appropriate in this study as it reduced the likelihood of making any suggestions to the participants about how they should think about diagrams.

Compared to previous studies that have employed free writing, however, a more systematic, empirical approach was used in this study to analyse the data. First, morphological analysis was undertaken during which the free writing data, which comprised mostly of phrases and sentences, were segmented into words, and then all the nouns, verbs, and adjectives were selected. Frequency counts were made, and only words that occurred 5 times or more were then included. Then, for each participant, the occurrence of these words was identified, hence enabling the co-appearance of words to be worked out. Following this, correspondence analysis, using Hayashi's (1993) quantification methods type III, was conducted. In essence, this enabled the distance between words to be calculated. Finally, the configurations of the words were plotted on a two-dimensional grid to portray the proximity between the words.

Results

The plot revealed three main clusters: (i) words denoting where diagrams are found or are used (e.g., statistics, text books, social sciences), (ii) words that indicate functions, uses, or outcomes of diagrams use (e.g., organisation, understand, imagine), and (iii) words that pertain to specific kinds of diagrams (e.g., graph, line graph, pictures). These clusters were distributed on the grid along what approximated an X-shape without the top left segment. On the top right segment were the first group of words; on the bottom left were the second group of words; and on the bottom right were the third. The top right segment/cluster (location/appearance of diagrams) appeared to lie along a continuum leading toward the bottom left segment/cluster (functions of diagrams).

Discussion

The findings suggest that students mentally represent diagrams in terms of (i) where they know diagrams appear or are used, (ii) the functions or outcomes of diagrams use, or (iii) specific examples or kinds of diagrams. The words proximity plot suggests that the first two may lie along a continuum, from more 'shallow' notions pertaining to where students may have seen diagrams, to more 'deeply' processed ideas about the functions that diagrams use may serve. This continuum connecting the first and second clusters may represent ideas about "what diagrams are for", while the

third cluster may represent ideas about diagrammatic entity (i.e., "what diagrams are"). Hence, it may be that diagrams are mentally represented along two dimensions, one pertaining to their entity and the other to their purpose. Underpinning these dimensions may be the extent to which each student has processed knowledge and experiences about diagrams.

The entity and purpose dimensions suggested by the results of this study require experimental verification, particularly with different groups of students. If these prove to accurately portray how students generally represent diagrams in their minds, they could potentially contribute towards a better understanding of knowledge and skills development about diagrams – and possibly other learning strategies as well. In turn, such understanding could directly help towards the formulation of more effective methods for addressing common student problems in the use of these strategies.

The findings of this study also indicate that correspondence analysis can usefully be employed in applied educational contexts to provide insights into human cognitive structures that may latently be represented in qualitative data such as writing output.

PAPER PRESENTATION

Effects of Headings and Keywording on Learning in Self-regulated Text-based Learning

Marie Lippmann, TU Dresden, Germany; Susanne Narciss, Technische Universität Dresden, Germany; Neil Schwartz, California State University, Chico, United States; Robert Danielson, California State University, Chico, United States; David Sarmiento, California State University, Chico, United States

Metacognitive monitoring affects students' self-regulation, and this affects overall learning. Monitoring accuracy is influenced by the characteristics of the learning material. Thus, this study investigates two common characteristics of text-based learning tasks – headings and post reading summarizing tasks – and their effects on learning processes and outcomes in a self-regulated learning setting. Headings varied in relatedness and distance to the target topics. Summarizing tasks were keyword tasks that took place either immediately (IMM) after reading a text, or with a delay (DEL). In a 2 between, 3 within subjects design, 243 students studied 6 expository texts, generated keywords either immediately or delayed, restudied the texts and performed a posttest with deep-level processing tasks. The results of this study are contrary to former findings indicating a superiority effect on performance for delayed keywording. The results also revealed an interaction of relatedness and distance in the heading conditions – participants in the DEL-condition gave fewer correct answers from text than participants in the IMM-condition if headings were related/close; participants in the IMM-condition gave fewer correct answers from text if headings were related/distant, compared to related/close headings; there was no difference for performance regarding information from text if headings were unrelated. In the unrelated heading condition, performance scores were noticeably high compared to the other heading conditions.

Aims

Self-regulated learning (SRL) is defined as the independently applied monitoring and control of behavior, cognition, or motivation in an academic context (Dinsmore, Alexander & Loughlin, 2008). SRL is affected by monitoring accuracy. Prior research revealed that delayed summarizing tasks increase a learner's monitoring accuracy, which results in better self-regulatory activities and test performance (Thiede, Anderson & Theriault, 2003). Headings are organizational signals (Lorch & Lorch, 1996). Headings have different effects on learning depending on their relatedness to the text content and their distance to the emphasized contents (Richtey, Schuster & Allen, 2008). If headings affect the establishment of a mental text representation, headings may also affect self-regulatory processes. If both, summarizing tasks and headings, affect SRL, they should interact when manipulated in a SRL setting. Therefore, this study aims at investigating the effects of headings and summarizing tasks on learning processes and outcomes in a SRL setting.

Methodology

Participants and design: 243 American students (64 males, 179 females; age range: 18 – 59; mean: 22.7 years) participated in the study. In a 2 between, 3 within subjects design, the between subjects variable was type of summarizing task (immediate (IMM) - delayed (DEL) keywording). The within subjects variable was type of heading (related/close (RC), related/distant (RD), unrelated (UR)). Each participant experienced all heading conditions twice throughout the course of the study. The heading conditions were counterbalanced, following a Latin square. Participants were randomly assigned to the immediate or delayed keyword condition. **Study material, measures and procedure:** The study was run online with 6 expository study texts. Each text consisted of two distinct subtopics of an overall related topic. Topics varied for each text. Each text had 3 different possible heading conditions. In the RC-condition, the heading highlighted the first subtopic in the text. In the RD-condition, the heading highlighted the

second subtopic in the text. In the UR-condition, the heading was not related to any of the subtopics. The presentation of the topics was counterbalanced. Keywords and essays were realized as word documents. The deep-level processing task contained 12 questions with an open answer format. Each of the 12 questions targeted one of the 12 subtopics from the texts. The questions provided a new scenario and a problem statement. The participant was asked to solve the problem and provide an explanation. Correct answers were scored according to a 2-category scoring rubric for two sources of knowledge - knowledge from text (TEXT) and prior knowledge (PK). Answers were scored by 2 different scorers, reaching an interrater reliability of .86. The procedure included learning from texts, keyword generation, comprehension ratings, a first set of reproduction tasks and confidence ratings, a self-regulated restudy trial, a second set of reproduction tasks and confidence ratings, and a deep level processing task (see table 1).

INSERT TABLE 1.

Findings and conclusions

Within the scope of this proposal, only results from the deep-level processing task will be reported. Results were computed using a 2 Keyword (IMM vs. DEL) x 3 Factor Headings (RC vs. RD vs. UR) x 2 Source of Learning (TEXT vs. PK) ANOVA with repeated measures on the factor headings and source of learning conditions. The ANOVA revealed a significant main effect for source of learning [$F(1,241)=511.339$ MSerror=0.557, $p=0.00$] with more information remembered from text ($M = 0.741$; $SD = 0.026$) than from prior knowledge ($M = 0.117$; $SD=0.009$). The 3-way interaction was also significant [$F(1,241)=3.94$, MSerror=0.38, $p=0.04$] (see figure 1). Participants used more information from the texts to answer the questions than information from prior knowledge. Participants with delayed keywording gave significantly fewer correct answers from the text than participants with immediate keywording if the heading was related/close. Participants with immediate keywording gave significantly fewer right answers from the text if the heading was related/distant, compared with the related /close heading. There was no difference for performance regarding information from text between the keyword conditions if the heading was unrelated. Also, the performance level regarding information from text was higher for the unrelated heading condition. When participants brought in information from their prior knowledge to answer the questions, participants with immediate keywording performed significantly better than participants with delayed keywording. Apparently, the keywording and heading conditions affect learning on a number of levels. The RC-condition may cause a perceived ease of comprehension, which has a negative impact on monitoring accuracy, causing an illusion of knowing (Kroll & Ford, 1992). Thus, a lack of deep level processing may occur, which impacts the establishment of a coherent mental model of the text. In the RD-condition, the text structure does not promote a perceived ease of learning and thus, no illusion of knowing occurs. In the UR-condition, the perceived ease of learning is the lowest. Thus, participants are encouraged to apply deeper levels of processing. In some cases, immediate keywording may result in a rehearsal loop that fosters the consolidation of knowledge for simple information, as in the RC-condition (Baddeley, 2003). Significance of findings Headings and summarizing tasks are commonly found in text-based learning tasks. Findings derived from this study contribute to a better understanding of cognitive events and improved design of text-based learning tasks. The paper will address the theoretical issue of self-regulated learning as a mediating variable of comprehension in text-based learning.

References:

- Baddeley, A. (2003). Working memory: Looking back and look forward. *Nature Reviews Neuroscience*, 4, 829-839.
- Dinsmore, D.L., Alexander, P.A. & Loughlin, S.M. (2008). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. *Educational Psychological Review*, 20, 391-409.
- Kroll, M.D. & Ford, M.L. (1992). The illusion of knowing, error detection, and motivational orientations. *Contemporary Educational Psychology*, 17 (4), 371-378.
- Lorch, R. F., Jr. & Lorch, E. P. (1996). Effects of organizational signals on free recall of expository text. *Journal of Educational Psychology*, 88, 38-48.
- Ritchey, K., Schuster, J. & Allen, J. (2008). How the relationship between text and headings influences readers' memory. *Contemporary Educational Psychology*, 33, 859-874.
- Thiede, K. W., Anderson, M. C. M. & Theriault, D. (2003). Accuracy of metacognitive monitoring affects learning of texts. *Journal of Educational Psychology*, 95 (1), 66-73.

PAPER PRESENTATION

Self regulation and sense of community in online learning. An analysis of reciprocal interactions

Barbara Girani De Marco, University of Milano Bicocca, Italy; Ottavia Albanese, universita milano Bicocca, Italy; Stefano Cacciamani, University of Valle d'Aosta, Italy; Giulia Balboni, University of Valle d'Aosta, Italy; Nicoletta Businaro, University of Milano Bicocca, Italy; Stefano Castelli, University of Milano Bicocca, Italy; Alessandra Coscarelli, University of Turin, Italy; Eleonora Farina, University of Milano Bicocca, Italy; Vittore Perrucci, University of Valle d'Aosta, Italy; Luca Vanin, University of Milano Bicocca, Italy; Giovanna Conenna, University of Milano Bicocca, Italy

The development of a sense of community in an online course could increase the level of satisfaction and the academic success (Rovai e Wighting, 2005). Contemporaneously, the participation in a virtual community promotes self-regulation and the reflection on knowledge, motivating the e-learner to assume an active role (Rovai, 2002). In our research we analyze the relationship between the two variables. We hypothesized that more self-regulated students are facilitated to develop an early sense of community. At the same time the early development of the sense of community can offer the optimal conditions for the application in the online courses: that will allow students to enrich their SRL competencies. We asked university e-learners to fill in the Motivated Strategies for Learning Questionnaire (Pintrich et Al, 1993; Italian version by Bordin et Al, 2009) at the very beginning and at the end of the course. A week after the beginning of the course we asked the students to fill in the sense of community in online course scale, developed by Perrucci, Balboni, Cacciamani, (2008). A preliminary sample was composed by 29 e-learners. We analyze correlations between the two variables. Results show an association between early sense of community and incoming SRL, this association increase at the end of the course. The results lead us to verify more in depth the existence of a circular relation between the two constructs with an enlarged sample.

Theoretical framework

The relevance and the variety that distance learning is assuming today, requires a notable effort to plan activities that promote in the students the activation of self-regulative, motivational and relational processes, in order to use effectively the instruments and the contents offered (Albanese, De Marco, Fiorilli, 2008; Perrucci, Cacciamani, Balboni, 2007). The research on the success of the on-line activity meant as an active knowledge building has brought to light the crucial role of two interconnected factors: the self-regulative components of learning and the sense of community among the participants in the lowering of the risk of drop out of the courses, (Rovai, 2002). The theoretical construct of self-regulation is described by Zimmerman (2008) as a group of pro-active self-directive processes and beliefs about self that are used by the student to acquire competences in order to improve personal academic results and to reach fixed goals. Therefore, to evaluate the individual level of self-regulation in learning, it is necessary to consider its multiple components: cognitive, metacognitive, motivational, behavioural and environmental. The concept of "sense of community" is defined, by McMillan and Chavis (1986), as the sense of belonging and hard interdependence of a person within a group, in terms of the perception of being part of a very reliable and stable group, and in terms of being available to offer and to do for the other members whatever one expects from them, and the expectation of seeing one's needs satisfied thanks to the mutual commitment. The online learning at the university is a significant context to study both the sense of community and SRL. Various investigations have revealed that the development of a sense of community in an online course could increase the level of satisfaction and the academic success and could reduce the drop-out (e.g. Rovai e Wighting, 2005). Contemporaneously, the participation in a virtual community promotes an activation of epistemic processes that promote the self-regulation and the reflection on knowledge, enhancing the e-learner's motivation to assume an active role (Rovai, 2002; Albanese, De Marco, Fiorilli, 2008).

Aims and hypotheses

Although the literature shows that blended courses adopting a collaborative and/or co-constructive approach promote the development of self-regulative abilities, assuring at the same time the development and the preservation of an adequate sense of community (Bruckman, 1998), the interrelation between the two variables has not yet been considered and analyzed in depth. In our research we want to identify the relationship between the two variables. We hypothesized that more self-regulated students are facilitated to develop an early sense of community. At the same time the early development of the sense of community can offer the optimal conditions for the application in the online courses: that will allow students to enrich their SRL competencies even more.

Method and data analyses

Participants of our research are university students who attend e-learning courses at Milano Bicocca University. All the courses we take into account in our research are based on collaborative learning or collaborative knowledge building models. A preliminary sample was composed by 29 e-learners. At the beginning and at the end of the online course students were asked to fill in the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia e McKeachie, 1993; Italian version developed by Bordin, Bastianelli e Fluperi, 2009). The questionnaire analyses two different components: the motivational and the strategic one. The motivational scale involves three components (value, expectancy and affect) and the strategic scale involves two components (cognitive and metacognitive strategies and resource management strategies). Each component involves one or more indexes. A week after the beginning of the course we asked the students to fill in another questionnaire, the "Scala del Senso di Comunità nei corsi online" (The sense of community in online course scale), developed by Perrucci, Balboni, Cacciamani, (2008; Perrucci, Cacciamani, Coscarelli, Balboni, 2009) on the model of McMillan e Chavis (1986). Assessing the sense of community after just a week of activity allow us to assess the early sense of community. We correlated the early sense

of community general index with all MSLQ components at the beginning and at the end of the course (non parametric correlation index, Spearman's Rho).

Results

Our preliminary data show significant correlations between three SRL competencies and early sense of community: 1) value ($r=.60$, p Results show an association between early sense of community and incoming SRL competencies. This association increased at the end of the course. The results lead us to verify more in depth the existence of a circular relation between the two constructs (SRL and the sense of community). Our sample will be enriched by 90 or more questionnaires in few months; structural equation models will be used to analyse the new sample to identify causal relations between the two constructs.

Conclusion

Our sample do not allow us to make causal inference from data, but our results suggest the necessity to develop among students inner self regulation competencies and to support the development of the sense of community since the beginning of the course. If further analyses confirm preliminary results, we could suggest the necessity to plan specific activities to allow students to understand the importance of collaboration and sense of community development. The promotion of the sense of community in fact could allow them to get more benefits from the course, not only about discipline's contents, like literature has already showed, but also on transversal competencies like SRL.

PAPER PRESENTATION

A Model Integrating Goal Orientation and Selective Attention Strategy Frameworks

Ordene Edwards, Lamar University, United States

A theoretical model is proposed that would interject the selective attention strategy into an achievement goal orientation framework. The proposed model may explicate one mechanism that underlies the relationship between achievement goal orientation and various learning patterns and outcomes. The basis of the integration of the two learning models is the schema theory which explains the nature of both frameworks. The model focuses on reading and reading comprehension. The model proposes that text salience and attention may mediate the relationship between goal orientations and reading comprehension. The proposed model may expand our understanding of one likely process whereby achievement goals affect learning outcomes.

Purpose

The achievement goal theory evolved as a major research area in achievement motivation (Midgley, Kaplan, Middleton, & Maehr, 1998). Heretofore, a number of researchers have documented the link between achievement goals and learning (see Ames & Archer, 1988; Butler, 1987; Elliott & Dweck, 1988; Elliott & McGregor, 2001). However, a likely reason for the connection is not clearly described in the literature. Thereby, a framework explaining a process by which goals can create and/or sustain engagement or disengagement in learning tasks is warranted.

Education researchers identified and tested other learning models to explain connections among various learning outcomes. These models may also help explain the link between goals and learning. One such model, the Selective Attention Strategy (SAS) conceptualizes one process that may underlie learning, specifically reading comprehension (Reynolds, 1992). SAS research shows that the amount or intensity of students' attention may affect reading comprehension (Goetz, Schallert, Reynolds, & Radin, 1983; Kaakinen, Hyona, & Keenan, 2003). Specifically, they identified positive links among reading variables, attention, and comprehension. Could SAS explain a process whereby goals are related to learning? The objective of this paper is to propose an integrated theoretical model of goal orientation and SAS via the schema theory.

Theoretical Framework and Background

Schema Theory

The schema theory is a relevant framework for connecting selective attention and goal as it is the underlying theory that explains their bases (see Kaplan & Maehr, 2007; Reynolds, 1992). Schema theory helps us understand that learners can effectively use their cognitive capacity to selectively focus on information that are salient to their schemata and ignore information that are non-salient (e.g., Anderson, 1982; Goetz et al., 1983). Schemata set in motion cognitive mechanisms that can affect learning. This essentially describes SAS.

Selective Attention Strategy

According to the SAS, salient information is learned better than non-salient information (Reynolds, Standiford, and Anderson, 1979). That is, individuals allocate extra attention to salient text information, via schema theory (Anderson,

1982), which aids in better learning (Goetz et al., 1983). Can SAS framework help us better understand how goal orientation affects student outcomes?

Goal Orientation

The achievement goal theory emphasizes that individuals construct cognitive representations of motives for academic-related situations (Ames, 1992; Dweck, 1986). Kaplan and Maehr (2007) proposed that situation and self schemas partly explain the nature of achievement goal orientations. That is, goal orientations as cognitive-affective frames can be constructed from schemata that may be tied to specific academic situations (Kaplan & Maehr, 2007). Also, self-schemata inform the individual's expectations and affect all levels of engagement in an academic situation including what they pay attention to, what they can remember, and what they deduce from the situation (Markus, 1983).

A plethora of research shows relationships among goals and learning (Ames & Archer, 1988; Elliott, 1999; Elliot & Church, 1997; Wigfield & Guthrie, 1997). These studies expand our understanding of the relationships among goals and learning. However, they do not answer one important question: how do goal orientations increase/decrease learning? Specifically, do goals influence attention and comprehension of text via the SAS? The proposed model will explore these possibilities.

The Proposed Model

How are goal orientations, text salience, attention, and comprehension related? To answer the question, a model is proposed that integrates goals and SAS via the schema theory. Figure 1 presents the proposed integrated model.

In any reading situation, individuals possess text information schemata and other schemata including achievement goals schemata that influence text salience, attention, and comprehension.

Reading involves a schematic structure for text information (Anderson, Reynolds, Schallert, & Goetz, 1977). An important component of that schema is inference formation that helps readers decide what schema they should activate in order to understand text (Anderson & Pearson, 1984). This schema may influence text salience, which in turn affect attention and subsequently comprehension (Cirilo & Foss, 1980).

Individuals are sometimes given reading perspectives. Instructions and objectives can activate schemata that prompt readers to focus on certain text information (McCrudden & Schraw, 2007).

As individuals read, they use motivational processes (Guthrie & Wigfield, 1999), specifically, goals and beliefs (Pintrich & DeGroot, 1990a). Thereby, self and situation schemata may be activated that guide goal adoption, which in turn influence salience, attention, and learning.

Each type of goal may affect text salience in different ways. These predictions are consistent with the assumptions of Pekrun, Elliott, and Maier (2006) regarding object focus and valence of achievement goals. Individuals with a mastery goal focus on value and controllability of understanding. Therefore, a mastery goal may intensify the salience and value of text as a means to understanding the information. In turn, individuals may devote more attention to reading, which may lead to better comprehension.

On the other hand, a performance approach goal focuses on value and controllability of the outcome of tasks (Pekrun, Elliott, & Maier, 2006). Therefore, a performance approach goal may influence salience solely because of test outcomes. Consequently, individuals may spend less time understanding information (see Wigfield & Guthrie, 1997) and adopt strategies that aim to demonstrate their ability rather than increase competence (Midley et al., 2001). For example, they may focus only on information they believe may appear on the test. This may lead to good grades but not necessarily good understanding (see Midgley et al., 2001). Moreover, their attention may be less than that of mastery oriented readers.

Individuals with a performance avoidance goal focus on failure, the negative value of the task outcomes, and lack of controllability (Pekrun et al., 2006). This may evoke text salience tied to test outcomes, anxiety, and fear, which may decrease attention.

The model also presents the possibility of goals directly affecting salience. Given that schemata can be implanted into each other (Anderson & Pearson, 1984), it is possible that goal schemata may activate certain text information schemata that match specific goals, which may influence salience. For example, a mastery goal may prompt focus on text just to master information, which may be the entire text. Performance goals may prompt focus on information

that may help with getting a good grade (performance approach) or decrease focus on text information because of fear (performance avoidance).

Significance

This model may be the first step in establishing a useful parallel between selective attention and motivation. It may also allow for more grounded and warranted theoretical connections among goals and learning. That is, it may identify one causal mechanism whereby achievement goal orientations are linked to academic outcomes.

PAPER PRESENTATION

Enhancing self-regulated learning with texts: Towards self-paced monitoring

Christian Stamov Roßnagel, Jacobs University Bremen, Germany

The self-monitoring approach posits that improving the metacognitive monitoring of learning enhances learning performance (Dunlosky et al., 2005). With three experiments, I sought to contribute to an applied self-monitoring approach. In the first experiment, I tested whether manipulating the monitoring criterion boosts accuracy by comparing local and global matched and standard judgements of learning, respectively. Accuracy exceeded .82 when participants locally (after each text segment) judged the likelihood of correct answers in a knowledge test compared to judging the likelihood of keyword recall. In the second experiment, I manipulated the sequence of easy and difficult segments as measured by propositional density. Participants read different difficulty sequences (e.g., EDEDED, DDDEEE) and made global or local matched JOL. The latter type of JOL covaried with the difficulty sequence and yielded superior accuracy to global JOL, showing how judgements can be systematically biased. In the third experiment, participants made an ease of processing (EoP) judgement after each text segment and were instructed to make a matched JOL after the EOP rating only if they had made a low EoP rating. Control group participants after each segment made both JOL and EoP judgements. As a main result, participants in the experimental group performed significantly better in the knowledge test than control participants. Moreover, metacomprehension in the experimental group was .91, as compared to .63 in the control group. We discuss how such self-paced ("spontaneous") monitoring may be used to design self-regulated learning trainings.

The self-monitoring approach of text learning posits that improving the metacognitive monitoring of learning enhances performance (Dunlosky et al., 2005). Self-monitoring appears to work with complex settings and materials, such as academic lectures (Nietfeld, Cao, & Osborne, 2005), chess problem-solving (De Bruin, Rikers, & Schmidt, 2007), and with texts containing diagrams (Serra & Dunlosky, in press). Given the importance of meta-cognitive control for real-world learning (e.g., informal workplace learning, see Schulz & Stamov Roßnagel, 2010), the self-monitoring approach may be a promising platform for developing self-regulated learning trainings.

Three issues need dealing with, however, on the way to an applied self-monitoring approach. First, self-monitoring significantly predicts learning performance, but monitoring accuracy is often low (Dunlosky & Lipko, 2007). Second, accuracy is affected by features of the materials such as test question difficulty (Nietfeld, Cao, & Osborne, 2005) or presentation format (e.g., Serra & Dunlosky, in press). Third, participants use self-monitoring strategies when prompted, but little is known about spontaneous, self-paced monitoring.

In three experiments, I therefore tested whether judgement accuracy depends on the self-monitoring criterion (Exp. I), how context effects bias learning judgements (Exp. II), and whether two-step judgements of learning support self-paced monitoring. In Exp. I, 80 participants read expository texts and took a knowledge test. Texts were divided into segments of 2-3 sentences each; segments were requested by keypress. In a 2x2 design, half the participants made judgements of learning (JOL) after each segment (local monitoring) or after reading the entire text (global monitoring). Half the participants in each monitoring condition either judged the likelihood of recalling the keyword (standard JOL) or of answering a test question (matched JOL). Local JOL yielded higher accuracy than global ones; this local effect was most pronounced for matched JOL.

In the second experiment, I manipulated the sequence of easy and difficult segments as measured by propositional density. 40 new participants read different difficulty sequences (e.g., EDEDED, DDDEEE) and made global or local matched JOL. The latter type of JOL covaried with the difficulty sequence and yielded superior accuracy to global JOL, showing how judgements can be systematically biased.

In the third experiment, 40 new participants read the texts used in Experiment II. In the experimental group, participants made an ease of processing (EoP) judgement after each segment, stating how comprehensible they found the segment. In addition, participants were instructed to make a matched JOL after the EOP rating only if they had made a low EoP rating. Control group participants after each segment made both JOL and EoP judgements. As a main

result, participants in the experimental group performed significantly better in the knowledge test than control participants. Moreover, metacomprehension in the experimental group was .91, as compared to .63 in the control group. We discuss how such self-paced ("spontaneous") monitoring may be used to design self-regulated learning trainings.

References

- De Bruin, A.B.H., Rikers, R.M.J.P. & Schmidt, H.G. (2007). Improving metacomprehension accuracy and self-regulation in cognitive skill acquisition: The effect of learner expertise. *European Journal of Cognitive Psychology*, 19, 671-688.
- Dunlosky, J., Lipko, A.R. (2007). Metacomprehension: A brief history and how to improve its accuracy. *Current Directions in Psychological Science*, 16, 228-232.
- Dunlosky, J., Hertzog, C., Kennedy, M. & Thiede, K. (2005). The selfmonitoring approach for effective learning. *Cognitive Technology*, 10, 4-11.
- Nietfeld, J.L., Cao, Li & Osborne, J.W. (2005). Metacognitive Monitoring Accuracy and Student Performance in the Postsecondary Classroom. *Journal of Experimental Education*, 74, 7-28.
- Serra, M. & Dunlosky, J. (in press). Metacomprehension judgements reflect the belief that diagrams improve learning from text. *Memory*.
- Schulz, M. & Stamov Ropnagel, C. (2010). Informal workplace learning: An exploration of age differences in learning competence. *Learning and Instruction*, 20, 383-399.

PAPER PRESENTATION

Validation of CIE-TMa: an instrument of measure of the emotional impact of mathematics learning

Rosario Del Rey, Seville University, Spain; Esther Madera, Cordoba University, Spain; Rosario Ortega-Ruiz, Universidad de Cordoba, Spain

The area of Mathematics is one of the most linked to the school failure (Bermejo, Lago, Rodríguez and Péêrez, 2000) and there are a lot of students who relate it with inappropriate attitudes and especially with emotional shocks and refuse to this kind of learning (Gómez-Chacôn, 2000). In this paper we present the design and validation of the questionnaire CIE-TMa (Cuestionario sobre Impacto Emocional y Tareas Matemáticas – Emotional impact and mathematics tasks questionnaire), whose aim is to highlight the emotional impact (resilience versus mental block) to which Secondary students face when they tackle tasks of mathematic learning. The data obtained from the initial pilot questionnaire was used as a base for the CIE-TMa elaboration, which finally has been validated by a sample of 342 participants. The results indicate that the CIE-TMa possesses enough psychometrical properties and it can be used to measure the three factors which can influence in the success perception to the mathematic tasks in an adequate way: self-confidence, resilience capacity against the perception of failure and emotional block.

Introduction

In the last few years, with the aim of measuring the students' achievement, several public organisms have carried out certain studies which have ranked and classified the different countries on the basis of the level of development of the basic competencies. The most utilized as a reference for comparing the learning quality is the Programme for International Student Assessment, PISA (2000; 2003; 2006), set up in 1997 by the OECD for measuring the level of development of some basic competencies in which the capability of dealing with mathematics is included.

When developing these competencies thorough learning tasks, and in particular the mathematics competency, the attitude and interest of the students occupy an important position according to the experience of teachers of this area (Gil, Rico y Fernández, 2002). The concept that the students have about themselves as trainees in mathematics appears to be one of the variables that has influence on the self-confidence when facing the task. Such a variable has an essential role at the time of achieving positive academic results (McLeod, 1992). But, particularly, the emotional modulation what each student do during the learning process which is specially linked with the academic self-esteem. Claxton (1999) stated the need for the trainees to maintain for learning an adequate level of confidence and, with the goal of explaining the emotional participation in the learning process, established a cognitive-behavioral model which considers that emotions may play a stimulating and positive role or, on the contrary, turn into barriers for achieving an effective learning. For such purpose, we use the personal tools that he classified in three great groups: reflection, resources and resilience.

The purpose of our study has been the implementation of resilience micro procedures against the mental block when tackling the school task of learning mathematics, the designing and validation of an instrument for detecting the emotional impact that said tasks have on the students, considering the influence in the impact of the self-confidence of the students, the resilience capacity and the emotional block that is provoked.

Methodology

On the basis of the theories stated by Claxton (1999), we elaborated a 20 items questionnaire ". The initial hypothesis was to consider the existence of a factorial and empiric relationship that supports the virtuality of the referred theories in relation to the mathematic learning. Once the instrument was designed, we developed a pilot study with a sample of 95 students among six groups of Second Grade of ESO (14 year-old). A factorial analysis was performed with data obtained, which showed the existence of three factors but also some series of items which were not correlated to any of them. After eliminating and reordering the items, the definitive version of the CIE-TMa Questionnaire (Emotional impact and mathematics tasks questionnaire, Madera, Ortega y Del Rey, 2009), composed of 13 items, was elaborated. The questionnaire was answered by 342 students of ESO following the standards of voluntarily, anonymity and independence.

Results

When performing the factorial analysis we checked that, in effect, the use of this analysis was feasible (Bartlett Sphericity Test =1161.095; $p=.000$). The KMO coefficient of Kaiser-Meyer-Olkin offered a value of .811. The variation percentage was of 55.66% and the Cronbach α for each of the three resulting factors: .833 for block, .636 for resilience and .668 for self-confidence. In the oral presentation the items composing all of them will be described.

Conclusions

The exploratory study suggests that the emotional modulation that students do when facing mathematic tasks may be regarded as tridimensional. The exploratory factorial analysis showed that a structure of three factors (self-confidence, resilience and mental block) is adequate, explaining an acceptable total variation percentage for measuring emotional impact and the way to deal with it when tackling school tasks related to the learning of mathematics. In addition, the scale has a good internal consistence.

The results of this study indicate that the CIE-TMa has good psychometric properties, contrasted by the KMO coefficient and the Cronbach α . Therefore, it provides us with an acceptable measure of the different factors that have influence when facing said tasks. In addition, it shows a good performance with the sample of students utilized, which increase the possibilities for its utilization with more representative samples.

On the other hand, given its simplicity and ease to be used by the teachers of mathematics and by other educational agents as school counselors, the CIE-TMa seems to be an useful instrument that may, in case used as a diagnosis instrument, anticipate and prevent many of those little and big problems related to motivation and attitudes towards learning one of the most relevant school domains: the mathematics competency.

References

- Bermejo, V., Lago, M.O., Rodríguez, P. y Péêrez, M. (2000). Fracaso escolar en matemáticas: cómo intervenir para mejorar los rendimientos infantiles. *Revista de Psicología General y Aplicada*, 53(1), 43-62.
- Claxton, G. (1999). *Aprender. El reto del aprendizaje continuo*. Barcelona: Paidós.
- Gil, F., Rico, L. y Fernández, A. (2002). Concepciones y creencias del profesorado de secundaria sobre evaluación en matemáticas. *Revista de Investigación Educativa*, 20(1), 47-75.
- Gómez-Chacón, I. (2000). Affective influences in the knowledge of mathematics. *Educational Studies in Mathematics*, 43(2), 149-168.
- OECD (2000). *Pisa 2000: Conocimientos y aptitudes para la vida*. París: Organisation for economic co-operation and development.
- OECD (2003). *PISA 2003. Aprender para el mundo del mañana*. París: Organisation for economic co-operation and development.
- OECD (2006). *PISA 2006. Marco de evaluación. Conocimientos y habilidades en Ciencias, Matemáticas y Lectura*. París: Organisation for economic co-operation and development.
- McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. En D. A. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning*, (pp. 575-596). New York: McMillan.

PAPER PRESENTATION

The Relation between Situational and Individual Interest and the Quality of Instruction in Mathematics

Ariane S. Willems, TU Munich, Germany

The paper focuses on the analysis of students' interests in mathematics. Based on results that document a motivational decrease during students' school careers, it appears vital to identify contextual factors that facilitate interest development. Here, the theoretical framework of a situational interest is employed. This construct focuses on a two-phase process of externally triggering interests in particular learning situations and maintaining interests over

time. Comprehensive research results based on theories on learning motivation and theories on learning and instruction suggest that the instructional quality of classroom processes is a significant influencing factor for both triggering and maintaining interests. Theories on interest development complementary emphasize the association between a situational interest of students and a manifested subject-specific interest. As empirical evidence on the interrelation of the situational interest, the subject-specific interest, and the quality of instruction in math is currently lacking, the paper aims at disentangling the interaction of these constructs. It is investigated if the subject-specific interest moderates the influence of the quality of instruction on the two SI-phases. Using data from a questionnaire study (N=951 students; N=38 classes), cross-level interaction analyses applying HLM were performed. The results revealed that the situational and the subject-specific interest are related, but separate constructs. Both SI-phases are significantly predicted by different aspects of the quality of instruction. The strengths of these interrelations are mainly independent from the level of the students' manifested subject-specific interests.

Research results on the facilitation of students' learning motivation and interest in mathematics show that both, the learning motivation and the students' interest in math are relatively low and decrease over time (German PISA-Consortium, 2004; OECD, 2004; Rakoczy et al., 2007; Stigler et al., 1999; Kßller, Baumert & Schnabel, 2001). Although the causes for this situation are complex, empirical analyses recurrently document that the quality of instruction plays a vital role in explaining motivational processes across different subject areas (Rakoczy et al., 2007; German PISA-Consortium, 2004). Studies based on theories on learning and instruction primarily investigate a general, comprehensive quality of instructional processes which are measured by the students' retrospective perception of a typical (math) lesson. Such an approach sheds light on general trends in the development of students' learning motivation and interests. In particular, studies document that the perceived lesson structure, goal clarity, and cognitive activation are important variables that predict the quality of motivational processes (German PISA-Consortium, 2004; Kunter, Baumert & Kßller, 2007; Rakoczy et al., 2007). However, these macro-genetic assessments do not account for situation-specific aspects of instruction and are therefore insufficient to describe processes in the development of motivation/interest. Such shortcomings are addressed in current theories of interest development which explicitly distinguish between a situational and individual interest (SI/II). According to these theories, a SI is a content related motivational quality which emerges in response to specific features of a particular learning situation. (Hidi & Renninger, 2006; Krapp, 2002; Linnenbrink-Garcia et al., 2010; Schiefele, 2009). As such, SI is understood as a state-variable that mainly operates within specific learning situations. Conceptually, two developmental SI-phases are distinguished: Triggered and maintained situational interest (SI-Catch/SI-Hold; Hidi & Renninger, 2006; Mitchell, 1993). A triggered SI mainly involves heightening the affective experiences individuals associate with the learning environment; a maintained SI is a more involved, deeper form of the situational interest in which individuals begin to forge a meaningful connection with the learning content and start to realize its deeper significance. From an educational viewpoint, the SI-concept is important because it provides a description of how interests develop and may carry over from one learning situation to another.

Additionally, this framework suggests ways in which teachers can contribute to the development of their students' interests by identifying situational factors of a learning environment that help to trigger and maintain interests. In contrast to a relatively short-lasting SI, the individual interest of students is conceptualized as a trait-variable that has a dispositional quality and resides in individuals across situations (Krapp, 2002). In school contexts such as mathematics instruction, individual interests are usually manifested in stable subject-specific interests. From an ontogenetic perspective, triggering and maintaining interests in a particular learning situation facilitates the development of individual interests (Hidi & Renninger, 2006). Against this background, theoretical frameworks of interest development additionally emphasize the complex interdependence between the SI of students and their subject-specific interest: Following these considerations, states of interest in specific learning situations arise through an interaction between the person and the context (Krapp, 2002). Therefore both situational and individual factors should be taken into account when analyzing different levels of interest in specific learning situations. Following the Four-Phase-Model of Interest Development, first stages of interest should be more closely related to contextual factors and less to individual factors. This pattern should gradually change during the course of interest development, so that later stages of interest development should be less directly affected by contextual factors and more closely related to individual factors (Hidi & Renninger, 2006).

Generally, there is only little research on how contextual factors can promote interest in a particular learning situation. Furthermore, no empirical evidence exists that helps to disentangle the relationship between SI, subject-specific interest and the students' perception of the quality of instruction. One reason for this situation may be that the field currently lacks a valid and reliable tool for measuring SI. Such an instrument does not only need to differentiate between both SI-phases. Furthermore, the measurement scales used for assessing SI should be empirically distinguishable from a subject-specific, individual interest. In line with these considerations, the goals of this paper are (a) to introduce a measurement scale for the assessment of the SI, (b) to clarify the relationship

between the perceived quality of instruction and both SI-phases, and (c) to investigate the role of a subject-specific interest for the state of interest in particular learning situations. To approach these goals, a questionnaire study (951 8th grade students from 38 classes) was conducted. The students were surveyed immediately after a math lesson dealing with the topic linear functions. The questionnaire included newly developed scales for the assessment of SI-Catch and SI-Hold and scales for measuring the subject-specific interest and the quality of instruction. Cross-level interaction analyses were performed in which both SI-phases served as dependent variables on the individual student level, the three aspects of the quality of instruction as independent variables on the class level and finally, the subject-specific interest as (cross-level) moderator on the individual student level.

The results show that the two SI-phases can be empirically separated from each other and need to be distinguished from a subject-specific interest. As expected, all three interest constructs are positively correlated. The results obtained via HLM illustrate that a higher overall predictive power of the quality of instruction can be found for SI-Catch. When controlling for the individual interest, the predictive power of the quality of instruction for both SI-Catch and SI-Hold is only slightly reduced. The cross-level interaction analyses revealed that the strength of the relationship between the perceived quality of instruction and the situational interest is independent from the level of the subject-specific interest. Only one exception was found: The effect of the perceived goal clarity on SI-Catch is higher for students with high subject-specific interests. Although SI and II are highly associated, these results emphasize that contextual factors can trigger and maintain SI in math mostly independent from the individual interest level.

PAPER PRESENTATION

Cognitive, social and affective factors related to engagement in instrumental music learning

Jennifer StGeorge, University of Newcastle, Australia; Allyson Holbrook, SORTI, The University of Newcastle, Australia

The power of music to shape personal living and lifelong trajectories has been long acknowledged, but the experiences that contribute to successful and enjoyable participation in musical instrument learning have been less clearly identified. Drawing on mixed methods research that explored engagement with learning, I show how the nature and quality of the learning experience influenced continuing involvement with music for a group of children, youth and adults in Australia. I set out an explanation for continuation that consists of a set of interrelated experiential domains. When experiences in each of these domains of experience were satisfying, there was a greater likelihood for research participants to continue their involvement with music. This research provides a way of understanding how and why music students become attached to their learning and can continue to be so, illustrating the importance of considering both the individual and their context. The practical implications suggest that educators will be in a better position to foster musical meaning and affinity if they target students' practice approaches while closely appraising the social context of student learning.

Theoretical background and research question The power of music to shape personal living and lifelong trajectories has been long acknowledged, but the experiences that contribute to successful and enjoyable participation in musical instrument learning have been less clearly identified. Most individuals have to work hard to succeed at learning a musical instrument simply because playing an instrument fluently is not easy. For any instrumental music student, the demands of skill building are high: regular and accumulated practice, effective practice routines, self-evaluation and emotional perseverance (Hallam, 1997). However, to remain involved, the experience should be engaging mentally and emotionally in order for the child to effectively process and assimilate the required array of complex skills. Boredom and disinterest occur when these emotions and cognitions are not engaged (Damrad-Frye & Laird, 1989; Ryan & Deci, 2000b). The prevalence of boredom in studies of attrition from music (AMA, 2001; Bushong, 2005; Govel, 2004; Klinedinst, 1989; Pitts et al., 2000b; O'Neill, 2001) suggests that the mental, emotional, or subjective experience of learning is a significant determinant of children's decisions to continue. The aim of this study was therefore to investigate the subjective nature of the learning experience in childhood and youth, and to understand how these varied subjective experiences influence intention to continue learning an instrument. This paper summarises the findings from the final stage of a three part analysis.

Methods

In the research reported here, a mixed methods design with quantitative and qualitative methods as complementary strategies was used in order to explore overlapping but different facets of the phenomenon of music learning and its relationship with continuing participation (Greene, Caracelli & Graham, 1989). The first stage of the study consisted of a questionnaire administered to primary and secondary school students across eight schools (n=376). The questionnaire was administered to complete year-groups of students (Years 5 & 6, and 10 & 11) who were either currently learning a musical instrument, had discontinued formal instruction sometime in the past, or had never learned an instrument. In the second stage, group and individual interviews (n=66) were held with individuals who had learned an instrument during childhood and/or youth (primary school students, tertiary students and adults in the

community), and into young adulthood (tertiary students). The first stage employed descriptive and inferential analyses, while the qualitative method consisted of a bricolage of thematic and phenomenological analysis (Larkin, Watts & Clifton, 2006). The first stage laid the foundation for the major status qualitative method by establishing the dimensions of music learning most relevant to continuing participation, while in the second stage, the contexts and processes that underlay these dimensions were explained through an interpretive account of participants' experiences.

Overall findings

Through the synthesis of the two stages of analysis, an account was developed to explain the relationship between students' learning experiences and their decisions to continue learning. Participants' interactions across five interrelated domains determined how they developed, sustained or lost their connection to learning an instrument. The first, affinity for music, represented a connection with music; it constituted the degree of significance, value or meaningfulness held in music by the individual and was characterised by varying intensities of positive affective states. Affinity for music developed where learning was musically meaningful and where affective responses to learning and to music were predominantly stable and positive. Contributing to musically meaningful experiences were experiences in two further domains; the cognitive, which included participants' understanding of their learning and their levels of instrumental fluency, and the social, which involved the immersion of the student in repertoire that had resonance with their cultural context, that is, their families, their friends, and their learning environment. Figure 1 shows the relationships between each of these domains.

Discussion and conclusion

An understanding of the role affect plays in learning has been an important research agenda of recent times (Ainley, 2006; Isen & Reeve, 2005; Linnenbrink & Pintrich, 2002), although its role in instrumental music learning has been generally overlooked. This research explains that, as a connecting agent between the individual and the activity, affinity for music facilitates the learning of music. Having a high affinity for music was generally associated with continuing involvement, although this involvement varied across listening and making music. Affinity for music was both an outcome of consistent, positive involvement with music playing and learning, as well as a motivator for continuing. The notion of affinity comes closest to the concept of interest as discussed by Hidi and Renninger (2006). An important difference between their four-phase interest model and the phenomenon of affinity proposed here may be the power of affinity to be a potent, internalising influence that is not only gauged by positive affect, but more powerfully blossoms as self-identity, in this study, as a 'musician'. The concept of affinity provides a way of understanding how and why music students become attached to their learning and continue to be so, illustrating the importance of considering both the individual and their context (Beltman & Volet, 2008; Buckley et al., 2004; Evans, 2009). The account developed here points to ways in which teachers might explore the complex interrelationships between subjective, aesthetic, or emotional experiences and objective skill development in music performance education.

PAPER PRESENTATION

The impact of school support at home on students' educational aspirations and attitudes

Louise Elffers, University of Amsterdam, Netherlands

Positive educational attitudes are critical for school success. However, the strength of this relationship differs between sociodemographic groups. Various studies point at the important role of support for school in students' home environment for their educational attitudes and achievement. We conducted a study with a sample of 1438 first-year students upon entrance to post-secondary vocational education in the Netherlands. Using multilevel regression analyses, we assessed the influence of support for school in students' home environment on their educational aspirations and attitudes. Moreover, we examined differences in the amount of support, and in aspirations and attitudes, between various sociodemographic groups. Results indicate that support for school, in particular from parents and peers, has significant impact on students' educational attitudes and aspirations. Immigrant students report significantly higher aspirations and more positive general attitudes towards education. While limited support may explain why immigrant students often appear less successful in transforming their positive attitudes and aspirations into school success, our findings do not correspond with such an explanation. Some sociodemographic groups that are overrepresented in Dutch dropout statistics report lower levels of support in their home environment, which may play a role in this overrepresentation. Implications of our results for educational research and practice are discussed.

Introduction

Educational attitudes and aspirations are positively related to academic achievement. However, the strength of this relationship differs between sociodemographic groups. Various studies point at the important role of support for

school in students' home environment for their educational attitudes and achievement. Limited support at home may restrain students from succeeding in school despite positive attitudes. In this paper, we assess the influence of support for school in students' home environment on their educational aspirations and attitudes. Moreover, we examine differences in the amount of support, and in aspirations and attitudes, between various sociodemographic groups.

Theoretical framework

Positive educational attitudes are critical for school success. If students have high aspirations and positive attitudes towards their education, they are more likely to succeed (e.g. Ekstrom et al. 1986; Maehr and Meyer 1997; Morgan 2005; Sewell and Shah 1968; Tinto 1993). However, while students with a lower socioeconomic or immigrant background generally report more positive aspirations and attitudes, those aspirations and attitudes do not seem to contribute to their school success as much as for middle class and non-migrant students (Alexander, Entwisle and Bedinger 1994; Downey, Ainsworth and Qian 2009; Kao and Tienda 1998; Mickelson 1990; Van der Veen and Peetsma 2006). The expectations that significant others hold of the student may play a mediating role in the relationship between sociodemographic background and educational attainment (Davies and Kandel 1981; Sewell and Shah 1968). The interpersonal influence of significant others on students' aspirations and expectations is a prominent notion in motivational research as well (Wigfield, Eccles and Rodriguez 1998). In particular, the importance of parents' emotional and practical support for school has been established in various studies (Alexander, Entwisle and Kabbani 2001; Ekstrom et al. 1986; Hossler and Stage 1992; Linnenbrink-Garcia and Fredricks 2008; McCarron and Inkelas 2006; McMillan and Reed 1994; Rumberger 1995; Schoon 2008; Trusty 1998). Peer behavior and attitudes have been shown to impact students' educational attitudes as well (Chang and Le 2005; Ryan 2000; Steinberg, Dornbusch and Brown 1992). Students make use of supportive ties from various networks for their school careers (Crul 2000; Stevens et al. 2009). For many working class and minority youth, the supportive ties that are particularly useful for their school career may be found mainly outside the family, for instance among other relatives or friends (Stanton-Salazar and Dornbusch 1995; Stevens et al. 2009).

Method

We conducted a study with a sample of 1438 first year students upon entrance to post-secondary vocational education in the Netherlands. The following variables were measured with a self-report questionnaire:

- . Sociodemographic characteristics: gender, age, ethnic background, socioeconomic status (parents' job status, educational level parents, financial circumstances)
- . Support for school: parents ($\alpha=.67$), peers ($\alpha=.68$), community in general ($\alpha=.73$).
- . Educational aspirations ($\alpha=.74$), general attitudes towards education ($\alpha=.80$).

We performed multi-level regression analyses with class ($N=61$) and students ($n=1438$) as two levels.

Preliminary results

1. Impact support on educational attitudes

The amount of support has a significant impact on students' aspirations and educational attitudes. Support from parents has most impact on students' aspirations ($b=.18$, $p=.021$, p

2. Differences in support

Boys ($b= -.12$, $p=.033$, $p=.028$, $p=.036$, $p=.040$, $p=.041$, $p=.016$, $p=.023$, $p=.026$, $p=.026$, $p=.039$, $p=.018$, p

3. Differences in educational attitudes and aspirations

Immigrant students report significantly higher aspirations (Surinamese students $b=.40$ $p=.027$ $p=.040$ $p=.030$ $p=.039$ $p=.056$, $p=.038$, $p=.011$, $p=.006$ $p=.012$, $p=.019$, p

Discussion

Our results attest to the importance of support for school in students' home environment for their educational aspirations and attitudes. Boys, some immigrant groups, students with low educated parents and students from poor families report lower levels of support from parents, and/or from peers and their community in general. Those groups are overrepresented in Dutch dropout statistics (Dutch Ministry of Education Culture and Science 2009). It is possible that lower levels of support for school play a role in this overrepresentation. Immigrant students report higher aspirations and more positive attitudes. While limited support may explain why immigrant students often appear less successful in transforming their positive attitudes and aspirations into school success, our findings do not correspond with such an explanation. The immigrant groups who score significantly higher on aspirations and attitudes, do not score significantly lower on support, with the exception of students from other ethnic backgrounds than native Dutch/Moroccan/Turkish/Surinamese/Antillean. A longitudinal follow-up study will enable us to assess the impact of

students' aspirations, attitudes and support on their achievement. We hope to present results from this follow-up study at the Earli 2011 conference as well.

Our findings stress the value of a broad perspective, taking into account both the home and school context, in research on motivational processes and academic achievement. Moreover, our findings underline the necessity to compensate limited supportive resources in students' lives, as those resources have significant impact on their orientation towards school. Schools and community organizations can offer personal coaching and support, with the help of mentors at school, external coaches, or peer tutoring programs, to ensure adequate access to resources to support successful school careers for all.

PAPER PRESENTATION

The effectiveness of one-to-one private tuition in England

Katie Rushforth, Institute of Education-London, United Kingdom; Judith Ireson, Institute of Education-London, United Kingdom

Amidst reports that the private tuition industry is rapidly expanding and government pledges to fund one-to-one tuition for a substantial number of students in England, this paper examines the impact of private tuition on attainment. Research shows that tutoring programmes can be very effective in raising achievement, yet some studies have found negligible learning gains. This paper presents findings on the impact of one-to-one private tuition in maths and English on Key Stage 2 (KS2) and General Certificate of Secondary Education (GCSE) achievement. Data on private tuition participation was collected from over 2000 pupils aged 10-11 and 15-16 years from 30 primary and 28 secondary schools in England, and was matched with centrally collected government data on achievement. Using statistical modelling that reflects school effects in the data and controlling for prior attainment and pupil background characteristics, private tuition in maths was found to have a significant impact on maths achievement at GCSE. There was no evidence to suggest that private tuition in English made an impact on respective GCSE or KS2 attainment. Using a combined measure of tuition in any subject, findings indicated that extended periods of private tuition made a small impact on maths KS2 and GCSE achievement. These findings suggest that one-to-one tuition in mathematics may give students an advantage in the education system but that tuition in English may be less effective. Reasons for these differences are discussed.

Aims

International surveys indicate wide variation in the extent of private tutoring (Baker, Akiba, LeTendre, & Wiseman, 2001). A recent survey of parents in England found that 12% of primary and 8% of secondary school pupils participate in private tuition (PT) (Peters, Carpenter, Edwards, & Coleman, 2009). The "Mapping and Evaluating Shadow Education" (MESE) project found 27% of pupils had participated in PT at some point during their schooling (Ireson & Rushforth, 2009). These findings suggest that a large proportion of parents consider PT a worthwhile investment, perceiving a link between educational achievement and future career progression. Despite the numbers of students participating in PT, research in this field is largely absent from the education literature. Amidst reports that the PT industry is rapidly expanding and government pledges to fund one-to-one tuition for a substantial number of students in England, this paper aims to investigate the impact of PT on attainment at two transition points in the education system; the end of Key Stage 2 (KS2) when students are aged 10-11 (year 6) and the end of Key Stage 4 (KS4) when students take their GCSE examinations aged 15-16 years (year 11). Ellson (1976) states that "there is a widespread belief among educators and laymen that individualised instruction, especially in a one-to-one teaching situation, is almost infallibly effective" (p. 133). Logically one could conclude that spending time engaged in supplementary learning activities would increase achievement; however as a number of studies have shown this does not always convert into higher test results (Baker et al., 2001; Ireson & Rushforth, 2005; Smyth, 2008, 2009).

Methodology

The data analysed for this paper was collected as part of the MESE project which employed a stratified sampling strategy through the distribution of questionnaires in schools selected to represent a range of demographic areas. The sample included schools from Local Authorities (LAs) across central and southern England with a range of ethnic diversity and social disadvantage, from a cross-section of urban, suburban and rural areas including both selective and comprehensive schooling systems. In total 30 primary and 28 secondary schools were involved in the study from 10 LAs. This provided questionnaire responses from a total of 2468 pupils. KS2 and GCSE attainment and pupil background data supplied by the Department for Children, Schools and Families was utilised to determine the impact of PT on attainment. Statistical modelling was completed using fixed effects robust regression models to give less weight to outlying cases and to ensure transparency during data analysis (Beaton & Tukey, 1974; Huber, 1964; StataCorp, 2009). To reduce the risk of making inaccurate inferences in the presence of heteroskedacity, the robust estimate of variance (Huber, 1967; White, 1980) was also calculated. To explore the impact of PT on achievement,

separate models were constructed for year 6 and year 11, using KS2 tests and GCSE examination results as the dependent variables. The models controlled for prior achievement, gender, home possessions, time spent on homework, extra classes, gender and ethnicity. Three different measures of PT were added to the models to indicate participation in English and maths tuition and a combined measure of PT in any subject. For each year group variables were included to reflect the intensity of PT participation (one term or two or more terms).

Summary of main findings

The analysis revealed that PT in maths and the combined measure of PT in any subject had significant effects on maths GCSE scores. The overall effect of two or more terms tuition in maths during the two years prior to taking the GCSE examinations represented an effect size (ES) of 0.25 (nearly half a GCSE grade). No evidence was found to suggest that PT in English made an impact on respective GCSE or KS2 achievement, although the combined measure of PT in any subject had a significant effect on English score in the GCSE analysis. A significant effect was found for extended periods of PT in any subject on KS2 maths score (ES 0.24). An analysis of the interactions between PT and other explanatory variables indicated that the effect for PT was greater for certain groups of students and in certain subject areas; however, the interactions were based on very few participants and should be treated with caution.

Significance of the research

This paper presents, for the first time, a systematic and rigorous analysis of the effects of PT on student attainment at two key transition points in the English education system. It employs an innovative methodology that combines data collected centrally by government with data from questionnaires completed by students. The findings extend an earlier analysis of a subset of data (Ireson & Rushforth, 2005) and indicate that intensity is an important variable to include in future research. In 2007, the government outlined plans to provide progression tuition by qualified teachers for students who are not making expected levels of progress. Progress tuition comprises an "intensive burst [10 hours] of individual tuition" in English and/or maths for a number of pupils aged between 7 and 14 years (KS2 and KS3) (Department for Education and Skills, 2007, p. 23). An evaluation of progression tuition in the pilot phase found a small significant effect on progress in reading and writing but no significant impact in maths (Pricewaterhouse Coopers LLP, 2010). In April 2009 the government provided funding directly to all LAs to allow 3.5% of KS2 and KS3 pupils to access one-to-one tuition. The provision of progression tuition in the state sector is likely to have an impact on PT providers and the demand for PT in England (Rushforth, 2010).

PAPER PRESENTATION

The family-study interface and academic outcomes: Testing a structural model

Marieke Meeuwisse, Erasmus University Rotterdam, Netherlands; Marise Ph. Born, Erasmus University Rotterdam, Netherlands; Sabine Severiens, Erasmus University Rotterdam, Netherlands

Expanding on family-work and work-study models, this paper investigated a model for family-study conflict and facilitation. The proposed model extended prior research by explicitly distinguishing between time-based, strain-based and behavior-based conflict, and instrumental and affective facilitation. The focus of the study was the relationship between these types of family-study conflict and family-study facilitation and students' effortful behaviors, school satisfaction and academic performance among a sample of university students (N = 1656). Model tests using structural equation modeling identified participation in family activities, family social support and involvement with family as antecedents of both family-study conflict and family-study facilitation. In turn, family-study conflict was negatively related to study effort and school satisfaction, and family-study facilitation positively contributed to students' study effort and school satisfaction. Both effort and school satisfaction positively predicted students' GPA.

School is an important realm of students' lives. However, student jobs have become a major activity as well (Butler, 2007; Derous & Ryan, 2008). Besides work, students also spend time with their families and are involved in leisure activities (e.g., spending time with friends, sports). As a consequence, students need to combine their role as a student with their roles as an employee, family member and friend. Combining multiple roles can result in conflict between (Ford, Heinen & Langkamer, 2007; Greenhaus & Beutell, 1985) as well as facilitate (Greenhaus and Powell, 2006; Wayne, Grzywacz, Carlson & Kacmar, 2007) these roles. Although most research has focused on the work-family interface, several recent studies suggested similar conflicts and facilitation between work and school (Butler; Markel & Frone, 1998). As Herndon and Hirt (2004) argue that the family is important for educational attainment, the present study investigates to what extent possible experienced family-to-study conflict and family-to-study facilitation relate to the school performance and school satisfaction of students.

The participants are 1656 fulltime university students at a four year university in the Netherlands. Each participant completed an online version of a questionnaire measuring conflict and facilitation between the family domain and the

study domain, possible antecedents of conflict and facilitation, and academic outcomes (see Table 1). Structural relations are estimated using linear structural modelling analyses (Amos) (Arbuckle & Wothke, 1999).

The present study revealed several general findings concerning the family-study interface (see Figure 1). First, it was shown that the more students participate in family activities (e.g., spending time with family, household duties for the family), the more time-based conflict they experienced between their family lives and their lives as students. Second, family support negatively predicted time-, strain- and behavior-based conflict. In other words, the more students perceived support from the family, the less conflict they reported between their family and study. Third, the results indicated that involvement with the family is positively related to strain-based family-study conflict. This means that the more students were involved with the family, the more stress they seem to experience combining their family lives and their study. Contrary to expectations, the relationships between involvement with the family and time- and behavior-based conflict were non-significant.

As regards family-study facilitation, family support and the students' involvement with the family appeared to be antecedents of instrumental and affective family-study facilitation. In other words, the more students perceived family support and the more students were involved with the family, the more family-study facilitation they reported. Our study also demonstrated that students' effortful behaviors and school satisfaction are affected by the family-study interface. Time- and behavior-based conflict negatively affect students' effortful behaviors, which on the other hand were positively, and more strongly, affected by affective family-study facilitation. Students' school satisfaction was negatively predicted by strain-based family-study conflict and positively, and again more strongly, by affective family-study facilitation. Finally, academic performance was positively predicted by effortful behaviors and study satisfaction, with effortful behaviors being the strongest of both predictors.

In sum, the results of the present study show that known antecedents of the family-work interface also operate in the family-study domain and that conflict and facilitation, as extensively studied between family and work, also exist between family and study. Furthermore, it was found that experienced family-to-study conflict and family-to-study facilitation relate to students' school performance.

This study has several implications for research on interrole processes and on the relationship between family and study in particular. Most studies on interrole processes to date have focused on the relationships between work and family (Ford et al., 2007; Greenhaus & Beutell, 1985; Greenhaus & Powell, 2006; Wayne et al., 2007). Studies on the relationship between work and a non-work role such as school (Butler, 2007; Markel & Frone, 1998) have only recently been conducted. However, no prior studies have shifted these theories on interrole processes away from the work domain and applied them to non-work domains such as family and school. The results of the present study show that processes of conflict and facilitation, as extensively studied between family and work, also exist between family and study.

Second, this study shows the importance of family in the lives of students in higher education. Family support reduces the conflict experienced between family and study and increases the family-study facilitation experienced, which in turn positively impacts study effort and ultimately students' grades. Involvement with the family enhances both instrumental and affective family-study facilitation, resulting in more study effort, school satisfaction and in the end in higher grades. These positive contributions of family involvement on facilitation seem to outweigh the negative impact of strain-based family-study conflict resulting from higher levels of involvement with the family. In terms of opportunities to improve academic success (higher grades), support for involvement with the family and creating family support are probably effective policy measures.

References

- Arbuckle, J. L. & Wothke, W. (1999). *Amos 4.0 users guide*. Chicago, IL: Smallwaters Corporation.
- Butler, A. B. (2007). Job characteristics and college performance and attitudes: A model of work-school conflict and facilitation. *Journal of Applied Psychology*, 92(2), 500-510.
- Derous, E. & Ryan, A. M. (2008). When earning is beneficial for learning: The relation of employment and leisure activities to academic outcomes. *Journal of Vocational Behavior*, 73, 118-131.
- Ford, M. T., Heinen, B. A. & Langkamer, K. L. (2007). Work and family satisfaction and conflict: A meta-analysis of cross-domain relations. *Journal of Applied Psychology*, 92(1), 57-80.
- Greenhaus, J. H. & Beutell, N. J. (1985). Sources of conflict between work and family roles. *The Academy of Management Review*, 10(1), 76-88.
- Greenhaus, J. H. & Powell, G. N. (2006). When work and family are allies: A theory of work-family enrichment. *Academy of Management Review*, 31(1), 72-92.

Herndon, M. K. & Hirt, J. B. (2004). Black students and their families: what leads to success in college. *Journal of Black Studies*, 34, 489-513.

Markel, K. S. & Frone, M. R. (1998). Job characteristics, work-school conflict, and school outcomes among adolescents: Testing a structural model. *Journal of Applied Psychology*, 83(2), 277-287.

Wayne, J. H., Grzywacz, J. G., Carlson, D. S. & Kacmar, K. M. (2007). Work-family facilitation: A theoretical explanation and model of primary antecedents and consequences. *Human Resource Management Review*, 17, 63-76.

PAPER PRESENTATION

The learning life course of at 'risk' children aged 3-16: Perceptions of students and parents

Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom

The paper reports on 50 Child and Family Case Studies (CFCS) that were conducted as part of the Effective Provision of Pre-School, Primary and Secondary Education (EPPSE) research project. The CFCS was designed as a mixed-methods study in order to look at why and when certain children manage to succeed 'against the odds' while others do not. Using in-depth interviews with students, parents and teachers, quantitative data available from EPPSE and a literature review on risk and resilience, the CFCS provides 'thick descriptions' and explanations of how child, family and school factors interact and contribute to children succeeding against the odds of disadvantage. The study shows that in families with children succeeding against the odds, parenting is characterised by 'active cultivation' and that schools, teachers, peers and the wider community contribute to children's academic success by providing emotional, practical and relational support. As a result these children are facilitated and encouraged to develop a combination of positive cognitive and socio-behavioural characteristics that helps them become active agents in their learning life-course. The CFCS provide information that can be of use to both policymakers and practitioners. It has implications for parenting and home-school relations and may serve to inform policies and practices that aim to increase the chances of children 'at risk' and help in closing the gap between those who are academically and socially advantaged and disadvantaged.

Background

The Effective Provision of Pre-School, Primary and Secondary Education (EPPSE) research project is a large scale, longitudinal, mixed-method study that has followed the progress of 3000+ children from the age of 3 to 14 and will continue to do so beyond the end of their compulsory schooling (age 16 in the UK). An ongoing focus for EPPSE is the extent to which pre-school, compulsory education and children's home learning experiences (HLE) can reduce inequality. While the study found that parents' socio-economic status (SES) and levels of education were significantly related to child outcomes, it also found that the quality of the HLE was important: it was what parents did that was more important in terms of the children's outcomes than who they were (Melhuish et al., 2001; Sammons et al, 2002).

A pilot study funded by the UK Cabinet Office focussed on disadvantaged children who were unexpectedly over-achieving at the end of primary education. It found that their families often had high aspirations and provided significant educational support that resembled 'concerted cultivation' (Lareau, 2003; Siraj-Blatchford, 2010).

In this paper we report on 50 mixed-method Child and Family Case Studies (CFCS) that were conducted when the children were in secondary education, in order to extend our understanding of how child, family and school factors interact and contribute to children's achievements.

Aims

The CFCS aimed to help us understand more fully the statistical patterns that have been found in the quantitative analyses of the EPPSE sample. The general question addressed in the CFCS was 'When and why do some 'at-risk' children succeed 'against the odds' while others fall further behind?', specifically looking at:

1. Key factors within families shaping educational outcomes of resilient and vulnerable children and how this varies with ethnicity;
2. The role of the school and teachers in enhancing or neglecting to promote children's academic and social potential at different ages i.e. leading to resilience or vulnerability;
3. Factors, external to school and family, that influence children's views of themselves as successful learners;
4. Views of vulnerable and resilient children and their parents of the children's educational experiences.

Methodology

In developing the CFCS we applied an adaptation of grounded theory. A systematic purposeful sample was obtained by using multilevel modelling on the EPPSE 3-11 sample (N=3172). Residual scores were created for each child, indicating differences in predicted and obtained academic achievement for English and Maths at age 11, while controlling for age, gender, birth weight, early developmental problems, parent education, social class and family

income (Melhuish et al., 2008). Three performance groups were created based on these residuals: 'succeeding against the odds', 'performing as predicted', and 'unexpected underachievers'. Family SES was then used to create four groups: socioeconomically disadvantaged children performing either as predicted or above prediction and advantaged children performing as expected or below prediction.

Two forms of analysis were conducted. Firstly the learning trajectories for English and Maths were identified for each child. Assessments spanning age 3 to 14 were ranked according to their relative position to the full EPPSE sample. Five general patterns described the trajectories: stability, improvement, decline, changeability and mixed (i.e. different trajectory for each subject).

Secondly, using NVivo software, interviews with 50 parents and students and 28 teachers were coded and analysed through an iterative process. Codes continued to be readjusted and redefined as we moved back and forth between the qualitative interview data, quantitative EPPSE data and relevant (inter)national literature on protective and risk factors.

Findings

The trajectories showed apparent differences between children before they started school. The succeeding children's initial rankings were relatively high and their trajectories were characterised by improvement. The general pattern of decline observed for more vulnerable children suggested a poor goodness-of-fit between their specific needs and the ability of schools, teachers and parents to tailor to these needs.

The systematic qualitative analysis identified protective and risk factors that influenced children's academic trajectories. Child related factors included perceived cognitive ability, self-regulation, psychological resilience, problem-solving strategies, intrinsic motivation, goal orientation and relationships with parents, teachers and peers. Positive attribution was associated with more successful adaptation to school and learning. The positive perception of the child as a learner was reinforced by parents, family, teachers, peers and the extended social environment. In contrast, negative attribution appeared to interfere with learning processes and contributed to and reinforced a sense of helplessness in children and (often) parents.

Parenting in families with children succeeding against the odds was characterised as 'active cultivation'. In these families parents provided rich (early) HLE experiences and went to great lengths to provide a broad range (extra curricular) learning experiences, often by enlisting their social network. These parents provided abundant practical, emotional and relational support for learning. They emphasized the importance of education, expressed consistent and high expectations regarding behaviour and (future) achievement and facilitated development of self-regulation skills, particularly for girls. From pre-school onwards, parents made it clear to their children that school and teachers were to be respected and perceived as important sources of learning.

High quality teaching (as perceived by children) helped students bond with teachers and encouraged them to achieve beyond their predicted attainment. How well schools were perceived to deal with children's specific educational needs reinforced positive or negative attitudes towards school and learning, both for students and parents. For vulnerable children, reports of high numbers of supply teachers and disorganized lessons were seen to have contributed to lower attainment.

Positive peer relationships and friendships facilitated academic success through emotional and practical support for children succeeding against the odds, while for others different forms of peer group/friendship relationships could reinforce negative attitudes to school and learning for academically less successful children.

Theoretical and educational significance

The CFCS provide information that can be of use to both policymakers and practitioners. It has implications for parenting and home-school relations and may serve to inform policies and practices that aim to increase the chances of children 'at risk' and help in closing the gap between those who are academically and socially advantaged and disadvantaged.

PAPER PRESENTATION

Scientific trends in the field of teacher education

Kristine Balslev, Universite de Geneve, Switzerland

This literature study deals with current researches in the field of teacher education. It is based on the analysis of articles published between 2005 and 2010 in *Teaching and Teacher Education*. It attempts to describe the scientific

trends in this field by pointing the main aims, the methodological approaches and tools, and the issues of the studies presented in these articles. Furthermore, it seeks to point out strengths and weaknesses of these studies.

Teacher education is an immense, current and increasing research field. The Educational Resources Information Center (ERIC) proposes around 10'000 articles having the expression - teacher education - in the key words published in peer-reviewed journals between 2000 and 2010 ; and numerous journals have - Teacher education - as a core subject (for example, *Teaching and Teacher Education*; *Journal of Teacher Education*; *Action in Teacher Education*; *Teacher Education Quarterly*; *Issues in Teacher Education*). A way to better know this research field is to make an analysis of recent scientific articles. There are many types of researches on the theme of teacher education and in order to have an overview of the kind of studies that are conducted in that domain and to explore the main trends in this field, we are conducting a literature study on the articles published between 2005 and 2010 in the journal *Teaching and Teacher Education*. We chose this journal because it is international and peer-reviewed. This journal publishes 8 issues per year, and each issue has between 7 and 40 original research articles. 730 original research articles written by authors from all around the world have been published in the five last years. It should well reflect the main trends of our domain of interest. The analysis of these articles consists in listing the key words and marking out theoretical concepts, theoretical frameworks, and resource - authors of the articles; identifying the main aims and issues (pragmatic, ontogenic, political or nomothetic, Van der Maren, 1996) of the studies the articles deal with. We are specially concerned with methodological aspects, therefore we identify these studies' approaches (qualitative, quantitative or mixed-designs); their main instruments (questionnaires, interviews, tests, reflexive journals, observations, videotapings, etc.); the number of subjects studied in the researches; the types of data gathered; and the way the data is analysed. The principal aim is to describe the types of scientific studies in this field, and to point out dominant types of researches as well as marginal ones. We started this analysis recently and our first findings (based on the analysis of 33 articles) show that nearly most (18 of 33) of the articles relate to studies that adopt an interpretative or qualitative approach (hermeneutic phenomenological research inquiry, comprehensive approach, case studies, narrative methodology, grounded theory methodology, ethnographic study, inductive analysis, self-study, autoethnography); less than a fourth (7 out of 33) can be considered as being experimental (using quantitative data and measures, and making statistical analysis such as hierarchical regression analysis or logistic regression); and fourth (8 out of 33) adopt mixed designs. We also noticed some recurrent and main aims, such as evaluation of teacher education programmes; description of teachers (or pre-service teachers) beliefs, values, emotions; description of teachers' reasonings; describing teachers' experiences and practices; the rate of satisfaction of pre-service teachers or new teachers; description and evaluation of effects teacher education programmes; understanding of teachers' professional identity construction. Our presentation will point out the aspects of teacher education that are recurrent in studies about teacher education and those that are absent; the strengths and weaknesses of studies conducted in the field of teacher education; the dominant theoretical frameworks; the authors and theoretical frameworks that researchers and this domain relate to. We will discuss the methodological features of these studies. We will also present future perspectives of this research, i.e. complete this analysis with the one of articles published in other European scientific journals, French scientific journals (for example *Repères*) and American ones (for example *Journal of teacher education*).

PAPER PRESENTATION

Perceptions Regarding the Accomplished Teacher among research and teaching oriented institutes

Irit Levy-Feldman, Kibutzim College, Israel; David Nevo, Tel Aviv University, Israel

Issues related to the "accomplished teacher", effective training programs and whether these programs are better taught at universities or at special teacher education colleges, are at the center of public debate in recent years, in Israel and elsewhere. The professional literature has described six core components of the accomplished teacher. These include three traditional components and three contemporary or modern components.

The aim of this study

To examine perceptions of the core components among teacher educators from universities and teacher colleges in Israel. It also looks at differences in these perceptions between schools of education and other faculties in the universities. Data was collected by questionnaire from a total of 523 staff members in research and teaching institutes in Israel. Quantitative method was used. The research findings carry both theoretical and practical implications. The currently prevailing notion of the effective teacher reflecting the complexity of teaching as it is now understood. In the present study these components can be traced back in the attitudes of teacher educators – whether in universities or at the teaching colleges. Furthermore, the study's results can give us some idea about the various advantages and drawbacks of teacher education in the different institutes – thus adding valuable findings to question regarding the desirable location of teacher education.

The purpose of the study

Teacher education takes place both in research-oriented and in teaching-oriented institutes. In Israel the difference between the institutes is clear cut. Teacher colleges are teaching-oriented institutes and universities are research oriented. Usually research oriented institutes enjoy higher academic status because they are seen to emphasize academic knowledge, generating new knowledge, research and criticism. Teaching institutes have relatively lower academic status, they are identified as pedagogical-professional in nature with a focus on practice, learning, interpersonal relations and collaboration. (Levy-Feldman, 2008; Niderlanc, Dror, & Hoffman, 2007). In addition, there is also evidence of differences within research institutes between schools of education and other faculties. Schools of education have a relatively low status in the research institute of which they are part (Goodlad, 1990a, b, 2002; Labaree, 2004, 2008; Levy-Feldman, 2004, 2008). The purpose of this study was to examine perceptions of core components of accomplished teachers, as they appear in the professional literature, among teacher educators from "research-oriented" and "teaching-oriented" institutes and, unlike other studies, this study looks also at differences in held perceptions between university-based schools of education and other faculties in the universities.

Theoretical Background

The literature describes six core components of the accomplished teacher (Carnegie Foundation, 1986; Holmes Group, 1986). The formulation of these components refers to both traditional and modern educational philosophies beginning with Dewey (1959) and developed by other educational philosophers (for example: Aloni, 2005; Fenstermacher & Soltis, 1986). One approach in traditional philosophy is cultural, regarding education as a process of acculturation. This philosophy considers education as part of the humanities and has been identified with the educational approach of research-oriented institutes) Darling-Hammond, 1987, 1997; Darling-Hammond & Snyder, 2000; Feiman-Nemser, 1990; Shulman, 1987; Zeichner, 1994). Teacher training emphasizes the teacher's subject matter knowledge and the pedagogical skills specific to the subject matter (Darling-Hammond, 1987). According to the second traditional approach, social philosophy, education is a tool in the service of socialization, Fenstermacher and Soltis (1986) describe this approach as "the executive approach". The main goal is to transmit knowledge. Teacher training emphasizes teaching theories and techniques and promotes teachers' general pedagogical skills (Cochran-Smith, 2004). This philosophy has been identified with the educational approach of teaching-oriented institutes (Feiman-Nemser, 1990; Cochran-Smith, 2004; Zeichner, 1994). From the 1990s a modern, student-centered philosophical approach towards education developed (Aloni, 2000; Dewey, 1959; Fenstermacher & Soltis, 1986). The goal of education, here, is to create the optimal conditions for self-growth with no direct connection to cultural or social goals. The accomplished teacher is required to be committed to the full diversity of students and their learning. Such a teacher is called a "caring" teacher (Noddings, 1999), and his professional development fosters the ability to critically examine his own practice (reflection) (Silberstein, 1998) as well as to cope with and adjust to ongoing changes. Hence Shulman's (2005) notion of the "pedagogy of uncertainty". To be able to acquit himself of this, the accomplished teacher also must be involved in a learning community. Modern approaches are not clearly identified with either research or teaching institutes. But when looking at what the literature describes as good teacher education - broad and authentic practice, teaching research, staff and institute support (Darling-Hammond, 2005, 2006; Feiman-Nemser, 1990; Goodlad, 1990a; Howey & Zimpher, 1989) - it would seem that teaching institutes are more likely to train accomplished teachers (Levy-Feldman, 2008).

Research questions and hypothesis

The first research question examines differences between staff members in research and in teaching institutes regarding components of the accomplished teacher. We hypothesized that staff members from research institutes will emphasize traditional components especially those that are associated with their institute. Teaching institutes will mainly emphasize modern components but also general pedagogical skills, a traditional component that can be attributed to teaching institutes. The second research question examines differences regarding the components between three groups of staff members: from teaching institutes, university-based schools of education and other faculties in the universities. We assumed that staff from school of education in the research institutes and from teaching institutes would resemble each other more than staff in other faculties of the research institutes. MethodData was collected by questionnaire from a total of 523 staff members in research and teaching institutes in Israel. Quantitative method was used. The questionnaire was validated both through a pilot study as well as in the subsequent study.

Findings and implications

Data analysis supports the main research hypothesis. Faculty members in teaching institutes emphasize what we defined as modern components, while faculty members in research institutes emphasize traditional ones. However, when we look within research institutes, the outcomes change. While science and humanity faculties rank traditional components highly, schools of education emphasize both modern and traditional components. Findings show that participants from both teachers colleges and schools of education in the universities attribute high significance to

modern components of the accomplished teacher. In teachers colleges the emphasis is mostly on the teacher's commitment to students and their learning, as well as to cooperation and membership in learning communities. Schools of education focus mainly on the teacher's professional development. In addition, schools of education attribute high importance to the teacher's subject matter knowledge. In this they differ from teachers colleges as well as from their colleagues in the other faculties of the research institutes. Practical and theoretical significance These findings carry both theoretical and practical implications. The currently prevailing notion of the effective teacher includes a core of traditional as well as modern components, reflecting the complexity of teaching as it is now understood. In the present study these components can be traced back in the perceptions of teacher educators – whether in research or at the teaching institutes. They can, indeed, be used to evolve a profile of the good teacher and as such contribute to the ongoing debate on this issue. Moreover, the broad view taken by this study, taking into account the various actors in teacher education, allows better understanding as well as more accurate comparison between research and teaching institutes, and therefore more valid conclusions and recommendations. Furthermore, our results reveal that the idea, reflected in policy-level recommendations in Israel, regarding a connection between type of institution, the accomplished teacher and the best mode of training in teacher education, is misguided. The present results can give us some insight into the various advantages and drawbacks of teacher education in the different institutes under examination – thus adding valuable findings regarding the issue of the desirable location of teacher education, indicating that settings are more than just sites (Houston, 2008; Robinson, 2008; Zeichner, 2008; Zeichner & Conklin, 2008).

PAPER PRESENTATION

Using Video to Assess the Development of Professional Vision in Teacher Education

Kathleen Sturmer, School of Education, Germany; Geraldine Blomberg, TUM School of Education, Germany; Tina Seidel, Technische Universität München, Germany

There is a general consensus among researchers and teacher educators that video has the potential to be a valuable tool for supporting pre-service teacher learning. Thus, video has become a popular resource in teacher education. This study presents how video can be used to assess development of professional vision in the context of pre-service teacher education. Teachers' professional vision is the ability to engage in knowledge-based reasoning about components of effective teaching and learning in the professional observation of classrooms. Professional vision is a critical component of teachers' expertise and thus should be developed during teacher education. We developed an internship-term to foster professional vision by supporting the integration of theoretical knowledge (video-based university courses) and conceptual knowledge (practical experiences at school). Development of professional vision was assessed via the video-based, yet standardized online tool Observer in a pre-/post design with N=110 pre-service teachers. Our findings indicate substantial gain of professional vision over the course of the four-month internship-term and present a useful concept as well as design to foster professional vision at an early stage of teacher education programs.

Introduction

Professional vision is an important component of teacher expertise (Goodwin, 1994). It describes teachers' ability to apply their knowledge of teaching and learning processes in order to notice and interpret significant features of classroom situations (van Es & Sherin, 2002). However, teacher candidates during teacher education are often not yet able to reason about key elements of classroom instruction (Star & Strickland, 2008). When it comes to foster professional vision, previous studies have shown that video-based trainings can help teachers to engage in knowledge-based reasoning on teaching and learning processes in authentic contexts (Sherin & van Es, 2009). However, these programs are mostly targeted on experienced teachers. Few studies have assessed the impact of video-based trainings of professional vision for pre-service teachers at the beginning of their careers (van Es & Sherin, 2002; Star & Strickland, 2008; Santagata & Guarino, in press). Furthermore, the findings available do not derive from standardized studies wherefore they do not allow general conclusions to be drawn about specific conditions under which teacher candidates develop professional vision in video-based teacher education programs (Star & Strickland, 2008). To systematically foster and study pre-service teachers' development of professional vision in a video-based way, several characteristics of professional vision need be considered. Professional vision is a strongly knowledge guided process (Palmeri, Wonn, & Gauthier, 2004) what requires to offering specific theoretically knowledge about teaching and learning. Furthermore, with regard to pedagogy, the development of professional vision can only occur through a contextualized generalization of knowledge in the course of practical experience (Putnam & Borko, 2000). In addition, we need some degree of standardization to assess growth and to analyze how to foster pre-service teachers' professional vision (Kersting, 2008). This led us to (1) develop an intervention (internship-term) that fosters the integration of conceptual and practical knowledge and (b) to evaluate this intervention with a tool that combines contextualizing video prompts with standardized rating items. Against that background, we investigate how professional vision develops over the course of the internship term.

Internship-term

The four-month internship-term combines elements of practical experience at schools and course work at university. The university course offers theoretical input and use of video-based examples to successively deal with the educational content of effective instruction (goal clarity, learners' support, learning climate). To assure best learning conditions in class, the sample of pre-service teachers was (randomly) divided into three classes. All classes were based on the same curriculum but since they took place simultaneously, they were taught by different instructors. The instructors were trained together and evaluations show no difference between the instructional quality of the three classes.

Sample

The N=110 pre-service teachers from the three different course-groups do not differ significantly in their relevant student characteristics and theoretical and practical pedagogical experience. They thus could be treated as one single sample group. Overall, the mean age of the participants was 21.43 (SD = 1.42), 65.8 % were female; in average they were attending their 4th semester of study program (SD = .21). Measure: ObserverThe computer-based online tool Observer was developed to measure teachers' ability to apply their knowledge to evaluate videotaped classroom situations. Participants were presented six video clips showing classroom interactions and, based on their concepts of instructional quality, asked to evaluate these situations on 121 items using a four-point Likert-type scale ranging from 1 (disagree) to 4 (agree). Items focussed on three sub-dimensions that research has distinguished in the process of knowledge-based reasoning: (a) description, (b) explanation, and (c) prediction. Participants' ratings of the video clips were compared with expert ratings (hit = 1/miss = 0). The Observer proved to be highly reliable (Cronbach's alpha in the present sample: .92). For further information see Seidel, et al. 2010. Selected ResultsPre-service teachers' professional vision develops over the course of the internship-term. Analyzing pre-/post-scores of knowledge-based reasoning in a MANOVA indicates significant growth ($F(1, 110) = 10.28, p$

Conclusions

Professional vision develops over the course of the internship term, mainly in the aspect of prediction what is the most knowledge-based facet of knowledge-based reasoning compared to description and explanation. Our findings show that linking practice (experiences at schools) to theory (knowledge about teaching and learning) shows potential in fostering professional vision in pre-service teacher education.

References

- Darling-Hammond, L. & Bransford, J. D. (Eds.). (2005). *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do*. San Francisco, CA: Jossey-Bass.
- Goodwin, C. (1994). Professional Vision. *American Anthropologist*, 96 (3), 606-633.
- Kersting, N. (2008). Using video clips of mathematics classroom instruction as item prompts to measure teachers' knowledge of teaching mathematics. *Educational and Psychological Measurement*, 68(5), 845-861.
- Palmeri, T. J., Wong, A. C.-N. & Gauthier, I. (2004). Computational approaches to the development of perceptual expertise. *TRENDS in Cognitive Sciences*, 8(8), 378-386.
- Putnam, R. T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 29(1), 4-15.
- Santagata, R. & Guarino, J. (in press). Using video to teach future teachers to learn from teaching. *ZDM the International Journal of Mathematics Education*.
- Seidel, T., Prenzel, M., Schwindt, K., Styrmer, K., Blomberg, G. & Kobarg, M. (2009). LUV and Observe: Two projects using video to diagnose teachers' competence. In T. Janik & T. Seidel (Eds.), *The power of video studies in investigating teaching and learning in the classroom*. Mynster, Germany: Waxmann.
- Sherin, M. G. & van Es, E. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, 60, 20-37.
- Star, J. R. & Strickland, S. K. (2008). Learning to observe: Using video to improve preservice mathematics teachers' ability to notice. *Journal of Mathematics Teacher Education*, 11(2), 107-125.
- Gauthier, I. (2004).
- Van Es, E., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education*, 10(4), 571-596.

PAPER PRESENTATION

A Taxonomy of Educational Knowledge for University Teacher Education: A Delphi Study

Olga Kunina-Habenicht, Johann Wolfgang Goethe-University, Germany; Mareike Kunter, Goethe-University, Institute of Psychology, Germany; Hendrik Lohse-Bossenz, Goethe-University, Germany; Jurgen Baumert, Max Planck Institute for Human Development, Germany; Detlev Leutner, Duisburg-Essen University, Germany; Ewald Terhart, Westfalische

Wilhelms-Universität Münster, Germany; Theresa Dicke, Duisburg-Essen University, Germany; Jill Goessling, University of Duisburg Essen, Germany; Franziska Schulze, Westfälische Wilhelms-Universität Münster, Germany; Doris Foerster, University of Frankfurt, Germany

Foundations of professional teacher competence are laid in the theoretical part of teacher education, which aims particularly at providing content knowledge, pedagogical content knowledge, and pedagogical knowledge in formal learning settings. For subject-specific knowledge, several researchers have suggested taxonomies of content and pedagogical content knowledge, showing the practical relevance of these taxonomies in teaching situations. However, for subject-unspecific educational topics such taxonomies do not yet exist. This paper describes a Delphi study that aims at developing the taxonomy of core educational topics that should be taught in university teacher education. The Delphi study consisted of three consecutive rounds involving 48 experts of various professional backgrounds. Results of the Delphi study show that experts from different disciplines involved in German teacher education share an understanding of topics relevant to the training of prospective teachers. Based on the resulting taxonomy of core educational topics, a standardized instrument is currently being developed, for use in a longitudinal study to track the professional development of prospective teachers.

Theory

There is a consensus that teachers' success in providing high quality instruction is connected to their profession-specific declarative and procedural knowledge (Baumert et al., 2010; Shulman, 1986). Thus, the foundations of professional competence are laid in the theoretical part of teacher education, which aims particularly at providing content knowledge, pedagogical content knowledge, and pedagogical knowledge in formal learning settings. While the importance of the professional knowledge base per se is uncontested, it is less clear how the relevant knowledge should be taught, and which content such a knowledge base should include (Zeichner, 2005).

Most teacher education systems are structured in two consecutive parts: university and practical induction. University education has often been criticized for providing insufficient practical preparation, and for teaching theoretical knowledge that is perceived as practically irrelevant (Cochran-Smith & Zeichner, 2005). However, given the high complexity of teachers' actions in rapidly changing situations with high demands on reflection ability, we argue that a thorough conceptual understanding of the domain and of educational topics is the key to improving teachers' assessment skills (Rittle-Johnson, Siegler, & Alibali, 2001).

In order to test this hypothesis, a theoretical framework that describes the aspects comprising the "conceptual understanding" is needed. For subject-specific knowledge (e.g. mathematics) several researchers have suggested taxonomies of content and pedagogical content knowledge showing the practical relevance of these taxonomies in teaching situations (Baumert, et al., 2010). For the subject-unspecific part of teacher education such taxonomies do not yet exist. Hence, this paper describes a Delphi study that developed a taxonomy of core educational topics that should be taught in university teacher education. Based on this taxonomy a standardized test instrument will be developed to assess educational knowledge of prospective teachers.

Research questions

- 1) Do experts from different disciplines in teacher education share an understanding of relevant topics in teacher education?
- 2) Which topics comprise the potential taxonomy of educational knowledge?

Methods

The study took place in Germany, where teacher education is structured in two parts: university and practical induction. The expert panel consisted of 35 university lecturers and 13 experts involved in practical training and teaching practice. University lecturers were selected from the disciplines of Education, Psychology, and Sociology. Experts participated in a paper-pencil Delphi study in which they rated the importance of educational topics in three consecutive rounds. In the first round 213 educational topics, collected from detailed curriculum analyses of teacher education programs and textbooks, were presented. They covered the following nine areas: Instructions, Educational theory, Educational system, Teacher profession, Developmental processes, Socialisation processes, Learning processes, Heterogeneity, Diagnostics.

Within each area, specific topics were listed (e.g., within the section Instruction "Teacher-student interaction models"). The aim of the Delphi study was to reduce the list of topics to a core taxonomy consisting of topics with high relevance ratings. Consensus between panel members was estimated using the Average Deviation Index (ADM, Burke, Finkelstein, & Dusig, 1999) that measures within-group agreement. The procedures of each Delphi round are reported in the next section.

Findings

In the first round experts rated the relevance of all topics on four dimensions (understanding the academic discipline, understanding the teaching profession, analyzing situations, practical application) on a three-point scale (1–negligible; 2–helpful; 3–necessary). Experts also had the opportunity to add missing topics. The results revealed reasonable agreement among the whole panel as well as in most expert subgroups (see table 1 in appendix). The expert panel did not mention any missing topics, indicating that the presented canon of topics was exhaustive.

In order to reduce the number of relevant topics in the second round, experts had to choose a range of topics to be taught at university within a given time and to choose a range of topics relevant for practical application. The presented topics were ranked by the results of the first round, with the most important topics presented first. This round resulted in a further differentiation of the relevance of the topics.

The third round provided experts with the information on how many experts had chosen the particular topic. Furthermore, members of the expert panel received feedback on their individual choice in the previous round, in order to initiate deep level processing when forming a decision. As intended, the third round resulted in increasing consensus within the expert panel. Based on these final ratings, topics that were chosen by the majority of the expert panel with respect to either university teaching or practical application were considered as representing core educational topics in teacher education. Overall, 104 of the 213 original topics formed this core knowledge base.

Relevance

Our results show that experts from different disciplines involved in teacher education share an understanding of the educational issues most relevant to teacher training. Thus, despite various professional backgrounds, experts agree that a conceptual understanding of core topics in educational science, psychology, and sociology provides prospective teachers with a good preparation for professional life. Based on the final topic taxonomy, a standardized instrument is currently being developed for use in a longitudinal study to track the professional development of prospective teachers. This study will allow reliable statements about the impact of educational knowledge on later professional success.

References

- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., . . . Tsai, Y.-M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal*, 47(133–180). doi: 10.3102/0002831209345157
- Burke, M. J., Finkelstein, L. M. & Dusig, M. S. (1999). On Average Deviation Indices for Estimating Interrater Agreement. *Organizational Research Methods*, 2(1), 49–68. doi: 10.1177/109442819921004
- Cochran-Smith, M. & Zeichner, K. M. (Eds.). (2005). *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education*. Washington, DC: American Educational Research Association.
- Rittle-Johnson, B., Siegler, R. S. & Alibali, M. W. (2001). Developing Conceptual Understanding and Procedural Skill in Mathematics: An Iterative Process. *Journal of Educational Psychology*, 93(2), 346–362.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–21.
- Zeichner, K. M. (2005). A research agenda for teacher education. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The AERA Panel on Research and Teacher Education* (pp. 737–760). Mahwah, N. J.: Lawrence Erlbaum.

PAPER PRESENTATION

Fostering Self-Regulated Laboratory Tasks by Video Demonstrations and Incremental Scaffolds

Florian Schmidt-Weigand, University of Kassel, Germany; Martin Haenze, Institut für Psychologie, Germany; Karsten Rincke, University of Regensburg, Germany; Rita Wodzinski, University of Kassel, Germany

The research project aims to explore two instructional means for supporting self-regulated laboratory tasks: (a) video demonstrations to instruct experimental skills and (b) incremental scaffolds for laboratory tasks. First, we present the results of a study on the effectiveness of videos to moderate students' experimental skills. One-hundred and eighty-five junior high-school students saw either one of two videos for different subject matters (mechanics, electricity) and completed tests (retention, transfer) for both subject matters. Students performed better on retention (i.e. planning and obtaining observations) when they had seen the respective video. Results for the transfer tests were mixed. A second study which was run in October/November 2010 aimed to explore incremental scaffolds in self-regulated laboratory tasks and possible interactions of the giving or withholding of such scaffolds with experimental skills (manipulated by video demonstrations). The results of this second study will also be presented and discussed.

In laboratory tasks students often have to follow laboratory guides prescribing each step of an experiment (Hofstein & Lunetta, 2004). These cookbook-like guides bear resemblance to worked examples which have been shown to support initial skill acquisition in well-structured domains such as mathematics, physics, and programming better than unguided problem-solving (e.g. Corey, Bennell, Emeno, & Martens, 2009). Worked examples and laboratory guides ("worked experiments"), however, may not foster self-regulation, cognitive activation and inquiry. These learner activities are of particular importance to achieve the goals of laboratory tasks, which may be a reason why students' laboratory work often falls short of expectations (Hucke & Fischer, 2002). Concerning worked examples, learners can be activated by presenting the example steps incrementally, on demand, and preceded by strategic prompts. These incremental scaffolds have been shown to increase the effectiveness of worked examples (Schmidt-Weigand, Hänze & Wodzinski, 2009). It appears reasonable to assign such incremental scaffolds to laboratory guides.

Laboratory tasks may also be ineffective because students lack basic experimental skills (handling the apparatuses, planning experimental steps, obtaining and documenting viable observations, etc.). Those skills can be instructed by the teacher or in a demonstration video prior to the students' laboratory work.

In this research project we explore the effects of problem-solving scaffolds for laboratory tasks, and video demonstrations on students' self-regulated laboratory work. Besides simple main effects, one may expect interactions between scaffolds and the matter of experimental skills. Before these interactions can be explored, it is necessary to test if experimental skills can effectively be manipulated by a video.

In a first study, 185 junior high-school students (7th to 9th grade) saw one of two videos demonstrating (a) how to obtain extension characteristics of a spring using different weights (mechanics) or (b) how to obtain the amperage for different voltages in an electrical circuit with an omic resistor (electricity). The study followed a 2x3-design with the between-subjects factors video (mechanics, electricity) and grade level (7th, 8th, or 9th grade). Each student saw one video and completed retention ("What do you have to do if you want to explore the characteristics of a spring/a consumer load ...?") and transfer (e.g. "How can you obtain an unknown mass/voltage when you have measured the extension of the spring/the amperage in the electrical circuit?") tests for both subject matters.

Separate ANOVAs for mechanics and electricity retention as dependent measures, respectively, and with the between-subjects factors 'video' (seen vs. not seen) and 'grade level' revealed the following results. Students performed better in both retention tests when they had seen the respective video compared to those students who had not seen the video (mechanics: $F(1,173) = 18.33$, $p < .01$, $F(2,173) = 3.24$, $p < .05$, $F(2,179) = 15.92$, $p < .01$, $F(2,179) = 2.29$, $p = .16$).

ANOVA for the mechanics transfer test revealed significant effects of video ($F(1,173) = 12.98$, $p < .01$, $F(2,173) = 10.57$, $p < .01$, not seen the mechanics video). ANOVA for the electricity transfer test also revealed significant effects of video ($F(1,179) = 4.57$, $p < .05$, $F(2,179) = 5.40$, $p < .01$, $F(2,179) = 2.68$, $p = .07$), both main effects appear to be due to the 9th grade students who had seen the electricity video. Those students gained higher scores than any other experimental group. Experimental skills can be fostered by a video. As expected, grade level affects overall performance but concerning retention it does not interact with the effect of the video. While the effect in mechanics transfer is somewhat puzzling, overall transfer performance (10 to 30%) was low enough to conclude that the learning goals are not reached without further laboratory work.

In order to explore scaffolds for such tasks we currently conduct a second study following a 3x2-design with the between-subjects factors 'scaffold' (none, "cookbook", incremental) and 'video' (seen/not seen). The students receive a problem (e.g. an object with an unknown mass) which can be solved by generating appropriate observations (e.g. measuring and documenting the extensions of a spring for different known masses). The students either receive no guidance or they are guided by written instructions. This guidance is either given at once (i.e. a "cookbook") or incrementally, on demand, and preceded by strategic prompts (e.g. "What do you know or presume about the relation between the extension of a spring and the mass of an object?"). Similar to worked examples, a laboratory guide is expected to foster transfer performance compared to an unguided laboratory task. The incremental scaffolds, however, are assumed to promote self-regulation, cognitive activation and inquiry and, hence, should lead to the highest transfer performance. This effect may interact with experimental skills in that the differences between scaffolded and unguided laboratory tasks will be bigger if the students had not seen the video before. The study will be completed in November 2010 and results will be reported.

References

Corey, S., Bennell, C., Emeno, K. & Martens, C. (2009, March). A meta-analysis of the worked example effect. Poster presented at the 3rd International Cognitive Load Theory Conference, Heerlen, The Netherlands.

Hofstein, A. & Lunetta, V.M. (2004). The laboratory in science education: Foundations for the twenty-first century. *Science Education*, 88(1), 28-54.

Hucke, L. & Fischer, H. E. (2002). The link of theory and practice in traditional and in computer-based university laboratory experiments. In D. Psillos & H. Niedderer (Eds.), *Teaching and learning in the science laboratory - A look on the European project "Labwork in Science Education"* (pp. 205-218). Dordrecht: Kluwer Academic Press.

Schmidt-Weigand, F., Hänze, M. & Wodzinski, R. (2009). Complex problem solving and worked examples: The role of prompting strategic behavior and fading-in solution steps. *Zeitschrift für Pädagogische Psychologie [German Journal of Educational Psychology]*, 23 (2), 129-138.

PAPER PRESENTATION

Self-Assessment and Task-Selection Training improves Self-Regulated Learning Outcomes

Danny Kostons, University of Groningen, Netherlands; Fred Paas, Erasmus University Rotterdam, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands

Students need to be able to accurately assess their own performance on a learning task and use this assessment for the selection of a new learning task for self-regulated learning to be effective. However, evidence suggests that students have difficulties with accurate self-assessment and task selection, which may explain why self-regulated learning often leads to poor learning outcomes. Experiment 1 investigated and confirmed the hypothesis that observing a human model engaging in self-assessment, task selection, or both could be effective for the acquisition of self-assessment and task-selection skills. Experiment 2 investigated and confirmed the hypothesis that acquisition of self-assessment and task-selection skills, either through examples or through practice, would enhance the effectiveness of self-regulated learning.

For self-regulated learning in which students are free to choose their own learning tasks to be effective, students should be able to accurately assess their own performance after completing a learning task, and to select a next learning task based on that assessment that is appropriate given their current level of knowledge or skill. However, students, and especially novices, may experience difficulties in assessing their own performance, due to high cognitive load, a lack of knowledge of assessment criteria and standards (Dunning et al., 2003), and a lack of knowledge on how to use assessment outcomes in combination with task characteristics to select new tasks (Kostons, Van Gog, & Paas, 2010). This may explain why self-regulated learning is often not effective for novices (Azevedo et al., 2008; Niemiec et al., 1996). Two experiments are presented here that investigated whether self-assessment and task-selection accuracy could be improved by means of training, and whether this would enhance the effectiveness of self-regulated learning. Experiment 1 investigated whether self-assessment and task-selection skills could be trained via examples, leading to higher accuracy of self-assessment and task selection on a test. A 2 x 2 design with the factors Assessment Example (yes/no) and Task-Selection Example (yes/no) was used. All 80 secondary education students (age M = 15.23, SD = .53) first completed a pretest, which did not show any differences between groups. Then they studied the modeling examples (see Van Gog & Rummel, 2010), in which models performed a learning task, and -depending on students' assigned condition- they subsequently observed the model engage in self-assessment, task selection, both, or neither (this control group had to find and correct mistakes made by the models). In total they saw four modeling examples. Finally, they completed a posttest, and after each problem on that test they assessed their own performance and indicated what new task they would select (but they did not get this task, the test was the same for all students). Results of a 2 x 2 ANOVA showed that students who had been trained on self-assessment, were more accurate self-assessors at posttest than students who were not ($F(1, 76) = 8.04$, $MSE = 33.08$, $p = .006$, $\eta^2_p = .10$) and the same applied to task-selection ($F(1, 71) = 11.57$, $MSE = 323.27$, $p = .001$, $\eta^2_p = .14$). There was no interaction effect. We also did not find any differences on posttest scores F , which was expected, as all learning tasks were the same for all student.

Experiment 2 investigated whether training self-assessment and task-selection skills would enhance the effectiveness of self-regulated learning. First, all 90 secondary education students (age M = 14.66, SD = .71) completed a pretest (showing no differences), then they received no training, training consisting of modeling examples (as in Experiment 1), or practice (instruction on self-assessment and task selection beforehand that they could then practice on the model's performance). Subsequently they engaged in self-regulated learning, working on eight heredity problems which they chose from a database containing 75 tasks. This database had tasks at five levels of complexity, each with three levels of support. Finally, participants completed a posttest. ANOVAs with planned contrasts showed that self-assessment and task-selection training, either through modeling ($t(87) = 2.68$, $p = .005$, one-tailed, $d = 0.64$) or practice ($t(87) = 2.27$, $p = .013$, one-tailed, $d = 0.61$) enhanced the effectiveness of self-regulated learning in terms of pretest to posttest learning gains. Training via modeling and practice seemed to be equally effective ($t(87)$ ns). Previous research on improving self-regulated learning in hypermedia environments has shown that training can improve students' application of self-regulation activities such as monitoring or planning during task performance and

that this can increase their learning outcomes (e.g., Azevedo & Cromley, 2004). Our study extends that research to self-regulated learning environments in which students can choose their own tasks, by showing that a relatively simple training intervention of self-assessment and task-selection can significantly increase learning gains attained through self-regulated learning.

References

- Azevedo, R. & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia? *Journal of Educational Psychology*, 96, 523-535.
- Dunning, D., Johnson, K., Erlinger, J. & Kruger, J. (2003) Why people fail to recognize their own incompetence. *Current Directions in Psychological Science*, 12, 83-87.
- Kostons, D., Van Gog, T. & Paas, F. (2010). Self-assessment and task selection in learner-controlled instruction: Differences between effective and ineffective learners. *Computers & Education*, 54(4), 932-940.
- Niemiec, R. P., Sikorski, C. & Walberg, H. J. (1996). Learner-control effects: A review of reviews and a meta-analysis. *Journal of Educational Computing Research*, 15, 157-174.
- Van Gog, T. & Rummel, N. (2010). Example-based learning. Integrating cognitive and social-cognitive research perspectives. *Educational Psychology Review*, 22, 155-174.
- Van Merriënboer, J. & Kirschner, P. (2007). Ten steps to complex learning. A systematic approach to four-component instructional design. Mahwah, New Jersey: Lawrence Erlbaum Associates.

PAPER PRESENTATION

Framing effects of informal learning sources on risk perception, emotions and learning

Christine Otieno, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany; Katharina Liebler, University of Freiburg, Germany; Ulrich Deil, University of Freiburg, Germany; Thomas Ludemann, University of Freiburg, Germany; Hans Spada, University of Freiburg, Germany

Internet and information brochures are important sources for informal learning. In contrast to learning materials used in formal curricula these sources are often written in journalistic styles. Effects of these styles on the perception of information have been investigated within the framework of media effects, in particular within research on framing theory. In the present study we broadened existing research by focusing on the effects of different news frames, in particular a rather sensational vs. an expository representational style, on learning outcomes. Seventy-two students in two conditions (sensational vs. expository) read five brochures about climate change and invasive species. They rated their emotions and risk perception in reaction to the information presented, and they completed a posttest with multiple-choice items and open questions. As expected, the sensational condition showed higher risk perception and stronger negative emotions compared to the expository condition. In addition, a sensational style also led to better learning outcomes (multiple choice test). Furthermore, participants in the sensational condition prioritized in particular negative aspects in answers to open questions when asked what information they considered most important. Taken together, our results indicate that while a sensational style enhances learning it might lead to a rather negative and one-sided instead of a well-informed and balanced view.

Informal learning plays an important role in lifelong learning. The term informal learning refers to learning activities outside formal curricula and without direct reliance on a teacher. It is typically interest-guided and self-directed (Livingstone, 2006). Given that most informal learning sources such as the internet and information brochures are influenced by journalistic styles it seems important to investigate informal learning effects in an interdisciplinary framework. Framing theory provides such a framework in which one can investigate the effects of different news frames on audience's interpretation and evaluation of information. According to de Vreese (2005, p.53), "a frame is an emphasis in salience of different aspects of a topic" and is concerned "with the presentation of a topic". Different framing leads to different emotional reactions as well as different focus in thoughts about a topic. Framing effects have to be distinguished from information effects, that is, effects of the core facts of information. To our knowledge, there is hardly any research about framing effects on learning. One exception is Valkenburg, Semetko, and de Vreese (1999) who found negative effects of the human interest frame (i.e., a personalizing and dramatizing frame) on recall (multiple choice test).

In the present study we tested the effects of a rather sensational presentation (dramatizing aspect of the human interest frame), to a rather expository presentation of the topic of climate change and invasive species in information brochures in a pretest-posttest design. The length of texts and basic information as well as the pictures included were held constant across conditions. Dependent variables were elicited emotions, risk perception, and learning measured with a multiple choice test and open questions.

Method

Seventy-two students of psychology (age: $M = 22.60$; $SD = 4.42$) were randomly assigned to the sensational condition (dramatizing frame, using expressions like "extreme dangers"; 36 participants) or the neutral condition (expository frame, using expressions like "possibly problems"; 36 participants). Participants completed a pretest on knowledge about and perception of climate change as well as of local invasive species. They then read their respective versions of five short information leaflets: one about climate change, which served as an introduction to the topic, two about invasive plants, and two about invasive animals. After reading each leaflet students were asked to rate their emotions on four 5-scale items (1= not at all angry/sad/guilty/affected to 5= very angry/sad/guilty/affected) as well as their risk perception on seven 5-scale items. Finally students completed a posttest consisting of five open questions ("Which do you consider the three most important aspects you would tell a friend about...?") and six multiple choice items on the information presented in the brochures. Answers to open-ended questions were segmented and coded differentiating between positive, negative, and neutral statements about topics covered.

Results

Risk perception was significantly higher ($F(1, 67) = 63.48$, $p < .001$), and negative emotions (anger, guilt, and sadness) were significantly stronger ($F(1, 67) = 6.44$; $p < .01$) in the sensational condition as compared to the expository condition (ANCOVAs controlling for prior risk perception). Additionally, tests for a mediation effect of risk perception on negative emotions indicate that risk perception functioned as a mediator between the way information was presented and negative emotions ($a*b = -.51$, $LCL = -.80$, $HCL = -.21$, $zab = -3.37$, $p < .001$). The direct effect of different styles on emotions was no longer significant when controlling for risk perception.

Regarding learning outcomes, students in the sensational condition showed a significantly better performance in the multiple choice posttest ($F(1, 67) = 4.64$, $p < .05$). Additionally, there was a difference in students' prioritizations in their answers to open questions: Students in the sensational condition made significantly more statements about negative aspects, $F(1, 67) = 56.00$, $p < .001$, whereas students in the neutral condition made significantly more statements about positive, $F(1, 67) = 70.38$, $p < .001$, and neutral aspects, $F(1, 67) = 12.46$, $p < .01$ (ANCOVAs controlling for prior knowledge).

Discussion

Up to now, research has rarely focused on effects of journalistic styles on learning. Given the increasing importance of, and the role media plays in informal learning more insight is needed about these effects. In our study, a sensational style improved learning outcomes. However, answers to open questions indicate that sensational style lead to the prioritization of negative aspects. These findings indicate that the style in which information is presented not only influences how much is learned but also what kind of information is emphasized. Similar to social cues in the personalization principle of Mayer (e.g., 2003), sensational style seems to increase memory for the rather sensational aspects taught. At the same time sensational style seems to distract from positive and neutral aspects. In analogy to the effect of seductive details (e.g. Harp & Mayer, 1998) this effect could be termed as seductive emphasis. However, before we can establish a seductive emphasis effect, findings have to be replicated.

The positive effects of sensational style on learning we found contradict Valkenburg et al. (1999) who found a negative effect. This divergence might be due to the specific framing used. Whereas Valkenburg emphasized the effects on an individual (i.e., focused on the "personalization aspect" in the human interest frame), we utilized dramatizing vocabulary as a means of sensitization. Against this background, we are presently conducting a second study comparing the effects of three different "sensational news frames" ("sensational- drama", "sensational - emotion" and "sensational- personalization") and an expository "control frame".

References

- De Vreese, C. H. (2005). News framing: Theory and typology. *Information Design Journal and Document Design*, 13(1), 48-59.
- Harp, S. F. & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of Educational Psychology*, 90(3), 414-434.
- Livingstone, D. W. (2006). Informal learning: Conceptual distinctions and preliminary findings. In Z. Bekerman, N. C. Burbules & D. Silberman-Keller (Eds.), *Learning in Places: The Informal Education Reader*. New York: Peter Lang.
- Mayer, R. E. (2003). The promise of multimedia learning: Using the same instructional design methods across different media. *Learning and Instruction*, 13(2), 125-139.
- Valkenburg, P. M., Semetko, H. A. & de Vreese, C. H. (1999). The effects of news frames on reader's thoughts and recall. *Communication and Research*, 26, 550-569.

PAPER PRESENTATION

Assessing Cognitive Load with Subjective Rating Scales: Is the whole more than the sum of its parts?

Annett Schwamborn, Duisburg-Essen University, Germany; Maria Opfermann, Duisburg-Essen University, Germany; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Fred Paas, Erasmus University Rotterdam, Netherlands; Detlev Leutner, Duisburg-Essen University, Germany

Subjective cognitive load (CL) ratings are widely used in educational research. However, it is currently unclear, whether to measure CL repeatedly during learning or problem solving, or only once afterwards. To investigate if these two methods are comparable and thus reliable indicators of the actual load experienced, 172 students worked through a sequence of six problems. CL was assessed by means of mental effort and perceived task difficulty after each problem and after the whole process. Results show that the two retrospective scores are significantly higher than the means of the respective six scores assessed during problem solving. This might point to an overestimation when assessing CL only once retrospectively and speaks in favor of measuring CL continuously during learning.

Objective and Theoretical Framework

Research on Cognitive Load Theory (CLT; Sweller & Chandler, 1991; Sweller, 1999, 2005) has recently been accompanied by discussions regarding the measurement of CL. For subjective rating scales, learners are typically asked to rate their invested mental effort (Paas, 1992; Van Gog & Paas, 2008) or perceived task difficulty (Kalyuga, Chandler, & Sweller, 1999; Mayer & Chandler, 2001) on a 7- to 9-point Likert scale.

Some open questions remain regarding the use of subjective ratings, e.g., when to apply such scales (van Gog, Kirschner, & Paas, 2009). Whereas some studies assessed CL as a retrospective, overall measure (e.g. Kalyuga et al., 2001; Schwamborn, Thillmann, Opfermann, & Leutner, in press), others used concurrent, online measures that were directly applied after each task (e.g. Tabbers, Martens, & van Merriënboer, 2004). Contrasting both, it seems reasonable to assess CL concurrently instead of retrospectively. First, it seems unclear what a single measurement once after learning reflects: estimations of learners' invested mental effort as an average over all tasks, the last task, or the most complex task? Additionally, one retrospective rating cannot give information on fluctuations in CL over time (van Gog et al., 2009). However, before investigating what both measures reflect, it is necessary to investigate whether there are actually differences between the average of concurrent vs. retrospective scores. Van Gog et al. (2009) showed that a single mental effort rating after a sequence of problems results in higher scores than the average of ratings provided immediately after each problem.

The present study investigates whether there are differences between the average of concurrent scores and a retrospective CL score. We assume that single retrospective ratings of mental effort and perceived task difficulty after a sequence of problems result in higher scores than the average of concurrent ratings. That is, after learning, both task difficulty and mental effort are assumed to be overestimated.

Method

One hundred and sixty-eight undergraduate students participated in this study (mean age: 23.13 years, SD = 4.43; 68.5 % female).

Six so-called "weekday-problems" were used (e.g., "Suppose today is Tuesday. What day of the week is tomorrow?"; see also Sweller, 1993; van Gog et al, 2009). The element interactivity (intrinsic load) increased continuously from the first to the sixth problem.

CL was assessed with two subjective rating scales: the mental effort item by Paas (1992) and the perceived task difficulty item by Kalyuga, Chandler and Sweller (1999). Both items were answered on 7-point Likert scales.

A repeated-measures-within-subjects-design was used. Students were instructed to solve a sequence of six problems without taking notes, and had one minute to answer each problem. After each problem, invested mental effort and perceived task difficulty were rated immediately (concurrent rating). Additionally, after having completed all six problems, overall invested mental effort and perceived task difficulty were rated as well (retrospective rating).

Results and Conclusions

Means and standard deviations of performance, perceived task difficulty and invested mental effort are shown in Table 1.

Performance for each problem was rated as either correct or incorrect and scored with 0 or 1 points.

Mean scores for the respective six concurrent ratings regarding mental effort ($M=3.43$; $SD=.81$) and task difficulty ($M=2.96$; $SD=.81$) were compared to the overall scores reported retrospectively (mental effort: $M=4.32$; $SD=1.24$; task difficulty: $M=3.74$; $SD=1.16$). Two paired samples t-tests reveal that retrospectively both, mental effort, $t(167)=13.54$; p .

These findings confirm our expectations with regard to the overestimation of invested mental effort and perceived task difficulty when being assessed retrospectively. This is also supported by the results of two multiple linear

regression analyses (cf. Tables 2 and 3), in which the retrospective ratings of invested mental effort and perceived task difficulty were predicted with the respective six concurrent ratings. The strongest predictors of retrospective ratings are in both cases the ratings for the 4th, 5th and 6th problem, which are assumed to be more complex than the 1st, 2nd and 3rd problem. This interpretation has to be taken with care, however. Even though, as could also be concluded from performance scores, the last problems appear to be more complex and, thus, the overestimation hypothesis seems salient, it could as well be that this effect rather concerns the order of problems, e.g., a recency effect.

Discussion

This study aimed at shedding light onto the question, which point of measurement is suitable to assess CL for a sequence of increasingly complex problems. In line with expectations, the average of single concurrent ratings for invested mental effort and perceived task difficulty was significantly lower compared to an overall retrospective rating once after all problems had been completed. This difference points to an overestimation of CL when it has to be reported retrospectively - it seems that students in this case orient their ratings towards the ratings for the more complex problems. On the other hand, this effect could also be due to recency effects caused by the sequence of the problems (the last problems were designed to be more complex than the first ones) instead of being due to the problem complexity itself. However, since van Gog et al. (2009), who varied the order of problems in their experiments, did not find any impact of presentation order, but also an overestimation of retrospective mental effort scores compared to the means of concurrent scores, we agree with their conclusion that "the whole might be more than the sum of its parts". In either case, differences between average scores of concurrent ratings versus retrospective scores might get larger, the more problems have to be solved (that is, the longer such a sequence is) or the larger a learning unit is. In other words, retrospection abilities would likely be more stressed the more would have to be remembered for giving overall ratings after learning.

To sum up, our results support current CL research ambitions that plea for concurrent measures instead of assessing CL once after learning or problem solving.

PAPER PRESENTATION

Using a General Problem Solving Strategy in Mathematics to Facilitate Transfer

Amina Youssef, University of New South Wales, Australia; Paul Ayres, University of New South Wales, Australia; John Sweller, University of New South Wales, Australia

Recently, cognitive load theory has used the principles of evolution to argue that novel information is generated by a random generation process known as the randomness as genesis principle. In other words when faced with a problem, where no domain-specific knowledge is available, humans rely on general problem solving strategies. The aim of this study was to demonstrate that a general problem solver could be learned to facilitate far transfer effects. It was hypothesized that learners with little prior knowledge would benefit more from the general problem solving strategy in comparison to high prior knowledge problem solvers. During an acquisition phase 43 grade 9 students were either taught a general problem solving strategy to solve a set of geometry problems or required to solve problems without instructional help. On post-tests related to geometry, no difference was found between the two strategies. On a further test unrelated to problems linked to acquisition, there was an expertise reversal effect. Students with high mathematical knowledge were advantaged by an initial problem solving approach. In contrast, students with lower mathematical ability benefited from a general problem solving approach. This group had learned the general problem solving strategy and were able to transfer it outside the domain. In conclusion, this study suggests that students who lack domain specific knowledge can benefit from being guided by a general problem solver. In contrast students with more advanced domain-specific knowledge do not need such assistance because they can rely on that knowledge to generate problem solving moves.

The search for general problem solving strategies that transcend specific domains has been a goal of researchers in the field of cognitive processes and instructional design for a long time (Newell & Simon, 1972). The aim has been to find teachable/learnable strategies that students could acquire and then apply to all or most of the subject areas that they encounter. It is a search that has produced few outcomes. In contrast, cognitive load theory (CLT) has generated a number of instructional design effects based on the assumption that learning occurs due to the accumulation of a large quantity of domain specific knowledge in long-term memory. Recently, CLT has been linked to evolution (Sweller, 2004) and the role of general problem solving has been reconceptualized accordingly in the theory. Using the principles of evolution it has been suggested that novel information is generated by a random generation process known as the randomness as genesis principle. In other words when faced with a problem, where no domain-specific knowledge is available, humans have no choice but to rely on general problem strategies such as means-ends analysis. These general problem solving strategies enable humans to function in everyday life. However as domain-specific

knowledge increases in any particular domain, less reliance on general problem solvers are needed. This paper explores the use of a general problem solver in mathematics.

This study tested the hypothesis that students can be taught to use a random generation type strategy during problem solving. Geometry students faced with a conventional problem with a conventional goal such as "Find a value for Angle X" were instructed to ignore the goal and randomly calculate the value of as many angles as possible. These instructions were designed so that students could randomly calculate the value of as many angles as possible in the well-defined problem solving area of geometry. Previous work by Ayres (1993) provides evidence that problem solvers can more easily generate solutions to problems when they are presented in a goal-free format. Goal-free problems as opposed to conventional problems eliminate the use of complicated search routines been used to find a solution to a problem leading to a reduction in cognitive load. It was hypothesised that by following this instruction, students would learn to use a similar general strategy in unrelated areas, demonstrating the acquisition of a general problem solving skill. However, for students with prior knowledge in such unrelated areas would use schematic knowledge rather than a general problem solver.

Methodology

Participants

43 grade 9 students from a Sydney high school participated. Prior knowledge tests classified students as Higher or Lower Mathematical Ability. Students were randomly assigned to one of two experimental conditions (Conventional Problem and a General Problem Solver, GPS) creating a 2 (ability) X 2 (strategy) design.

Materials and Procedure

There were four sets of problems, one set for each of an acquisition phase, a test of similar problems, a test of unfamiliar problems and a test of unfamiliar far transfer problems. For the first 3 sets, questions required knowledge of basic mathematics geometry theorems. During the acquisition phase students in the GPS group were asked to "For each question, find as many angles as you can in any order you like". Students in the Conventional Problem Solving group were asked to "For each question, find the value of x". In the two testing phases, identical problems were given to both groups. The first test phase (similar problems) contained problems identical to those in the acquisition phase, except the size of the angles was changed. The second test phase (transfer problems) contained more complex geometry problems. In the far transfer test phase, the problems were designed to determine if students could solve problems in a different domain using their learnt strategy.

Findings

There was an ability main effect showing that the Higher Ability group performed significantly better than the Lower Ability group on acquisition, $F(1, 43)=46.8$, $p < 0.001$; test, $F(1, 43)=39.7$, $p < 0.001$; and transfer, $F(1, 43)=47.8$, $p < 0.001$. There was no main effect for problem solving strategy ($F<1$) nor an interaction ($F<1$) on acquisition, test and transfer. For far transfer, there was a significant main effect for ability where the higher ability group performed significantly better than the lower ability group: $F(1, 43)=10.4$, $p < 0.01$, but no main effect for strategy ($F<1$). However, there was a significant interaction: $F(1, 43)=10.9$, $p < 0.001$. Simple effects tests revealed that for high ability students the Conventional Problem group outperformed the GPS group, $t(25)=2.56$, $p < 0.05$. For the lower ability students the reverse effect was found as the GPS group outperformed the Conventional Problem group, $t(18)=2.15$, $p < 0.05$. For the higher ability students the mean scores for the Conventional Problem group were higher than the GPS group on each task. In contrast for the lower ability students the GPS group had higher scores indicating an expertise reversal effect (Kalyuga, Ayres, Chandler & Sweller, 2003).

Conclusion

From an instructional perspective, the current results suggest that students should be taught this general problem strategy. When faced with problems for which they do not have knowledge of a solution, this strategy can enhance problem solving performance. Nevertheless, it should not be seen as a substitute for domain specific knowledge. In conclusion, this study suggests that students who lack domain specific knowledge can benefit from being guided by using a random move generation strategy as a general problem solver. In contrast students with more advanced domain-specific knowledge do not need such assistance because they can rely on that knowledge to indicate appropriate problem solving moves.

References

- Ayres, P. (1993). Why goal-free problems can facilitate learning. *Contemporary Educational Psychology*, 18, 376-381.
- Kalyuga, S., Ayres, P., Chandler, P. & Sweller, J. (2003). The expertise reversal effect. *Educational Psychologist*, 38, 23-31.
- Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice Hall.

Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science*, 32, 9-31.

PAPER PRESENTATION

Teacher activities in innovative and traditional teaching learning environments

Michelle Overman, Utrecht University, Netherlands; Jan Vermunt, Utrecht University, Netherlands; Astrid Bulte, Freudenthal Institute for Science and Mathematics Education, Netherlands; Paulien Meijer, Utrecht University, Netherlands; Mieke Brekelmans, Utrecht University, Netherlands

Abstract

Insights in educational and psychological theories have caused a shift in the understanding of learning, whereby learning is considered as a process of knowledge construction in stead of a process of knowledge transmission. Influenced by these insights, educational reforms in Dutch secondary education have brought more diversity in the ways schools organize their teaching learning environments (TLEs). As a consequence, the role of the teacher has been brought into discussion and is assumed to have changed as well, congruent with the educational reforms. In this study we aim to obtain an elaborate picture of teaching activities in innovative and more traditional teaching learning environments by studying teaching from multiple perspectives: an interpersonal, a learning activities and a content perspective. Three types of teaching learning environments were selected, which were expected to represent an optimal variety. This study included 21 chemistry teachers and their classes in three different types of TLEs in secondary education. Contrary to our expectations, the TLEs did not differ that much on these three perspectives as we thought. A first conclusion is that it is more important what a teacher does than in what TLE this teaching takes place.

Teacher activities in innovative and traditional teaching-learning environments from an interpersonal, a learning activities and a content perspective Michelle Overman, Jan D. Vermunt, Paulien. C. Meijer, Astrid M.W. Bulte & Mieke Brekelmans Department of Education, Faculty of Social and Behavioral Sciences, Utrecht University AimsInsights in educational and psychological theories have caused a shift in the understanding of learning, whereby learning is considered as a process of knowledge construction in stead of a process of knowledge transmission (e.g. Shuell, 1996). Influenced by these insights, educational reforms in Dutch secondary education have brought more diversity in teaching learning environments (TLEs) in schools. As a consequence, the role of the teacher has been brought into discussion and is assumed to change as well, congruent with the educational reforms (Bransford et al., 2005; Thadani, Stevens & Tao, 2009). In this study we aim to obtain an elaborate picture of teaching activities in innovative and more traditional teaching learning environments by studying teaching from multiple perspectives: an interpersonal (e.g. Wubbels and Brekelmans, 2005), a learning activities (e.g. Vermunt & Verloop, 1999) and a content perspective (Van Driel, Bulte & Verloop, 2007; Roberts, 1988). The research problem for this study is: How do teacher and students perceive teacher activities in different types of teaching learning environments from an interpersonal, a learning activities and a content perspective?

Methodology

In this study, three types of teaching learning environments have been selected (table 1), which we expect to represent an optimal variety in teaching activities from the content perspective and the learning activities perspective. We expect the interpersonal relationship to be more dependent on individual teacher level, rather than on type of TLE. We also expect this to be the case for affective activities. The TLEs are restricted to natural classroom settings and the subject chemistry. For each type of teaching learning environment 7 experienced chemistry teachers in secondary education were selected with one of his/her fourth year classes (students age 15-17) of senior general secondary education. Questionnaire data from 517 students and 21 secondary education chemistry teachers in the Netherlands were obtained. Teacher activities were measured by means of questionnaires that map both teachers self perceptions and students' perceptions on the interpersonal, the learning activities and the content perspective. For the interpersonal perspective the Questionnaire on Teacher Interaction (QTI) from Wubbels et al. (1985) has been used. For the learning activities perspective a new instrument has been developed, based on the taxonomy of teaching and learning as described by Vermunt and Verloop (1999). This instrument is called the Questionnaire on Teaching Activities in Chemistry (QTA-C). This instrument demonstrated acceptable internal consistency (Chronbach's alpha's ranging from .80-.90). The content perspective has been measured with the Questionnaire on Chemistry Education (Van Driel, Bulte & Verloop, 2005). Currently, only ANOVAs have been performed to examine differences within and between TLEs. The procedure we will follow next is that data first will be analysed within single cases (teachers), next across cases within single TLEs and last between types of TLEs. Relations between teacher activities and cognitions will be analyzed by calculations of correlations and subsequent techniques.

Findings

It appeared that variances are larger on teacher level than between these three TLEs. Further, it was found there is a friction between teacher cognitions about their teaching and students' perceptions of teacher activities in most cases. In general, teachers considered their control to be more shared than students did. Further, teachers found it very important to relate chemistry to real life issues and knowledge development, while students do not experience chemistry in that way. Contrary to our expectations, the TLEs did not differ that much as we thought. A first conclusion is that it is more important what a teacher does than in what TLE this teaching takes place.

Theoretical and educational significance

This study may provide a more elaborated, detailed and specified description of teaching in different teaching learning environments than is currently available because it includes data on teacher activities from multiple perspectives. Furthermore, by using these three perspectives we wish to add to the empirical knowledge base for what really matters in teaching. In this way, we aim to contribute to the knowledge that can be used for enhancing professional development.

References

- Bransford, J., Derry, S., Berliner, D., Hammerness, K. & Beckett, K. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world* (pp. 40-87). San Francisco, CA: Jossey-Bass.
- Glaser, R. (1991). The maturing of the relationship between the science of learning and cognition and educational practice. *Learning and Instruction*, 1, 129-144.
- Roberts, D.A. (1988). What Counts as Science Education? In P.J. Fensham (Ed.), *Development and Dilemma's in Science Education* (pp. 27-54). London: Falmer Press.
- Shuell, T.J. (1996). Teaching and learning in a classroom context. In *Handbook of Educational Psychology* (pp. 726-764). New York: MacMillan.
- Thadani, Vandana , Stevens, Ronald H. and Tao, Annie (2009) 'Measuring Complex Features of Science Instruction: Developing Tools to Investigate the Link Between Teaching and Learning', *Journal of the Learning Sciences*, 18: 2, 285-322.
- Van Driel, J.H., Bulte, A.M.W. & Verloop, N. (2005). The conceptions of chemistry teachers about teaching and learning in the context of curriculum innovation. *International Journal of Science Education*, 27, 303-322.
- Vermunt, J.D. & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction*, 9, 257-280.
- Wubbels, T.& Brekelmans, M. (2005). Two decades of research on teacher-student relationships in class. *International Journal of Educational Research*, 43, 6-24.
- Wubbels, Th., Créêton, H. A. & Hooymayers, H. P. (1985). Discipline problems of beginning teachers, interactional teacher behavior mapped out. Abstracted in *Resources in Education*, 20, 12, p.153.

PAPER PRESENTATION

Enhancing approaches to learning: The added value of gradually implementing case-based learning

Marlies Baeten, K.U.Leuven, Belgium; Filip Dochy, K.U.Leuven, Belgium; Katrien Struyven, University of Brussels (VUB), Belgium

This study investigates whether a learning environment that combines both case-based learning and lectures can enhance students' approaches to learning, compared to the sole use of either case-based learning or lectures. Therefore, a quasi-experimental pre-test/post-test design took place in teacher education during a course on child development. Participants were 1099 first-year professional bachelor students. Research conditions were: 1) a completely lecture-based learning environment, 2) a completely case-based learning environment, 3) a mixed learning environment in which lectures and case-based learning were used alternately, and 4) a mixed learning environment in which lectures gradually made place for case-based learning. At the start and end of the course students' approaches to learning were measured. Results of analyses of (co)variance showed that the gradually implemented case-based setting was the most beneficial for students' approaches to learning. In comparison to the other learning environments, students in the gradually implemented case-based setting scored the highest on deep approach, monitoring and organised studying, and the lowest on surface approach.

Theoretical framework

A deep approach to learning, which aims at understanding, is highly valued in higher education. Previous research tried to enhance the adoption of deep approaches by implementing student-centred teaching, e.g. case-based learning (CBL) and problem-based learning (PBL). However, the results of these studies were not univocal (Baeten, Kyndt, Struyven, & Dochy, 2010). One possible explanation is that not the sole use of student-centred instruction encourages a deep approach, but instead the combination with lectures (Sivan, Wong Leung, Woon, & Kember, 2000).

Goals of lectures, e.g. structuring information, may offer support for disadvantages of student-centred teaching, e.g. a lack of structure and high workload (Struyven, Dochy, Janssens, & Gielen, 2008). Vice versa, the incorporation of active learning may minimise weaknesses of lectures, e.g. providing feedback about students' comprehension of the learning contents (Bonwell, 1996). The objective of the current study is to investigate the explanation of Sivan et al. (2000) that not the sole use of student-centred instruction encourages a deep approach, but instead the combination with lectures. The student-centred teaching method central to this study is CBL. Research question What is the influence of the teaching method (CBL, lectures or a combination of both) on students' approaches to learning?

Methodology

Participants were first-year professional bachelor students in teacher education who followed a course on child development. 26 teachers from 11 institutions for teacher education participated with their student groups (NStudents=1099 students). The design of the research was quasi-experimental. Each teacher and his/her student group were assigned to one research condition. 1) A completely lecture-based learning environment (LeLe) which comprised lectures, consisting of PowerPoint presentations, visual aids and teacher-student interaction. 2) A completely CBL environment (CaCa) in which students discovered the course content themselves by applying those contents necessary to solve authentic cases in small groups. 3) A mixed learning environment in which lectures and CBL were alternated (LeCaLeCa). About each development phase students received first a lecture and afterwards a case study. 4) A mixed learning environment in which CBL was implemented gradually (LeCaLeCa). The first chapters were provided by means of lectures, the next chapters were provided by means of a combination of lectures and CBL, and the final chapters were provided solely by means of CBL. Approaches to learning were measured by means of the Approaches to Learning and Studying Inventory (Entwistle, McCune, & Hounsell, 2002), which distinguishes between 5 subscales: 'deep approach'(a=0.75), 'surface approach'(a=0.72), 'monitoring studying'(a=0.65), 'organised studying'(a=0.79) and 'effort management'(a=0.75). The questionnaire was administered twice: at the beginning of the first course general approaches to learning were measured, and at the end of the final course approaches to learning child development were measured. Results ANOVAs and paired samples t-tests were conducted to answer the research question. Regarding deep approach, monitoring studying, organised studying and effort management, initial differences were found between the research conditions. In order to examine the effect of the research condition on these variables, ANCOVAs were conducted which controlled for initial differences in these approaches. Results showed a significantly higher deep approach in LeLeCaCa compared to CaCa and LeLe ($F(3,1094)=4.06$, $p\text{-value}=.01$). With regard to monitoring studying, students scored significantly higher in LeLeCaCa compared to CaCa and LeCaLeCa ($F(3,1094)=7.03$, $p\text{-value}=.02$). As to organised studying, significantly higher scores were found in LeLeCaCa compared to the other three settings ($F(3,1094)=12.64$, $p\text{-value}=.03$). Regarding effort management, ANCOVA could not be conducted since the assumption of homogeneity of regression slopes was not met. Concerning the surface approach, no initial differences were found between the research conditions. ANOVA showed that the surface approach was significantly lower in LeLeCaCa, compared to all other settings ($F(3,1095)=8.98$, $p\text{-value}=.02$).

Based on these findings, LeLeCaCa seemed the most beneficial in terms of students' approaches to learning. Nevertheless, this research condition did not have the power to enhance students' approaches. Instead, deep approach, organised studying and effort management remained the same and monitoring studying even decreased significantly. In the other research conditions, a significant decrease in monitoring studying was found too, next to a significant decrease in deep approach, organised studying and effort management. Regarding the surface approach, LeLeCaCa had the power to diminish this approach, just like LeCaLeCa. In the two other settings, the surface approach did not change. Conclusion Implementing CBL gradually was the most beneficial for students' approaches to learning. In comparison to the other learning environments, students in the gradually implemented CBL setting scored the highest on deep approach, monitoring and organised studying, and the lowest on surface approach. Nevertheless, the gradually implemented CBL setting did not encourage the use of deep approaches, monitoring studying, organised studying and effort management over time. Instead, these approaches remained the same or decreased significantly. Therefore, this research showed that it is difficult to enhance not only students' deep approach (Marton & Säljö, 1997) but also monitoring studying, organised studying and effort management. Possibly other variables might explain why no general increase is found in approaches to learning, e.g. student characteristics (Baeten et al., 2010).

References

- Baeten, M., Kyndt, E., Struyven, K., Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: factors encouraging or discouraging their effectiveness. *Educational Research Review*.
- Bonwell, C. (1996). Enhancing the lecture: Revitalising a traditional format. *New Directions for Teaching and Learning*, 67, 31-44.
- Entwistle, N., McCune, V. & Hounsell, J. (2002). Occasional Report 1: Approaches to Studying and Perceptions of University Teaching-Learning Environments: Concepts, Measures and Preliminary Findings. University of Edinburgh, ETL project, Higher and Community Education, The School of Education, United Kingdom.

Marton, F. & Säljö, R. (1997). Approaches to learning. In F. Marton, D. Hounsell & N. Entwistle (Eds.), *The experience of learning. Implications for teaching and studying in higher education* (2nd ed., pp. 39-58). Edinburgh: Scottish Academic Press.

Sivan, A., Wong Leung, R., Woon, C. & Kember, D. (2000). An implementation of active learning and its effect on the quality of student learning. *Innovations in Education and Teaching International*, 37 (4), 381-389.

Struyven, K., Dochy, F., Janssens, S. & Gielen, S. (2008). Students' experiences with contrasting learning environments: The added value of students' perceptions. *Learning Environments Research*, 11, 83-109.

PAPER PRESENTATION

The Effects of Two Contrasting Approaches to Peer Tutoring on Student's Learning

Inneke Berghmans, Catholic University of Leuven, Belgium; Filip Dochy, K.U.Leuven, Belgium; Katrien Struyven, University of Brussels (VUB), Belgium

Over the years, interest in different kinds of student-centred learning environments has grown. Among others, Peer tutoring has been reported to have diverse positive effects on students' learning. However, in order to understand these effects, they have to be considered in terms of the processes and dynamics occurring in this learning environment. In this respect, research is not clear on which approach to tutoring is more beneficial for students' learning. While some studies advocate the power of a facilitative tutor, other studies generate support for a more controlling and directive tutor. This study takes up the challenge to investigate the effects of these two diverse approaches to tutoring on students' approaches to learning, motivation and self-efficacy beliefs, and their related experiences with these approaches to tutoring. A quasi-experimental study was set up in a medical faculty that implements peer tutoring in the context of clinical skills training. The results did not verify the hypotheses in favour of the facilitative approach to tutoring. On the contrary, results indicated that students benefited more from a directive approach to tutoring, particularly in terms of their autonomous motivation. Moreover, medical students turned out to be less satisfied with a facilitative tutor and expressed diverse concerns related to this specific approach to tutoring. This research challenges the expected positivism of a facilitative approach as a discrepancy was brought to the fore between pedagogically and constructivist advocated practices, and the intended effects on students' learning.

Theoretical Framework

Peer Assisted Learning (PAL) has gained a lot of support over the years. However, while some studies support the notion of PAL stimulating a more deep approach to learning (Loke & Chow, 2005), others report that students tend to act more strategic-oriented after attending PAL-sessions (Ashwin, 2003). Among other things, the tutor and his approach to tutoring have an important effect on students' learning. However, limited research focuses on the effects of peer tutor approaches. More though conflicting evidence is present in the context of teacher-tutors. Pata, Sarapuu and Lehtinen (2005), defining an active and passive tutor style, suggest that an active and more controlling tutor seems to cause a negative influence on students' self-initiative. Other research (Rasku-Puttonen, Eteläpelto, Arvaja, & Häkkinen, 2003) reports however that students' self-regulation was stimulated in controlling environments where tutors took control and initiative. This study will investigate these somewhat conflicting results more into depth. More specific, the effects of two contrasting approaches to tutoring on students' self-regulation of learning and motivation will be investigated (RQ1). Furthermore, previous research in the context of workplace training indicates that self-efficacy moderates the effect of the training method on training outcomes (Saks, 1994). Since the general added value can be questioned, this study will look into the effects of the approach to tutoring taking into account different student profiles concerning their level of self-efficacy (RQ2).

Methodology

A quasi-experimental study was set up in a Medical faculty. Students from the second master year were supported by peer tutors in the preparation for their medical skills examination. Peer tutors with specific skill expertise were recruited from the third, fourth and fifth year and provided each eight hours of skills training. A number of peer tutors (n=16) was trained to approach their tutoring directive, others (n=17) to act facilitating. These two contrasting approaches were developed and defined based on a literature review (e.g. Roséé, Moore, VanLehn, & Albritton, 2001). While a directive tutor gave cut-and-dried answers and demonstrated skills, a facilitating tutor asked questions and stimulated students to think for themselves. The approach implementation was checked by video observations and the administration of a student questionnaire concerning their peer tutor. Students were randomly assigned to either the directive (n=102) or the facilitating (n=99) condition. To investigate the effects on students' learning, students administered on beforehand and at the end a questionnaire concerning their self-regulation of learning, self-efficacy (MSLQ: Pintrich & Garcia, 1991) and motivation (Vansteenkiste, Soenens, Sierens, Luyckx, & Lens, 2009). AN(C)OVA analyses were performed.

Results

ANOVA analyses showed no initial differences between the two conditions concerning the variables of interest. However, two differences were installed after the sessions. A first difference in self-regulation concerned the rehearsal behaviour of students, $F(1,196)=3.831$, p Three profile groups were created concerning students' level of initial self-efficacy: a low (x pct.75) group. The differences found in the general ANCOVA analyses only remained in the average self-efficacious group. Directive trained students with an average self-efficacy concerning the course reported a higher degree of rehearsal behaviour ($M=12.23$, $SD=2.82$), $F(1,92)=4.093$, p Conclusion This study suggests that the approach to tutoring affects to some degree students' learning. On the one hand, students from a directive tutor seemed to feel a greater need to rehearse while facilitative trained students could be hypothesised to experience a sufficient mastery or confidence concerning the subject matter. However, these latter students were less autonomously motivated despite the potential of this approach in fostering an autonomous motivation. However, it seems that the approach primarily matters for students with an average self-efficacy, although also low self-efficacious students benefitted more from one approach in particular, the facilitating approach. This study suggests that the best approach to tutoring does not exist. Student profiles should be taken into account. This study opens the discussion concerning the discrepancy between the actual practice where teachers and tutors are still directive steering the learning process and the pedagogically preferred practices where students are stimulated and inspired to create their own learning.

References

- Ashwin, P. (2003). Peer Support: Relations between the context, process and outcomes for the students who are supported. *Instructional Science*, 31, 159-173.
- Loke, A. & Chow, F. (2007). Learning partnership. The experience of peer tutoring among nursing students: A qualitative study. *International Journal of Nursing Studies*, 44, 237-244.
- Pata, K., Sarapuu, T. & Lehtinen, E. (2005). Tutor scaffolding styles of dilemma solving in network-based role-play. *Learning and Instruction*, 15, 571-587.
- Pintrich, P. R. & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M. Maehr & P.R. Pintrich, *Advances in motivation and achievement: Goals and self-regulatory processes*, vol. 7. Greenwich, CT: JAI Press.
- Rasku-Puttonen, H., Eteläpelto, A., Arvaja, M. & Häkkinen, P. (2003). Is successful scaffolding an illusion? Shifting Patterns of Responsibility and Control in Teacher-Student Interaction during a Long-Term Learning Project. *Instructional Science*, 31 (6), 377-393.
- Rosé, C. P., Moore, J. D., VanLehn, K. & Allbritton, D. (2001). A Comparative Evaluation of Socratic versus Didactic Tutoring. In J. D. Moore & K. Stenning (Eds.), *Proceedings of the Twenty-Third Annual Conference of the Cognitive Science Society* (pp. 897-902). Mahwah, NJ: Lawrence Erlbaum Associates.
- Saks, M. (1994). Moderating Effects of Self-Efficacy for the Relationship between Training Method and Anxiety and Stress Reactions of Newcomers. *Journal of Organizational Behavior*, 15 (7), 639-654.
- Vansteenkiste, M., Soenens, B., Sierens, E., Luyckx, K. & Lens, W. (2009). Motivational Profiles From a Self-Determination Perspective: The Quality of Motivation Matters. *Journal of Educational Psychology*, 101 (3), 671-688.

PAPER PRESENTATION

Enhancing text comprehension through TV viewing

Lucia Lumbelli, University of Trieste, Italy; Gisella Paoletti, University of Trieste, Italy; Maurizio Boscarol, Univ. of Trieste, Italy; Sara Rigutti, Univ. of Trieste, Italy

An educational approach aimed at enhancing reading comprehension and based on TV viewing was experimentally checked. Suggestions from studies on the importance of inference both in text and TV processing (Pezdek, 1987) and on animation in multimedia learning were applied to educational sessions focused on 6 episodes of the cartoon series *The Simpsons*. In particular, the use of pauses (Schnotz & Lowe 2008), and the activities of self-explaining (Hegarty et al. 2002) and recalling as learning strategies (Kombartzky et al. 2010) were applied to the TV passages in which connective inferences were required.

Two groups of 19 ninth graders were formed matched on reading comprehension ability. The experimental group was given 6 educational sessions of about one hour, each centered on one episode of *The Simpsons*. No special task was given to the control group. At the end of the 4-months experimental period, both groups were given a post-test, consisting of 30 multiple choice questions about 4 informative texts with pictures, designed and tried-out ($\alpha = 0,72$) to measure the ability to provide coherence (both within the text and between text and pictures) by drawing the inferences required. Comparison between the scores on this post-test proved the effectiveness of the educational intervention : $F(1,36) = 5.47682$, $p = 0.02493$. The feasibility of using amusing material to reach an important educational goal has thus been shown.

The investigation started from the following research question : can we enhance the ability to draw connective inferences in the comprehension of written text with static pictures through an educational task focused on viewing a TV program? precisely, a program with two features, (a) being amusing and (b) requiring many inferences necessary both to coherently organize the sequence of narrative events, and to fully understand the frequent gags and witty utterances?

The prediction of the feasibility and effectiveness of such an educational approach is based on a series of main premises deriving from different research fields.

Firstly, the ability to integrate explicit text information by making correct inferences is an important component of both reading comprehension and TV comprehension (Pezdek, 1987).

Secondly, while we agree with Schnotz & Lowe(2008) that the association of an educational task with amusement may be a source of cognitive flaws, we also assume with them that dynamic pictures have the potential for playing a motivational or affective role and that the educational task can be designed so as to counterbalance those flaws.

Thirdly, the perspective of this counterbalancing task can be also based on those analyses of the cognitive processes involved in animation that make it challenging for important operations of text comprehension. Because of the transitory, fleeting nature of animation, students cannot adequately monitor their own processing and their selection of information is more likely to be based on the visual prominence than on the cognitive significance (Lowe 2003, 2004, Schnotz & Lowe 2008). One of the consequences of the insufficient processing due to the above mentioned characteristics of dynamic pictures is the fact that the connective inferences which would provide coherence to text representation are less frequent in TV comprehension than in reading(Salomon, 1994; Lumbelli, 2008).

Our hypothesis is that the ability to connect information items with each other can be enhanced by (a) inviting students to watch successive segments of TV text, and recall and self-explain the outcome of their processing , and (b) encouraging them to complete their own verbal protocols and go on with the search through their memory. Precisely because a whole series of comprehension problems are likely to arise, students will be given just as many opportunities to face them and be helped to solve them.

The participants were two groups of 19 ninth -graders (the first year of an Italian secondary school) matched on the scores on a standardized test of reading comprehension ability. While the experimental group participated in the individual educational sessions which our intervention consisted of, the controls only took part in the ordinary classroom activity .

Here is a synthesis of the method adopted. The TV texts on which the sessions were focused had to satisfy two main conditions. On the one hand, they had to attract our young viewers , thereby ensuring sufficient motivation to process the information; on the other hand, they had to require that many inferences to be drawn to give coherence to the viewer's representations. Both conditions seemed to be satisfied by most episodes of the cartoon series The Simpsons. Six episodes were selected and analyzed to identify the most important passages where inference is needed to restore local and global coherence. Pauses were introduced immediately after each of these . During these pauses (2 or 3 for each episode) the participants were asked to recall what they had just watched and heard. Completion and clarification of the spontaneous verbal protocols have been encouraged by a feedback consisting of mirroring those passages which appeared to require integration (Lumbelli, 1996). This special feedback has been shown to facilitate further search through a participant's memory and self-revision of initial protocols without interfering with autonomous mental activity. This procedure can be considered as an example of 'the principled design of learning strategies' (Kombartzky et al. 2010) ; in this case, what has to be learned is a correct monitoring of the inferences drawn when processing a text. In fact, recalling, paraphrasing, summarizing(Dansereau et al. 1979; Huk & Ludwigs 2009) and self-explaining (Hegarty et al. 2002;Lowe 2004) are considered as learning strategies.

The 6 educational sessions lasted about one hour and were carried out over a period of 4 months. Each session was audio-recorded.

In the post-test session, the ability to comprehend texts with static pictures was measured. The test consisted of 30 multiple choice questions referring to 4 informative texts that asked the students to draw inferences both to connect verbal items with each other, and verbal items with visual ones. An initial version of 34 questions was tried out and examined by item analysis, and 4 questions were eliminated to obtain an acceptable value of alpha (0.72).

The experimental group obtained mean score of 23.1(SD 2.7) while the control group's score was 20.3 (SD 4.4). The computation of ANOVA showed that the difference between the two means was statistically significant: $F(1,36) = 5.47682$; $p = .002493$. This outcome can be considered as a first confirmation of our prediction that the ability to comprehend a written text with static pictures can be improved by means of an educational treatment centered on

the experience of TV watching, accompanied by indirect encouragement to increase the mental effort invested in the processing.

Our educational experiment seems to have proved that research both about learning with animation and TV watching can help us solve the crucial question of combining cognition and motivation in instruction aimed at improving reading comprehension, such an important ability in almost all school activities.

PAPER PRESENTATION

How implementation intentions in multimedia learning can improve the use of learning strategies

Kim Colin Stalbovs, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

Successful learning with text and pictures requires learners to actively process both information sources. This can be achieved by the application of appropriate learning strategies. However, the self-regulated use of such strategies is demanding. Therefore, a promising means to help learners use learning strategies may be implementation intentions. Implementation intentions are "if-then" plans that strongly link opportunities for applying learning strategies to the actual act of carrying out such strategies. In order to investigate the effects of implementation intentions on learning outcomes, a first study was conducted comparing two groups who learned either with or without implementation intentions. Task interest was included as a factor. A significant interaction between implementation intentions and task interest showed that especially less interested learners benefited from implementation intentions, indicating that implementation intentions facilitate learning of learners with less suitable learner characteristics in particular. A second study, which is currently being conducted, investigates how implementation intentions should be phrased and used in an optimal way. The number of implementation intentions as well as the type of evoked strategy is varied. Learners either learn with one or three implementation intentions. With regard to types of strategy whose use is supported, the implementation intentions either evoke the use of text, picture, or integration strategies. Additionally, there is a group with mixed strategies and a control group without implementation intention. Learning outcomes are assessed; in addition, eye-tracking serves as an online measure of strategy use. Results of both studies will be presented at the conference.

Learning with multimedia (i.e., text and pictures) yields better comprehension than learning with text alone (Mayer, 2009). A prerequisite for this effect to emerge, however, is that learners actively process both representations. Active processing can be achieved by the application of cognitive strategies (Weinstein & Mayer, 1986). Within the Cognitive Theory of Multimedia Learning (Mayer, 2009) cognitive strategies pertain to the selection, organization, and integration of information from both text and picture (Kombartzky, Plötzner, Schlag & Metz, 2010). However, certain challenges are associated with the use of cognitive strategies. Not only do learners need to know what to do, they also have to know when to act. Furthermore, the self-regulated use of strategies requires cognitive resources and can easily overwhelm novice learners (Van Merriënboer & Sluijsmans, 2009). Only when strategy use is automatized, less cognitive resources are required. Hence, measures to improve the use of strategies should support the automatization of strategy use. Based on these requirements, we suggest the use of implementation intentions. Implementation intentions are a well-researched concept in motivational psychology (Gollwitzer & Sheeran, 2006). These "if-then" plans strongly link a situation that is favorable to achieve a goal to effective behavioral responses for attaining the goal (e.g., "After I have read a sentence, I will search the picture for the contents described therein!"). The formation of implementation intentions thus delegates behavioral control from the self to specific situational circumstances, creating very effective "instant habits". Not only do implementation intentions contain information about what to do and when to act, actions evoked by implementation intentions also share similarities with automatized actions. Study 1 In a first study, we tested the hypothesis that implementation intentions support the use of cognitive strategies in multimedia learning, thereby improving learning outcomes. Furthermore, based on prior research, motivation to learn was hypothesized to play an important albeit ambiguous moderating role: Either implementation intentions might be more effective for highly motivated learners (cf. Koestner, Lekes, Powers, & Chicoine, 2002) or they might show a compensatory effect and help especially those who are less motivated regarding the task at hand (cf. Orbell & Sheeran, 2000).

Method

Sixty university students participated in this study. The study used a two-group experimental design with task interest—as measure for motivation to learn—acting as a continuous factor. Participants learned about the topic of cell division by means of an illustrated explanatory text. Before studying the materials, participants either internalized two pre-phrased implementation intentions about the use of strategies of text-picture integration, or they did not internalize any implementation intentions. After learning, participants' learning outcomes were assessed by a multiple-choice post-test, both recall and transfer. Results. Multiple regression analyses were conducted for recall and

transfer performance with implementation intentions, task interest, and the interaction of implementation intentions and task interest as predictors. To follow up on significant interactions, simple slope analyses were conducted. All reported significant results are at least significant at $p < .05$. For recall, there was no main effect for implementation intentions or for task interest. However, an interaction between both predictors indicated that implementation intentions positively influenced recall performance for learners with low task interest, while no effect was found for learners with high task interest. For transfer performance, we found no main effect for implementation intentions, but a main effect for task interest. Surprisingly, performance decreased with increased task interest. Furthermore, there was a significant interaction between both predictors; implementation intentions had a marginally positive effect for learners with low task interest, but no effect on learners with high task interest.

Discussion

Implementation intentions brought no overall advantage to learners. The pattern of results suggests, however, that implementation intentions significantly support less motivated learners. This result corresponds well with previous findings that implementation intentions have a strong compensatory effect, especially when the involved activities are unpleasant. Thus, implementation intentions are a promising support for those who are in need of help the most.

Study 2

In a second study, which is currently being conducted, we investigate how to optimize the content and use of implementation intentions for fostering strategy use in multimedia learning. The study uses a $2 \times 3 \times 2$ between-subject design, with number of concurrently used implementation intentions (1 vs. 3) and type of strategy specified in the "then" part (text comprehension vs. picture comprehension vs. integration) as factors. Additionally, there is a group that learns with three implementation intentions (one of each strategy type), and a control group without implementation intentions. We assume that the internalization of three implementation intentions leads to a more adaptive use of strategies. Furthermore, evoking a mix of strategies should yield better results than evoking only one type of strategy. In order to test whether strategy use mediates the effect of implementation intentions on learning outcomes, the second study measures strategy use online by means of eye-tracking data. The results will be discussed at the conference. Implementation intentions represent an efficient and easily implemented means of improving multimedia learning especially for learners with unfavorable learning characteristics. Thus, it shows promise as an intervention for a variety of educational settings and learning domains.

References

- Gollwitzer, P. M. & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 38, pp. 69-119). San Diego: Academic Press.
- Koestner, R., Lekes, N., Powers, T.A. & Chicoine, E. (2002). Attaining personal goals: Self-concordance plus implementation intentions equals success. *Journal of Personality and Social Psychology*, 83, 231-244.
- Kombartzky, U., Plötzner, R., Schlag, S. & Metz, B. (2010). Developing and evaluating a strategy for learning from animations. *Learning and Instruction*, 20, 424-433.
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge: Cambridge University Press.
- Orbell, S. & Sheeran, P. (2000). Motivational and volitional processes in action initiation: A field study of implementation intentions. *Journal of Applied Social Psychology*, 30, 780-797.
- Weinstein, C. E. & Mayer, R. E. (1986). The teaching of learning strategies. In Wittrock, M. C. (Ed.), *Handbook of research on teaching* (pp. 315-327). New York: Macmillan.

PAPER PRESENTATION

Getting a Clue: How Initially Attending to a Picture Fosters Learning from Subsequent Text

Alexander Eitel, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Anne Schueler, Knowledge Media Research Center, Germany

Previous research has shown that information about the gist (after 150ms) and the functioning (after 2sec) are rapidly extracted from an instructional picture and presumably represented as a mental scaffold in memory. When corresponding text is read afterwards, we assume that information from the text is added to this mental scaffold. Hence, mental model construction from and comprehension of subsequent text should profit from a brief initial glance at an instructional picture. Ninety-five students learned from a text that described the structure, the kinematics, and the underlying principles of pulley systems and in four out of five conditions from an additional picture of a pulley system. Students saw either the text only, the picture preceding the text for 150ms or 2sec, a self-paced presentation of the picture before the text, or the text and picture were shown simultaneously. Facilitation of mental model construction was measured by the time students took to read the text about the pulley system. Text comprehension was measured by verbal and pictorial questions about the kinematics and the underlying principles of

pulley systems. Results confirm our assumptions that compared to a text-only condition students spent less time reading the text about the pulley system, and had a better comprehension of the underlying principles of pulley systems when they saw the picture for 2sec prior to reading the corresponding text. Comprehension of the kinematics, however, did not profit from the short presentation of the picture before the text.

Theory

In the current study we were interested in whether students learn better from the short presentation of a picture before the corresponding text than from text only. In a prior study we investigated which information can be extracted from common instructional pictures (i.e., causal systems) after short presentation (Eitel, Scheiter, & Schýler, 2010). The results of this study showed that students were able to verify statements about the "gist" of instructional pictures (i.e., about their global theme) after 150ms already. Students were able to verify statements about the functioning of instructional pictures after 2 seconds presentation time. In the current experiment we investigated whether information about the gist (after 150ms) and/or about the functioning (after 2sec) from an instructional picture (of a pulley system) would help in learning from subsequent text. Castelhana and Henderson (2007) argue that a short presentation of a picture is sufficient to activate a mental scaffold of the picture's spatial structure. We hypothesize that information acquired from subsequently read text may be added to this mental scaffold. Presenting the instructional picture for 150ms and/or 2sec should hence lead to an integrated mental model from text and picture information. This integrated mental model should result in better comprehension than a mental model constructed from text only (Schnitz, 2002). Moreover, adding information acquired from subsequently read text to the initially acquired mental scaffold should be less demanding than constructing a spatial mental model from text only (Glenberg & Langston, 1992). This should be measurable in terms of shorter reading time when presenting the picture for 150ms and/or 2sec versus presenting text only.

Method

Ninety-five students learnt about pulley systems. They were randomly assigned to one of five conditions (see Figure 1): (a) text only, (b) a picture presented for 150 ms before the text (150ms-before), (c) a picture for 2 seconds before the text (2sec-before), (d) a picture for as long as they liked before the text (self-paced-before), or (e) text and picture simultaneously (simultaneous). The text described the spatial structure of the pulley system, and what happens when the rope is pulled (cf. Boucheix & Schneider, 2009). The picture of the pulley system was a simple line drawing in black-and-white. Reading was self-paced in all conditions. Comprehension was assessed with a verbal multiple choice test and a labelling test (pictorial). Results from both tests were merged in the analysis. We distinguished between comprehension of the underlying principles of pulley systems (e.g., each free pulley reduces weight to be lifted by half), and comprehension of the kinematics of the system (i.e., being able to mentally animate the pulley system; Hegarty, 1992). Eye movements during learning from text and picture were recorded.

Results

We conducted three univariate ANOVAs to test our hypotheses. All reported differences were significant at $p < .05$. Comprehension of kinematics differed among experimental conditions in that it was better in the simultaneous and in the self-paced-before condition than in the text-only condition. Moreover, it was better in the self-paced-before condition than in the 2sec-before and in the 150ms-before condition. There were no further differences. Reading time on text differed among experimental conditions in that it was shorter in all conditions containing text and picture compared to the text-only condition with the exception of the 150ms-before condition.

Discussion

Presenting the picture of a pulley system for 2 seconds before the text led to a better comprehension of the underlying principles of pulley systems, and to shorter reading time on the text than presenting text only. We explain this finding by assuming that students will rapidly acquire a mental scaffold about the spatial structure of the pulley system that can then be integrated with information extracted from subsequent text, leading to facilitated processing and better comprehension of subsequent text. Presenting the picture of the pulley system for 150ms most likely was too short for students to acquire a mental scaffold about the spatial structure of the system. Comprehension of the kinematics was fostered only when students could inspect the picture for as long as they wanted to. The longer students inspected the picture, the higher the probability that they did not only encode the structure of the pulley system, but also inferred its kinematics during inspection (Hegarty, 1992). A brief glance at the picture (i.e., for 150ms or 2sec), by contrast, probably did not lead to a mental model that represented the kinematics of the system in an accurate way. Analysis of students' drawings of their mental models as well as their eye fixation patterns during picture inspection will check for these assumptions. These data will be presented at the conference.

References

- Boucheix, J.M. & Schneider, E. (2009). Static and animated presentations in learning dynamic mechanical systems. *Learning and Instruction*, 19, 112-127.
- Castelhano, M. S., & Henderson, J. M. (2007). Initial scene representations facilitate eye movement guidance in visual search. *Journal of Experimental Psychology: Human Perception and Performance*, 33, 753-763.
- Eitel, A., Scheiter, K. & Schýler, A. (2010). What can information extraction from scenes and causal systems tell us about learning from text and pictures? In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd Annual Conference of the Cognitive Science Society* (pp. 2822-2827). Austin, TX: Cognitive Science Society.
- Glenberg, A. M. & Langston, W. E. (1992). Comprehension of illustrated text: Pictures help to build mental models. *Journal of Memory and Language*, 31, 129-151.
- Hegarty, M. (1992). Mental animation: Inferring motion from static displays of mechanical systems. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18, 1084-1102.
- Schnotz, W. (2002). Wissenserwerb mit Multimedia. *Unterrichtswissenschaft*, 4, 293-318.

PAPER PRESENTATION

The Importance of Design in Learning from Diagrams

Marije van Amelsvoort, Tilburg University, Netherlands; Jan van der Meij, University of Twente, Netherlands; Anjo Anjewierden, University of Twente, Netherlands; Hans van der Meij, Twente University, Netherlands

An experiment was conducted to assess whether the design of a node-link diagram influences how people look at the diagram, and whether this in turn effects recall of the presented information. Four diagrams were created that contained the same information (on the development of babies in the first four months of their lives), but had a different lay out. The orientation of the arrows between chunks of information was either from left to right or top-down, and the organization of the information was either with months on the left and development categories on top or the other way around. 82 participants were asked to study one of these four diagrams for five minutes, and do a retention test. Eye movements were recorded to analyze participants viewing patterns. We found that participants mainly followed the development categories when reading the diagram. The effect was stronger when the arrows followed the categories. Participants performed better on the questions that were focused on categories than on the questions that focused on months, regardless of the condition they were in. We conclude that perceptual cues such as arrows guide learners' orientation, but that the conceptual information is more important for the order in which people learn.

Many scholars have argued that node-link diagrams are good for learning. They show text in boxes, with lines or arrows to relate these boxes. Node-link diagrams can facilitate learning by clarifying relationships and illustrating structure. Implied in their theoretical benefits is that diagrams support learning by their perceptual features, i.e., textual, spatial, and graphical elements that improve reading. In practice however, results have been equivocal. So far, learning scientists have largely ignored design characteristics of diagrams that may help or hinder learning. A meta-analysis on research into concept maps showed that they are better for learning than text, lists, and outlines, but did not reveal why this is the case (Nesbit & Adesope, 2006). In our study, we have systematically varied the design of a diagram without changing its content, to examine if and how perceptual cues influence learning. The perceptual cues we used were arrows between the nodes in the diagram. Although arrows can have different meanings, in our case they are presumed to direct learners in a specific reading order (e.g., Tversky, Zacks, Lee, & Heiser, 2000). To examine how learners processed the diagram, we used eye-tracking. With eye-tracking we could analyze in what order the diagram was read.

For the analysis we developed a technique to find sequences in the eye-tracking data. Since eye-tracking does not give and answer to why learners processed the diagram the way eye did, we combined eye-tracking with a retrospective interview. The goal of our study was to assess (1) whether perceptual cues in a diagram indeed guide students' reading behavior and (2) whether the way students read a diagram influences what they remember from its content. Four versions of a diagram showing babies' development were created. Content of the diagram was the same, but the layout was different. Arrows and boxes made the orientation of the diagram to be either from left to right or top-down, and the development categories were on the left while the months were on top, or the other way around (see Figure 1). Example of one of the lay-outs; orientation on categories from left to right - Eighty-two university students were randomly assigned to one of the diagrams and asked to study it for five minutes. Their eye-movements were recorded. A post-test was administered to test how much participants remembered from the content of the diagram. Half of the questions required an orientation on months and the other half required an orientation on developmental categories. We also asked them to indicate how they studied the diagram and explain why they studied it the way they indicated. For the analyses, the diagram was divided into 24 look zones, one for each cell, and further divided in heading cells and body cells. We developed a model to investigate the order in which participants studied the diagram. The model tries to find sequences of minimally three look zones in the diagram body from left to right and

top-down. As long as the time spent in a look zone belonging to the sequence is larger than twice the time spent in a look zone not fitting the sequence, the sequence is intact. A repeated measures ANOVA showed an interaction effect between condition and time in sequence for left to right compared to top-down, $F(3,78) = 32.33$, p partial $\eta^2 = 0.55$. In all conditions time in sequence for the headers was longer for the category headers compared to the month headers. These data show that when the category headers were on top, participants read longer top-down, while when the category headers were on the left, participants read longer from left to right. The effect was stronger when the arrows followed the categories. By analyzing the first sequence of each participant we found that most participants initially followed the arrows. This is consistent with participants' own account of how they initially studied the diagram, except for the condition where the arrows followed the months top-down (Table 1). Table 1. Number and percentage of participants who initially followed the perceptual cues based on eye-tracking data (left) and participants' own account (right).

Eye-tracking

Own account yesN (%)noN (%)yesN (%)noN (%)months left-right15 (71.4) 6 (28.6)13 (61.9)8 (38.1) top-down 12 (60.0)8 (40.0) 7 (35.0)13 (65.0)categories left-right 18 (85.7)3 (14.3)17 (81.0)4 (19.0) top-down 18 (90.0) 3 (10.0)16 (80.0)4 (20.0). Overall, participants answered about half of the post-test questions correctly, with a mean of 7.35 (SD = 2.96) out of 16 points. A paired-samples t-test showed that participants more often gave right answers on the questions focused on categories, $M = 4.14$, $SD = 1.79$, than on the questions focused on months, $M = 3.21$, $SD = 1.58$, $t(81) = 5.16$, $p F(1,81) = 0.09$, $p = 0.97$ and $F(3,81) = 0.42$, $p = 0.74$ respectively. Diagrams for learning promise to guide a learner through the information with perceptual cues. In our study, perceptual cues were arrows intended to guide the learners to read a diagram in a certain order. We found, however, that the arrows were hardly followed when studying the diagram. Most participants made their choice for reading order by looking at the content of the headers. Only in the initial stage participants followed the arrows.

Our results imply that in designing learning material, we cannot simply assume that learners will follow the design elements and that the perceptual features do not necessarily impact students' learning. ReferencesNesbit, J. C., & Adesope, O. O.(2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research*, 76, 413-448. Tversky, B., Zacks, J, Lee, P., & Heiser, J. (2000). Lines, Blobs, Crosses, and Arrows: Diagrammatic Communication with Schematic Figures. In M. Anderson, P. Cheng, and V. Haarslev (Eds.), *Theory and application of diagrams* (pp. 221-230). Berlin: Springer.

PAPER PRESENTATION

Statistical problem solving with external representations

Stephanie Lem, K.U.Leuven, Belgium; Patrick Onghena, K.U.Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium; Wim Van Dooren, K.U. Leuven, Belgium

Being able to reason about distributions of data is considered to be an important outcome of statistics education. In order to be able to reason about distributions, one must be able to interpret external representations for data distributions. Research did already provide some anecdotal evidence on the occurrence of misinterpretations of these representations by students, but no research has thus far focused on the role of external representations in distributional reasoning. In this study we systematically varied the representation that accompanied a task between participants. Following a cognitive fit approach, we searched for matches between tasks and representations. Depending on the task, some representations led to better achievement than other representations. However, because of the low overall accuracy rates and various difficulties that students showed in interpreting these representations, strong cautiousness in making claims about matches between tasks and representations seems to be warranted.

Understanding distributions of statistical data is considered to be an important outcome of statistics education and a prerequisite for understanding more complex theoretical and sampling distributions (Meletiou & Lee, 2002). As data distributions are only accessible by means of external representations, understanding these representations is an important skill students have to acquire in a statistics course. Some anecdotal evidence shows nevertheless that students have great difficulties interpreting especially box plots and histograms (e.g., Bakker, Biehler, & Konold, 2004; delMas, Garfield, & Ooms, 2005). More systematic research is however still necessary to learn more about the role of external representations in distributional reasoning.

In this study we systematically varied representations between participants in order to study the role of external representations in distributional reasoning. By taking a cognitive fit perspective we tried to find matches between certain tasks and certain representations. The cognitive fit theory (Vessey, 1991) states that problem solving is facilitated when the information emphasized in the external representation, in the task, and hence in the cognitive

processes, match, leading to a consistent mental representation of the problem at hand. This way the chances of finding a correct solution to the problem are maximized, because task and representation match, resulting in a 'cognitive fit'.

Method

167 first year university students of educational sciences participated in return for course credit. Prior to their participation they had all completed the same introductory statistics course that covered all topics that were part of our test.

The paper-and-pencil test consisted of eight items in which students had to compare the distribution of the life span of batteries of two brands with respect to the mean, the median, the skewness, or the variation. Half of the items were about two symmetrical distributions, while the other half were about a symmetrical and an asymmetrical distribution. The representation that accompanied the tasks was randomly varied between participants: either a dot plot, a grouped histogram, a box plot, or a list of descriptive statistics. The items had a multiple-choice format, but also asked the students to explain how they arrived at their response.

Results

Overall, 58 % of all responses were correct. Using a generalized linear mixed model with correctness of response as the dependent variable, we found a main effect of task, $F(7, 1129) = 21.35$, $p < .001$, $F(3, 1129) = 11.75$, $p < .001$, $F(21, 1129) = 2.78$, $p < .001$. Table 1 shows the percentages of correct responses per item and representation. The results of the logistic regression analyses per task show four main effects of representation. (Table 1 about here)

In this table we see that the matches between tasks and representations we would make based on the percentages of correct responses would frequently be based on low accuracy rates, rather than on high accuracy rates with a certain representation. This suggests that these representations do not lead to a cognitive fit with the specific tasks, and/or that students are not able to interpret the representations correctly.

A look at the explanations students provided for their erroneous responses reveals that indeed students very often misinterpret these representations. On top of that, 37% of the correct responses were also accompanied by an incorrect explanation. All erroneous explanations were systematically analyzed. Examples of misinterpretations are: Comparing the height differences of the bars in histograms in order to compare the variation of two histograms and interpreting the area of the box of a box plot as representing frequency or proportion of observations.

Discussion

Our results show that students' fluency with the studied representations is relatively low, which is mainly caused by some systematically occurring misinterpretations. Based on these results, it would be inappropriate to make claims about matches between representations and tasks.

Our results have several implications for research. First, when studying students' distributional reasoning, it is important to take the representation used to present students with tasks into account, as a representation can have a significant effect on students' reasoning. Second, it is clear that not only characteristics of the task and representation should be taken into account when looking for matches between tasks and representations; also other factors such as context and representational fluency of the problem solver are likely to influence these matches. Third, several new research questions arise, such as: Which subject characteristics influence the match between task and representation? And where do the misinterpretations that students hold against representations for data distributions come from?

For education these results show the importance of being fluent in the use of these representations. Education should hence pay more attention to the interpretation of these representations. Furthermore, the specific misinterpretations we found can help teachers diagnose, prevent, and remediate these misinterpretations.

PAPER PRESENTATION

Assessing the relationship between Piagetian operations, calculations and arithmetic problem-solving

Jose I. Navarro-Guzman, University of Cadiz, Spain; Manuel Aguilar-Villagran, University of Cadiz, Spain; Esperanza Marchena, University of Cadiz, Spain; Gonzalo Ruiz Cagigas, Universidad de Cadiz, Spain; Inmaculada Menacho, University of Cadiz, Spain; Estivaliz Aragon, University of Cadiz, Spain; Candida Delgado, University of Cadiz, Spain

The main target was to study the relationship between logical competences and addition, subtraction and verbal arithmetic problem-solving. Logical competences were assessed by the Piagetian test but using numerical contents. The TEDI-MATH test (Grêgoire, Noël, & Van Nieuwenhoven, 2005) was used. TEDI-MATH assesses several numerical

competences (counting skills, numbering, transcoding, Base-10 comprehension, arithmetic, quantity estimation). 122 first grade primary school children (61 boys and 61 girls) average age 6.11, from Cadiz (Spain) school district were evaluated. Participants were evaluated at the end of the first academic year (June 2006). The operational tests were number seriation, classification, number conservation, number inclusion and additive decomposition. Arithmetic skills were evaluated with different items: addition, gap addition, subtraction, gap subtraction, arithmetic total score and arithmetic problem-solving. Results show that participants with high scores in logical tests also got high scores in arithmetic, even if items were presented in classical or verbal style. Seriation and addition decomposition tests rather than classification better discriminated experts and non-expert participants. Data suggests validity using logical operation testing in order to assess mathematics development and diagnose Mathematics Learning Disabilities.

The influence of Piaget's model in number sense development has been very important in teaching and learning early mathematics. This model has also been useful in understanding Mathematics Learning Disabilities (Dyscalculia). From this point of view, Dyscalculia is the result of a lack of development of logical operations supporting number sense. As, according to Piaget, the level of logical development in children shapes a structure, then the assessment and treatment of Dyscalculia would be based on multiple contents that support logical operations. However, Piaget's model has been criticized from different perspectives. One of the most important considers that children do not all develop in the same way. Different studies using extensive samples have shown great variability in operational development. Those studies consider that Piaget's stages do not appropriately describe developmental psychology, and make it difficult to assess operational level with a small number of tests. Considering this position, operational assessment following Piaget's model is just an evaluation of a small number of mental operations and certain contents. No general inferences can be made from a simple operational assessment. Another criticism of Piaget's model is related to the factors linked with children's answers to the tests. Interaction with adults, language used and the size of comparative groups have all been considered to influence children's answers to Piaget's tests. Considering this and after analyzing experimental data, some authors have doubts about Piaget's operational model of number. They consider it to be incomplete and inadequate in addressing the development of children's numerical skills. Piaget under-estimated the role of language and counting as Gelman, & Baillargeon (1983) have elucidated. Despite these different perspectives, other authors consider that Piaget's model is still useful. A completed conceptualization of number necessarily infers logical functions and/or interaction between counting skills and logical capability (Lehalle, 2002; Van Luit, 1998). The logical capability defended by Piaget does not imply that, before logical operation acquisition, number does not have any sense for children, nor that their arithmetic skills are nil. (Grégoire, 2005). Gregory (2005) also remarks that if the main target is to assess logical skill acquisition involved in number comprehension, operational tests should be based on numerical items, minimizing non-numerical items when operational assessment is carried out. Following these rules should improve operational test validity in number contexts and give results more in accordance with Piaget's model.

Method

Taking the previous ideas as our starting point, a comparative study was designed. The main target was to study the relationship between logical competences and addition, subtraction and verbal arithmetic problem-solving. Logical competences were assessed by the Piagetian test but using numerical contents. The TEDI-MATH test (Grégoire, Noël, & Van Nieuwenhoven, 2005) was used. TEDI-MATH assesses several numerical competences (counting skills, numbering, transcoding, Base-10 comprehension, arithmetic, quantity estimation). 122 first grade primary school children (61 boys and 61 girls) average age 6.11, from Cadiz (Spain) school district were evaluated. Participants were evaluated at the end of the first academic year (June 2006). The operational tests were number seriation, classification, number conservation, number inclusion and additive decomposition. Arithmetic skills were evaluated with different items: addition, gap addition, subtraction, gap subtraction, arithmetic total score and arithmetic problem-solving.

Results and discussion

Considering the logical operations data, differences between expert and non-expert participants can be established (table 1)

Logical operations	Experts	Non-Experts
Number seriation	100	22
Classification	18	104
Number conservation	42	80
Number inclusion	21	101
Addition decomposition	25	97

Number seriation was the easiest logical operation acquired by children. Classification was the most difficult. Data indicated that first grade children still need a long time for logical operation acquisition. And probably a new assessment at the end of the second grade year would have very different results. Using the previous data, participants were assigned to 2 groups, according to their logical operation skills. Then the arithmetic performance for both groups was compared. Results show that participants with high scores in logical tests also got high scores in arithmetic, even if items were presented in classical or verbal style. Seriation and addition decomposition tests rather than classification better discriminated experts and non-expert participants. Data suggests validity using logical operation testing in order to assess mathematics development and diagnose Mathematics Learning Disabilities.

Implications for the theoretical context

This research brings together knowledge from Science Education, Cognitive Psychology and Early Mathematic Learning. It also has an added value validating the measurement of cognitive skills involved in Mathematical Learning. Both should result in the early diagnosis and identification of children with Mathematics Learning Disabilities and a subsequent improvement in their school performance. Results would stress how important to implement specific learning programs is in order to build up the Math performing Spanish range in PISA report.

References

- Gelman, R. y Baillargeon (1983). A review of some Piagetian concepts. In P.H. Mussen (ed.) *Handbook of Child Psychology* (pp.167-230). New York: Wiley.
- Grégoire, J. (2005). Développement logique et compétences arithmétiques. Le modèle piagétien est-il toujours actuel ?. In Crahay, M., Verschaffel, L., De Corte, & Grégoire (Dir.). *Enseignement et apprentissage des mathématiques. Que disent les recherches psychopédagogiques ?* (pp. 57-77).
- Grégoire, J. Noíl, M. P. y Van Nieuwenhoven, C. (2005). *TEDI-MATH. Manual*. Madrid: TEA Ediciones. (Adaptación española de M. J. Sueiro y Jaime Pereña, 2005).
- Lehalle, H. (2002). Connaissances numériques et modèles de développement. In J. Bideaud & H. Lehalle (Eds). *Le développement des activités numériques chez l'enfant* (pp. 29-54). Paris : Lavoisier.
- Van Luit, J. E. H.; Van de Rijt, B. A. M. & Pennings, A. H. (1998). *The Utrech Early Numeracy Test*. Doetinchem: Graviant Publishing Company.

PAPER PRESENTATION

Abstract and concrete examples in learning math-Replicating and elaborating Kaminski et al.'s study

Dirk De Bock, Hogeschool-Universiteit Brussel, Belgium; Johan Deprez, Universiteit Antwerpen, Belgium; Wim Van Dooren, K.U. Leuven, Belgium; Michel Roelens, Katholieke Hogeschool Limburg, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Kaminski, Sloutsky, and Heckler (2008) published a study on "The advantage of abstract examples in learning math" in *Science* in which they claim that students may benefit more from learning mathematics through a single abstract, symbolic representation than from multiple concrete examples. In their central experiment, participants learned either an abstract (or "generic") instantiation of a mathematical concept, or one or more concrete instantiations of that concept. This publication called forth both enthusiastic and critical comments by mathematicians, mathematics educators and policy makers worldwide. Basic elements of critique refer to the unfairness of Kaminski et al.'s comparison due to the role of uncontrolled variables, which poses a threat to the generalizability of their results. But, as far as we know, no attempts have been undertaken yet to test these critiques empirically. We report an empirical study that involves a partial replication but also an important extension and validation of this widely noticed study. Our quantitative results confirm the findings of Kaminski et al., but our qualitative data raise serious questions about their interpretation of what students actually learned of the abstract concept exemplification. Moreover, whereas Kaminski et al. showed that abstract learners transferred what they had learned into a similar abstract context, through our extended design, we were able to show also that students who learned from concrete examples transferred their knowledge into a similar concrete context. In light of these new findings, the generalizability of Kaminski et al.'s results and their basic claim about learning mathematics are reviewed.

Theoretical and empirical background

Most mathematics educators nowadays take more or less for granted that mathematics should be taught "from concrete to abstract" and that a series of well-chosen examples (and counterexamples) can facilitate students' understanding of an underlying or more general mathematical idea. Recently, this point of view was explicitly questioned. In *Science*, Kaminski, Sloutsky, and Heckler (2008) published a study on "(t)he advantage of abstract examples in learning math" in which they claim that students may benefit more from learning mathematics through a single abstract, symbolic representation than from multiple concrete examples. In their central experiment, participants learned either an abstract (or "generic") instantiation of a mathematical concept, or one or more concrete instantiations of that concept. The publication in *Science* called forth both enthusiastic and critical comments by mathematicians, mathematics educators and policy makers worldwide. Basic elements of critique refer to the unfairness of Kaminski et al.'s comparison due to the role of uncontrolled variables and the content validity of the instrument, which poses a threat to the generalizability of their results. But, as far as we know, no attempts have been undertaken yet to empirically substantiate these critiques.

Aims

We elaborate on two main elements of critique and we provide empirical evidence to substantiate them. First, we argue for why the comparison made by Kaminski et al. is basically unfair. Second we query about what the students actually learned from the abstract examples. To support these two elements of critique empirically we set up a replication and extension study.

Method

One hundred and thirty undergraduate students in educational sciences participated in a study with two phases: (1) training and testing in a learning domain, and (2) testing for transfer. All participants were randomly assigned to one of four experimental conditions – AA, AC, CA, and CC – in which the first letter specifies the learning domain and the second one the transfer domain, both of which could be either abstract (A) or concrete (C). The AA- and CA-conditions were used in Kaminski et al.'s experiments; the AC- and CC-conditions were important additions by us in order to measure transfer to a new concrete domain. The A-domains were operationalized by a context using arbitrary symbols and their combination rules. For the C-domains, a modulo 3 addition context with physical referent was developed. In the four experimental conditions, the test at the end of the learning phase as well as the transfer tests consisted of 24 multiple-choice questions.

As second important difference with Kaminski et al.'s procedure – besides adding two conditions –, we included a single open question immediately after the learning phase in order to qualitatively investigate what students actually learned of the abstract or concrete examples, something that was not investigated at all by Kaminski et al.

Training and testing happened individually on a computer screen and the two phases immediately followed after each other. Participants proceeded through training and testing at their own pace. Participants' learning and transfer test scores were analyzed using two single-factor ANOVA's. To analyze participants' explanations for their answers on the open question, a scoring system was developed and applied to all participants' explanations by two independent raters.

Results

Our results with respect to the two conditions that were taken from Kaminski et al.'s original study confirm their findings: The AA-group outperformed the CA-group on the abstract transfer task ($p < 0.001$). So if transfer in a new abstract domain is targeted, abstract instantiations are more advantageous than concrete instantiations. However, through our extended design, we were able to show that the opposite holds too: CC-group outperformed the AC-group on the concrete transfer task ($p = 0.044$). So, transfer to a new concrete domain is more enhanced by a concrete learning domain than by an abstract one.

The analysis of participants' explanations on the open question after learning in the abstract learning domain provided little or no evidence that these participants learned the quintessence of the abstract concept that was aimed at in the intervention: Although participants were asked to explain as precisely as possible how they had found their answer, they rarely used the intended concepts in their explanations. On the contrary, a vast majority of participants just repeated specific rules – suggesting that they merely learned them by heart – or referred to a very different mathematical concept, i.e. addition modulo 3.

Discussion

We replicated and elaborated Kaminski et al.'s widely noticed study and re-examined their claim that students may benefit more from learning mathematics through a single abstract, symbolic representation than from multiple concrete examples of a to-be-learned concept. Our results confirm the basic finding by Kaminski et al.: Transfer in a new abstract domain is enhanced by abstract rather than by concrete instantiations. But, whereas Kaminski et al. showed that abstract learners transferred what they had learned into a similar abstract context, through our extended design, we were able to show also that students who learned from concrete examples transferred their knowledge into a similar concrete context. Moreover, our qualitative data raise questions about their interpretation of what students actually learned of the abstract examples. These results pose a serious challenge to Kaminski et al.'s affirmative conclusions about "(t)he advantage of abstract examples in learning math".

Kaminski et al.'s original study boosted the public debate on how mathematics should be taught and learned. However, for several reasons, we think it is inappropriate to already extrapolate Kaminski et al.'s – and, thus, also our – findings to the broader realm of mathematics education: The mathematical topic of both studies is a very particular one, the conducted short-term "laboratory" experiments differ on crucial points from that in typical educational settings, and their effects over longer periods of time remain unexplored.

Reference

Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2008). The advantage of abstract examples in learning math. *Science*, 320, 454–455.

PAPER PRESENTATION

Increasing freshmen's responsibility for learning in Web-based courses: Advantages and challenges

Ornit Sagy, Technion, Israel; Yael Kali, Technion, Israel; Masha Tsaushu, Technion, Israel; Tali Tal, Technion, Israel; Dan Zilberstein, Technion, Israel; Shimon Gepstein, Technion, Israel

Instruction in large higher-education introductory courses is usually based on lectures. Research shows that such instruction fails to help students develop conceptual understanding because it does not encourage them to take responsibility of their own learning. In this research we developed an instructional model that harnesses technology to support students in assuming responsibility of their own learning, and gradually implemented this model in a large introductory biology course. We examined how the gradual shift of responsibility from the instructor to the students affected their self-regulation and self-efficacy. Verbal analysis of students' utterances revealed that students felt a sense of confidence when all course contents were provided to them both in the lectures and in an online tutorial, this confidence encouraged them to take responsibility of their own learning. However, when students knew that they have to rely on their self-learning from the tutorial for some of the course material, they were reluctant from taking that same responsibility. We conclude that it is imperative to provide appropriate supports that will induce a critical level of comfort and confidence that will enable students to take higher responsibilities of their learning.

Introduction

In many universities across the world, introductory courses are huge, constraining the teaching mainly to lectures. Research shows that such instruction fails to help students develop conceptual understanding because it does not encourage them to take responsibility of their own learning (McCray et al., 2003).

The literature refers to two related entities that enable learners to take such responsibility: Self-regulated learning, and Self-efficacy. Zimmerman (1998) describes self-regulated learning as a self-directed process (including thoughts, feelings and actions) that a learner uses in order to attain a personal goal of learning. He claims that it's a cyclical process with three phases: Forethought, Performance-Control and Self-Reflection. Self-efficacy, on the other hand, is described as one's belief in his/her capability to produce at a designated level of performance and to influence the process of getting to that level (Bandura, 1994).

In this research we developed an instructional model that harnesses technology to support students in assuming responsibility of their own learning gradually, and implemented it in a large introductory biology course. In phase-1 of the study, we introduced an online tutorial (including videotaped lectures, interactive visualizations and self feedback) which usage was optional while the lectures covered all course contents. In phase-2, students were required to self-learn some contents, so that the lecturer could focus on more complicated topics. The purpose of the research was to examine if the gradual shift of responsibility from the instructor to the students affects their self-regulation and self-efficacy.

Methods

834 freshmen biology students participated in the study over 3 semesters (2008-2010).

Data sources were: (a) students' free comments from a feedback survey given toward the end of the course, (b) protocols of interviews with 18 selected students (c) server logs which provided information regarding the usage of the tutorial, (d) final exam scores.

Students' survey utterances were analyzed using verbal analysis (Chi, 1997), with the categories shown in Table 1.

Table 1: Verbal analysis categories

Findings and Discussion

Use of the online tutorial, satisfaction and test scores. Once the tutorial was introduced (phase-1) its usage was high (used by more than 90% of students). The usage became even more extensive in phase-2. For example: the average number of different video lectures watched per student rose from eight to eighteen. Students' satisfaction from the tutorial is evident from the survey results: 80% of the utterances regarding the tutorial were positive. No difference was found in the final exam scores, indicating the students' ability to cope with the self-learning requirement.

Self-regulation and self-efficacy

Analysis of student survey answers showed a rise in three indicators in phase-1 (Intrinsic interest, Mastery experience and Emotional state), and then a drop in phase-2 (Figure 1). However, Strategic planning constantly decreased (Figure 2) as students were required to take more responsibility of their learning.

Figure-1: Rise and drop in positive self-regulation and self-efficacy indicators

Figure-2: Strategic planning utterances

We interpret the rise and drop in Figure-1 in terms of Maslow's hierarchy of needs theory (1943). We view the rise between the pre-intervention and phase-1 as an indication of a sense of confidence that students felt when all course contents were provided to them both in the lectures and in the online tutorial (Student: "I always prefer to rely more on the lectures. But there is like self confidence ... a good feeling that you can't miss anything... there's always the website"). Building on Maslow's theory, we believe that this confidence provided students with an environment comfortable enough to expand their self-interest. However, in phase-2, students knew that not all contents are covered in lectures, their sense of confidence was shattered, and their psychological resources were directed towards more basic needs (making sure they learn everything they should know for the test). Thus their interest in expanding their horizons decreased.

We believe that the drop in strategic planning (Figure 2) results from a gap between students' theoretical aspiration to be provided with a variety of learning resources, and their actual desire to be taught via lectures. When students thought hypothetically about improving the course they suggested additional learning resources "A video-taped lecture will help for sure... more copies of the textbook in libraries..." However, once additional tools were provided, and especially when students were required to use them, they restrained from taking more responsibility of their learning. It seems that students prefer to keep their comfort zone in a situation in which the instructor has the responsibility for making all the strategic planning.

Theoretical and Educational Significance and Implications

This study shows that indeed, use of technology can encourage self-regulated learning and support self-efficacy. However, when using technology to do so, it is imperative to provide appropriate supports that will induce a critical level of comfort and confidence that will enable students to take higher responsibilities of their learning. We believe that the drop in self-efficacy and self-regulation components in phase-2 resulted from transferring only partial responsibility to the learner. We have evidence showing that students were confused. Based on Maslow's theory (1943) it seems that phase-2 students were not provided with enough support that would give them confidence that they can succeed. That said, we would like to stress that we are not backing away from our goal to increase students' responsibility of their own learning, rather, we stress the importance of providing them with the appropriate support in doing so.

References

- Bandura, A. (1994). Self-efficacy. In V.S.Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*. San Diego: Academic Press, 1998).
- Chi, M.,T.,H. (1997),Quantifying Qualitative Analyses of Verbal Data: A Practical Guide, *THE JOURNAL OF THE LEARNING SCIENCES*, 6(3), 271-315.
- Maslow, A. (1943). A theory of human motivation. *Psychological Review*, 50, 370-396.
- McCray, R.A., DeHaan, R.L. & Schuck,J.A. (2003). *Improving undergraduate instruction in science, technology, engineering, and mathematics: Report of a workshop*: National Research Council, Washington, DC : National Academies Press.
- Zimmerman, B.J. (1998). 'Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models.' In D.H. Schunk & B.J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 1-19). New York: Guilford Press.

PAPER PRESENTATION

The use of videoconference in online education and its effect on student performance

Bas Giesbers, Maastricht University, Netherlands; Bart Rienties, University of Surrey, United Kingdom; Dirk Tempelaar, Maastricht University , Netherlands; Wim Gijselaers, Maastricht University, Netherlands; Mien Segers, Maastricht University, Netherlands

Synchronous communication is superior to asynchronous communication in establishing discourse due to the ability to express immediate feedback (e.g. via chat), the ability to use voice and intonation and to show body language (e.g. via videoconferencing). However, research has shown that just using social media not necessarily has the desired effect

(e.g. increased performance). This may be explained by the pedagogical model used or by personal characteristics of the student. This contribution focuses on the relationship between learning performance, the choice of communication tools and the influence of personal characteristics motivation and learning style on these. Initial analysis shows there are relationships though further analysis like multilevel analysis is required to gain further insight first in the effect of belonging to a certain tutor group and second in the interaction effects of different elements of our model.

Synchronous communication (like chat and videoconferencing) is superior to asynchronous communication (like discussion forums) in establishing discourse due to the ability to express immediate feedback (chat), the ability to use voice and intonation and to show body language (videoconferencing) (Beers, Boshuizen, Kirschner, & Gijssels, 2007; Derks, Bos, & Grumbkow, 2007; Haythornthwaite, 2000; Tu, 2002; Tu & McIsaac, 2002). It is generally assumed that synchronous communication might reduce meaning barriers, the obstruction of mutual construction of meaning of information from sender to receiver, when learners are working and learning together in an online classroom (Bromme, Hesse, & Spada, 2005; Rummel & Spada, 2005). The choice to incorporate social media that allow for synchronous communication thus seems logical when aiming for improvement in the performance of learners in an online setting. In addition, many tools nowadays are easily accessible for free or at a very low cost. However, research has shown that using social media alone for this purpose not always has the desired effect (Lou, Bernard, & Abrami, 2006). Several factors help to explain why of which the first is pedagogy. In an extensive meta-analysis comparing asynchronous and synchronous communication in undergraduate online learning, Lou et al. (2006) follow Clark (1994) in his conclusion that the pedagogical model used is of higher influence on learning than the social media used. The pedagogical model underlying the online classroom in this contribution is Problem Based Learning (PBL) which is founded on generally accepted characteristics for effective learning like active learning, structured cognitive interaction and instructor guidance and has proven to be effective (Schmidt, Van Der Molen, Te Winkel, & Wijnen, 2009). Therefore, the pedagogical model in itself will not be the main focus of our study. Personal characteristics of a learner constitute the second factor. Among different personal characteristics that have been found to have an influence on student learning, motivation and learning style are probably the most extensively researched and both have been found to affect students' performance and the choices they make during the learning process (Järvelä, Volet, & Järvenoja, 2010; Vermetten, Lodewijks, & Vermunt, 2001). For this contribution we will focus on individual academic motivation from the perspective of self-determination (Ryan & Deci, 2000). Learning style is defined by Vermunt & Vermetten (2004) as a concept that encompasses a learners' conception of learning and learning orientation, the preference for cognitive and affective processing of content and his or her metacognitive regulation strategies. The present study focuses on the relationship between learning performance, the choice of communication tools and the influence of personal characteristics motivation and learning style on these. Students who attend more videoconferences and use more rich tools are expected to perform better than others. Further, we expect that students' choices to participate more actively, as defined by the number of web-videoconferences attended and the richness of communication tools used are mediated by motivation and learning style.

Method Setting

The present study took place in an online preparatory course in Economics for prospective bachelor students of an International Business degree program. This course bridges the gap in prior knowledge for prospective bachelor students. Students never met face-to-face prior to the course and could meet during the four weekly web-videoconferences that were offered (one hour each). Further communication took place via asynchronous discussion forums. The planned work load was 10 to 15 hours per week. Participants In total, 155 students participated in the preparatory course and were randomly assigned to 12 groups. The average number of members for each group was 14.08 (SD = 3.96). Their average age was 19 and 44% was female.

Instruments Performance measures

During the course, three progress tests and a final test were offered to students.

Academic Motivation Scale

The Academic Motivation Scale (AMS) was developed by Vallerand et al. (1992). The AMS consists of 28 items divided into seven subscales of which three concern intrinsic motivation, three subscales concern extrinsic motivation and the final scale concerns amotivation.

Inventory of Learning Styles

This instrument was developed by Vermunt (Vermunt & Vermetten, 2004) who distinguishes four domains or components of learning: cognitive processing strategies, metacognitive regulation strategies, learning conceptions or mental models of learning, and learning orientations.

Initial results

A one-way ANOVA to test for AMS differences based on the number of videoconferences participated in showed a significant difference between groups only on the Intrinsic motivation to accomplish subscale ($F(4,115) = 2.92$; p A one-way ANOVA to test for ILS differences did not show a significant difference between groups. A one-way ANOVA showed significant differences between groups on average progress test score ($F(4,164) = 41.69$; p Post-hoc tests showed that students who had participated in all four videoconferences on average scored significantly higher than all others on the progress tests. Performance of students who did not participate or participated once was significantly lower than performance of other students. Further, post-hoc tests showed the difference on final test scores between all groups to be significant except for the difference between group 0 and 1 and between group 3 and 4. Finally, post-hoc tests showed no significant difference on tool-use between groups of students who participated in the videoconference at least once.

Further analysis

The current analysis shows a relationship between videoconference use and performance and a weak relationship between motivation and videoconference use. However, drawing causal relationships and/or gaining insight in interaction effects require different methods to rule out error caused by selection effects for example. Also, subjects all were assigned to a tutor group which may further have influenced results as each group was tutored by a different tutor and developed its own social dynamics. Therefore, multilevel analysis will be performed to gain further insight first in the effect of belonging to a certain tutor group and second in the interaction effects of different elements of our model.

PAPER PRESENTATION

Orchestrating collaborative learning in a wiki-environment

Bram De Wever, Ghent University, Belgium

The present study investigates how activities should be orchestrated within a CSCL-environment in order to enhance students' collaboration. More specifically, in a wiki-environment the introduction of a collaboration script guiding students towards true collaboration and group work, instead of merely dividing the work and simply combining individual chunks of work, was studied.

First-year university students Educational Sciences taking the course Instructional Sciences ($N=262$) were asked to work intensively together in groups ($n=56$) of 5 during a two-week period in order to create a wiki documenting the use of peer assessment in education. All groups were required to develop a wiki containing several pages (overview, description, theoretical rationale, advantages, disadvantages, and points of attention) on peer assessment, based on 10 provided sources. Students were randomly assigned to groups and groups were randomly appointed to two conditions: 28 groups worked with a specific collaboration script (scripting condition) and 28 groups collaborated without the script (control condition).

The research question was whether the introduction of a collaboration script in the wiki-environment had a positive impact on students' actual collaboration. The results show that introducing a collaboration script actualizes that students (a) collaborate more instead of dividing the work, (b) get information out of more sources, (c) write on multiple parts/pages of the wiki, (d) read all the pages of the wiki, (e) feel that everyone is responsible for the complete wiki instead of one person per page, and (f) feel oneself responsible for the complete wiki instead of a single page. To conclude, the study shows an important impact scripting and concludes by discussing two critical elements, namely the time consuming nature and the risk of over-scripting.

Introduction

Within the field of computer-supported collaborative learning (CSCL), an important question is whether students are actively engaged and highly collaborating. In this respect, an important issue brought into attention by Larusson and Alterman (2009) is whether the "technology adequately support[s] the students' collaboration" (p. 371). The present study aims at taking this question one step further and investigates how activities should be orchestrated within a CSCL-environment in order to enhance students' collaboration. More specifically, the introduction of a collaboration script in a wiki-environment was studied.

Theoretical framework

The theoretical foundations for the design and implementation of CSCL-environments are generally based on the idea that knowledge is actively constructed by the learners (see e.g. Merrill, 1991). In this respect, sociocultural theorists draw on the insights of Vygotsky (1978), who argues that any higher mental function is first external and social before

it becomes internal. Therefore, they claim that knowledge is constructed through social interaction with others (see e.g. Duffy & Cunningham, 1996).

It is in this respect that the present study aims to guide students towards true collaboration and group work, instead of just dividing the work and merely combining individual chunks of work.

Method

Context & participants – The participants in this study were first-year university students Educational Sciences taking the course Instructional Sciences. Participation to the wiki-assignment was a complimentary part of the course. Students were divided in groups of 5. Due to non-participation (drop-out) one group consisted of 3 students and 16 groups consisted of 4 students. The other 39 groups consisted of 5 students. In total 262 students were divided over 56 groups.

Design – Students were asked to work intensively together during a two-week period in order to create a wiki documenting the use of peer assessment in education. All groups were required to develop a wiki containing several pages (overview, description, theoretical rationale, advantages, disadvantages, and points of attention) on peer assessment, based on 10 provided sources (10 research articles, of which 5 were labeled as main sources and 5 as additional sources). In addition, they were informed on the fact that it was allowed – and even appropriate – to look for additional sources.

Conditions – Two conditions were contrasted within this study: a scripting and a control condition. In the control condition, students were asked to look into the provided sources, the main sources being the most important ones, and to develop the wiki. In the scripted condition, students were requested to follow a specific script. First, they were informed that the step-by-step plan was meant to guide them and that it was to be seen as a flexible aid and not as a strict path. Next, the specific script was introduced. The script required students to read two sources and to start writing a draft of one part of the wiki. In this respect, the sources as well as the pages were divided among students, so that all students started reading different sources and started writing drafts for different pages. In succeeding steps, students had to read more sources and write and revise different parts of the wiki, until eventually everybody at least has read the main sources and rewritten all the parts. A detailed overview of this script is presented in Figure 1.

Figure 1: visual presentation of the script

Research question & hypotheses – The research question that drives this study focuses on whether the introduction of a collaboration script in the wiki-environment had a positive impact on students' collaboration. We hypothesized that the introduction of the collaboration script would actualize students to (a) collaborate more instead of dividing the work, (b) get information out of more sources, (c) write on multiple parts/pages of the wiki, (d) read all the pages of the wiki, (e) feel that everyone is responsible for the complete wiki instead of one person per page, and (f) feel themselves responsible for the complete wiki instead of a single page.

Results

Likert-scale (1-7) items were used to question students and gather data to check the hypotheses. The results are presented in Table 1.

Table 1: means for both conditions

Conclusion

The introduction of the collaboration script orchestrates the learning activities in the wiki-environment and lead students in the hypothesized direction of higher collaboration. However, a number of side effects will also be critically discussed in the presentation, more specifically the amount of time invested and the risk of over-scripting the learning activities.

References

- Duffy, T. M. & Cunningham, D. J. (1996). Constructivism: implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170-198). London: Prentice Hall International.
- Larsson, J. A. & Alterman, R. (2009). Wikis to support the "collaborative" part of collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, 4, 371-402.
- Merrill, M. D. (1991). Constructivism and Instructional Design. *Educational Technology*, 31, 45-53.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

PAPER PRESENTATION

Designing Online Interactive Environments with Animated Conversational Agents

Katerina Theodoridou, Centre for the Advancement of Research & Development in Educational Technology, Cyprus;
Charalambos Vrasidas, CARDET - University of Nicosia , Cyprus; Theano Yerasimou, Centre for the Advancement of Research & Development in Educational Technology, Cyprus

This paper presentation discusses findings from three research studies that involved the use of animated conversational agents for educational purposes. The agents were designed to present course-related material in university-level courses, and interact with the learners both in speech and in text form. The discussion revolves around findings pertaining to learning outcomes, as well as learners' perceptions and affective outcomes (interest, motivation, enjoyment) related to the agents' presence, image, interactivity, and humanness. The presentation concludes with guidelines that educators and instructional designers should consider when developing learning environments, in which agents are integrated. Findings from the studies and the relevant guidelines for designing such interactive environments contribute to the current literature as limited empirical research has addressed design indicators for effective online environments with animated conversational agents.

Aims

One of the latest products of the technological evolution with respect to virtual reality as a medium for enhancing education is animated conversational agents. They are software entities (avatars) supported by Artificial Intelligence engines, capable of displaying human-like characteristics while interacting with the learner in the form of speech and/or text.

The effectiveness of such agents in educational settings has been researched in various content areas in science, humanities, and education fields (Baylor & Ryu, 2003; Baylor, Shen, & Warren, 2004; Choi & Clark, 2006; Cole et al., 2003; Doering & Veletsianos, 2007; Doering, Veletsianos, & Yerasimou, 2008; Moreno, Mayer, Spires, & Lester, 2001; Theodoridou, 2009). Multiple studies have aimed at investigating the impact of agents on learning and affective outcomes, such as interest and motivation.

Up to this point however, empirical research findings are still rather inconclusive as to how agents should be incorporated in online learning environments so as to yield optimal learning and affective outcomes (Clark & Choi, 2005; Gulz, 2004). The purpose of this paper is to present guidelines that educators and instructional designers should consider when developing online learning environments, in which agents are integrated. These suggestions are based on three completed research studies conducted with university-level students that involved the use of animated conversational agents for educational purposes.

Methodology

This paper compiles the results from three empirical research studies, all of which were based on a mixed methods design.

The first study took place at a large research university in the Southwest United States, with 47 students enrolled in two fourth-semester Spanish courses; 24 participants belonged to the Control group (online environment with agent in audio) and 23 belonged to the Experimental group (online environment with agent in audio and image).

Quantitative data sources included: vocabulary pre-test, immediate and delayed post-tests, pre- and post-attitudes scale. Qualitative data sources included: open-ended questionnaire on learners' experiences in the environment.

The data collected from the pre-test and immediate and delayed post-tests were analyzed through descriptive statistics and a two-way repeated-measures ANOVA. The data collected from the pre- and post-attitudes scales were analyzed by using MANCOVA. The data collected from the open-ended questionnaire were analyzed in depth, based on the model of the Constant Comparative Method.

The second study involved 45 pre-service teachers enrolled in a blended teacher-education course at a large Midwestern university in the United States. Five different technology tools were incorporated within the course's online environment, and were utilized inside and outside of class based on the learners' needs. One of the tools was the agent, with which the learners were able to interact through synchronous conversation.

Quantitative data sources included learner questionnaires and qualitative data sources included learner-learner, learner-instructor, and learner-agent conversation and interaction data from the various technology tools. The data

collected from the learner questionnaires were analyzed through descriptive statistics, and the data collected through the conversations were analyzed using the Constant Comparative Method.

The third study involved 14 secondary education pre-service teachers enrolled in an online class at a large Midwestern university in the United States. Two online learning environments were available to the learners, both of which involved an intelligent system with which learners could converse. The first one had the agent only with audio and the second one had audio and the animated image of the agent.

Quantitative data sources included pre- and post- learner surveys and qualitative data sources included learner-agent conversations. The data collected from surveys were analyzed through descriptive statistics, while the data collected through the learner-agent conversations were analyzed through Computer-Mediated Discourse analysis.

Findings

In the first study, both groups yielded significant learning outcomes with respect to vocabulary recall and retention of new lexical items, but the ANOVA performed indicated no significant between-subject effect ($p = .935$). In regards to affective outcomes though, learners in the Experimental group expressed enthusiasm and attraction to the environment, indicating that they would definitely use the environment to complement their foreign language learning.

In the second study, learners indicated that the tools offering higher levels of interactivity, and in particular real-time interactions with the instructor and peers, were the most useful in: a) providing learners with support, b) advancing their motivation in completing the assignments, and c) intriguing them in further exploring other technologies and classroom integration practices. They indicated the agent as one of such tools offering high interactivity.

In the third study, a higher number of speech acts and conversations was recorded in the online environment with the agent's presence with the learners showing distinct preference for the specific environment due to the agent's humanness, friendliness and willingness to interact with the learners.

By examining the results obtained from all three studies and focusing specifically on the integration of the agents in the environments, some of the issues that emerge when it comes to designing effective environments of this sort are: the need for the agent to have an extensive knowledge base, accounting for the novelty effect of such a technology in the environment, providing for student autonomy and control with respect to the agent, emphasizing the humanness of the agent, giving the agent specific purpose, and developing structured and contextualized activities in the environment.

Theoretical and Educational Significance

In an era of continuing growth in the demand for online courses, it is important to design online environments that can provide to the learner even more than what the actual face-to-face environment can. Animated conversational agents have been proven to encourage and support learners during the learning process, while also increasing their motivation and enjoyment towards the course and the material. As a result, incorporating them in the online environment can reinforce the positive learning experience. However, for agents to be effective in the environment, some guidelines need to be followed. This paper combines results from three empirical studies in order to provide a list of such guidelines with the objective of adding to the current literature and providing recommendations so that the added pedagogical value of agents is utilized in online interactive learning environments.

PAPER PRESENTATION

Effects of role taking in on-line writing and reading activities in a blended University course

Donatella Cesareni, University of Rome, Italy; Stefano Cacciamani, University of Valle d'Aosta, Italy

Role taking has been often studied as an established technique used for educational activities. Educational researcher highlight that the possibility to play a specific role within the group in online forums leads students to greater responsibility to its own knowledge building activity other than towards the group itself. The present study focuses on participation in online activities, questioning if taking a role in a group leads to a higher level of participation and which role fosters more participation. 152 students, divided into 14 discussion groups, participated in a knowledge building activity in 3 modules lasting 5 weeks each. In each module students in turn took specific roles. We analyzed students participation in terms of both posted and read notes in knowledge building forums. We compared participation in the three different periods of two groups of students: students who took a role in the second period and students who didn't take a role at all. We used Module 1 as a pre-test and Module 3 as post test and we analyzed differences using T-Student test. Results evidence no differences in participation in Module 1 between the two groups, an higher participation of the group of students taking a role in Module 2, and this difference between the

two groups persists in Module 3. Students who had a role in Module 2 write and read more notes than students who didn't take a role also when none of them had particular roles.

Introduction

A relevant problem for the students in their first approach with the University is perceiving him/herself as an anonymous number in a large system, without a personal relationship with the teacher and sometimes also with other students. Many students feel then disoriented, without any guide about the strategies for an effective study activity. In this scenario it could be useful for the students to assume roles within work groups. In fact taking roles has been often studied as an established technique used for educational activities, mainly in terms of role playing activity. Resnick and Wilensky (1997), e.g., integrated role-playing activities into science and math classes and argue that role-playing can help students understand complex systems and relationships. Educational researchers have also investigated how role-playing in a digital environment fosters intrinsic motivation (Dickey, 2006). Despite this large interest, only few studies analyze the effect of students role taking in online and F2F activities in academic context (Spadaro, Sansone & Ligorio, 2009; Schellens, Van Keer & Valcke, 2006). These studies highlight that the assumption of a role leads the activity of individual students, providing them with a script in which to act, and regulates the interaction within the group. In addition the possibility to play a specific role within the group leads students to greater responsibility to its own knowledge building activity other than towards the group itself. To go in depth in this area of inquiry the present study focused on the following questions: 1) Does taking a role in a group in an on line course lead to a higher level of participation, in terms of writing and reading activity? And does the participation decrease, when the student end to take a role? 2) Which kind of role does foster a higher level of participation?

Method Participants

152 students (14 M, 138 F), attending the first year of the faculty of Psychology, University Sapienza of Rome, took part of this research. Procedure Students participated in a knowledge building activity in a blended course of Pedagogy, discussing online topics of the curriculum. Participants were distributed into discussion groups of 10-12 students. Online activities lasted the same period of the lectures and were divided into 3 modules, lasting 5 weeks each. In each module students were asked to analyze, discuss and reflect on different themes, connected to the course curriculum, and to build a conceptual map at the end of the activity. Groups were the same during the three module, and students in turn took specific roles: social "tutor", synthesizer, accountable for the conceptual map, "sceptical". Roles were assigned by the teacher at the beginning of each module. Measures and data analyses We analyzed students participation in the 3 different modules (subsequent in time) in terms of both posted and read notes in knowledge building forums. For the first question of inquiry, we compared participation in the three different periods of two groups of students: students who took a role in the second period ("with role in the second period") and students who didn't take a role at all ("without role"). So, in module 1, none of the students in the two conditions took a role in the group, in the second period students "with role" had particular responsibility in their group, and in the third period again none of the students had particular roles. We used Module 1 as a pre-test and Module 3 as post test and we analyzed differences using T-Student test. It was not possible to apply ANOVA for the lacking of the statistical conditions. Finally, for the third question of inquiry, we compared in a descriptive way, the writing and reading activity among the different roles.

Results

1st question of inquiry

The results evidence an higher participation (both in writing and reading notes) in each module among students who took a role in that period. Comparing students "without role" with students "with role in the second period", we can see that taking a role has an effect on writing activity also in module 3, when students do not have a specific role in the group. The two groups, in fact, do not differ in the Module 1 ($t(70) = 0,28, p > .05$) before the introduction of the design variable. Significant differences emerged in the Module 3 ($t(70) = -3,64, p = .001$): the students "with roles in the second period" wrote a higher number of notes in the web-forum. We have a similar situation with reference to the reading activity. Also in this case we have not differences in Module 1 ($t(70) = -1,11, p > .05$) between the two groups. In the Module 3 the students "with role in the second period" read a higher number of notes compared their counterparts ($t(69,5) = -3,41, p = .001$).

2nd question of inquiry

Concerning the second question of inquiry, the analysis of the participation considering the particular kind of role assumed by the students shows some differences. In each module the students more active in writing had the role of synthesizer of the group discussion, followed by the social tutor.

Discussion

These results show that students assuming a role in an on line course are more active in terms of writing and reading activity in the on line environment, and this activity remain high also when they end to take a role. Probably this is due to the cognitive responsibility they take in order to build knowledge in the group. Scardamalia (2002) express this in terms of a "collective cognitive" responsibility activated in the students participating in a Knowledge Building Community, also if the author does not mention the role assumption. It is also interesting to notice that the synthesizers of the group discussion are the students more active within the students assuming a role. This can confirm the previous idea, because, who works on the synthesis have the responsibility to define the advancements of knowledge of the community. Probably, then, he tends to stimulate the knowledge building process in the community through a more frequent writing activity .

PAPER PRESENTATION

Improving non-academic laypersons' knowledge and skills to evaluate source information on the Web

Yvonne Kammerer, Knowledge Media Research Center, Germany; Dorena Amann, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

This paper reports on the development and evaluation of the Web training TESWIN. TESWIN aims at improving non-academic adults' source evaluations during Web search for science-related issues, such as medical and healthcare information. The necessity of such a training is given by the increasing popularity of the Web as an information source for science-related contents on the one hand, and by previous research demonstrating Web users' lacking knowledge and skills to evaluate Web-based source information on the other hand. Contrary to already existing trainings, TESWIN is specially designed for non-academic laypersons, focusing on three components, that is, 'the importance of evaluating Web information, 'learning how to evaluate', and 'the comparison of information across different sources'. To test the effectiveness of the TESWIN training, we conducted a study with N=51 participants who were randomly assigned to a training group or a control group. The training group first received the TESWIN training and then conducted a Web research about a health-care topic, whereas the comparison group was required to complete the Web search task before receiving the TESWIN training. With regard to participants' Web search behavior, such as the type of Webpages accessed and the time spent on different types of Webpages, as well as their search outcomes, that is, the quality of decision making and of argumentative summaries, the training group significantly outperformed the control group. Thus, TESWIN seems to be a promising way to improve non-academic laypersons' knowledge and skills to evaluate source information during Web search for science-related contents.

In recent years, the World Wide Web (WWW) has evolved into a major information source for science-related contents. Particularly in the context of personal concerns of individuals, such as medicine and health care, using the Web as a supplement to the interaction with experts has become increasingly popular among laypersons. However, as anyone can publish virtually any information on the WWW, information sources on the Web differ dramatically with regard to authors' expertise and motives. Moreover, contrary to traditional information sources such as printed publications, documents on the Web seldom have explicit editorial review policies or undergo quality controls. Hence, Web users themselves are responsible for "gatekeeping", that is, evaluating the relevance and quality of information found on the Web. Previous research, though, has shown that searchers often lack prerequisite knowledge and skills to evaluate source information on the Web. Therefore, in recent years researchers have aimed at developing trainings for school or university students to foster Web search and evaluation skills (e.g., Gerjets & Hellenthal-Schorr; Walraven, Brand-Gruwel, & Boshuizen, 2010; Wiley et al., 2009). Up to now, another important target group for Web trainings has been neglected, namely non-academic adults. In contrast to today's students who have grown up using the Internet, non-academic adults have not learned to use the Web for science-related purposes in school or university. Thus, they can be assumed to face even bigger difficulties with evaluating Web information than today's students. Hence, we developed the Web training TESWIN (Training to Evaluate Science-related Web Information for Non-academics) that aims at teaching non-academic adults how to evaluate source information during Web search for science-related information (using the example of medical treatments). The TESWIN training, which is Web-based and self-paced, consists of three main parts:

First, the importance of source evaluations during Web search is illustrated.

Second, individuals learn how to evaluate sources, both when selecting search results presented by a search engine and when having accessed a Webpage.

Specifically, the focus is on the following four aspects of source information: document type (e.g., scientific article, private blog, commercial information), motives of the information provider (e.g., to inform, to exchange experiences, or to persuade), expertise of the information provider, and currency of the information.

Finally, the third part addresses the comparison of information across different sources to identify corroborated, unique, or discrepant information. All parts of the training contain a mix of declarative information, concrete examples, as well as several interactive exercises with feedback to apply the declarative information. Completing the training takes approximately 20 minutes. In order to test the effectiveness of the TESWIN training, we conducted a

study with 51 participants (mean age: 43.25 years; 45.1% male) without college or university education. Twenty-six participants were randomly assigned to the "training" group and 25 to a "control" group. In the training group participants received the TESWIN training and subsequently were required to conduct a Web search about "the effectiveness of L-Carnitine for sports performance" in order to give informed advice to a fictitious friend. In the control group, in contrast, participants received the TESWIN training only after having conducted the Web search task about the effectiveness of L-Carnitine. To complete the L-Carnitine search task, both groups were presented with 18 preselected search results presented on two subsequent Google-like search engine results pages (SERPs). Participants could access all Webpages associated with the search results. These were all relevant to the search topic with respect to the content of information provided, but reflected the large heterogeneity of information sources on the Web including six "objective" sources (e.g., official reports), six "subjective" sources (e.g., forum discussions), and six "commercial" sources (e.g., nutrition shops). Search time was limited to five minutes. Subsequent to the search task participants were given ten minutes to make a final decision about the effectiveness of L-Carnitine for sports performance and to write an argumentative summary on this issue.

Comparisons were made between the training group and the control group on participants' search process (i.e., the type of Webpages accessed during Web search and the time spent exploring the pages), as well as on their final decision and summary quality.

Results showed that the TESWIN training had a positive effect on participants' source evaluations as well as on their search outcomes. During Web search participants in the training group as compared to participants in the control group accessed significantly more "objective" Webpages ($p=.04$) and significantly less "subjective" ($p=.01$) and "commercial" Webpages ($p=.04$). Likewise, they spend more time on "objective" Webpages ($p=.001$) and significantly less time on "subjective" ($p=.02$). Furthermore, in line with scientific evidence reported in the Webpages, all but one participant in the training group made the decision that L-Carnitine was not effective to enhance sports performance, whereas in the control group only 15 participants made this decision (pTo conclude, our TESWIN training seems to be a promising way to improve non-academic laypersons' knowledge and skills to evaluate source information during Web search for science-related contents. Yet, further research is needed to investigate long-term results as well as transfer effects on science-related contents other than medicine and health care.

References

- Gerjets, P. & Hellenthal-Schorr, T. (2008). Competent information search in the World Wide Web: Development and evaluation of a Web training for pupils. *Computers in Human Behavior*, 24, 693- 715.
- Walraven, A., Brand-Gruwel, S. & Boshuizen, H.P.A. (2010). Fostering transfer of web searchers' evaluation skills: A field test of two transfer theories. *Computers in Human Behavior*, 26, 716-728.
- Wiley, J., Goldman, S. R., Graesser, A. C., Sanchez, C. A., Ash, I. K. & Hemmerich, J. A. (2009). Source evaluation, comprehension, and learning in Internet science inquiry tasks. *American Educational Research Journal*, 46, 1060-1106.

PAPER PRESENTATION

Collaborative literacy: Students exploring multiple online sources

Carita Kiili, University of Jyväskylä, Finland; Leena Laurinen, Agora, Psykocenter, University of Jyväskylä, Finland; Miika Marttunen, University of Jyväskylä, Finland

This study examines how students construct meaning and knowledge in a collaborative online reading situation. Student pairs ($n=19$) were asked to write a joint essay on a controversial issue. First, the pairs discussed the topic freely in order to activate their prior knowledge; next, they gathered source material on the Internet, and finally composed a joint essay. The data was collected using an interaction method (Miyake, 1986) and screen captures. At the beginning of the data analysis, the text-processing episodes ($n=195$) were separated from the interaction protocols. The text-processing episodes were divided according to the four-part model of collaborative reading patterns ($n=435$): individual vs. pair acquisition and clarification of information and individual construction vs. pair co-construction of meaning and knowledge. One individual reading pattern, silent reading, was added because it is impossible to say whether a silent reader is acquiring or constructing knowledge. A hierarchical cluster analysis was conducted to identify students' collaborative reading profiles. The students' joint essays were evaluated by teachers. Five different collaborative reading profiles emerged: co-constructors (2 pairs); collaborators (2); blenders (6); individually oriented readers (4); and silent readers (5). The reading profile seemed to reflect to the quality of the students' essays. The co-constructors' essays got the best marks whereas the silent readers got the weakest ones. Overall, it appeared that some students were capable of working as pairs whereas others had a stronger preference for working alone. Collaborative profiles might offer teachers an evaluative and instructional tool to support collaborative interaction in their classrooms.

The present study examines how students construct meaning and knowledge in a collaborative online reading situation. To be able to utilize multiple texts for the construction of knowledge, readers have to engage in a deep-level of text-processing: go beyond the literal comprehension of the text by connecting the text both with their prior knowledge (King, 2007) and with previously read texts. Reading that concentrates on gathering facts from the text as such may not produce more than raw material from which knowledge may be constructed (Volet, Summers, & Thurman, 2009). Unfortunately, recent studies of online reading (Jedekog & Nissen, 2004; Kiili Laurinen, & Marttunen, 2009) indicate that many students concentrate on locating and gathering information at the expense of deep processing of the information they find. This indicates that students need purposeful educational tasks that direct their thinking processes towards knowledge construction. Wells (2007, p. 264) argues that knowledge is most fully achieved in dialogue, when people are trying to solve problems, construct an explanation, or decide a course of action. In the present study we examine how students collaborate when they search for information on the Web to explore multiple perspectives on a controversial issue.

Methods

In the present study the students (n=38) were divided into pairs and they were asked to write a joint essay on the issue Should Internet censorship be tightened? First, the pairs were asked to discuss the topic freely (10–15 minutes) in order to activate their prior knowledge; next they gathered source material on the Internet (30 minutes), and finally composed a joint essay (45 minutes). The data consisted of 19 dyadic discussions (interaction protocols), when the students were searching and reading source material online. A computer program was used to capture all the activities the students conducted on the Web.

At the beginning of the data analysis, the text-processing episodes (n=195) were separated from the interaction protocols. After that, the text-processing episodes were divided into collaborative reading patterns (n = 435) on the basis of the four-part model with two dimensions: individual−collaborative and information acquisition − knowledge construction. The collaborative reading patterns were as follows: 1) individual acquisition and clarification of information; 2) individual construction of meaning and knowledge; 3) pair acquisition and clarification of information; and 4) pair co-construction of meaning and knowledge. One individual reading pattern, silent reading, was added because it is impossible to say whether a silent reader is acquiring information or constructing knowledge. A hierarchical cluster analysis was conducted to identify students' collaborative reading profiles. The analysis was based on five variables concerning the proportion of time each student pair spent on the five reading patterns. The students' joint essays were evaluated by four teachers who jointly determined the evaluation criteria to be applied. The essays were evaluated as outstanding (3), excellent (2), or good (1).

Findings

Five different collaborative reading profiles emerged: Co-constructors (n=2) engaged in collaborative text-processing with a strong emphasis on co-construction of meaning and knowledge (83.48% of text-processing time).

Collaborators (n=2) engaged mostly in collaborative text-processing. They used 46.36% of their text-processing time on pair acquisition and clarification of information and 40.84% on co-construction of meaning and knowledge.

Blenders (n=6) mixed collaborative (54.99 %) and individual (45.01%) modes of text-processing most equally. They spent most of their time on co-construction of meaning and knowledge (37.07%) and on silent reading (33.79%).

Individually oriented readers (n = 4), spent more time on individual text-processing, with the emphasis on silent reading (50.26%), than on collaborative text-processing. Silent readers (n = 5) spent most of their working time on reading silently (80.69% of text-processing).

The average mark awarded the pairs' joint essays was 1.84 (SD = 0.77). The reading profile seemed to reflect to the quality of the students' essays. The co-constructors' essays got the best marks (m=3.0) whereas the silent readers (m=1.2) got the weakest marks.

Conclusions

Overall, collaborative work during reading and writing seems to be beneficial for students. Firstly, teachers evaluated the joint essays better than the individual essays, which students normally write. Secondly, this study suggests that an argumentative task assignment conducted in a collaborative reading situation promotes information processing that goes beyond the facts presented in the texts. In the previous study (Kiili et al., 2009), in which students worked individually on the Internet in order to find information for an essay, the students concentrated mainly on gathering facts: 80% of all reading strategies were classified as fact gathering. The corresponding percentage in this study was only 38.

However, not all students are capable of taking full advantage of the collaborative situation. These students have a stronger preference for working alone. This would suggest that, in future, attention should be paid to developing methods for teaching students how to collaborate productively. Collaborative profiles might offer teachers one evaluative and instructional tool to support collaborative interaction in their classrooms.

References

- Jedreskog, G. & Nissen, J. (2004). ICT in the Classroom: Is doing more important than knowing? *Education and Information Technologies*, 9(1), 37–45.
- Kiili, C., Laurinen, L. & Marttunen, M. (2009). Skillful Internet reader is metacognitively competent. In L. T. W. Hin and R. Subramaniam (Eds.), *Handbook of Research on New Media Literacy at the K-12 Level: Issues and Challenges* (pp. 654-668). Hershey, PA: IGI Global.
- King, A. (2007). Beyond literal comprehension: A strategy to promote deep understanding of text. In D. S. McNamara (Ed.) *Reading comprehension strategies: Theories, interventions and technologies*. (pp. 267-290). New York: Lawrence Erlbaum Associates.
- Wells, G. (2007). Semiotic mediation, dialogue and the construction of knowledge. *Human Development*, 50(5), 244-274.
- Volet, S., Summers, M. & Thurman, J. (2009). High-level co-regulation in collaborative learning: How does it emerge and how is it sustained? *Learning and Instruction*, 19(2), 128-143.

PAPER PRESENTATION

Scaffolding information problem solving in web-based collaborative inquiry learning

Annelies Raes, Ghent University, Belgium; Tammy Schellens, Ghent University, Belgium; Bram De Wever, Ghent University, Belgium; Ellen Vanderhoven, Ghent University, Belgium

This study investigated the impact of different scaffolding conditions on students who are learning science through a web-based collaborative inquiry project. This project aimed to improve knowledge construction, as well as information problem solving (IPS) skills on the internet (strategy use), and metacognitive awareness (knowledge about cognition and regulation of cognition). Three experimental conditions (human tutor as an external regulating agent, embedded question prompts (EQP), and both forms of support) were compared with a control condition in a two-by-two factorial quasi-experimental design with 347 students involved. Findings revealed that students of all conditions make significant improvement in terms of the four dependent variables (knowledge construction, strategy use, knowledge about cognition and regulation of cognition). Yet, the learning gain significantly differs based on the scaffolds students are provided with. Providing students with EQP and a human tutor whose role is to facilitate the use of online search strategies and self-regulatory processes leads to statistically significant higher performances comparing to the other conditions. Only with regard to regulation of cognition and strategy use, EQP alone is as effective as the condition with EQP and human tutor. Providing students with only a human tutor, however, didn't seem to provide enough help by itself without incorporation of the embedded prompts. In this respect, our findings support the notion of multiple, distributed scaffolding as an approach to enhance web-based inquiry learning in complex classroom environments.

Theoretical background

Information and computer technologies are receiving increased attention in education because of their potential to support new forms of collaborative inquiry (Roschelle, Pea, Hoadley, Gordin, & Means, 2000) and the Web is more frequently used as a classroom and information resource (Large & Beheshti, 2000). Research indicates that computer technology can support learning, more specifically with regard to the development of higher-order skills such as scientific inquiry (Linn, Clark, & Slotta, 2003). However, this cannot be taken for granted. Particularly germane to web-based inquiry projects are the skills and processes associated with searching, evaluating, and understanding information sources which require regulation to learn about complex and challenging science topics (Brand-Gruwel, Wopereis, & Walraven, 2009). Yet, contemporary research has shown that most students have poor self-regulatory skills and use ineffective strategies (Azevedo, Moos, Greene, Winters, & Cronley, 2008). These findings stress the need to effectively scaffold the web-based inquiry process. Providing students with computer embedded scaffolds can be a method for improving students' regulation of web-based learning (Azevedo & Hadwin, 2005; Reiser, 2004). However, it is found that in the dynamic, complex environment with learners in a classroom, not all of the necessary scaffolding can be provided with only one tool or agent (Puntambekar & Kolodner, 2005; Tabak, 2004). Consequently, it is suggested to present multiple types of support for successful learning. Additional support can be provided by the teacher or human tutor (Azevedo et al., 2008; Wood, Bruner, & Ross, 1976). This study provides insight into these different modes of scaffolds and how they benefit students' learning through web-based inquiry. In our analysis of students' learning, we examined (1) knowledge construction, (2) IPS skills (strategy use), and (3) metacognitive awareness (knowledge about cognition and regulation of cognition).

Method

During a four-week field study students had to work on an inquiry based science project about climate change. Pretest-posttest differences in students' knowledge construction, strategy use and metacognitive awareness were measured. In total 347 students from 18 secondary school classes (grade 9 and 10) were involved and the classes were randomly distributed over the 4 conditions. Three experimental conditions were compared with a control condition in a two-by-two factorial quasi-experimental design (see table 1). The conditions differed in the provided type and amount of scaffolding during online inquiry.

Table 1: Quasi-experimental

The pre and post achievement test consisted of eight assessment items, 4 open-ended knowledge questions and 4 multiple-choice items, in which students were asked for explanation. To measure students' strategy use, they were faced with a scientific controversy problem. They were asked to take a stand that had to be justified with appropriate evidence from the web. Students were asked to describe in detail their strategy for searching for evidence and formulating their position. Finally metacognitive awareness was measured by means of an adapted version of the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), which supports the two-component view of metacognition, i.e. knowledge about cognition and regulation of cognition.

Results

Our results indicate that learning science by means of a web-based inquiry project is effective to enhance learners' knowledge construction and to enhance their strategy use and metacognitive awareness. We can conclude this based on evidence for an overall increase in students' performances. However, pairwise comparisons show that the learning gain significantly differs based on the scaffolds students are provided with. Providing students with embedded question prompts and a human tutor whose role is to facilitate the use of online search strategies and self-regulatory processes leads to statistically significant higher performances comparing to the other conditions. Providing students with only embedded question prompts is as effective as the condition with EQP and human tutor with regard to regulation of cognition and strategy use. Providing students with just a human tutor, however, doesn't provide enough help without incorporation of the embedded prompts. In this respect, our findings support the notion of multiple, distributed scaffolding as an approach to enhance web-based inquiry learning in complex classroom environments.

References

- Azevedo, R. & Hadwin, A. F. (2005). Scaffolding self-regulated learning and metacognition - Implications for the design of computer-based scaffolds. *Instructional Science*, 33, 367-379.
- Azevedo, R., Moos, D. C., Greene, J. A., Winters, F. I. & Cronley, J. G. (2008). Why is externally-facilitated regulated learning more effective than self-regulated learning with hypermedia? *Educational Technology Research and Development*, 56(1), 45-72.
- Brand-Gruwel, S., Wopereis, I. & Walraven, A. (2009). A descriptive model of information problem solving while using internet. *Computers & Education*, 53(4), 1207-1217.
- Large, A. & Beheshti, J. (2000). The Web as a classroom resource: Reactions from the users. *Journal of the American Society for Information Science*, 51(12), 1069-1080.
- Linn, M. C., Clark, D. & Slotta, J. D. (2003). WISE design for knowledge integration. [Article]. *Science Education*, 87(4), 517-538.
- Puntambekar, S. & Kolodner, J. L. (2005). Toward implementing distributed scaffolding: Helping students learn science from design. *Journal of Research in Science Teaching*, 42(2), 185-217.
- Reiser, B. J. (2004). Scaffolding complex learning: The mechanisms of structuring and problematizing student work. *Journal of the Learning Sciences*, 13(3), 273-304.
- Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N. & Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. *Future of Children*, 10(2), 76-101.
- Schraw, G. & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology*, 19(4), 460-475.
- Tabak, I. (2004). Synergy: A complement to emerging patterns of distributed scaffolding. *Journal of the Learning Sciences*, 13(3), 305-335.
- Wood, D., Bruner, J.S., & Ross, G. (1976). Role of Tutoring in Problem-Solving. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 17(2), 89-100.

PAPER PRESENTATION

Dialogical perspective for collaborative learning

The aim of this paper is to deepen the theoretical understanding of collaborative learning by focusing on the interrelationship of dialogue, context, temporality and learning, that is to say, dialogicality. Dialogical perspective for collaborative learning proposed here combines different theoretical approaches; both the theories of learning and theories of discourse. Bringing these perspectives together provides resources for the study of relationships among discourse, learning, and context that neither perspective can provide alone. Sociocultural theory is a theoretically framed approach to the study of learning and development as social constructions. In this study it is then used aligned with theories of language and discourse that build on the notion of (learning) contexts as being socially constructed. The notions of dialogicality, intertextuality, dynamic and historical nature of discourse and contextual resources all refer to the fact that any discourse or activity in which the individuals are involved takes its meaning with respect to other discourses and activities in which they have been involved or have some representation of. Hence, all collaborative moments are intertwined with other (past and future) situations that enable the subjects to make sense of the present situation. From the dialogical perspective collaborative learning can then be conceptualised as the collective process of innovative and interpretative reproduction of knowing and acting through different resources (or cultural tools) and their connection. In the presentation, along with the theoretical elaboration on collaborative learning, empirical examples are explored to highlight the dialogical nature of collaborative learning and methodological means for studying it.

In the area of collaborative learning, the focus of research has increasingly shifted from the outcomes and products of collaborative work towards the analysis of the processes of collaboration. This shift indicates an attempt to gain understanding about the nature of productive joint activity and to identify interactional features important for collaborative learning. In general, this "interactions paradigm" involves categorising students' interaction and correlating the frequencies of categories with learning outcomes (Baker, 2010). Baker (2010) calls this approach a "standard approach" and argues that the problem with this approach is that it does not take into account collaboration as a process of collective thinking manifested in and by dialogue. This kind of approach therefore discards the content and nature of knowledge construction that takes place in interaction between the collaborators. It has been argued that the "standard approach" reflects more broadly a view where language is isolated from its environment and a dichotomy is created between text and context (Goodwin, 2000), or between mind and world (Grossen, 2009). In the study of collaboration this has meant a separation of collaborative talk from the material and socio-cultural contexts in which it is embedded. Thus, in order to analyse collaborative learning we need to move from analysing structures of talk separated from their contexts toward a more dialogical approach for studying learning. This means both studying collaboration as a dialogue and the need to explore how material and sociocultural aspects mediate students' discursive activity.

The aim of this paper is to deepen the theoretical understanding of collaborative learning by focusing on the interrelationship of dialogue, context, temporality and learning, that is to say, dialogicality. Dialogical perspective for collaborative learning proposed here combines different theoretical approaches; both the theories of learning and theories of discourse. Bringing these perspectives together provides resources for the study of relationships among discourse, learning, and context that neither perspective can provide alone. Sociocultural theory is a theoretically framed approach to the study of learning and development as social constructions (Vygotsky, 1978; Wertsch, 1991). In this study it is then used aligned with theories of language and discourse that build on the notion of (learning) contexts and situations as being socially constructed (Gee & Green, 1998; Linell, 1998). These perspectives targets attention to the dynamic and interpretive nature of participants' actions and discourse, and how - through these actions and discourse - the participants shape and are shaped by the context being constructed. The context constructed involves aspects of the physical, social, cognitive and cultural environments that become relevant through the participants' activity and discourse. Participant's personal, social and cultural knowledge can be called mediated and abstract contextual resources (Linell, 1998) or aspects of situation (Gee & Green, 1998) that are reflected and constructed through participants' discursive activity. For example, the participants may draw on some past experience that is used as a resource for building understanding in the present situation, or the discourse may reflect norms, values, and expectations related to participants' communities. This highlights the historical nature of discourse pointing to the fact that discourse is mediated by the historical, institutional and socio-cultural contexts (Mercer, 2008). Immediate and concrete contextual resources or material aspects of situation, in turn, refer, for example, to physical spaces, persons, objects, artefacts and co-text that are referred to in discourse and mediate discourse. Co-text – e.g. preceding discussion - that is actively used in the "new act of sense-making" (Linell, 1998), is what makes discourse a dialogue. Co-textual referencing in discourse underlines its dynamic nature (Mercer, 2008). It shows how discourse emerges and speakers' contributions are contingent on what the other speakers say. The dynamic and historical nature of discourse is in line with Grossen's (2009) notion of spatial and temporal dialogicality meaning that in discourse there is always a here-and-now and there-and-then of the encounter. According to Gee and Green (1998),

one function of talk is "connection building", which refers to the intertextual ties that are constructed by participants in their joint meaning making. Intertextual ties are those connections that the participants in the group reflect, and make to different aforementioned aspects of a situation, or resources. The notions of dialogicality, intertextuality, dynamic and historical nature of discourse and contextual resources all refer to the fact that any discourse or activity in which the individuals are involved takes its meaning with respect to other discourses and activities in which they have been involved or have some representation of. Hence, all collaborative moments are intertwined with other (past and future) situations that enable the subjects to make sense of the present situation. From the dialogical perspective collaborative learning can then be conceptualised as the collective process of innovative and interpretative reproduction of knowing and acting through different resources (or cultural tools) and their connection. In the presentation, along with the theoretical elaboration on collaborative learning, empirical examples are explored to highlight the dialogical nature of collaborative learning and methodological means for studying it.

References

- Baker, M. (2010, September). Approaches to understanding students' dialogues: articulating multiple modes of interpretation. Keynote speaker lecture in EARLI Sig 17 meeting on "Methodology in Research on Learning", Jena, Germany.
- Gee, J. & Green, J. (1998). Discourse analysis, learning and social practice: A methodological study. *Review of Research in Education*, 23, 119-169.
- Goodwin, C. (2000). Action and embodiment within situated human interaction. *Journal of Pragmatics*, 32, 1489-1522.
- Grossen, M. (2009). Social interaction, discourse and learning. Methodological challenges of an emergent transdisciplinary field. In K. Kumpulainen, C. Hmelo-Silver & M. Céêsar (Eds.), *Investigating classroom interaction*. Sense Publishers.
- Linell, P. (1998). *Approaching dialogue. Talk, interaction and contexts in dialogical perspectives*. Amsterdam: John Benjamins.
- Mercer, N. (2008). The seeds of time: Why classroom dialogue needs a temporal analysis. *The Journal of the Learning Sciences*, 17(1), 33-59.
- Vygotsky, L. (1978). *Mind and society*. Cambridge, MA: Harvard University Press.
- Wertsch, J. (1991). A sociocultural approach to socially shared cognition. In L. Resnick, J. Levine & S. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 85-100). Washington, DC: American Psychological Association.

PAPER PRESENTATION

Digital Video as a Tool to Support Learning

Carmen Zahn, Knowledge Media Research Center, Germany; Karsten Krauskopf, Knowledge Media Research Center, Germany; Friedrich Hesse, Knowledge Media Research Center, Germany; Roy Pea, Stanford University, Wallenberg Hall (Room 232), United States

The potentials of digital video technologies reach far beyond the dynamical presentation and illustration of instructional information. They additionally encompass the collaborative exploration of video-based information in groups as well as the collaborative analysis of and reflection on video-based information in distributed communities of learners. Open research questions relate to the effectiveness of using these affordances for active learning in school-based education – thus expanding traditional teacher-centered approaches, whereby videos on curriculum topics are only watched by individual learners or in whole-class models. In our contribution we will present empirical evidence from an experiment on the use of digital video tools to support students' collaborative learning through design in history lessons. Precisely, we investigated 16-year old learners (N=148) jointly elaborating on a history topic with the help of web-based video tools during a design task. We compared two types of video tools (analysis tool vs. integration tool), as well as two contrasting types of instructive guidance for student collaboration in dyads (cognitive task related guidance or social interaction related guidance). Both types of guidance and tools aimed at supporting students' active and meaningful learning and critical reflection on the history topic. Results indicate that social interaction related guidance was more effective in terms of learning outcome (e.g., critical reflection skills) than cognitive task-related guidance. The different tools did not yield significant differences in learning. The practical implications of these results will be discussed.

Digital video technologies provide a variety of tools to support collaborative learning including functions for editing, or contextualizing digital videos. Learners may zoom into and out of digital video sequences, they may insert hyperlinks into digital video in order to relate visual information to other instructional materials and they may arrange digital video sequences for discussion and reflection. Such functions are expected to afford, for example, detailed observation (Smith and Reiser, 2005), or understanding of complex concepts in ill-structured domains (Spiro, Collins & Ramchandran, 2007).

The affordances of digital video technologies can be restructured for youthful learners in classrooms, so that students can either create their own representations (e.g., multimedia documents) or arrange video contents in order to understand and explain complex subject matter. This usage in a sense of learning through design (e.g., Kafai & Resnick, 1996) goes far beyond teacher-centered approaches, whereby videos on curriculum topics are only watched by individual learners or in whole-class models.

The aim of our contribution is to present empirical evidence on the use of collaborative video tools used to explore historical film sources during a design task in a history lesson in order to learn about a topic and thereby critically reflect on the sources as products of a specific period in history. Over the last years, evidence from experimental studies has indicated that specific affordances of video tools (e.g., of WebDiverTM, Pea, et al. 2004) employed in design tasks for history learning can guide and improve learners' social interactions and grounding processes to become more productive than those performed with simple technological solutions (Zahn, Pea, Hesse & Rosen, 2010). Yet, initial field studies (Zahn, et al., 2010) with 16-year-olds showed that the positive effects of video tools were sometimes limited and students would have needed specific instructive guidance to optimize their collaboration. This finding is consistent with findings from Barron (2003) showing that student groups can have problems to engage in productive knowledge-building conversations during video-based mathematics problem solving. Also, collaborating students need help in organizing, planning and conducting inquiries (Edelson, Gordin & Pea, 1999), choosing appropriate learning strategies (O'Donnell and Dansereau, 1995), and argumentation (Kollar & Fischer, 2004).

Here, we thus examine the open question of instructive guidance for students' collaborative learning through design using digital video technology in history lessons. 148 students from four different German high schools located in Southwestern Germany participated in the study. Their mean age was $M = 16.2$ years ($SD = 1.0$). The study was conducted in a computer classroom set up at the Knowledge Media Research Center, Tuebingen, Germany (KMRC). Students were randomly grouped into dyads and assigned to one of four conditions conforming to a 2×2 study plan. The first factor (Guidance) determined which type of instructive guidance was provided as support for the collaborative accomplishment of a specific visual design task. The second factor (Video Tool) determined which video technology the students used. Guidance varied by focusing either cognitive design related vs. social interaction related issues. The Video Tool factor varied in terms of whether the students worked with „WebDiverTM“ for analysis and guided noticing or „Asterpix“ for integration and hyperlinking of video information.

Results indicate that using either of the video tools (WebDiver or Asterpix) was generally effective and effectiveness did not differ between conditions. However, variations in instructive guidance (cognitive task related vs. social interaction related guidance) resulted in different learning outcomes: ANOVAs revealed that with social interaction related guidance, the students' immediate products of task work – the design products – were of better quality, and scores in a transfer test measuring individual skills of critical analysis of a video message were significantly higher ($F(1, 68) = 7.96, p = .01, \eta^2 = .11$). No differences emerged concerning performance in a multiple-choice posttest on factual knowledge about the topic indicating that there was no „trade-off“ with knowledge acquisition. No differences were found in the amounts of time devoted during the students' dyadic interactions to „planning“, „evaluation“, „technical issues“, „problems“ or „off task“ behaviors indicating that the better learning outcomes were not due to differences in time on task. This leads us to the conjecture that the dyads with social interaction related guidance learned more effectively than the dyads cognitive task related guidance due to qualitative differences in dyadic interactions. In a next round of analyses we will specify these quality differences. So far, we conclude that guidance addressing the cognitive task of design did not further improve learning (nor did it improve the design products), but guidance improving social interaction did. For teachers using video technology in their classrooms this aspect would be practically important if indeed their feedback during collaborative design would not focus on the emerging design product, but on social interaction and knowledge advancement – as was suggested earlier for hypertext projects by Bereiter (2002).

References

- Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences* 12(3). 307-359.
- Bereiter (2002). Emergent versus Presentational Hypertext. In: R. Bromme & E. Stahl (eds.) *Writing Hypertext and Learning*. (pp.73-78). Amsterdam: Pergamon.
- Edelson, D.C., Gordin, D.N. & Pea, R.D. (1999). Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design. *The Journal of the Learning Sciences*, 8 (3&4). 391-450.
- Kafai, Y. B., & Resnick, M. (Eds.). (1996). *Constructionism in Practice: Designing, Thinking, and Learning in a Digital World* (pp. XII, 339 S.). Mahwah, NJ: Lawrence Erlbaum Associates.
- Kollar, I., Fischer, F., & Slotta, J. D. (2007). Internal and external scripts in computer-supported collaborative inquiry learning. *Learning & Instruction*, 17(6), 708-721.

- Pea, R., Mills, M., Rosen, J., Dauber, K., Effelsberg, W. & Hoffert, E. (2004, Jan-March). The DIVER™ Project: Interactive Digital Video Repurposing. *IEEE Multimedia*, 11(1), 54-61.
- Smith, B. & Reiser, B. J. (2005). Explaining behavior through observational investigation and theory articulation. *Journal of the Learning Sciences*, 14, 315–360.
- Spiro, R. J., Collins, B. P. & Ramchandran, A. (2007). Reflections on a post-Gutenberg epistemology for video use in ill-structured domains: Fostering complex learning and cognitive flexibility. In R. Goldman, R. D. Pea, B. Barron, & S. Derry (Eds.), *Video research in the learning sciences* (pp. 93–100). Mahwah, NJ: Erlbaum.

PAPER PRESENTATION

Investigating the interaction effect between positive interdependence and individual accountability

Kwaku Frederick Sarfo, University of Education, Winneba, Ghana

This paper is aimed at investigating the interaction effect between positive resource interdependence and individual accountability on performance of individuals in cooperative working group. To achieve the purpose of the study 2 by 2 post-test experimental design was conducted to test the formulated hypotheses. Descriptive statistic and univariate analysis were used to analyse the data. The result shows that there is no interaction effect between positive resource interdependence and individual accountability. Interestingly, the results of the study reveal that when each member in the cooperative working group works on the full content of the information before group discussion they academically perform better than when each member in the group works on the part of the content before group discussion. Furthermore, the result of the study indicates that when members in cooperative working group are informed that there will be a random examination and the student's score will be the score for the rest of the group members and the score will be part of the final grade, it strengthens individual and group accountability and therefore facilitates learning. The theoretical and practical implications of the results were discussed.

Ability to work successfully in a group, critical thinking, problem solving and reflective thinking are very important in the modern aims of education and the world of work. Cooperative learning is acknowledged in the literature on learning and instruction (e.g. Slavin, 1991, Johnson & Johnson, 1998; Johnson, Johnson, & Holubec, 1998, 1999) as one of the teaching strategies that facilitates the learning processes for development of knowledge and skills that are required in the modern education and the world of work.

Cooperative learning group is based on the principle of social cognition by Vygotsky (1978) that social interaction has a dramatic impact on cognitive development. Biological and social development are not isolated from each other, and learning is largely mediated by social interaction of students and "more knowledgeable others" (teachers, parents, coaches, peers, experts, etc) (Driscoll, 1994). More recently, cooperative learning strategy has enjoyed a lot of attention in the literature on social constructivist and cognitive learning principles, and it is particularly prevalent in education and training institutions and e-learning environments. In spite of the fact that cooperative learning strategy has received remarkable attention in instructional community, empirical studies conducted on its effectiveness reveal mixed findings. On the one hand, research findings (e.g., Slavin, 1991; Chang & Mao, 1999; Fuchs, Fuchs, Mathes, & Simmons, 1997; Onwucabuzie, Collins, and Thao 2009; Merina, 2009) show that cooperative learning group enhances acquisition of social skills and academic performance. On the other hand, studies conducted on effectiveness of cooperative learning group (e.g Boyle 2010; Krause, Stark, Mandle 2009; Candas, 2009) indicate that cooperative learning group does not enhance academic performance. Based on these mixed findings and taking into account the recognition of cooperative learning strategy in instructional practice, there is the need to conduct further empirical studies to investigate and contribute to the theoretical understanding and practical implications of cooperative learning group. In cooperative learning group positive interdependence, more specifically positive resource interdependence and individual accountability are used to strengthen the achievement of the learning goal by the individuals and the entire group (Johnson, Johnson, & Holubec, 1998).

This paper is aimed at investigating the interaction effect between positive resource interdependence and individual accountability on performance of individuals in cooperative working group. To achieve the purpose of the study, 2 by 2 post-test experimental design was conducted. One hundred first year university students were randomly exposed to positive resource interdependence condition consisting of two different treatments: 1) full content and 2) part content; and individual accountability condition consisting of two different treatments: 1) told and 2) untold. The average age of the students was 25 years. The content for the treatments was the events of instruction by Gagne (1985) selected from *Psychology of learning for instruction* (Driscoll, 2005). The test items were six retention and transfer questions on the events of instruction. The experiment was conducted in the regular classroom to test the following hypotheses: 1) There is an interaction effect between positive resource interdependence and individual accountability on the performance of cooperative working group; 2) In cooperative working group if all the learners are asked to master the whole content before they work cooperatively to achieve the group's goal, it leads to more

effective learning than asking each of the learners to master part of the content; and 3) when members in cooperative learning group are informed that there will be a random examination and the student's score will be the score for the rest of the group members and the score will be part of the final grade, it strengthens individual and group accountability and therefore facilitates learning. Descriptive statistic and univariate analysis were used to analyse the data.

According to the results there was no interaction effect between positive resource interdependence and individual accountability on cooperative working group. Interestingly, the results of the study revealed that when each member in the cooperative working group works on the full content of the information before group discussion they academically performed better than when each member in the group works on the part of the content before group discussion. Furthermore, the result of the study revealed that when members in cooperative learning group are informed that there will be a random examination and the student's score will be the score for the rest of the group members and the score will be part of the final grade, it strengthened individual and group accountability and therefore facilitates learning. The theoretical and practical implications of the results on cooperative learning (for instructional designers and educational practitioners) were discussed.

PAPER PRESENTATION

Day Schools: Their Use and Pedagogical Quality from a multidimensional view

Esther Forrer Kasteel, Hochschule für Soziale Arbeit, Switzerland; Patricia Schuler, Pädagogische Hochschule, Switzerland

In the German speaking countries the topic of day schools is being discussed with a growing focus on the area of institutional quality. There have been few empirical studies conducted in this area, except with regard to the StEG-Study (Fischer/Kuhn/Klieme 2009) in Germany and the Edu-Care-Study (Schýpbach 2010) in Switzerland. The study "Evaluation of Day Schools in the City of Zurich" draws upon these research projects. It focuses on the pedagogical qualities of two day school models, those which offer a compulsory whole day attendance for children (day schools) and those which allow for a more flexible combination of attendance (so called school clubs). Both a quantitative and qualitative research analysis was conducted. The sample group included all forms of day schools in the city of Zurich. The results show that the parents of children in both day school models are very content with the services offered by the schools and that the students frequently use these. The qualitative interviews with the principals, teachers and child care taking personnel furthermore show that to build up a successful school culture and identity, a high level of cooperation in the school team is of greatest importance.

The demand for day schools or all day educational programmes for children and adolescents in Switzerland and Western Europe is steadily increasing. Yet in contrast to Scandinavian countries, which are clearly leading figures in this domain, Switzerland lags behind, offering few schools with all day care. The OECD (2001) points out that all day educational programmes and schools in Switzerland are developing more hesitantly than in other OECD countries.

Not only in the German speaking region of Switzerland but in the all German speaking countries are day schools an important aspect of the political agenda concerning education and it is also a key feature of current trends in education. Due to the fact that the demand for day schools is high the discussions circulate around the quantity thereof, not their quality.

The PISA study identifies that day schools and all day educational programmes hold within them an enormous potential, for they allow children to be surrounded by a stimulating social and educational environment and enable parents to pursue a career (Lanfranchi 2004). Research studies show that all day care taking structures for children are important areas of socialisation and education (NICH 1994; Lanfranchi 2002; Lanfranchi/Schrottman 2004). These empirical findings were strengthened by two large scale studies regarding all day educational programmes and day schools in Germany and Switzerland – StEG-Study (Study focused on the development of day schools in Germany: Fischer/Kuhn/Klieme 2009) and EduCare-Study (Schýpbach 2010).

With regard to the current discussion on school quality and school development it is the goal of the study "Evaluation of Day Schools in the City of Zurich" to focus on the pedagogical quality of day school programmes, thereby drawing upon the two largest studies in the German speaking region concerning this area. The study focuses on the pedagogical qualities of two specifically chosen day school models, namely schools which offer a compulsory whole day attendance for the children (day schools) and those which allow for a more flexible combination of attendance (so called school clubs). The aim is to collect empirical data which will enable the future development of both day schools models as well as all day educational programmes in the city of Zurich. The main focus of the study lies on the use of

different supervised services offered by the school, the quality of pedagogical services and frameworks, different forms of cooperation, as well as the general comparison of the two day school models.

In this cross sectional study the views of the parents as well as the principals, teachers and child care taking personnel were evaluated using quantitative and qualitative methods. The sample includes all day schools in the city of Zurich (five day schools and four school clubs). With regard to the quantitative part of the study the parents of children from day schools and school clubs from the City of Zurich were contacted, in total this included 1537 parents. Approximately half of the parents, namely 771 parents actually filled out the questionnaire. Wherever possible the questionnaire included scales from the StEG-Study (Quellenberg 2009) as well as the EduCare-Study (Schýpbach et al. 2008). With regard to the qualitative research, interviews were organised. In total nine interviews with the principals of the schools and four group interviews including teachers as well as child care taking personnel were conducted.

The results of the quantitative research show that there are three key factors which influence parents to send their child to a day school or school club. Primarily they value the high level of reliability that the schools provide, secondly the possibility of being able to combine having a family and career. Finally the parents also see the strong interaction between the school and the child care taking personnel as a key reason to send their child to a day school or school club. It becomes apparent that the parents of children in day schools have a higher appreciation for these areas than the parents of children attending school clubs. The parents of children attending school clubs tend rather to value the additional supervised activities that the school provides as well as the child's interest to attend such an educational institution. The parents of children from both school models rank the overall quality of the school very positively. This can also be seen with regard to the results of the indicators assessing overall satisfaction with the school. A total of 90% of the parents are content or even very satisfied with the school in addition to this every second person is fully satisfied with eight of the twelve indicators assessing satisfaction. The parents are though clearly less happy with the playground, the meals, the choice of supervised activities for the children and the costs for day care. The parents of children who attend day schools evaluate the indicators of satisfaction more positively than the parents of school club children. The parents of day school children also view the quality defining criteria with regard to the school structures, the pedagogical organisation of supervised and child care taking services as generally more positive. The pedagogical staff is evaluated most positively by the parents.

The qualitative interviews with the principals, the teachers as well as the child care taking personnel show that high levels of cooperation within the school teams is the key to the development of a successful school culture and identity. On the basis of mutual respect for one another, common goals as well as clear conflict management both school models are able to develop a fruitful educational environment. The result thereof is a changing view of the educational profession for all individuals taking part therein.

It appears that day schools achieve a higher level of cooperation in comparison to school clubs which results out of different domain specific structures such as proximity of all school related areas, the constant presence of the students, as well as the parental choice to send their child this to educational institution. In addition to this all schools uphold a distinct school culture and identity. Lastly the two school models coincide with the needs of the parents, for the school's top priority is to support the children on every level which is achieved by the cooperation of all members of the school team.

PAPER PRESENTATION

Pupils with behaviour problems in inclusive settings: Challenges for classmates and teachers

Annette Textor, Universitaet Bielefeld, Germany; Anna Funger, Universitaet Bielefeld, Germany

Inclusive Education with pupils who have emotional or behavioural difficulties is seen as particularly challenging (Dumke/ Eberl 2002, Sander 1998). Empirical findings about learning results and well-being of classmates are contradictory (Feyerer 1998, Dumke/Schaefer 1993, Wocken 1993, Zentall 1989) and incomplete, because studies about inclusive education do rarely regard the effects of different special needs, and the studies about children with emotional or behavioural problems mostly do not focus on systemic variables. On the other hand it must be expected that inclusion is going to increase in the next years due to political developments. On this basis, the research project "SISSI" examines inclusive education with students with emotional and social problems in primary schools and focuses on benefits and challenges for primary school teachers and for classmates in 19 inclusive classes with two hours of special needs education per week and 17 classes without inclusion. Findings suggest that reading performance and sociometric data in classes with inclusion of a pupil with behavioural problems are not different from those in the control group, but teachers find their work a little bit harder despite the additional resources they get. Since the special school still provides the possibility for primary schools to give very challenging pupils away, those findings have to be interpreted very carefully.

Inclusive Education with students who have emotional or behavioural problems is seen as particularly challenging. Teachers often think the behaviour of those students is difficult to handle for them and for the other students in the classroom (Dumke/ Eberl 2002, Sander 1998). On the other hand, an increasing tendency for mainstreaming children with special educational needs, especially with special needs concerning emotional or behavioural problems, is observed in Germany (KMK 2010). In the future it can be expected that this trend is accelerating significantly, due to political developments like the 2006 UN Convention on the Rights of Persons with Disabilities.

In contrast to the high relevance of including pupils with emotional or behavioural problems in mainstream settings, empirical findings are contradictory: Studies about inclusive education in common show that learning results and social cohesion of inclusive school classes are not less than those of regular classes without pupils with special needs (Huber 2008; Feyrer 1998; Dumke / Schaefer 1993). Furthermore, on the basis of the research about teachers' workload and social support it could be supposed that teachers benefit from the additional resources in inclusive settings (Schaarschmidt 2004, Rothland 2007). On the other hand, studies about children with emotional or behavioural problems suggest that classmates show high social distance to aggressive pupils (Wocken 1993, Preuss-Lausitz 1997), and children with hyperactive behaviour can influence their teacher and their classmates significantly (Zentall 1989, Campbell 1977). In total, studies about inclusive education rarely regard the effects of different special needs, although different dimensions of heterogeneity could cause different difficulties, and the studies about children with emotional or behavioural problems mostly do not focus on systemic variables like special resources that are provided for those children.

On this basis, the research project "SISSI" examines inclusive education with students with emotional and social problems in primary schools and focuses on benefits and challenges for primary school teachers and for classmates. The sample consists of 707 students in 36 classes and their class teachers. 19 classes include a student with special needs because of social or emotional problems, 17 classes are the control group. The classes in the study group are supported by a teacher for special needs education for two hours a week. Both kinds of classes – study group and control group – are similar concerning the social background of the pupils. In a longitudinal design with four times of questioning during one year, all students and teachers filled out questionnaires; the pupils of second classes were supported by a researcher. In addition, the reading skills of the students were tested four times. For data analysis quantitative (T-Tests and regression analyses; hierarchical multi-level analyses are planned) and qualitative methods are combined.

First Findings suggest that reading performance and sociometric data in classes with inclusion of a pupil with behavioural problems are not different from those in the control group. Pupils mention a similar number of classmates with whom they would like to play or to work in both settings, and they also mention a similar number of classmates they would work with by no means. Pupils like to play or to work with classmates they like (42%), with whom they are friends (30%), whom they adore for some reason (21%) or with whom they share interests (19%, the pupils could write as many reasons as they like). They do not like working with classmates who are aggressive (31%), whom they do not like globally (29%) or who break the rules in class or disturb their learning processes (21%). 17% of the pupils do not tell a reason why they do not like to work with some classmates, because there are no classmates they do not like to work with.

In the group of the teachers there are neither significant differences, but since the group is small, there are some non-significant effects worth being reported. The teachers in the study group like their job in a similar degree than the teachers in the control group. Furthermore, both groups feel a similar degree of quantitative overload, but teachers in the study group found their work a little bit more challenging and feel a little bit more isolated than teachers in the control group. They are more committed, but feel less under pressure to succeed. The teachers in the study group say they benefit from the cooperation with the special education teacher. Nevertheless, many of them would not like to have a pupil with behavioural and emotional problems in their next class again. In a group discussion, teachers were confronted with this contradiction. They explained that although they benefit from the cooperation, including a pupil with behavioural problems is challenging for them and before starting to work with this pupil, they do not know if they can handle it. So they conclude, if they had the possibility to choose, they would rather work in a regular class.

As a final result for pupils it makes no difference whether they are in class together with a pupil with social or emotional problems or not, but for the teachers, work gets a little bit harder. Nevertheless, these findings have to be interpreted very carefully: First, the teachers have the possibility to send pupils to the special school if they think that they cannot handle them in class – and in two of the 19 classes, this happens during the year of research. Second, the research area is a rural area and teachers say many classmates have good social skills and support the inclusion. So in total, better resources, first of all more hours of special teachers or more other professionals in each class, are desirable. Furthermore, the concepts of the visited schools are not really inclusive, because they only include pupils

with behavioural problems – slow learners for example still have to go to a special school. A fully inclusive concept would probably require more individualised learning and enhance the cooperation between teachers and other professionals.

PAPER PRESENTATION

The Role of Peer Facilitation in 3D Learning Environment

Paivi Poyry-Lassila, Aalto University, Finland; Timo Haukola, Aalto University, Finland; Riitta Smeds, Aalto University, Finland; Kristiina Kumpulainen, National Board of Education, Finland

Today's university graduates must be provided with the skills and competences for working with remote colleagues and solving complex problems collaboratively in virtual workspaces. The kinds of interaction and collaboration skills needed in virtual spaces urge us to re-consider the methods and pedagogy needed to support learners' active and productive participation in knowledge creation. In this paper we discuss a case study on a university-level course that was set to examine the role of peer facilitation in supporting students' interaction and learning in the context of 3D virtual spaces. Based on our empirical mixed-methods case study, we reflect on the effect of peer facilitation on interaction at virtual 3D learning environment. We compare facilitated and non-facilitated teams' interaction through survey data, chat log data and ethnography-informed analyses on video-recorded meetings in the 3D environment. The quantitative analyses on chat log and survey data indicate that there are differences between the facilitated and non-facilitated groups with regard to both amount and quality of communication. Furthermore, the ethnography-informed video analyses suggest that the facilitated teams became more fluent and efficient in collaboration, at least partly, as a result of peer facilitators' interventions. This research produces new knowledge and understanding on how to design instruction in 3D virtual settings. Especially it highlights the role of a peer facilitator in team interaction.

As today's work and business life require global collaboration, the university education has faced new challenges. The graduates must be provided with the skills and competences for working with remote colleagues and solving more and more complex problems collaboratively in virtual workspaces. The kinds of interaction and collaboration skills needed in virtual spaces urge us to re-consider the methods and pedagogy needed to support learners' active and productive participation in knowledge creation. In this paper we discuss a case study on a university-level course that was set to examine the role of peer facilitation in supporting students' interaction and learning in the context of 3D virtual spaces. Based on our empirical case study and data analysis, we aim to answer the following research question: What kind of effect does peer facilitation have on interaction at virtual 3D learning environment?

The context of this study was a global virtual collaboration project (GVCP) course that was designed and organized in 2010 co-operatively by five universities from Europe, USA and India. The objective of the course was to offer the students a possibility to discover and explore genuine challenges emerging from global team work and cultural differences, and develop skills and competencies needed in virtual collaboration.

The students (N=91) were located on three different continents, and during the course they solved in collaboration a real-life construction engineering problem by using a virtual 3D-environment "Second Life" as the primary arena for interaction. Seven structurally similar global teams were formed, and three of them had two additional students in the role of a process facilitator. By having both facilitated and non-facilitated teams, we were able to explore the role of peer facilitation in learning.

The pedagogical approach of the GVCP course is based on the socio-constructivist view on learning according to which learning takes place in and through social interaction (Lave & Wenger 1991). The pedagogical design of the course was built on the principles of problem-based learning (Capon & Kuhn 2004) and collaborative learning (Dillenbourg 1999). In addition, scaffolding (Pea 2004) and facilitation (Saranpää 2010) were central elements. The GVCP course aimed to develop the students' capabilities in self-directed learning through a facilitated and self-directed group work assignment (Grow 1991).

To develop students' skills in teamwork, knowledge acquisition, cooperation and respecting colleagues' views, the course followed a problem-based design (Wood 2003), and the students worked on a real-life case. The teachers acted as enablers and evaluators providing the framework and guidelines for the students' learning process. They intervened only when necessary, whereas the facilitator students assigned to half of the teams had an active tutor-like role (Neville 1999) supporting the problem-solving process through facilitation.

We define facilitation as helping people to navigate the processes that lead to agreed-upon objectives in a way that encourages participation and productivity (O'Hara-Devereaux & Johanson 1994). A facilitator supports the social group processes and maintains a propitious atmosphere for collaboration. Facilitators also contribute to the problem-

solving work by preventing counter-productive conflicts and by designing interventions that help others to progress. Facilitation has been shown to affect the quality of students' knowledge development (Ponte et.al. 2004).

In this research we applied the case study method with mixed methods approach (Creswell 2009). Empirical data was collected through three on-line surveys, automatically generated chat log data, and by video-recording the virtual team meetings (161). The surveys dealt with students' perceptions on conflicts and quality of communication in the 3D environment. We also collected the final grades of each student team.

The data was analysed in three phases. First, we analysed the quantitative survey data with basic statistical techniques, and calculated descriptive statistics from the chat log data. The quantitative analyses served as a background enabling us to form an initial understanding of the phenomenon and to design the qualitative video analysis. Second, an ethnography-informed analysis on the video recorded student team meetings in Second Life (60 hours) was implemented utilizing the ELAN software. Analysis was made on group level, a global student team being the unit of analysis. The facilitated teams' meetings were explored to find out what actually happened there, how the interaction unfolded, and how facilitation affected it. The non-facilitated teams' videos were used for comparison. Lastly, we compared the student teams' final grades.

The descriptive statistics of the chat log data showed differences between the teams. On average, the facilitated teams typed in total 5135 chat message, compared to the non-facilitated teams' 2063 messages. Furthermore, the survey data analysis indicated that peer facilitation affected the student teams' interaction; e.g. the facilitated teams had fewer conflicts, the conflicts were discussed more, and the members were less pushing their personal opinions during disagreements. Additionally, facilitation affected positively the students' perceptions on the quality of interaction.

The ethnography-informed video analysis suggests that the facilitators were able to create a supportive atmosphere that had a positive impact on collaboration and interaction. The facilitators spontaneously created a variety of extra interventions in addition to the predefined ones to enhance the group processes. Consequently, facilitated teams were able to agree upon responsibilities and work practices more quickly, and they also coped with unexpected situations more fluently and were in general more organized when compared to the non-facilitated teams. Yet, the final grades based on the written team reports did not differ between the facilitated and non-facilitated teams.

However, our other findings indicate that the course's overall aim was achieved better in the facilitated teams, as they seemed to have learned better virtual collaboration and communication skills through peer facilitation. Accordingly, the facilitated teams reached a deeper level of collaboration in studying.

This research produces new knowledge and understanding on how to design instruction in 3D virtual settings. Especially it highlights the role of a peer facilitator in team interaction. Findings presented have also potential significance to the management of virtual teams and their collaboration processes in work life.

References

- Capon, N. & Kuhn, D. (2004). 'What's so good about Problem-Based Learning'. *Cognition and Instruction*, Vol.22, No.1, pp.61-79.
- Creswell, J.W. (2009). *Research Design Qualitative, Quantitative and Mixed Methods Approaches*. (3rd ed.) Los Angeles: Sage Publications.
- Dillenbourg, P. (1999). (Ed.) *Collaborative learning: cognitive and computational approaches*. Advances in learning and instruction series. Oxford: Pergamon.
- Lave, J. & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.
- O'Hara-Devereaux, M. & Johansen, R. (1994). *Global work: Bridging distance, culture and time*. San Francisco, CA: Jossey-Bass.
- Pea, R.D. (2004). 'The Social and Technological Dimensions of Scaffolding and Related Theoretical Concepts for Learning, Education, and Human Activity'. *The Journal of the Learning Sciences*, Vol.13, No.3, pp.423-451.
- Saranpää, T. (2010). *Conflict resolution through facilitation in global virtual collaborative teams*. Aalto University, School of Science and Technology, Finland.

PAPER PRESENTATION

Teachers/ joint discovery of solutions – training peer consulting skills

Monika Trittel, Technical University of Darmstadt, Germany; Bernhard Schmitz, Technical University of Darmstadt, Germany

Most of the time, teachers have to work on their own, whether it is preparing and giving lessons or consulting with parents (Vogt & Rogalla, 2009). Solutions for problems could be found more easily together with colleagues (Hasbrouck & Christen, 1997). However, the collaboration of teachers seems to be an exceptional case. The aim of our study was to develop and evaluate a training programme for teachers concerning peer consulting (Toman, 1996). Up to now, 29 teachers have participated in this ongoing study, which is based on an experimental 2 x 3 design, with the factors time and training programme. Within the experimental group "peer consulting", a within-subject-design with three repeated measurements was exerted. The training programme consisted of a theoretical input and practical peer consulting sessions. The preliminary results show a significant growth in knowledge about peer consulting for the experimental group, but not for the control group. The same could be found for the attitude concerning peer consulting. Across the three peer consulting sessions, a significant positive effect could be found regarding the willingness to reflect and the satisfaction with the method of peer consulting.

The results have to be regarded as preliminary results. Nevertheless, some interesting statements can be made. The method of peer consulting seems to be highly valued from educational practitioners. The training programme is expected to lead to more profound knowledge about peer consulting. An increasingly positive attitude towards it may ensure the transfer to real school life, beyond the borders of the training programme.

Teachers have to tackle manifold problems in everyday school life, for example individual students' difficulties with the learning matter or conflicts within a learning group. Most of the time, they have to work on their own, whether it is preparing and giving lessons or consulting with parents (Vogt & Rogalla, 2009). Many problems are common; they also exist for other teachers. Solutions could be found more easily together with colleagues (see Hasbrouck & Christen, 1997), who have the same background but a fresh view on things, or have perhaps already experiences with this problem. However, the collaboration of teachers seems to be an exceptional case, due to lacking structures and competences at school and, at least perceived, a lack of time. There is a necessity to support teachers to tackle educational problems (Weinert, Helmke, & Schrader, 1990). The aim of our study was to develop and evaluate a training programme for teachers, wherein the participants learn the basic principles and practice peer consulting or intervention (Toman, 1996), in order to be able to implement peer consulting groups on their own responsibility at their schools.

Up to now, 29 teachers have participated in this ongoing study, which is based on an experimental 2 x 3 design, with the factors time and training programme (no participation, participation in peer consulting, participation in diagnosing learning behaviour). The training programme "diagnosing learning behaviour" is conducted at present, so no results can be reported at this stage. Within the experimental group "peer consulting", a within-subject-design with three repeated measurements was exerted to evaluate the three practical exercises / peer consulting sessions. The training programme consisted of four modules. The first module was a theoretical input concerning i.a. structured communication, and the usefulness and application of peer consulting. The other three modules consisted of peer consulting sessions as exercises of transferring the theoretical input to practical execution.

The effects of the training programme for peer consulting were measured using a multilevel questionnaire, which was filled out before the first module and after the last module. It consisted of questions regarding the knowledge, self-assessment of competences and attitude concerning peer consulting, using multiple methods such as Likert scales and Semantic Differentials. Measuring in more detail the effects of the practical modules, the experimental group filled out a questionnaire after each of the three peer consulting sessions.

The results of the presently existing sample show a significant growth in knowledge about peer consulting for the experimental group, but not for the control group. The same could be found for the attitude concerning peer consulting. The experimental group responded more positively in the post-test compared to the pre-test, which was not true for the control group. Across the three practical peer consulting sessions, a significant positive effect could be found regarding the willingness to reflect ($M_1 = 23.89$, $SD_1 = 2.430$, $M_3 = 25.57$, $SD_3 = 2.992$ [$F = 7.341$, $p = .028$, $\eta^2 = .55$]) and the satisfaction with the method of peer consulting ($M_1 = 18.57$, $SD_1 = 3.505$; $M_3 = 25.00$, $SD_3 = 3.697$ [$F = 4.000$, $p = .047$, $\eta^2 = .599$]).

The results have to be regarded as preliminary results, because of the small sample size at present, ongoing deeper statistical analyses and the awaited results of the training programme "diagnosing learning behaviour". Nevertheless, some interesting statements can be made. The method of peer consulting seems to be highly valued from educational practitioners. The training programme is expected to lead to more profound knowledge about peer consulting. An

increasingly positive attitude towards it may ensure the transfer to real school life, beyond the borders of the training programme.

References

- Hasbrouck, J. E. & Christen, M.H. (1997). Providing peer coaching in inclusive classrooms. A tool for consulting teachers. *Intervention in School and Clinic*, 32 (3), 172-177.
- Toman, W. (1996). A plea for more intervention. *Contemporary Family Therapy*, 18 (3), 385-392.
- Vogt, F. & Rogalla, M. (2009). Developing Adaptive Teaching Competency through coaching. *Teaching and Teacher Education*, 25, 1051–1060.
- Weinert, F.E., Schrader, F.W. & Helmke, A. (1990). Educational Expertise: Closing the Gap between Educational Research and Classroom Practice. *School Psychology International*, 11, 163-180.

PAPER PRESENTATION

Interlanguage as bridging the gap between colloquial and scientific knowledge

Clas Olander, University of Gothenburg, Sweden

This study explores the idea that learning science involves learning to talk science focusing the intersection between conceptual aspects of learning biological evolution and social languages, especially colloquial, inter- and school science language. Data was generated in secondary school classrooms in two ways: firstly through a pre and post test design with written answers; including both open ended and multiple choice questions. Secondly, through video taped peer group discussions, which was as an integrated part of the actual teaching. Analysis of the pre and post test design shows that when comparing written answers the students answered significantly more in line with a scientific view a year after teaching. During the peer group discussions the students negotiated the meaning of the notions: need, randomness and development and they used all three social languages (colloquial, inter- and school scientific language). The findings reported in this study make it possible to argue that colloquial expressions are not a hindrance in students learning; on the contrary they are a resource. Furthermore, the verbalisation in an interlanguage makes it easier to communicate in social life, outside the science classroom, and thus it increases the possibility of further learning.

Aim

This study explores the idea that learning science involves learning to talk science (cf. Lemke, 1990) focusing the intersection between conceptual aspects of learning biological evolution and social languages (Bakhtin, 1981), especially colloquial, inter- and school science language. The research questions explore the ways students appropriate school science language and the first question, out of three, deals with a macro analysis of students learning outcome and the two following questions deals with a micro analysis of students talk during peer group discussions.

- 1) In what way does the students' written answer develop from before to after teaching?
- 2a) In what way are conceptual constituents of biological evolution construed in the students' discussion?
- 2b) In what way does colloquial, inter- and school science language manifest and interconnect in the students' Discussion?

Methodology

The study was carried out in a Swedish upper secondary school, in two classes with 48 students (17 years old). The teaching sequence about biological evolution consisted of eight lessons and was taught by the same teacher. Data was generated in two ways: firstly (related to question one) through a pre and post test design with written answers; including both open ended and multiple choice questions. Secondly data was generated, through video taped peer group discussions which were one of the lessons, out of eight lessons in the teaching sequence. The peer group discussion dealt with a multiple choice question formulated as:

'Throughout the course of evolution living organisms have developed a lot of different traits. What is the origin of this enormous variation?

- The traits arose when they were needed
- Random changes in the gene pool of the organisms
- Living organisms pursue development
- Great variation is needed in order to get balance in nature'

The assumption was the discussion of the question would open a dialogic space (Wegerif, 2008) where different views on the topic would be articulated and thus generate data in relation to research question 2a and 2b. In all, 29 students in 7 groups were included since they gave permission to be video taped. When performing the discussion they went to

an adjacent room, started a video camera, discussed, turned off the camera and continued to the next activity. The remaining 19 students in 5 groups had their discussion in another room and were not video taped.

The analysis principally included three steps:

- Quantitative and qualitative analysis of students' written answers with a pre- and post test design (connected to question 1)
- Quantitative and qualitative analysis of what notions were important in the students' peer group discussion (connected to question 2a)
- Qualitative analysis of shifts between different social languages in the students talk (connected to question 2b)

Findings

In relation to research question one and the first step of analysis there where a significant change (calculated with χ^2 -test) in the way the 48 students answered test items about biological evolution. When comparing written answers (before teaching started and one year after teaching ended) the students answered significantly more in line with a scientific view a year after teaching.

Concerning research question 2a and second analysis transcripts from the groups' discussion were first analyzed as a whole, meaning that all communication from seven groups (ranging between 6 and 19 minutes with an average of 11 minutes) were divided in sequences where different conceptual notions were discussed, no matter if they originated in colloquial or scientific language. Mainly three notions were negotiated by the students: half of the talking time need and randomness (mostly at the same time and in contrast to each other) were in focus and during a quarter of the time the notion of development was discussed. The remaining quarter dealt with a range of issues (HIV, twins, animal/humans etc).

Finally, when it comes to research question 2b and the last step of the analysis the results are exemplified below with an excerpt from one peer group discussion:

- 1 Alice: if you imagine that the ducks in the beginning were land birds, and then some started to get web, and then it favoured them in swimming, and those who didn't have any web crawled onto land
- 2 Anna: they developed their own type of foot
- 3 Alice: exactly
- 4 Anna: then they developed because they needed it
- 5 Alice: no they who were webbed stayed in the water
- 6 Anna: and got more and more web
- 7 Alice: yes but not because they needed it
- 8 Anna: they develop it because
- 9 Amy: they can't think, I need that gene
- 10 all: no no
- /.../
- 15 Amber: I don't think that number one has to imply that now I need it and then I get it
- 16 Amy: not originated because it was needed but remained when it was needed in that case

As seen in this excerpt, the notion of need (in spite of its colloquial origin) plays an important role in the students' discussion and in turn 16 need is used in a rather sound scientific manner and the whole statement from Amy (16) is an example of using an interlanguage.

Theoretical and Educational significance of the research

The findings reported in this study make it possible to argue that colloquial expressions are not a hindrance in students learning; on the contrary they are a resource. Learning biological evolution encompasses both language and conceptual aspects: need, randomness, and development are important meaningful notions in reasoning and students develop their use. The notions get a scientific meaning in spite of their colloquial origin (cf. the notion 'need') and students have to enter the arena of interlanguage in order to connect colloquial and school scientific reasoning. Furthermore, students discern how colloquial and school scientific language on the one hand differs, and on the other could be kept together when discussing biological evolution. Language and conceptual aspects interact in intricate ways, and this paper hypothesize that the verbalisation in an interlanguage makes it easier to communicate in social life, outside the science classroom, and thus it increases the possibility of further learning.

PAPER PRESENTATION

Bilingual newspaper – a tool for multicultural education?

Roni Reingold, Achva-College of Education, Israel; Lea Baratz, Achva-College of Education, Israel

The aim of the current study is to analyze the discourse in a special newspaper, which is edited by the Israeli Ministry of Education and distributed among high school students, immigrants from Ethiopia. In Israel the Ministry of Education is a political agency which controls educational policy and practice throughout the country. Analyzing the discourse can help to examine and expose the formal and real educational policy. The newspaper is bilingual, written in Hebrew and in Amharic - the original language of the immigrants from Ethiopia. Preliminary, it seems as if the newspaper reflects pluralistic multicultural approaches, but deep content analysis of hundreds of articles revealed a different reality. The research reveals that there is no real multicultural attitude. Using the principals of critical discourse analysis (Gee, 1992, 2004; Van Dijk, 1991, 2001), we categorized the topics and the content (purposes) of the articles. Our findings are that the newspaper actually reflects an ethnocentric attitude of the editors or in other words implied an approach of assimilation. Thus; the multicultural cloak is actually a fake one. Never the less, in the voices of some of the members of the community of the immigrants themselves, there are some first signs of adopting a real multicultural attitudes.

Ethiopian Beta Israel community, comprising of more than 120,000 people, have immigrated to Israel under its "Law of Return", which gives Jews and those with Jewish origins, the right to immigrate to Israel and obtain citizenship (Ben Ezer 1992). The Ethiopian Jews' encounter with the Israeli experience exposed them to the process of socialization and acculturation. One of the obstacles that the Ethiopian society has to deal with as an immigrant society is the acquiring of a new language of the host country (Cohen & Spector, 2003). According to the structural functional attitude, language is a means for forming national identity (Menachem & Geijst, 1999), they did not have many formal opportunities to use their original language- Amharic Except among them inner milieu. Hence, when the Ministry of education begun, ten years ago, to publish and to hand to high school students, Ethiopian Jews, a bilingual newspaper it seemed as a tendency towards a multicultural education policy (Reingold, 2007). Bilingualism should be looked upon as an interdisciplinary area, including not only linguistics, but all behavioral sciences. According to Nevo and Olstein (2008) bilingual situations can be discerned: bilingualism or multilingualism is concerned with a few languages spoken in the home ground/environment (home or country); sequential bilingualism is concerned with acquiring a foreign language within the educational system, and acquired bilingualism as a result of immigration processes. On one hand a bilingual text can be a tool for acquiring the new language by having the graphic and parallel presentation of two languages side by side, and on the other hand it can be a means of emphasizing the fact that it is part of a process for preserving a language, indirectly aimed at preserving an ethnic identity.

Methodology

The principals of critical discourse analysis (Gee 1992, 2004; Van Dijk, 1991, 2001) served as the guidelines for deep content analysis of hundreds of articles in journals which were published revealed a different reality. Our purpose by using critical hermeneutics while categorizing the topics and the content (purposes) of the articles is to expose hidden power imbalances and challenges in the frame of the Israeli educational system. Findings Out of 169 articles which were published in the newspaper 60 focused on educational issues, 53 dealt with stories of personal success, 29 were about projects in the community, 24 about parents-children relationship and 3 about criminal activities and drug addiction in the community. In a lot of the articles there was use of the term excellence: "Excellency instead of criminality"; "Her three children are excellent students"; "How did you succeed to raise such an excellent children?"; "The excellent students will get stipend". In many articles there was a use of the term integrate or integration: "We should fully integrate in the Israeli society"; "We should integrate both in educational systems and society"; "If we will succeed in higher education programs we will succeed to fully integrated in the Israeli society". Never the less, in some of these articles the voices called for integrating the history of the Ethiopian Jews into the formal curricula.

Discussion

The story of the Beta Israel community, as it is being told in a bilingual Hebrew- Amharic newspaper, has a potential to help both the Ethiopian community members and the Native Israelis to accept the 'self' and the 'other' accordingly, to understand the significance of the individual within the social complex and to develop tolerance towards the other. In order to serve as such bilingually tool, words should not be used as a 'single voice' that represents the exclusive and hegemonic voice, but should represents a dialog among voices. Bilingual texts should actual be a demonstration of the term 'fruit salad' (Audrey, 1992), contrary to the grasps of the "melting pot" regarding hegemonic cultures that impose their essence over the 'other'. But in the current study we found that the Israeli Ministry of Education prefers not to use the potential of the bilingual Hebrew- Amharic newspaper as a tool for developing a dialog among voices, but rather to represents the hegemonic voice. Never the less, since the Ministry cannot fully control the voices; some voices of multicultural attitudes are becoming part of the discourse.

PAPER PRESENTATION

Stereotypes and their role in the educational careers of Turkish students in Germany

The paper presents an interview study that tried to explore if, how and to what extent students with a Turkish background in Germany experienced impairments from negative stereotypes during their school career. Although most of the respondents (N=15) denied in a general way that they were treated or judged according to stereotypes during their educational career, they recalled a series of specific episodes in which stereotypes came into play or were evident. Most of the episodes took place at transitional points, particularly at the transition from primary school to secondary schools and were associated with teachers' judgments. Students felt that they were not judged according to their individual capability but according to teachers' anticipated difficulties of minority students in higher education. Helpful for overcoming impairments seems to be a strategy of ignoring negative information, maintaining a positive self-concept, actively negotiating one's role and building upon a strong parental support.

Objectives and theoretical framework

When it comes to educational outcomes an achievement gap between immigrant/minority students and non-immigrant majority students is observed in many countries. In Germany this gap is particularly wide for students with a Turkish background (Stanat & Christensen, 2007). Different explanations have been proposed for understanding the causes of this under-performance. Some researchers point to the existence of group-specific stereotypes that may affect teachers' judgment and behaviour. Despite still sparse empirical evidence, existing studies make it plausible to assume that stereotypes play a (major) role especially in transitional phases. When teachers have to give recommendations for secondary schools and continuing education their judgment seems to be based on stereotypical knowledge (Alleman-Ghionda, 2006). Stereotypes may also account for expectancy effects of which students with a minority background are particularly likely to be negatively affected (Jussim & Harber, 2005). Research on stereotype threat reveals how existing stereotypes within a society undermine the academic success of minority students, even when their teachers do not share these stereotypes (Steele, Spencer & Aronson, 2002). Stereotype threat has a corroborated impact on members of many different types of groups and on their performance in varying domains (but has not yet been investigated for Turkish students in Germany). Research evidence, however, is almost exclusively based on experimental studies. It is still unclear whether these results can be generalized from the laboratory to classroom settings and whether or how this effect corresponds with students' subjective experiences. The proposed paper presents an interview study that tried to explore if, how and to what extent students with a Turkish background in Germany experienced impairments from negative stereotypes during their school career. This study focused students who successfully graduated from secondary schools. There were several reasons for restricting the sample to "successful" students: 1) According to stereotype threat research those with high educational ambition are particularly vulnerable to stereotype threat. 2) Those who succeeded in the given educational system despite the alleged impact of negative stereotypes may have developed particularly promising coping strategies. Furthermore, students at the end of a rather long schooling career may have gathered a wealth of experiences with negative stereotypes to report of, especially as they had to go through a series of transitional phases.

Method

Research questions. The following questions were addressed: 1. In as far and to what extent did students with a Turkish background in Germany experience impairments from negative stereotypes during their school career? 2. How did they cope with these experiences? 3. What factors proved to be supportive in overcoming impairments?

Design and Sample. Semi-structured, in-depth interviews were carried out with 15 students who had just successfully graduated from school and were about to enroll in university courses. Participants' age ranged from 22 to 32 years (M=25,7), nine of them were female and six were male students. All were second or third generation immigrants.

The interviews were retrospective and explorative in nature. Participants were asked to give an account on the course of their educational career. They were instructed to tell everything that came to their mind. Participants' knowledge and awareness of negative stereotypes in the society about their group was addressed explicitly by the interviewer.

Procedure and Analysis

The interviews were digitally recorded; verbal transcripts from the recordings were produced. Analysis was based on an inductive content analysis. The transcribed interviews were segmented into statements; these statements were assigned to identified themes and categories and interpreted as to the research questions. Two researchers categorized the subjects' statements independently. The categorizations were compared and discrepancies discussed until a consensus was reached. This procedure enabled the researchers to supplement and challenge each other findings, thereby strengthening the validity of the categories. The following main categories were developed 1) knowledge of stereotypes 2) personally meaningful episodes associated with negative stereotypes and/or experiences of discrimination 3) characteristics of reported episodes and situations (frequency, time, persons involved) 4) ways of dealing with relevant situations 5) sources of support.

Preliminary Results and Conclusions

Results so far indicate that all interviewed students are aware of negative stereotypes in the society. In their view existing stereotypes linked Turkish students' poor performance with innate competence deficiencies and with a specific value system of Turkish families. Although most of the participants denied in a general way that they were treated or judged according to stereotypes during their educational career, they recalled a series of specific episodes in which stereotypes came into play or were evident. Most of the episodes took place at transitional points, particularly at the transition from primary school to secondary schools and were associated with teachers' judgments. Students felt that they were not judged according to their individual capability but according to teachers' anticipated difficulties of minority students in higher education. Helpful for overcoming impairments seems to be a strategy of ignoring negative information, maintaining a positive self-concept, actively negotiating one's role and building upon a strong parental support. Specific support of German friends and teachers was also helpful for most of the respondents.

It may be concluded that stereotypes play an important role in Turkish students' educational careers, especially in the transition to secondary schools. Hence, the stereotypes Allemann-Ghionda (2006) identified in teachers' recommendations correspond to students' actual experiences. Awareness of stereotypes, however, seems to be gained in retrospective reflection and may not be given in the actual educational situation. The tendency to deny that they as individuals were judged or treated according to stereotypes can be regarded as defense mechanism; a view that is in line with stereotype threat research. Developing strategies of self-affirmation may help to overcome the psychological threat. This can be a starting point for possible educational interventions as the results of Cohen et al. (2009) indicate. To overcome this explorative study's limited scope ongoing research investigates differences between high and underachieving Turkish students' strategies and experiences.

PAPER PRESENTATION

Realities and Perceptions for Teachers of New Migrant Children in England

Naomi Flynn, University of Winchester, United Kingdom

Migration from Poland to the UK since 2004 has presented schools and teachers with a new set of experiences as they accommodate Polish children in their classrooms. Interviews with English teachers reveal that this has been a largely positive encounter because of their perception that Polish identity is characterised by aspiration and hard work. Contrasting interviews with Polish teachers whose pupils have left with their families in order to build a 'better life' in England, suggest that this rose-tinted view is based on some over-simplified assumptions that fail to engage with the reality for migrant workers and their children. This paper uses a Bourdieusian framework for analysis to interpret teacher response from both Eastern and Western Europe. Narrative interviews present divergent accounts of children's experiences that enhance current understanding of the ways in which migrant children cope with school and how they establish social and linguistic capital.

Schools in England have recently undergone a shift in their pupil demographic which reflects changing patterns of trans-European migration since the accession of new member states to the EU in 2004 and 2007 (DCSF, 2008). There is evidence that this shift is one experienced not just in inner-city schools most commonly associated with minority ethnic populations, but in a wide range of schools in rural and smaller town settings in a number of counties across the country (Gaine, 2007). Perhaps the most visible of migrants in the workplace and in schools are Polish nationals. In adjusting to new faces and new languages in their classrooms, teachers in areas not previously associated with national or ethnic difference are required to respond pedagogically and pastorally in ways not necessarily matched to their existing teaching repertoire. Such a change fosters experiences that will fuel these teachers' images of national differences, and these images will grow from a mixture of both their preconceptions about migration and their particular encounters with the families and children they work with.

The aim of this study is to compare teacher's responses and attitudes to Polish children in Primary schools in England with the perceptions of Polish teachers whose children have left their native country as part of the post-2004 cross-European migration. There is growing evidence that the migration of Eastern Europeans, particularly Poles, is somehow different from earlier waves of migration to the UK and the US (Favell, 2008). The new migrants have rights to work and to move freely within EU countries as European citizens and this makes comparison with Post-colonial theories of race, migration and ethnicity largely redundant (p.706). Studies of teacher response to difference come largely from the US and they focus on teachers working with pupils from Black or Hispanic backgrounds. There is very little research to date on how teachers, or other community members, respond to migrant families who are white and European. Research in to this recent phenomenon is needed in order that the teaching profession can be informed in its response to children's cultural and linguistic differences. Interviews were conducted with teachers in schools in the south of England at the beginning and end of academic years between 2007 and 2009. The schools were selected for

having admitted Polish children in the previous school year and because they had limited or no experience of receiving children from other countries. The conversations focussed on their pedagogical approaches to supporting their pupils' language acquisition, but coded analysis revealed a seam of thinking related to migration and, in particular, a range of very positive attitudes to Polish children and their families. The comparison interviews with Polish teachers in 2010 explored the reasons why Polish families might choose to come to England, and the impact of migration on their schools. Questions were designed specifically to query the reality behind English teachers' perceptions and positive attitudes to Poles. Coding of the interview transcripts used Bourdieusian constructs of field, habitus and capital to map how perception and reality in the teaching profession plays out in response to the unfamiliar. Applying an interpretivist approach supported by constructivist grounded theory (Charmaz, 2006) nodes clustered on teachers' responses to the children that rested on their pupils' classroom habitus as hard working and aspirational. English teachers' images of national differences appeared to grow from a mixture of both their preconceptions about the reasons for migration and their particular encounters with the families and children they worked with (Flynn, forthcoming). Thus teacher habitus, as governed by existing perceptions of minority ethnic children and their needs, triggered generalised views based on limited experience. Furthermore, these teachers' views of their children as attentive and studious meant cultural difference was minimised (Bennet, 1998). Perceptions bred realities that may or may not have been based on truths. Comparing the English teachers with their Polish counterparts, there were clearly elements of the narrative around migration from the Poles' point of view that were unseen and unknown in the field of the English classroom. Initial inspection of the data suggests that the experience of migration is more complex than Western Europeans might perceive for both the Polish families leaving Poland and for the schools and communities they leave behind. Interpretivist enquiry assumes that what we imagine is the truth is not an objective reality but is the result of our perceptions (Schwandt, 2000). Such perceptions grow unconsciously from habitus, and as such cannot adapt unless challenged explicitly. The cross-referencing of interviews from both the host and the donor nations allowed the researcher to consider where reality and perception might lie for Polish children and their English teachers. Moreover, it threw in to question the ways in which English education policy for new arrivals assumes oversimplified needs that do not take account of individual difference, and which do not require the dominant culture to look beyond conjecture. This research is significant because of the way that it presents a lens on a recent socio-cultural phenomenon using data from both Eastern and Western European perspectives. Furthermore, it explores the world of the classroom which has been hitherto under-represented in studies examining the new migration. Theoretically it enhances and broadens a small, existing body of work using a Bourdieusian framework to analyse classroom interaction (Grenfell and James, 1998; Christian and Bloom, 2004; Christ and Wang, 2008); it does this by looking at both social and linguistic capital in schools in the specific context of migration. The application of Bourdieu for analysing interview narrative reveals levels of behaviour and response that surpass literal interpretation and question assumed realities.

PAPER PRESENTATION

Exploring hurdles to immigrants' academic success in secondary education

Karolina Retali, University of Oxford, Greece

The last two decades large amounts of immigrants came to Greece, which led to a change of students' population. Schools in Greece have amassed a large number of immigrant students, mainly from Albania and the former Soviet republics. However, there is a lack of national, representative large-scale research on immigrant students' academic achievement in Greece. The present research consists of two main studies: In Study 1, differences between immigrant students' science achievement, as measured by PISA 2006, and their native-born counterparts' are examined and compared, and the potential effect of various factors on immigrant students' science performance in Greece is explored. Then, in Study 2, the key findings of Study 1 are explored and similar trends are sought in other 20 countries with significant immigrant population. Thus, the generalisability of the significant results from Greece is examined, in order to test the ecological validity of the conclusions.

An in-depth multilevel analysis was conducted, with fixed and random slopes models. Results showed that immigrant students in Greece performed significantly worse in science than their native-born counterparts. However, controlling for the language spoken by students at home eliminated the difference between immigrant and native-born students: Students who did not speak Greek at home performed worse in science. Similar trends were noted in the cross-national comparison. These findings point to a need for a stronger language support policy at schools.

Aim of the study

The last two decades, large amounts of immigrants came to Greece, which led to a change of students' population. Schools in Greece have amassed a large number of immigrant students, mainly from Albania and the former Soviet republics; a number that every year is increasing. However, there is a lack of national, representative large-scale research on immigrant students' academic achievement in Greece. Therefore, the present study focuses on the

differences between immigrant and native-born students in Greece and the relationship between various factors and immigrants' academic performance (Study 1). The key immigration issues found as significant in Greece are explored and similar trends are sought in 20 countries with significant immigrant constituencies (Study 2). An in-depth multilevel analysis of the PISA 2006 science data was conducted to address these issues, in order to get a better insight into immigrants' performance in Greek schools and to assist in the promotion of excellence and equity in the Greek education system.

Theoretical background

The overarching theoretical framework of the study is an eco-systemic approach based on Bronfenbrenner's (1979) ecological systems model. This approach argues that the variables examined in the study belong to various environments and levels, but are intertwined and influenced by each other, which provides a theoretical support to the models used in the analysis of the data. The cultural capital theory (Bourdieu & Passeron, 1977) is also central to the analysis of the data. The study looks at the extent to which family background characteristics influence academic achievement and whether there is evidence that socio-economic status (SES) can explain the differences among students as well as the differences among students from various ethnic groups. Issues of contextual effects of schools on students' academic achievement are also discussed (e.g. school-average SES, schools' educational resources).

Data

The present study uses Programme for International Student Assessment (PISA) database. PISA is a cross-sectional international assessment distributed by the Organisation for Economic Cooperation and Development (OECD) every three years, which consists of questionnaires aiming to assess not only students' knowledge on an academic subject but also their ability to use knowledge and skills acquired in reading, mathematics and science in everyday life (OECD, 2007). The Greek PISA 2006 data were used for the purposes of the Study 1, and consists of 4,873 students and 190 schools. 7.5% of the students included in Greek PISA 2006 are immigrants (weighted percentage). Study 2, the cross-national comparison, had a sample of 145,323 students, using data from 21 countries in PISA 2006 with significant immigrant population.

Methods used for analysis

Immigrant students' science achievement in PISA was scrutinised, with various individual, background and school factors included in the model. The database used in the present study was gathered taking into account that students are grouped within schools and therefore influenced by them, and thus it includes both individual and school level variables. Therefore, it was possible to perform a multilevel modelling analysis, which is considered the most appropriate method for the analysis of the associations of the independent variables with the dependent variable, as it is not overlooking the contextual effects. Thus, variances at different levels are separated and the different effects of individual and group level variables on the outcome variable are distinct (Gelman & Hill, 2006; Goldstein, 2003; Hox, 2002; Van de Vijver et al., 2008; Snijders & Bosker, 2004). Both random intercept and random slopes models were conducted.

In addition, the standardised final weights provided by PISA were used in the present study in order to account for the complex survey design of PISA and multiple imputation was used to deal with missing data in order to reduce the risk of biased results.

Results

Results of the analysis of the PISA 2006 Greek data showed that immigrant students performed significantly worse in science than their native-born counterparts. However, after controlling for language spoken at home, the effect of immigrant status was no longer statistically significant: Students who did not speak Greek at home performed worse in science. The actual language spoken at home (Russian, Albanian, other) did not make a difference as long as it was not Greek. Although controlling for various background variables decreased the effect of immigrant status on science achievement, it was the language spoken by students at home that eliminated the difference between immigrant and native-born students. This finding implies that a number of immigrant students in Greece do not have sufficient Greek language skills and therefore there is a need for a stronger language support policy at schools. In addition, another important finding of the present study regarding immigrant students' achievement is the fact that the effect of immigrant status on science achievement does not differ across schools. In other words, the difference in immigrant and native-born students in achievement is the same across schools. Furthermore, the age of immigrant students when they arrived in Greece showed that students that had arrived within the last four years before their science assessment were more disadvantaged than their immigrant counterparts that had lived longer in Greece. These effects did not vary with language spoken at home. The cross-national comparison showed similar trends.

Educational importance of the study

The present study analyses for the first time Greek PISA results in depth and provides an extensive report of factors associated with immigrants' science achievement in secondary education in Greece. Although causation cannot be implied, policy makers and practitioners can find valuable information in the described links among predictor factors and immigrants' academic success. Results can provide the basis for future longitudinal studies on immigrants' achievement and for discussion for future reform of different aspects related to immigrants' educational needs, such as student enrolment policies, language support and teacher training. Therefore, the present study provides useful information by extending the existing knowledge of factors associated with immigrants' academic achievement in Greek schools, as it uses an international assessment with large and representative sample of students from Greece and tests the ecological validity of the findings. This is essential in order to start understanding immigrants' educational needs in Greece and help the Greek education system provide immigrant students with equal chances to academic success.

PAPER PRESENTATION

Research projects in taught Masters programs and possible preparation for doctoral entry

Margaret Kiley, CEDAM, Australia

The aim of this project was to illuminate the poorly understood research education components of taught/coursework Masters programs. With a substantial increase in enrolments in coursework Masters in Australia and with a growing number of applicants seeking PhD entry with coursework Masters qualifications this project examined the extent to which a coursework Masters that includes a substantial research project, provides an effective, supportable entry to a PhD research program.

Given the extremes of variability in Masters programs e.g. one year to two years fulltime in length, and with a research project worth less than a quarter of the total credit to those worth up to one half, it is critical that we understand this variability and what it means for students, institutions and funding bodies.

The research indicates that the research experience of some coursework Masters students is such that they determine they want to undertake a doctoral program. Influences on these decisions include the rigour of the research component, the assessment criteria, the experience, training and expertise of staff supervising the research project, and an understanding the contribution and impact of the research project.

Aims

The aim of this project was to illuminate the poorly understood research education components of taught/coursework Masters programs (Trigwell, Shannon & Maurizi, 1997). With a substantial increase in enrolments in taught/coursework Masters in Australia and with a growing number of applicants seeking PhD entry with taught Masters qualifications this project examined the extent to which a taught/coursework Masters that includes a substantial research project, provides an effective, supportable entry to a PhD research program in Australia (Neumann, 2002, Pearson, Evans, Macquale, 2008).

Given the plethora of Masters programs with extremes of variability e.g. one year to two years fulltime in length, and with a research project worth less than a quarter of the total credit to those worth up to one half, it is critical that we understand this variability and what it means for students, institutions and funding bodies.

Methodology

Research on this question commenced in 2009 with research conducted in conjunction with the Australian Deans and Directors of Graduate Studies (DDoGS). The Deans, that is those University senior staff responsible for doctoral education, as a group were asked to:

- List the knowledge, skills and attitudes that you believe to be essential for entry to a PhD
 - In groups, collectively rank these from most important to least important
- Against each of the ranked characteristics/criteria note one or more ways in which an
- applicant could demonstrate these criteria in an application.

The second stage of the research was the collection of data on the variation of Masters programs where PhD applicants use coursework masters results as a PhD entry qualification. Data were collected at four publicly funded universities (one each from the Group of Eight, Australian Technology Network, and Innovative Research Universities groupings, as well as one regional university). The research aimed to identify the extent to which the research project in a taught/coursework masters is "experienced," as a research preparation program. Findings

The research indicates that:

- The research experience of some taught/coursework Masters students is such they determine that they want to undertake a doctoral program
 - Much of this decision making is based on the rigour, seriousness of the research component, and the assessment criteria adopted in the research project
 - Another factor in decision making is the experience, training and expertise of staff supervising the research project
 - Understanding the contribution and impact of the research project in taught/coursework Masters programs on the quality and nature of the learning experience and learning outcomes of graduates is critical. Theoretical and educational significance of the research
- Possible entry and exit points and curriculum structures that allow for variation in learning and professional experiences are still poorly understood. A particular urgency for this study was brought about by the global recession, given that previous experience suggests that there is a correlation between unemployment and increased enrolments in research degrees (Harman, 2002).

In particular the research provides insights into why Masters students' make the decisions that they do regarding doctoral study.

References

- Harman, G. (2002). Producing PhD graduates in Australia for the knowledge economy. *Higher Education Research and Development*, 21(2), 179-190.
- Neumann, R. (2002). Diversity, Doctoral Education and Policy. *Higher Education Research and Development*, 21(2), 167-178.
- Pearson, M., Evans, T. & Macauley, P. (2008). Growth and diversity in doctoral education: Assessing the Australian experience. *Higher Education*, 55(3), 357-372.
- Trigwell, K., Shannon, T. & Maurizi, R. (1997). Research—coursework doctoral programs in Australian universities (Evaluations and Investigations Program). Canberra: Australian Government Publishing Services.

PAPER PRESENTATION

“Coming to this community was a great moment in my life” -Critical experiences during PhD process

Jenna Tuomainen, University of Helsinki, Finland; Kirsi Pyhalto, Helsinki University, Finland; Kirsti Lonka, University of Helsinki, Finland

Little is known about what drives the doctoral journey. What kinds of experiences make doctoral students keep up with this demanding process? This study explores the critical experiences during doctoral journey perceived by the students themselves. Nineteen doctoral students from natural sciences were interviewed. The interviews were content analyzed by using a phenomenography inspired strategy. The turning points described by the doctoral students were situated in various academic activities, such as conducting field measurements, attending to courses, participating in conferences and publishing articles. Within these situations the doctoral students emphasized the importance of participation in the scholarly community, such as becoming a member of their own research community and getting to know the international field. They also highlighted the significance of their development as a scholar, in terms of constructing motivation and strengthening views of efficacy. In addition, the doctoral students considered advancements in research and in domain specific knowledge and skills including advancements in working with and knowing of instruments as important. Moreover, they described the importance of balancing between different requirements, for instance, combining own research and other academic assignments. In all these four categories the majority (84%) of turning point experiences were described as positive or promoting. In doctoral students' experiences, other things besides advancement in knowledge and skills were commonly mentioned. In natural sciences, the critical experiences were often related to becoming an acknowledged member of the scholarly community and perceiving oneself as a scholar. Such experiences were reported in relation to common academic activities.

Introduction

Little is known about what drives the doctoral journey. What kinds of experiences make doctoral students keep up with this demanding process? This study explores the critical experiences during doctoral journey perceived by the students themselves.

Students' experiences of their doctoral process are central regulators for their learning as a scholar. These experiences reflect interpretations and choices students make, and thus, experiences define, for instance, what students perceive as a goal and how they interpret feedback. This way the experiences contribute to students' learning.

Doctoral experiences include different kinds of dimensions. Recent research has explored some of these dimensions, for instance, doctoral students' experiences of their academic identity (McAlpine & Amundsen, 2009), research work (Meyer, Shanahan & Laugksch, 2005) and socialization (Gardner, 2007). However, little is known what students perceive as critical experiences during their doctoral journey.

Aims

The aim is to identify 1) the critical experiences during doctoral journey perceived by students, 2) in what kinds of activities the experiences are situated perceived by students, and 3) how the experiences contribute to the doctoral process perceived by students. This study is a part of a national research project on doctoral education in Finland.

Doctoral studies in natural sciences context

Characteristic of doctoral education in natural sciences is collective and international training in research communities and shared projects (Cumming, 2009) as well as pursuing a thesis based on co-authored articles. Thus, the scholarly community provides a collective mechanism for supervision.

Methods

This study included data collected from an internationally acknowledged research community in a large research intensive Finnish university. Altogether, nineteen doctoral students (female: 10, male: 9) from natural sciences were interviewed. The critical experiences were explored through key events (a.k.a. critical incidents, Tripp 1994). In the semi-structured interviews the participants were asked to visualize and point out key events as well as explain what they were.

The data were content analyzed by using a phenomenography inspired strategy. Thus, the analysis was driven by the data and the focus was on variation in the described experiences. First, all the text segments where the participants referred to significant turning points were coded in the same category. Then, the turning points were coded according to the primary context of the experience: research work, PhD studies, academic meetings, supervision, publishing, academic assignments, and personal activities. After this, the turning points were coded in four exclusive categories according to general meaning given to the experience as perceived by the participants: participation in the scholarly community, development as a scholar, advancements in research and in domain specific knowledge and skills, and balancing between different requirements. Finally, the key events were coded in two exclusive promoting and hindering categories as perceived by the participants.

Findings

The doctoral students reported a variety of situations ranging from attending to study courses to conducting research work. They emphasized experiences varying from encouraging leaps in understanding promoting satisfaction and enthusiasm to problematic situations, for instance, tensions in supervision causing insecurity and anxiety. Moreover, they reported both long episodes as well as short events.

The key events described by the doctoral students were typically situated in various academic activities. The students described research work (24%), such as conducting field measurements and working with new projects. They reported also their PhD studies (19%) including attending to courses and recruitment. In addition, the students described academic meetings (15%), such as participating in conferences as well as their supervision (15%), for instance, having new advisors. Furthermore, they also reported publishing (13%), such as writing and getting articles accepted, and academic assignments (10%) including teaching. Moreover, few of the events were situated to students' personal activities (4%), such as having sabbatical free.

Within these situations the doctoral students emphasized the importance of participation in the scholarly community (35%). They highlighted becoming a member of their own research community, meeting international researchers as well as mismatch in a supervisory relationship. The students also described the significance of development as a scholar (29%). Especially, they described becoming interested in their domain, struggling with ambiguous image of the doctoral process as well as strengthening views of their efficacy and future intentions. In addition, the students emphasized the significance of advancements in research and in domain specific knowledge and skills (29%). They often brought out advancements in working with and knowing of instruments as well as understanding their research object. Furthermore, the students described the importance of balancing between different requirements (7%), for instance, combining own research and other academic assignments.

In all these four categories the majority (84%) of the experiences were described as promoting. Advancements in perceptions of oneself as a scholar, understanding the domain as well as participation in the scholarly community were considered as constructive and supporting progress. In contradiction, for instance, inadequate supervision and

problems with instruments were considered as destructive and leading students to struggle with interruptions in their research.

Theoretical and educational significance

In doctoral students' experiences, other things besides advancement in knowledge and skills were commonly mentioned. In natural sciences, the critical experiences were often related to becoming an acknowledged member of the scholarly community and perceiving oneself as a scholar. The results demonstrate that the critical experiences in doctoral students' lives take place in the context of quite ordinary academic activities. Supporting the growth of a doctoral student appears to lie in reflecting on everyday practices from an educational perspective.

References

- Cumming, J. (2009). The doctoral experience in science: Challenging the current orthodoxy. *British Educational Research Journal* 35(6), 877-890.
- Gardner, S.K. (2007). "I heard it through the grapevine": Doctoral student socialization in chemistry and history. *Higher Education* 54(5), 723-740.
- McAlpine, L. & Amundsen, C. (2009). Identity and agency: Pleasures and collegiality among the challenges of the doctoral journey. *Studies in Continuing Education* 31(2), 107-123.
- Meyer, J.H.F., Shanahan, M.P. & Laugksch, R.C. (2005). Students' conceptions of research. I: A qualitative and quantitative analysis. *Scandinavian Journal of Educational Research* 49(3), 224-244.
- Tripp, D. (1994). Teachers' lives, critical incidents, and professional practice. *Qualitative Studies in Education* 7(1), 65-76.

PAPER PRESENTATION

Developing employability skills of doctoral researchers: exploring students' perceptions

Elena Golovushkina, Glasgow Caledonian University, United Kingdom; Colin Milligan, Glasgow Caledonian University, United Kingdom

Past few decades have seen an increased interest in the issues of graduate employability including that of doctoral researchers. The purpose of this paper is to address the gap in the literature and explore the views of doctoral researchers on the employability and skills development issues. The paper details the views of researchers on three aspects of employability: the concept of employability and its meaning for doctoral researchers; employability skills that doctoral researchers expect to develop; and their awareness of employers' expectations. Based on the literature review, research questions have been designed to explore the perceptions of social science doctoral researchers on the issues of employability. Semi-structured interviews have been conducted with 15 full-time PhD students in various social science disciplines at one of the Scottish universities. Initial findings suggest that there is a link between the initial motivations of doctoral researchers to do a PhD degree and their views on employability. The data provides an insight into doctoral researchers' perceptions the understanding of the skills that PhD graduates expect to develop during candidature. The results of the interviews pose questions for further debate on the skills formation at the PhD level. Paper provides a valuable insight into the under researched area of employability of doctoral researchers.

Graduate employability has been the focus of much activity at both research and policy levels within Higher Education. Initially focused primarily on undergraduate students, in the past few years the debate has broadened to include the development of employability skills of postgraduates, including doctoral researchers. Interest in this area is further enhanced by the large number of doctoral researchers pursuing careers outside academia. For example, a recent report produced by the UK Royal Society (2010) indicates that 53% of PhD graduates are employed in the sectors outside academia. These figures are confirmed by the Vitae report "What do researchers do?" (2010) that shows that more than a half of UK doctoral graduates are employed outside academia across the commercial, government and non-for-profit sectors. An emphasis on the range of employment destinations challenges a traditional understanding of a PhD as a degree leading to the employment in academia. In these conditions one of the priorities of Higher Education Institutions is to seek ways of transforming "students into highly proficient, independent researchers, capable of adapting to a range of employment destinations and taking up positions in academe, industry and the professions" (Manathunga 2007, p 19).

The diversity of career paths of doctoral researchers poses important questions about the skills that PhD candidates should develop to be successful in their chosen occupations later on. Previous attention in this area has been focused primarily at policy and practice level. For example, one of the biggest initiatives in this area in the UK was introduced by the Research Councils that developed the Joint Skills Statement (2001) - a set of skills that Research Councils-funded postgraduate researchers are expected to develop during their candidature. As a result, this framework was adopted by many UK universities for providing transferable skills training for researchers. Past few years have also

seen a growing body of research literature outlining the current discussion on the formation of professional researchers and their employability skills (Cryer 1998, Gilbert et al 2004, Manathunga et al 2009). Despite an increased focus on this aspect of doctoral education, discourse in this area still lacks studies exploring perceptions of doctoral researchers themselves on their employability and the key skills they need to develop.

In an attempt to address this gap, this paper provides an insight into the perceptions of social science doctoral researchers on the concept of employability and development of employability skills. The paper details the views of researchers on three aspects of employability: the concept of employability and its meaning for doctoral researchers; employability skills that doctoral researchers expect to develop; and their awareness of employers' expectations. Perceptions of doctoral researchers were investigated by means of exploratory semi-structured interviews. The questions used in the interviews were devised on the basis of the relevant literature review as well as the data obtained from the analysis of the secondary data. Semi-structured interviews have been conducted with 15 full-time PhD students in different social science disciplines at one of the largest Scottish universities. Social sciences disciplines were selected based on the list of disciplines provided by the UK Economics and Social Research Council. The participants have been recruited using a mixed sampling technique. The findings represent the first phase of data collection on exploring the perceptions of doctoral researchers and other stakeholders in Scottish Higher Education Institutions on development of employability skills and the ways we can enhance employability of social science doctoral researchers.

The initial findings suggest that there is a link between the primary motivations of doctoral researchers to do a PhD degree and their views on employability and future career aspirations. The majority of students interviewed expressed an intention to pursue a career in academia upon graduation. This largely determines their understanding of their employability skills and the expectations of employers. For example, when asked what are the 3 things that PhD students need to do to be employable upon graduation, the activities cited most frequently by respondents were 'publishing research papers' and 'teaching'.

The views of participants related to requirements of the employers were also largely determined by their pursuit of an academic career. Another important finding relates to the PhD candidates' perceptions of their learning and how they develop employability skills. The majority of researchers acknowledged the important role of everyday tasks they are involved in, and stated that they develop various skills by engagement in these tasks. Only few researchers mentioned that they develop these skills by attending the skills workshops provided by the university. These perceptions are closely related to the concept of situated learning where learning is acquired in the context of its application (Lave & Wenger 1991). However, one of the biggest challenges of situated learning is its transferability to other contexts. This poses further questions for development of skills of doctoral researchers that can be transferred to different contexts (Greeno et al 1996). These findings potentially may also have some implications for a wider agenda of employability skills development of researchers and the impact of the skills training.

The study contributes to the body of knowledge on development of employability skills of doctoral researchers in social sciences. It also provides the ground for further exploration of the perceptions of PhD candidates on the skills development during candidature.

PAPER PRESENTATION

An early-stage Personal Development & Planning course to engender effective self-management in PhD s

Sofie Kobayashi, University of Copenhagen, Denmark; Sine Grumloese, Roskilde University, Denmark; Brian Grout, University of Copenhagen, Denmark; Camilla Osterberg Rump, University of Copenhagen, Denmark

This study seeks to examine the lasting benefits of an induction course developed to support new postgraduate students in becoming 'self organising agents' and managers of their own personal and professional development. A cohort of course participants were interviewed 18 months after they participated in the course, and the study shows that 50% of respondents continue to use tools and methods provided at the induction course, and that the course had supported them significantly to take charge and manage their own learning environment. This paper describes the rationale behind the course design based on a theoretical grounding in situated learning in communities of practice, and concludes with suggesting seven essential elements of the course: Self perception, Meeting PhD students as whole persons, Personal Development Planning – working with them, Intercultural, Safe haven - 5 days off campus residential, Inclusiveness – sense of belonging, Managing relationship with and reducing distance to supervisors. The study confirms that viewing research education in terms of situated learning, using a pedagogy which mobilizes the resources of the research (learning) environment, can support the development of PhD students to become self organising agents and enable them to take up opportunities available in their environment.

Introduction

The Faculty of Life Sciences at the University of Copenhagen (LIFE) has experienced a dramatic increase in PhD students over the last 10 years, and with this follows the challenges of increased diversity among PhD candidates. This calls on new pedagogies for educating researchers, and we set out to design an induction course based on own and reported experiences: Phillips and Pugh (1994) advise PhD students that supervision and research should be 'under your own management' (p. 2). Grant and Graham (1999) attempt to empower PhD students by introducing strategies for more effective self management, including learning journals, project planning, time management and goal setting. Cryer (1998) has developed guidelines for developing 'transferable skills'. The Quality Assurance Agency (QAA, www.qaa.ac.uk) in the UK provides guidelines for personal development planning (PDP). Boud and Lee (2005) challenge the prevailing institutional approach to supervisor training and provision of rich research environments, and advocate for new pedagogies in research education to enable students to take up opportunities that are available, as self-organising agents in a broader learning environment. Especially Boud and Lee's work inspired our design of the course, which aims at supporting new PhD students in becoming 'self-organising agents'. We designed an optional, 5-day residential Introduction Course at LIFE in 2007. Two courses were held in 2007 and growing interest has resulted in five courses in 2010 with an ongoing waiting list. However, despite very positive evaluations little is known about its lasting effects. We did not know if the students went on to use what they learnt on the course during the remainder of their study, and we did not know if they retained the feelings of ownership and empowerment that we hoped for.

Aims

The aims of this qualitative study is to identify lasting benefits of our induction course to enable us to make general recommendations for induction courses in higher education, and to develop our course further. Methods Twelve PhD students who participated in an Introduction Course in 2008 took part in qualitative research interviews conducted according to an interview guide with a clear purpose and structure controlled by the interviewer as described by Kvale and Brinkmann (2009). There is a continuous condensation of meaning during the interview, and this condensation continues in analyzing the material. To gather information about the respondents' professional lives, the interviewer asked questions in three areas: Had they used, and did they still use, any of the personal management tools and strategies introduced at the course? Did they view themselves as having a significant level of influence over their PhD process, and had any feeling of empowerment that the course provided been sustained? Did they regard themselves as people with a high level of self-management control in their professional lives?

Findings

According to the respondents the elements of the course with most impact were: understanding how to construct and use a Personal Development Plan meeting other PhD students to share cultural diversity and build networks being met in an acknowledging way A number of the participants recognised the PDP as part of the empowering process and talked of it as providing tools to help structure the PhD process. I still use it, I think it is a good way to think about the process. (...) in the PDP you write more about your skills and also other things, which are not related to your PhD so therefore I think that it is a good way to keep it to write on, that there are some professional things and theories I need to know about. (...) I update my PDP every six months and I have added new points (Man 1) Respondents acknowledged the importance of being recognised as more than "just a PhD student" and, potentially, as a 'researcher in charge', and saw it as a part of their empowerment. These guys are lecturers and they supervise PhD students so if they know that I am not just a PhD student but that I am a person then it actually makes it better for you as a student. This guy knows that I am a person! It is good that he knows that I am a person then I also see myself as a person. (Woman 1) The study gives evidence of the value of using the PDP tools particularly in the beginning of the PhD study. The participants all completed a PDP, which was discussed with their supervisor. Two years later half of the PhD students still use this tool and describe it as a part of their ability to be in charge.

Conclusions

The qualitative study clearly shows that our introduction course does exactly what Boud and Lee (2005) suggest: We enable PhD students to take charge and make use of the learning opportunities available in the broader research environment. Our course is different from what is offered most other places in the ways we meet and work with PhD students, their self perception and their collaboration with supervisors. The very high level of lasting benefits from the course proves that our approach is right.

References

- Boud, D. and Lee, A. (2005) 'Peer learning' as pedagogic discourse for research education. *Studies in Higher Education* 30: 501-16.
- Cryer, P. (1998) Transferable skills, Marketability and lifelong learning: the particular case of postgraduate research students. *Studies in Higher Education*, 23: 2, 207-216.

- Grant, B. and Graham, A. (1999) Naming the game: reconstructing graduate supervision. *Teaching in Higher Education*, 4: 1, 77-89.
- Kvale, S. and S. Brinkmann (2009) *InterViews. Learning the craft of qualitative research interviewing*. Sage Publications, pp. 354.
- Phillips, E. M. and Pugh, D. S. (2000) *How to get a PhD*. Open University Press, UK.

PAPER PRESENTATION

Effective Teaching and Learning in Higher Education

Sabine Hoidn, Harvard University, Switzerland

This paper provides an overview of three major strands concerned with the effectiveness of teaching and learning in higher education. The paper is based on an extensive literature review and brings research findings from (1) process-outcome research, (2) information-processing concepts of teaching effectiveness and (3) constructivist instruction and the creation of effective learning environments together. Reviewing the literature it might be useful to synthesize and align the research from these different strands to apply an increasingly holistic perspective. Based on the evidence found in research studies and meta-analyses in each strand implications for effective learning and teaching in higher education will be outlined.

This paper provides an overview of the effectiveness of teaching and learning in higher education. It is based on a literature review and brings research findings from the following three strands together to draw implications from these findings for higher education.

(1) Process-outcome research

In the 1970s studies on instructional or teacher effectiveness became influential and researchers tried to determine important factors to improve teacher effectiveness. Process-outcome research helps to understand what effective teaching is, why it is effective, and how it impacts student learning and development. The process-outcome definition of effective teaching is concerned with the link between process and outcome – between what teachers do and whether and how students change as a result. In this paper I will introduce Marsh's (1987; Marsh & Dunkin, 1997) nine, Feldman's (1989, 1997) twenty-eight and Abrami, d'Apollonia and Rosenfield's (2007) four factors/dimensions on teaching effectiveness as well as Murray's (1997, 2007) low-inference teaching behaviors to outline the state-of-the-art in research on instructional effectiveness based on process-outcome research.

The review indicates that the following three dimensions emerge consistently as strong predictors of diverse instructional outcomes: Enthusiasm/Expressiveness, Clarity of Explanation and Rapport/Interaction. However, additional theoretical thinking is necessary to learn more about cognitive processes of students as well as about effective teaching processes. An increasing emphasis on student-centred learning in higher education has made traditional forms of student ratings based on lecture-style courses and lower-level educational objectives questionable to judging teaching effectiveness.

(2) Information-processing concepts of teaching effectiveness

In the course of the cognitive revolution the focus began to shift to instructional activities that support cognitive processes involved in knowledge building. The teacher makes decisions and judgments on basis of a multitude of variables and it is assumed that good teaching leads to student learning. For example, the teacher plans the lessons taking students' background such as motivation and prior knowledge into account and adjusts his teaching strategies accordingly. Research suggests connections between effective instructional dimensions and cognitive information-processing concepts (Mayer, 1987; Murray, 1997, pp. 181-183): Enthusiasm factors can serve to elicit and maintain student attention to material presented in class due to elements of spontaneity and stimulus variation. Attention is crucial for all information processing and research indicates that students are more likely to pay attention to teachers who exhibit expressive behaviors. Clarity factors facilitate meaningful encoding (e.g. structured outlines of the subject matter), connection to prior knowledge (e.g. through concrete examples) and storage in long-term memory in the course of information processing. Interaction factors encourage active student participation in the classroom and allow students to actively engage in all stages of information processing. From this point of view teaching is regarded as helping students to store information and knowledge in long-term memory.

Ramsden (2003) condensed research findings based on the cognitive tradition into six principles for effective instructors:

- (a) Interest and explanation (quality of explanation and stimulation of student interest)
- (b) Concern and respect for students and student learning (interest in and compassion and consideration for students)

- (c) Appropriate assessment and feedback (helpful comments on students' work, quality of feedback on students' progress, appropriate assessment tasks)
- (d) Clear goals and intellectual challenge (high academic expectations, clear structure focused on key concepts, provide interesting challenges)
- (e) Independence, control and engagement (student choice and control over learning and interest in the subject matter)
- (f) Learning from students (openness to change)

(3) Constructivist instruction and the creation of effective learning environments

Constructivist pedagogy is a way to help students learn so that they can construct knowledge and develop meaning and deep understanding based on their prior knowledge while interacting with their material, social and cultural environment (Richardson, 2003). However, so far there is a lack of a sense of effective constructivist teaching and this is in part due to the lack of a constructivist teaching theory. Thus, constructivist teaching often defines itself by what teachers should not do compared to the cognitive transmission model (e.g. "Do not tell!"), for example (Fenstermacher and Richardson, 2000). Constructivists suggest that learning does not only depend on cognitive processes but also on social interactions, participation in a community and other processes leading to a contemporary understanding of cognition as distributed and learning as essentially "contextualized". Hence, a change in knowledge stored in long-term memory as a result of learning is not enough (cognitive theory). The same was true for sole changes in visible behavior (behaviorist theory).

Research on constructivist teaching has largely focused on the description of the constructivist teacher who thinks, beliefs and acts in a way consistent with a constructivist philosophy rather than on effective teaching. Research has shifted from laboratory-based experiments towards real-life classroom situations. There are many case studies that describe exemplary constructivist teaching (often compared to traditional teaching); however, there is scarcely research that describes "effective" constructivist teaching, and the measurement of learning outcomes and factors that affect them is less developed (Fenstermacher & Richardson, 2000). Up to today, there is a lot of stimulating rhetoric for the constructivist position, but only a slim empirical research base supporting constructivist instruction (Tobias & Duffy, 2009). One exception is the extensive research base on problem-based learning, for example.

Overall, there is a vast literature on effective teaching and scholars from different research fields and strands work in this area – often without connecting and building upon each other's work. Reviewing the literature it might be useful to synthesize and align the research from different strands to apply an increasingly holistic perspective. Based on the evidence found in these three major research strands implications for effective learning and teaching in higher education will be outlined.

PAPER PRESENTATION

Pedagogical Models for Developing Work Life Skills in Higher Education

Paivi Tynjala, University of Jyväskylä, Finland; Seija Nykanen, University of Jyväskylä, Finland; Anne Virtanen, University of Jyväskylä, Finland

The purpose of the study is to identify pedagogical models for developing generic skills in academic education. Data were collected from six courses in three Finnish universities. Data included 1) group and individual interviews with teachers, educational developers, heads of departments and other staff members (altogether 10 interviews with 33 interviewees) 2) student questionnaires in three of the courses (N=163, n=123), and observations of two courses. Data analysis is based on the mixed methods approach. Three tentative models for organising the development of work life skills have been identified: 1) Specialist/Centralised Model, 2) Distributed and Integrated Expertise Model, and 3) Cultural Networked Model. In the Specialist/Centralised Model the connections between education and work are taken care of by specialists, while in the Distributed Model all teachers and staff are involved in developing collaborative networks with the outside world. Characteristics of the Cultural model are a holistic approach to competence development and the planning and coordination processes of the whole institution. The following characteristics were also identified: 1) Collegial and collaborative working culture 2) Instructional design based on theory, 3) Holistic planning 4) Integration of theoretical, practical and self-regulative knowledge, and 5) Positive atmosphere. Furthermore, all courses were based on long-span development. Students reported that in these courses they had learnt domain-specific skills, collaboration and communication skills, and situational sensitivity or working creatively and proactively in different situations.

Rapid changes in society pose urgent challenges to higher education. It is recognised that in addition to providing students with deep domain-specific academic knowledge, education must provide them with the skills to cope with continuous change and an uncertain future. As a consequence, higher education institutions have increasingly paid

attention to the development of skills that go beyond content knowledge and are often described as transferable skills, generic capabilities, generic skills, or key skills. It has also been noticed that although these skills seem to be transferable from one situation to another, they still have a domain specific character (e.g. Jones, 2008). Therefore it has been suggested that they should be developed as integrated into domain knowledge rather than taught in separate courses (e.g. Bowden et al., 2000).

The purpose of the present study is to identify pedagogical models for organizing higher learning in a way that academic goals and generic skills are given equal emphasis. In more detail, the following research question is addressed: what kind of pedagogical models higher education institutions have devised for developing the kind of skills and competencies needed in the world of work? Theoretically, identifying promising pedagogical practices is based on the idea of integrative components of the development of professional expertise (Tynjälä, 2008), the model of learning by developing (Raj 2007) and the notion of constructive learning environments (e.g. Biggs 2003; Tynjälä, 1999; Tynjälä et al. 2009).

Data were collected from six courses in three Finnish universities (one of which is a university of applied sciences). Three of the programs were selected on the basis of student questionnaire where students were asked to name a study module which, in their experience, had best developed their generic skills and increased their knowledge about the world of work. Other three were selected on the basis of previous studies on work-related learning in higher education (e.g. Vyakarnamet.al. 2008; Tynjälä et al., 2009). Data included 1) group interviews and individual interviews with teachers, educational developers, heads of departments and other staff members (altogether 10 interviews with 33 interviewees) 2) student questionnaires in three of the courses (N=163, n=123), and observations of two courses. Themes of the interviews were: 1) skills needed to perform successfully in the world of work 2) activities of the educational organization to develop work life skills; 3) networking within the educational organization and with the world of work 4) guidance and 5) evaluation and development. The questionnaires included questions about students' perceptions of their learning environments and learning experiences. The observations were carried out using a coding scheme that focussed on the features of constructive learning environments (e.g. Biggs 2003; Tynjälä et al., 2009) and a model of integrative pedagogy (Tynjälä, 2008).

Data analysis is based on the mixed methods approach. Questionnaire data and quantitative observational data are being analysed with quantitative methods, while the interview data and qualitative observation data is being analysed by qualitative content analysis adopting abductive approach. Thus, data-driven and theory-driven analyses interact in the analysis.

So far, our analyses have produced the following preliminary findings. Three tentative models for organising the development of work life skills have been identified: 1) Specialist/Centralised Model, 2) Distributed and Integrated Expertise Model, and 3) Cultural Networked Model. In the Specialist/Centralised Model the connections between education and work are taken care of by specialists, while in the Distributed Model all teachers and staff are involved in developing collaborative networks with the outside world. Characteristics of the Cultural model are a holistic approach to competence development and the planning and coordination processes of the whole institution. The following characteristics were also identified in courses that were successful – as assessed by students - in developing generic skills: 1) Collegial and collaborative working culture 2) Instructional design based on theory, 3) Holistic planning 4) Integration of theoretical, practical and self-regulative knowledge, and 5) Positive atmosphere.

Furthermore, all courses were based on long-span development. The teachers were in close interaction with the world of work. Therefore, it was flexible for them to work in the interface of theory and practice. Students reported that in these courses they had learnt domain-specific skills, collaboration and communication skills, and situational sensitivity or working creatively and proactively in different situations. Thus, the learning outcomes differed from those of more traditional university courses in which skills of knowledge acquisition and working independently have been reported as most important outcomes (e.g. Virtanen & Tynjälä, 2010). Final results will include theoretical models of 1) the development of work life skills, 2) networking and 3) leadership and management of educational institutions in developing students' work skills (cf, Nykänen 2010).

References

- Bowden, J. Hart, G., King., B. Trigwell, K. & Watss. O. (2000). Generic Capabilities of ATN University Graduates. <http://www.clt.uts.edu.au/TheProject.htm>
- Biggs, J.B. (2003). Teaching for quality learning at university. Buckingham: Open University Press/Society for Research into Higher Education. (Second edition)
- Jones, A. (2008). Generic attributes as espoused theory: the importance of contexts. *Higher Education* 58, 175-191.

Nykänen, S. 2010. Leadership and management in guidance and counseling networks: conceptions of actors - Moving towards leadership and management in networks? University of Jyväskylä. Institute for Educational Research. Research Reports 25. (In Finnish with English summary).

Raj, K. 2006. Learning by Developing. Laurea publications A 58. Laurea University of Applied Sciences: Vantaa.

Tynjälä, P. (2008). Perspectives into Learning at the Workplace. Educational Research Review 3, 130-154.

Tynjälä, P., Pirhonen, M. Vartiainen, T. & Helle, L. (2009). Educating IT project managers – How to meet working life requirements. Communications of the Association for Information Systems 24 (Article 16), 270-288. <http://aisel.aisnet.org/cais/>

Virtanen, A., & Tynjälä, P. (2010, August). Students' experiences of learning generic skills in university studies. Paper presented at the European Conference on Educational Research (ECER), Helsinki, Finland.

Vyakarnam S., Illes, K., Kolmos, A. & Madritsch, T. (2008). Making a difference. A Report on Learning by Developing – Innovation in Higher Education at Laurea University of Applied Sciences. Laurea publications B 26. Laurea University of Applied Sciences: Vantaa.

PAPER PRESENTATION

Evaluation of an Entrepreneurship Education Course for Students

Karin Heinrichs, Goethe-University in Frankfurt, Germany

In line with other entrepreneurship education courses the so called 5-Euro-Business-Competition intends to foster entrepreneurial intentions and to offer students various opportunities to gain experience in creating and realizing an entrepreneurial opportunity. Therefore this program represents a modern Entrepreneurship Education: Students are not only taught about entrepreneurship. They learn how to deal with real problems in forming and running a new venture and are coached how to solve real problems.

This paper presents an evaluation study of this voluntary 5-Euro-Business-Course. On the one hand the study assessed the selection effect of this voluntary course. On the other hand we asked whether the treatment really had a positive effect on fostering entrepreneurial intentions as expected. So we tested whether the participants of the course gained more in entrepreneurial intention than the control group and had a higher increase in the predictors of forming an entrepreneurial intention. In order to answer these questions we conducted a quasi-experimental study with pre- and posttest. The results show remarkable effects.

Beyond that effects on strengthening entrepreneurial intentions we think that this program may also foster growth in personal determinants of entrepreneurial success in the post-formation phase (e.g. experience-based knowledge in coping with critical incidents or self-regulation strategies), which is planned to be investigated during the next term evaluation.

Theoretical framework and aims of the study:

Today more and more modern Entrepreneurship Education concepts do not only teach about entrepreneurship. They change to a more active way of learning and provide students opportunities to develop context-specific knowledge, entrepreneurial skills, attributes and behavior. They foster competencies to recognize entrepreneurial opportunities as well as to solve problems which are quintessentially for the phase of forming a new venture (Kickul & Fayolle, 2007, p. 2; Kirby, 2007, p. 21-24). They offer the participants the chance to gain experience in authentic situations and to reflect this experience.

The 5-Euro-Business-Competition, which has been conducted at different German Universities for 10 years, can be considered as such a modern learning concept. During this voluntary course students of various faculties are coached in forming a new venture within only one term. The participants got the chance to increase be coached in performing a start-up process (BBW & Hochsprung, 2010). The organizers presume that this course will help to encourage the participants to form entrepreneurial intentions. Referring to the Planned-Behavior-Theory therefore it would be important to foster positive attitudes (attractiveness) towards entrepreneurship as well as to develop perceived behavior control (as an aspect of feasibility, e.g. context-specific self-efficacy and entrepreneurial knowledge (Krueger & Casrud, 1993). The question is if these objectives can be reached during only one term and if they, can they be achieved by engaging in the 5-Euro-Business-Competition.

On the one hand we know from previous research that entrepreneurial intentions really can be developed in student programs, especially in courses fostering active and experience-based learning (Walter & Walter, 2008, p. 562). On the other hand we know from an evaluation of a compulsory course that particularly these students stand to benefit from entrepreneurship education who have already started at a high level of entrepreneurial intention. However, those

participants who started at a low level of entrepreneurial intention, tended to decrease in their motivation to form a new venture (Graevenitz, von, Harhoff & Weber, 2010).

But what are the effects of this Entrepreneurship course "5-Euro-Business" due to entrepreneurial intentions? The effects of this competition were evaluated in the presented study.

Research Questions:

1. Is the competition more attractive to persons with high or with low entrepreneurial intentions and perceived behavior control? (Effect of Participant Selection)
2. Do the participants show an increase in the entrepreneurial intention and in perceived behavior control more than the control group does?

Methodology

Design and Sample:

We chose a quasi-experimental design with

- (a) an experimental group (participants of the Entrepreneurship Competition in summer 2010 and a control group (students of different faculties of the University of Frankfurt) and
- (b) a pretest as well as a post test. So we contrasted students having attended Entrepreneurship Education course and those having not.

Instruments:

The relevant personal determinants we measured by common tests:

- a. Entrepreneurial intention (Davis, 2002),
- b. Entrepreneurial self-efficacy (de Noble, 1999),
- c. Entrepreneurial prior knowledge (Shane, 2000).

In addition we gathered some basic demographic data like gender, age or field of study.

Results

1. The participants of the competition differ in the pretest from those of the control group in entrepreneur-specific personal determinants significantly in entrepreneurial intentions (high effect: $d=0,8$), domain-specific self-efficacy (middle-sized effect: $d=0,59$) and prior knowledge (small effect: $d=0,29$). The program is apparently more attractive to students who already think entrepreneurship to be attractive and feasible.
2. The participants of the competition differ in their growth of entrepreneur-specific personal determinants compared to the control group significantly. They seem to benefit from the course in the intended way: prior knowledge in entrepreneurship ($p=0,001$; high effect: $d=0,85$), entrepreneurial self-efficacy ((tendency: $p=0,007$; small effect: $d=0,36$).

Theoretical and Educational Significance

The results confirm that entrepreneurship courses can foster personal determinants which are relevant for forming an entrepreneurial intention even if the treatment lasts only 2-3 months. We actually found powerful effects. However, the evaluation is restricted to determinants which are supposed to explain the way to form such an intention. It would firstly be very helpful to get information about the sustainability of the increased intentions. Secondly we plan to assess learning outputs which are crucial particularly for solving entrepreneurs' problems not on the way to form an entrepreneurial intention, but to cope with the problems in the post-formation phase: the ability to assess and solve critical incidents which may emerge during the first years.

References

- BBW (Bildungswerk der Bayerischen Wirtschaft) & Hochsprung (2010). 5-Euro-Business. Ein Praxis-Wettbewerb für Studierende zum Thema Existenzgründung. Gefunden am 25.10.2010 unter: <http://www.5-euro-business.de>
- Davis, L.E., Ajzen, I., Saunders, J. & Williams, T. (2002): The Decision of African American Students to Complete High School: An Application of the Theory of Planned Behavior, *Journal of Educational Psychology*, vol. 94, no. 4, pp. 810-819.
- De Noble, A. F., Jung, D. & Ehrlich, S. B. (1999). Entrepreneurial self-efficacy: The Development of a measure and its relationship to entrepreneurial action. In R. D. Reynolds, W. D. Bygrave, S. Manigart, C. M. Mason, G. D. Meyer, H. J. Sapienza et al. (Eds.), *Frontiers of entrepreneurship research* (pp. 73-87). Waltham, MA: P&R Publications Inc.
- Graevenitz, G., Harhoff, D. & Weber, R. (2010) The effects of entrepreneurship education, *Journal of Economic Behavior & Organization*, Volume 76, Issue 1, October 2010, pp. 90-112, Special Issue: Experimental Methods in Entrepreneurship Research.

Kirby, D. (2007) Changing the entrepreneurship education paradigm (pp. 21-46). In: A. Fayolle (Ed.) (2007) Handbook of research in entrepreneurship education, Volume 1, Bodmin Cornwall: MPG Books Ltd.

Kickul, J. & Fayolle, A. (2007) Cornerstones of change: revisiting and challenging new perspectives on research in entrepreneurship education (pp. 1-10). In: A. Fayolle (Ed.) (2007) Handbook of research in entrepreneurship education, Volume 1, Bodmin Cornwall: MPG Books Ltd.

Krueger, N.F. & Carsrud, A.L. (1993). Entrepreneurial intentions: Applying the theory of planned behaviour, *Entrepreneurship & Regional Development*, 5:4, 315-330.

Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities, *Organization Science*. 11 (4), 448-469.

Walter S. G. & Walter, A. (2008). Deutsche Universitäten als Gründungsinubatoren: Der Beitrag der Gründungsausbildung zur Gründungstention von Studierenden, *Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung*, Volume 60, September 2008, p. 542-56.

PAPER PRESENTATION

Students' approaches to learning in six different Bachelor study modules

Liisa Postareff, University of Helsinki, Finland; Telle Hailikari, Faculty of Behavioural Sciences, Dept of Education, Finland; Sari Lindblom-Ylänne, University of Helsinki, Finland

Research focusing on changes in approaches to learning of individual students in different study modules is missing, while approaches to learning at group level have been studied more often. The present study aims to analyse the changes and differences in approaches to learning described by students at the beginning and at the end of Bachelor level study modules in two different disciplines. Specifically, the aim is to analyse how individual students describe change in their approaches to learning in one or more study modules. The results showed at group level, that in two of the six study modules, there was a statistically significant change in the deep approach scale, while in three study modules there was a statistically significant change in the surface approach scale. In five study modules, the change in the organized studying approach scale was statistically significant. Preliminary results imply, however, that there are differences in how individual students describe change in approaches to learning within one study module and between different study modules. More fine grained analysis of individual change in learning approaches will be conducted to identify different types of combinations of changes in approaches to learning. The results deepen our understanding of the stability or changeability of approaches to learning of individual students and are useful in developing university teaching and learning environments.

Introduction

The studies concerning the context specificity of approaches to learning have had contradictory results. According to Liez and Matthews (2010) science students' approaches to learning are relatively stable whilst Rodrigues and Cano (2007) found approaches to learning to be changeable. In addition, studies concerning the context-specificity of approaches to learning in different study modules have been scarce. Furthermore, studies indicate that some students tend to change their approaches to learning more easily during their studies while other students approaches to learning are more stable (Lindblom-Ylänne, 1999). The aim of the study is to analyse the differences in approaches to learning described by students at the beginning and at the end of Bachelor level study modules. Specifically, the aim is to analyse how individual students describe change in their approaches to teaching within one study module and between different study modules.

Method

A total of 293 bachelor students participated in the study. Of these, 199 students participated in one, two or three Bachelor level (mainly second year) study modules at the faculty of Biological and Environmental sciences, and 94 students participated in one, two or three study modules at the faculty of Behavioural Sciences, University of Helsinki. All the study modules, except for one, were lecture type modules, the number of students varying from around 40 to 100. One study module was a different type of course, in which the students had a very active role in regulating their own studying. At the beginning of the study module the students filled in a short version of the Approaches to Learning and Studying Inventory (ALSI), including 16 items in which students were asked to describe how they usually study during a course unit or module (Entwistle & McCune, 2004). At the end of the study module the students filled in the ALSI again, but they were instructed to describe how they have studied during that particular study module. In addition, the students filled in an 21-item version of the Experiences of Teaching and Learning Questionnaire (ETLQ; Entwistle, McCune & Hounsell, 2002) modified to the Finnish context. The students were asked to respond to the items using the 5-point Likert scale (1=agree to 5=disagree).

Analysis and results

Factor analyses using Maximum Likelihood extraction with Varimax rotation were carried out. The items describing approaches to learning constituted a three factor solution: Organised studying, Deep approach and Surface approach. Based on this, sum scales of the three approaches were created. A paired samples t- test was used to analyse the significance of the change between the two measurements on students' approaches to learning. In two of the six study modules, there was a statistically significant change in the deep approach scale, while in three study modules there was a statistically significant change in the surface approach scale. In five study modules, the change in the organized studying approach scale was statistically significant. The shift in the three approaches to learning from the typical approach students usually apply, described at the beginning of the study module, to the course-specific approach, described at the end of the study module, was further analysed by computing 'change variables' for each approach. This was done by subtracting the students' approach scale scores when they were describing their typical approaches at the beginning of the study module from the scores when describing the course specific approaches. The students' change scores on the three approaches from the usual approaches to the course specific approaches varied. The change in the deep approach scores varied from -1.38 to 1.50, for the surface approach from -2.5 to 2.00 and for organized studying from 1.00 to 2.75 on the 1–5 point scale. Negative values indicate that the scores of the approaches were higher at the beginning of the study module than at the end of the study module. Conversely, positive scores indicate that the scores of the approaches were lower at the beginning of the study module than at the end.

There was variation between the study modules in the change variables on the deep and surface approach scales. Two of the three study modules at both faculties resulted a positive change, i.e. a decrease in the deep approach scale and a negative change, i.e. an increase in the surface approach scale. On the contrary, one study module at both faculties resulted a negative change, i.e. an increase in the deep approach and a positive change, i.e. a decrease in the surface approach scale. All six study modules resulted a decrease in the organized studying approach scale. Preliminary results imply that individual students describe changes in different approaches within the study modules they have participated in very different ways. Some students describe an increase in both deep and surface approaches, while others describe changes in opposite directions. In addition, some students do not describe changes at all, or describe changes only within one approach. Furthermore, some students describe similar changes in approaches in all study modules they have participated, while others describe different types of changes between different study modules. More fine grained analysis will be applied in investigating changes of individual students. Students' experiences of their teaching and learning environment will be analysed to find out how they are related to possible changes in approaches to learning.

Theoretical and educational significance

The results deepen the understanding of the stability or changeability of approaches to learning. Specifically, research focusing on changes in learning approaches of an individual student in different study modules is missing, while approaches to learning at group level have been studied more often. The results help to identify direction and magnitude of changes within individual students in approaches to learning and help to recognise different types of learners. In addition, the effect of the teaching-learning environment on approaches to learning in different study modules help to identify which specific factors in the environment have an effect on how students study and learn. The results are valuable in developing university teaching and learning environments and in helping different types of learners to cope with their university studies.

PAPER PRESENTATION

The Effects of Autonomous Learning on Cognitive Load and Learning Results

Chantal Gorissen, Open University of the Netherlands, Netherlands; Liesbeth Kester, Open University of the Netherlands, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Rob Martens, Open University, Netherlands

This study concerns the effect of autonomy when studying learning material on students' motivation, perceived mental effort and learning results, taken into account students' prior domain knowledge, learning ability and attitude towards learning. The study is situated in the area of instruction design. Research about cognitive load has shown noteworthy implications for instructional design. However, how to foster the active use of available cognitive load through instructional design is still debated. Motivation may be considered an important aspect. Consulting Self-Determination Theory, fostering motivation through instruction design would mean more learner autonomy. A total of 95 grade 5 students studied material about volcano's and earthquakes. The setup was a between subjects design with three conditions. In the first condition (fixed procedure) students worked their way through the study material in a predetermined way. In the second condition (learner control) the students had to choose their own study material from a database, no structure was provided. In the last condition (autonomy) the students got control over the type of control for each task, by being able to choose their own study materials (condition two), follow the structured learning

path (condition one), or creating a mix of the two. The data has been collected, the analysis is still in progress, but are expected to be final by the end of this year.

Introduction

Research in the area of the Cognitive Load Theory (CLT) (Sweller, 2003; Van Merriënboer & Sweller, 2005) has, in the past, mainly focussed on reducing extraneous load on working memory. How to stimulate germane load, the load on working memory from processes that contributes to learning, is still debated. One way of stimulating germane load is thought the improvement of motivation (Paas, Tuovinen, Van Merriënboer & Darabi, 2005). Paas and Van Merriënboer (1994a), already concluded that the design of instruction to optimize cognitive load on working memory, is only useful when the learner is willing to invest the mental effort that is required. We introduce the motivation perspective of Self-Determination Theory (SDT), which focuses on control and self-directedness of the learner, as this plays a major role in hypermedia learning environments. From the SDT-perspective, adding autonomy to a learning environment seems the most appropriate way to improve motivation through instruction (Katz & Assor, 2007; Ryan & Deci, 2006). This means that the learner has a certain amount of control. Research on learner control has shown that control can have positive effects on motivation (Corbalan, Kester & Van Merriënboer, 2009). However, there are many inconsistent results and according to Skinner (1996) there is little consensus about what types of control are beneficial or harmful for motivation and learning, and how learner control interacts with certain learner and situational characteristics. Autonomy and learner control differ on the level on which the learners receive control. Autonomy provides control on a higher level compared to learner control. In an autonomy supportive environment, learners also control the type of control for a learning task, and can therefore choose not to choose. Autonomy supportive environments enable learners to obtain or maintain an autonomous type of motivation. Which, according to SDT, causes more deep-level learning strategies (Grolnick & Ryan, 1987; Vansteenkiste, Lens, & Deci, 2006), leading to more in-depth understanding in contrast to memorized facts, and more curiosity and explorative behavior (Martens, Gulikers & Bastiaens, 2004). The aim of this study is to examine the effect of autonomy when studying learning material on students' motivation, perceived mental effort and learning results, while taken into account students' prior domain knowledge, learning ability and attitude towards learning.

Method

Participants A total of 95 grade 5 students (49 male, mean age 10.72) participated in this study. The experiment was setup as a project and took place in the regular school environment of the participants. **Set-up** The set-up of this study is a quasi experimental between subjects pre-test post-test control group design, with three conditions. All students were presented with the same short essay questions on volcano's and earthquakes, which they had to answer using video material. The conditions differed in the type of control students had when working their way through the material. In the first condition (fixed procedure) students worked in a predetermined way. In the second condition (learner control) the students had to choose their own study material from a database, no structure was provided. In the last condition (autonomy) the students got control over the type of control for each task, by being able to choose their own study materials (condition two), follow the structured learning path (condition one), or creating a mix of the two. Participants worked 4-8 hours individually with a digital hypermedia learning environment on a computer. Before working with the tasks the participants prior knowledge and general regulation style was measured. After each essay question the participants rated their cognitive load and enjoyed of the task. Afterwards, the students' learning results were measured twice, by two different types of tests (one to measure factual knowledge and one to measure in-depth understanding), once immediately following the tasks and again after 3 months. Following the learning result measures the type of motivation the students had for the tasks was measured, together with the satisfaction of their basic psychological needs scale (as proposed by SDT). Learning ability of the participants was indicated by the CITO (Central Institute for Test Development)-scores from each student, provided by the school. Log files recorded which video's were watched per task, as well as time per task.

Results/ Discussion

The collecting of the data was completed on the 25th of October 2010. The data analysis is still in progress, but are expected to be final by the end of this year.

References

- Corbalan, G., Kester, L., & Van Merriënboer, J. (2009). Combining shared control with variability over surface features: Effects on transfer test performance and task involvement. *Computers in Human Behavior*, 25, 290- 298.
- Grolnick, W. S. & Ryan, R. M. (1987). Autonomy in children's learning: An Experimental and individual difference investigation. *Journal of Personality and Social Psychology*, 52, 890-898.
- Katz, K., Asor, A. (2007) When Choice Motivates and When It Does Not. *Educational Psychology Review*, 19, 429–442.
- Martens, R.L., Gulikers, J., & Bastiaens, T. (2004). The impact of intrinsic motivation on e-learning in authentic computer tasks. *Journal of Computer Assisted learning*, 20. 368- 376.

- Paas, F., Tuovinen, J.E., Van Merriënboer, J. J. G., & Darabi, A. A. (2005). A motivational perspective on the relation between mental effort and performance: Optimizing learner involvement in instruction. *Educational Technology, Research & Development*, 53, 25-33.
- Paas, F. & Van Merriënboer, J. J. G. (1994a). Variability of worked examples and transfer of geometrical problem solving skills: A cognitive-load approach. *Journal of Educational Psychology*, 86, 122–133.
- Ryan, R. M., & Deci, E. L. (2006). Self-Regulation and the Problem of Human Autonomy: Does Psychology Need Choice, Self-Determination, and Will? *Journal of Personality*, 74, 1557-1586.
- Skinner, E.A. (1996). A Guide to Constructs of Control. *Journal of Personality and Social Psychology*, 71, 549- 570.
- Sweller, J. (2003). Evolution of human cognitive architecture. In B. Boss (Ed.), *The psychology of learning and motivation* (vol. 43, pp. 215-266). San Diego: Academic press.
- Van Merriënboer, J. & Sweller, J. (2005). Cognitive Load Theory and Complex Learning: Recent Developments and Future Directions. *Educational Psychology Review*, 17, 147-177.
- Vansteenkiste, M., Lens, W. & Deci, E. L. (2006). Intrinsic versus extrinsic goal-contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist*, 41, 19-31.

PAPER PRESENTATION

A long and winding road – on requirement of a critical approach in self-regulated work

Anders Eklof, Kristianstad University, Sweden

Assessed, independent, creative and connected. The demands on students doing assessed self-regulated work are extensive. They are supposed to produce texts that require them to master a variety of competences. The capacity to exercise source criticism and the ability to think critically is considered to be substantial competences in these modes of work.

In this article we examine how secondary schools students relate to demands concerning criticism of sources and critical thinking. The students are studied in situations where teachers and tutors are not physically present. Drawing on Goffman's frame analysis and socio-cultural risk theory we discuss how different apprehensions on "what's going on" correlates with estimations on potential dangers connected with choices that has to be made. Different laminations of frameworks are put in play which can be related to an overall notion of an opaque and ubiquitous regime of assessment. In looking at dilemma situations, analysing different ways of framing, we will try to illuminate and understand obstacles students experience connected with demands for source criticism and critical thinking in self-regulated work. If the students' handling of demands placed upon them in some ways can be questioned in relation to a critical approach, we claim that what can be seen also can be described as a rational adaptation to a different framing on what school and education really are about.

The empirical material has been drawn from video recorded sessions where students are participating in collaborative writing. Our data consists of 60 hours of video filmed interaction collected over a three year period. The filmed interactions were then merged with films of screen activity and analyzed in Transana.

Assessed, independent, creative and connected. The demands on students doing assessed self-regulated work are extensive. They are supposed to produce texts that require them to master a variety of competences such as genre knowledge, different writing skills, ability to value and to make use of a number of institutional resources. Especially the capacity to exercise criticism of sources and think critically is considered to be substantial competences in self-regulated work.

The strive towards more individual work and the potential challenges this entails for education are discussed among others by Carlgren (2000, 2006) and Eriksson (2009). Granstrom (2003) shows that individual based teaching methods, in Sweden, have increased from 22% in the 1960s to 41% in the 2000s, while whole class teaching during the same period has decreased from 60 – 44%. Carlgren (2006) sets the amount of individual work as high as 50 % in 2003. This tendency towards a more individualized organization of teaching space coincides with a more general trend in late modern society requiring each individual to design and govern his/her own life (c.f. Bauman, 2000, 2002; Giddens, 1990, 1991). The increase of self-regulated work and the need to develop competences to find, evaluate and use different sources can also be seen in the light of how resources are used in "everyday life research" which might affect the educational outcome. Skills and competences developed in everyday settings can collide with skills and competences aspired in more formal educational settings. There are indications that students find searching and evaluation more difficult in educational settings than in "everyday life research" (Head & Eisenberg, 2009). Different forms of online activity and potential educational implications of increased peer collaboration are discussed among others by Mizuko (2008). New forms of authority emerges from the life on the net, something that has to be

considered in relation to the demand for criticism of sources and critical thinking connected with different forms of self regulated work.

The concept of critical thinking has been of major concern in educational science at least since the sixties when Ennis (1962) first published "A concept of critical thinking". In the light of the growth of self-regulated work and the special emphasis that is placed on critical aspects, there is a need for investigating how individualization, self-regulation and the impact of non-institutional learning strategies influence students work with source criticism and critical thinking in assessed situations.

In this article we examine how secondary schools students relate to demands concerning criticism of sources and critical thinking. The students are studied in situations where teachers and tutors are not physically present. Drawing on Goffman's (1974) frame analysis and socio-cultural risk theory (Lupton, 2000) we discuss how different apprehensions on "what's going on" correlates with estimations on potential dangers connected with choices that has to be made. We show how different laminations of frames interact and how these can be related to an overall notion of "doing being independent" and an opaque and ubiquitous regime of assessment. In looking at dilemma situations, analysing different ways of framing, we will try to illuminate and understand obstacles students experience connected with demands for source criticism and critical thinking in self-regulated work. If the students' handling of demands placed upon them sometimes are questioned in relation to a critical approach, we claim that what can be seen also can be described as a rational adaptation to a different framing on what school and education really are about. The empirical material has been drawn from video recorded sessions where students are participating in collaborative writing. Our data consists of 60 hours of video filmed interaction collected over a three year period. The filmed interactions were then merged with films of screen activity and analyzed in Transana.

References

- Bauman, Z. (2000). *Liquid modernity*: Polity.
- Bauman, Z. & Torhell, S.-E. (2002). *Det individualiserade samhället*. Goteborg: Daidalos.
- Carlgren, I. (2005). *Konsten att sätta sig själv i arbete*. Ingar i E. Osterlind (Red.) *Eget arbete-en kameleon i klassrummet: perspektiv på ett arbetssätt från förskola till gymnasium*. Lund: Studentlitteratur.
- Carlgren, I., Klette, K., Myrdal, S., Schnack, K. & Simola, H. (2006). Changes in Nordic Teaching Practices: From individualised teaching to the teaching of individuals. *Scandinavian Journal of Educational Research*, 50(3), 301-326.
- Ennis, R. (1962). A concept of critical thinking. *Harvard educational review*, 32(1), 32.
- Eriksson, I. (2009). Re-Interpreting Teaching: A Divided Task in Self-Regulated Teaching Practices. *Scandinavian Journal of Educational Research*, 53(1), 53-70.
- Giddens, A. (1990). *The consequences of modernity*. Cambridge: Polity in association with Blackwell.
- Goffman, E. & Berger, B. M. (1974). *Frame analysis: An essay on the organization of experience*.
- Granström, K. (2003). *Arbetsformer och dynamik i klassrummet*. I S. Selander (red.). *Kobran, nallen och majjen. Tradition och förnyelse i svensk skola och skolforskning*, 223-243.
- Head, A. & Eisenberg, M. (2009). *Finding context: What today's college students say about conducting research in the digital age*. Project Information Literacy Progress Report, 1-18.
- Lupton, D. (2000). *Risk and sociocultural theory : new directions and perspectives*. New York: Cambridge University Press.
- Mizuko, I., Horst, H. A., Bittanti, M., Boyd, D., Herr-Stephensson, B., Lange, P. G., et al. (2008). *Living and Learning with New Media: Summary of Findings from the Digital Youth Project*. Retrieved 20090113, from <http://digitalyouth.ischool.berkeley.edu/report>

PAPER PRESENTATION

Studying primary school children's self-regulated learning

Sabrina Vandeveld, Ghent University, Belgium; Hilde Van Keer, Ghent University, Belgium

Notwithstanding the fact that self-regulated learning (SRL) is an important educational goal and the call for promoting SRL early in students' school careers, only little research has been conducted on primary school children's SRL. This empirical lack is related to the current need for valid measures of SRL regarding this age group. In order to gain more insight in primary school children's SRL, the present study focuses on the development and validation of a comprehensive self-report questionnaire. Based on the conceptual framework of Pintrich (2004), the Children's Perception of Self-Regulated Learning (CP-SRL) questionnaire, consisting of 9 subcomponents, was developed. After constructing the items for each subcomponent, the items were reviewed by a teacher and expert panel. Further, cognitive interviews were conducted to establish cognitive validity. The 108-item questionnaire was presented to 504 fifth and 463 sixth graders. After exploratory factor analyses on each subcomponent, the factor structure of each subcomponent was confirmed by confirmatory factor analyses. Further, internal consistency was computed. The

results of these analyses indicate that the CP-SRL is an appropriate instrument for assessing SRL in late primary school children. As the instrument comprises several subcomponents, a differentiated view of children's SRL can be obtained. Therefore, the CP-SRL can be considered as a valuable tool to evaluate SRL interventions as well.

Relevance and objective

Self-regulated learners can be defined as metacognitively, motivationally, and strategically active participants in their own learning (Zimmerman, 1990). Research indicates that learners, who analyse task demands, set goals for their learning and then attempt to monitor and regulate their cognition, motivation, and behaviour experience more success in different learning situations (Zimmerman, 2002). Although self-regulated learning (SRL) is considered as an important educational goal (Boekaerts, 1999), research indicates that a large number of learners encounter difficulties regulating their learning efficiently and effectively (Perry, Phillips & Dowler, 2004; Zimmerman, 2002). Perry et al. (2004) highlight the importance of promoting SRL already in primary education. In order to foster SRL within this age group, it is however important to gain more insight into the self-regulatory processes primary school children engage in. Theoretical and empirical background Research reveals that primary school children are capable of acquiring self-regulatory skills (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Notwithstanding these findings and the call for promoting SRL early in students' school careers (Perry et al., 2004), only little research has been conducted on young children's SRL (Winne & Perry, 2000). This empirical lack is connected to the current need for valid measures of young children's SRL (Winne & Perry, 2000). In order to enable large-scale research on primary school children's SRL, a comprehensive self-report instrument is wanting. Unlike most existing assessment methods restricting SRL to learning or metacognitive strategies, the self-report should comprise the different components of SRL. In this respect, Pintrich (2004) has developed a conceptual framework to assess SRL. This framework contains four areas of regulation: cognition, motivation, behaviour, and context. Within each domain, there are four phases referring to goal setting and planning, monitoring, control and regulation, and reflection. In this way the framework reflects the phased structure of SRL processes and the multi-component character of SRL.

Research goals

The aim of the present study is to develop and validate a comprehensive self-report questionnaire to gain insight in primary school children's self-regulated learning in academic contexts.

Research method

Participants 504 fifth and 463 sixth graders from 43 Flemish (Belgium) primary schools participated. Instrument Based on the framework of Pintrich (2004), a self-report questionnaire was developed. Taken into account the current literature and the fact that primary school children are the target group, 9 subcomponents were selected (see Table 1). For each subcomponent items were constructed, resulting in a pool of 108 items. The items were reviewed by an expert panel to establish content validity and by a teacher panel to determine the suitability for primary education. Finally, cognitive interviews with fifth and sixth graders (N=15) were performed to assess the cognitive validity of the self-report items (Karabenick et al., 2007). Based on the panel finding and cognitive interviews, the items were refined. The items were scored on a 5-point Likert scale. Data Analysis First, exploratory factor analyses (EFA) (maximum likelihood with promax rotation) were carried out to investigate the underlying structure of the items of each subcomponent. In order to determine the number of factors to retain, parallel analysis was used. Second, confirmatory factor analyses (CFA) were conducted on each subcomponent examining the stability of the exploratory factor structure. Finally, internal consistency (Cronbach's α) was computed.

Results and discussion

Regarding 5 subcomponents, both the parallel analysis and EFA suggest a one-factor model. With regard to the subcomponents 'self-efficacy', 'learning strategies', and 'self-evaluation' the analyses show a two factor solution. In line with self-determination theory and based on the parallel analysis and EFA four factors were retained for the 'motivation' subcomponent. Table 1 presents the results of the CFA, reliability analyses, and descriptive statistics. The CFA's show a moderate to good fit and the internal consistency was satisfying. The results indicate that the Children's Perceptions of Self-Regulated Learning (CP-SRL) questionnaire can serve as a valuable tool to assess SRL in late primary school children. In this respect, the development of the CP-SRL is of theoretical and empirical importance, since instruments measuring children's SRL are scarce. As the questionnaire comprises several subcomponents, it allows teachers and researchers to obtain a differentiated view of children's self-regulatory abilities and to evaluate SRL interventions. Additionally, it provides possibilities to explore the interrelationships among the self-regulatory subcomponents, leading to further theory development and testing. As the literature points at the importance of a multi-method approach to measure SRL (van Hout-Wolters, 2009), a combination of the present CP-SRL with concurrent methods (e.g. think aloud measures and trace methodologies) is advisable. Therefore, our current research focuses on the coherence between the self-report questionnaire, a task-specific questionnaire, and a think-aloud

protocol. The results of this follow-up study will also be discussed and related to the results of the present study during the presentation of the paper.

References

- Boekaerts, M. (1999). Self-regulated learning: where we are today. *International Journal of Educational Research*, 31, 445-457.
- Karabenick, S.A., Woolley, M.E., Friedel, J.M., Ammon, B.V., Blazeovski, J., Bonney, C. R., . . . Kelly, K. L. (2007). Cognitive processing of self-report items in educational research: Do they think what we mean? *Educational Psychologist*, 42, 139-151.
- Perry, N.E., Phillips, L. & Dowler, J. (2004). Examining features of tasks and their potential to promote self-regulated learning. *Teachers College Record*, 106, 1854-1878.
- Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16, 385-407.
- Winne, P.H., & Perry, N.E. (2000). Measuring self-regulated learning (pp.531-566). In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Eds.) *Handbook of self-regulation*. San Diego, CA: Academic Press.
- Van Hout-Wolters, B.H.A.M. (2009). Measuring learning strategies. Kinds of measurement methods and their usefulness in educational research and practice. *Pedagogische Studiën*, 86, 110-129.
- Veenman, M.V.J., Van Hout-Wolters, B.H.A.M., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition Learning*, 1, 3-14.
- Zimmerman, B.J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, 25, 1-17.
- Zimmerman, B.J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41, 64-70.

PAPER PRESENTATION

The growth in learning patterns during higher education: a latent growth curve model

Liesje Coertjens, University of Antwerp, Belgium; Vincent Donche, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium; Sven De Maeyer, Antwerp University, Belgium

Whether learning strategies change during higher education is increasingly investigated. To assess this, paired-samples t-tests or repeated measures ANOVA are primarily relied upon. Methodological literature has described two pitfalls concerning these statistical methods: first, only average growth is estimated and second, measurement error is unaccounted for. Recently, latent growth curve modelling has been described, allowing to model individual difference and to take into account measurement error. This study thus aims to estimate longitudinal change in learning strategies, using a latent growth curve analysis. The sample consists of one cohort of bachelor students, 245 of which participated in the three measurement waves by filling out the Revised Inventory of Learning Strategies (R-ILS), a self-report instrument mapping students' processing and regulation strategies. A curves-of-factors latent growth model is used. Such analysis estimates a growth trajectory by an intercept and a slope and estimates the variance in both parameters as well. Preliminary results indicate a significant increase in critical processing, relating and structuring as well as self-regulation during higher education. Memorising, external regulation and lack regulation decrease significantly, while analysing remains constant. For all scales, students vary in their initial level at the start of higher education, while no significant differences in growth trajectory were noted. Results from prior research are thus partially confirmed and supplemented with findings on individual differences.

Aims

A growing number of research has been investigating whether and how student learning strategies evolve during higher education. Vanthournout et al. (2010) therefore conducted a systematic review on longitudinal research using Vermunt's learning pattern model and derived Inventory of Learning Styles (ILS) questionnaire. The authors concluded that during higher education students predominantly evolve towards a more meaning-oriented way of learning and away from an undirected pattern, though effect sizes point on average to a small to moderate impact. In the majority of ILS-studies external regulation and stepwise processing (memorising and analysing) remained stable, pointing to high resilience to change. In analysing this change in learning strategies during higher education, statistical analysis has relied primarily on comparisons of mean factor scores over time using paired-samples t-tests or repeated measures ANOVA (Vanthournout et al., 2010). Two statistical pitfalls of these techniques are often noted in methodological literature. On the one hand traditional statistical methods only estimate average change in learning strategies. Individual differences in growth are unaccounted for. Such individual differences can for example be estimated using a multi-level approach (Singer & Willet, 2003). On the other hand, the use of this traditional statistical approach assumes absence of measurement error. By aggregating the scores on different items in composite factor scores, it is de facto presumed that items perfectly measure a certain learning strategy. Such error is however explicitly estimated in structural equation modelling (Byrne, 2010). Recently, a combination of both multi-level and

structural equation modelling has been described, being latent growth curve modelling (Duncan, Duncan & Strycker, 2006). While this statistical method is applied with increased frequency in other social science domains (e.g. De Fraine, Van Damme & Onghena, 2007), it has not been used before within longitudinal research of student approaches to learning to our knowledge. This study thus aims at estimating longitudinal change in learning strategies, using a latent growth curve analysis. Hereby, we focus on the average growth trajectory learning strategies show, as well as whether there are individual differences in this growth trajectory.

Methodology

One cohort of students entering a University College was followed up during the three years of higher education. 254 students participated at three measurement waves by filling out the Revised Inventory of Learning Strategies (R-ILS). This questionnaire maps four processing strategies (memoring, analysing, critical processing and relating & structuring) and three regulation strategies (external regulation, self-regulation and lack of regulation), using a five-point likert scale. Analysis consists of a curves-of-factors latent growth model as described by Duncan, Duncan and Strycker (2006) to assess change in learning strategies. Such analysis incorporates the items underlying a scales and estimates a growth trajectory by an intercept and a slope. To investigate individual differences, the variance of both parameters is estimated as well. Analyses were performed using Mplus 5 and relying on a distribution free estimation procedure to account for the ordinal nature of the data (weighted least squares means-variance; WLSMV). Findings Preliminary results indicate a decreasing reliance on the memorising strategy during higher education ($B = -.094$, $SE = .029$, $pB = .381$, $SE = .090$, $pB = .013$, $SE = .043$, $p = .77$), indicating that all students follow the general linear decrease. The level of analysing on the other hand remains constant over time ($B = .002$, $SE = .027$, $p = .95$), though students vary in their initial reliance on it ($B = .319$, $SE = .069$, p). Linearly increasing trends were confirmed for the degree of 'critical processing' and 'relating and structuring' ($B = .108$, $SE = .025$, $pB = .059$, $SE = .025$, $pB = .183$, $SE = .064$, $pB = .204$, $SE = .059$, p). The two scales 'external regulation' and 'lack of regulation' show similar trajectories as well: student decrease their reliance on these strategies during higher education ($B = .087$, $SE = .026$, $pB = -.127$, $SE = .023$, $pB = .158$, $SE = .064$, $pB = .173$, $SE = .051$, p). The self-regulation scale on the other hand shows a positive growth trajectory ($B = .106$, $SE = .030$, $pB = .259$, $SE = .083$, $pB = .026$, $SE = .040$, $p = .51$).

Theoretical and educational significance of the research

Results confirm prior research findings only partially. An increase in meaning directed learning was confirmed by the increase in critical processing, relating and structuring and self-regulation. The decreasing reliance on unregulated learning is in line with the findings of former ILS-studies (for a review, see Vanthournout et al., 2010). The high resilience to change in stepwise processing was however only exemplified in the analysing strategy, while significant decreases were noted in the reliance on memorising and external regulation. Additional to the general trajectory, individual variations in growth were examined. Results indicate that for all scales, students vary in their initial level at the start of higher education, while no significant differences in growth trajectory were noted. Future analysis will include latent class growth analysis and estimates of effect sizes for slopes parameters.

PAPER PRESENTATION

Overcoming the summer drop in reading: testing a localised intervention

Stuart McNaughton, The University of Auckland, New Zealand; Rebecca Jesson, University of Auckland, New Zealand; Tone Kolose, The University of Auckland, New Zealand; Sophie Kercher, The University of Auckland, New Zealand

A study in two phases was designed to overcome the summer learning effect (SLE), where drops in literacy achievement occur over summer. The effect reduces the effectiveness of schools with minority children from low SES communities. Initially, variability in SLE in 77 classrooms in 7 low SES urban primary schools was plotted for 2009 to 2010. High SLE and low SLE classrooms with 9-11 year old Maori (indigenous) and Pasifika (Pacific Islands) students were identified ($n = 16$). Interviews were conducted with high and low SLE students in each classroom ($n = 32$), their parents and their teachers to identify family, school and personal practices associated with SLE patterns. Teachers in low SLE classrooms more often prepared students specifically rather than just generally in four areas. Low SLE students and their parents more often reported interest based reading within and across genres, with parents responding to and providing guidance for reading for meaning and enjoyment. In the second phase a multi component intervention was designed using Phase 1 analyses and tested in a quasi experimental design across 25 classrooms over the 2010-2011 summer. The components include matching students with texts and a four week unit to prepare students in reading strategies, metacognition, and engagement; and specific guidance to parents. Teacher logs, student and teacher questionnaires provide measures of implementation. HLMs and repeated measures analyses of variance using reading comprehension scores provide comparisons across consecutive summers and comparisons between high and low implementing teachers

The presence of 'summer learning effects' (SLEs), where there is differential growth in learning over the months when schools are closed has been identified in a number of studies (Cooper, Charlton, Valentine, & Muhlenbruck, 2000; Entwisle, Alexander & Olson, 1997). Students from poorer communities and minority students often make less growth than other students over this period contributing to a widening gap in achievement. The SLE creates a barrier that gets larger over time (Alexander, Entwisle & Olson, 2007). Three intervention studies in reading comprehension involving over 50 schools serving largely Maori (indigenous) and Pasifika (Pacific Islands) students confirm the extent of the effect captured in previous research in New Zealand (McNaughton & Lai, 2009).

The SLE has been related to family social and cultural practices that provide differential exposure to school-related literacy activities (Cooper et al., 2000; Heyns (1978). The developmental processes involved mean that both schools and families (Anderson et al., 1988) may vary in providing access to and use of specific practices.

Two sorts of interventions that have been tested. One set adds resources in 'book flood' interventions such as Allington and McGill-Franzen's (2009) study with 17 high-poverty schools. Primary students selected their own books covering a range of topics and types to read over summer. The intervention produced reading growth compared to a control group that received no books that equalled the effect size Cooper et. al. (2000) reported in their meta-analysis for attending summer school. Other studies employ a programmatic approach, adding components to providing matched books. Kim's (2006) study with fourth grade children and their teachers in 10 high poverty schools added teacher preparation and guidance for students' independent reading and metacognitive development before summer with personally matched books. In addition, there were prompts to students and parents for 'read alouds' over summer. The programme produced relatively small gains relative to students who only got the teacher preparation and guidance. But the gains appeared to be sufficient to overcome the drop over summer.

Existing studies are not 'contextualised' for New Zealand. For example, it is not known whether access to books and guidance is a problem in the New Zealand context or whether classrooms practices and teacher guidance may be used in ways that might make a difference. The aim of the study was to firstly describe the variability in SLE and school, family and student practices associated with this variability. Then secondly to design and test an intervention using features of school and family practices associated with little SLE.

Methods and Results

Phase One

Growth curves using repeated measures of reading comprehension of 1,495 students in 7 multicultural low SES urban primary schools were plotted over 2009 to 2010. Variability in classrooms (n=77) over the summer break was used to identify two sets of classrooms of 9 year olds to 11 year olds: those associated with little SLE (n=8) and those with large SLE (n=8). A high SLE and low SLE student in each classroom (total n= 32) matched on achievement levels were interviewed together with their parents and their teachers about the practices within schools and their communities over summer. Quantitative analyses included coding teacher interviews in four areas of general or specific focus in preparing students for reading over summer (child strategies, child metacognition, child engagement and parental guidance). Teachers in low SLE classrooms more often prepared students specifically rather than just generally in the four areas (a finding supported by student and parent interviews). Most students and their parents reported a wide range of reading using multi media but low SLE students and their parents more often reported interest based reading within and across genres, with parents supporting access to texts, responding to and providing guidance for reading for meaning and enjoyment (rather than as homework, or for decoding).

Phase Two

From these data an intervention was designed with 3 major components. The classroom components include a survey of reading student interests, matching student interests with texts and a four week unit prior to the summer break focussed on preparing students (in the areas of strategies, metacognition, and engagement). The second component is specific guidance to parents about how to support engagement, and how to access and help children select texts. The third component will be a review session at the commencement of the new school year in February 2011. Teachers in 25 classrooms are implementing the programme with 9 year olds to 11 year olds (n=25). Teachers are filling in logs during the unit to provide a measure treatment integrity. Students and teachers will complete questionnaires at the end of the summer to provide self report (student) measures of student and family reading practices over summer and to provide social validity measures relating to the programme as implemented (teachers).

A quasi experimental design has been adopted for testing the effects of the intervention. Three sets of comparisons will be made using Hierarchical Linear Modelling and repeated measures analyses of variance. The comparisons firstly will be retrospective, comparing the patterns of gains (and losses) across classrooms in the 2010 to 2011 summer with those from the previous summer. A second retrospective comparison will be the patterns over the two summers for a

subset of teachers, those with large SLE in the previous summer. The third analysis will examine variation within the group of teachers using the teacher logs to directly compare high implementers with low implementers.

This study will contribute to solving a compelling educational problem. School effectiveness is limited by the cumulative effects of SLE. In addition, the data from this study will help our understanding of how family / community practices and school practices each contribute to continued learning and development in literacy over the summer break.

PAPER PRESENTATION

The understanding of written and spoken text of children from diverse language backgrounds

Selma Babayigit, University of the West of England (Bristol), United Kingdom

The study set out to examine the understanding of written and spoken text of monolingual and bilingual speakers of English language. Seventy two monolingual and bilingual pupils ($M = 10.01$ years, $SD = 0.42$) were tested at Year 5. Along with reading and listening comprehension of text, children's verbal memory, general reasoning, receptive vocabulary, and syntactic awareness skills were also assessed. As anticipated, oral language skills (i.e., vocabulary and syntactic awareness skills) emerged as the most powerful unique predictors of children's written and spoken text comprehension levels even when individual differences in general reasoning, verbal memory, and word reading skills were taken into account. There was also evidence to suggest that more bilingual learners were likely to experience difficulties in text comprehension that seemed to be associated with the weaknesses in semantic and syntactic processing of oral language. Hence, the overall results echoed the previous findings in this area of research (e.g., Lesaux, Lipka, & Siegel, 2006) and further signified the pedagogical implications of systematic support of the oral language skills of children from diverse language backgrounds.

The number of pupils who speak one or more language other than English (or the mainstream language of the schools) at home is increasing steadily. According to a recent report, 16% of primary school pupils speak English as an additional language in the UK and this is increasing by about 1% each year (SFR, 2010). There is now a substantial body of corroborating research evidence to suggest that while bilingual pupils perform at comparable levels with their monolingual peers on the measures of word level reading, they tend to underperform on the measures of text comprehension (e.g., Droop & Verhoeven, 2003; Hutchinson, Whiteley, Smith, & Connors, 2004; Stuart, 2004). The bilingual pupils' difficulties with text comprehension have been associated with weaknesses in oral language skills, such as vocabulary (Lesaux, Geva, Koda, Siegel, & Shanahan, 2008). However, the research in this area remains to be highly limited. The current study sought to further examine to what extent bilingual pupils experience text comprehension difficulties and the role of two central oral language skills, namely vocabulary and syntactic awareness skills in understanding of spoken and written text of bilingual and monolingual learners. This line of research has clearly important implications for developing our understanding of language and literacy needs of children from diverse language backgrounds.

Seventy two pupils ($M = 120.12$ months, $SD = 5.07$) at Year 5 were tested. Thirty five children were monolingual (i.e., spoke only English at home) and 37 were bilingual learners (i.e., spoke at least one language other than English at home). Children who have been attending a primary school in the UK less than four years and those with learning difficulties were excluded from the study. Thereby, it was ensured that bilingual pupils were not in the early stages of learning the English language, and that all children had adequate word decoding skills. The two language groups did not differ in terms of the distribution of age, $t(70) = -.48$, $p = .63$, or sex ratio, $\chi^2(1, N = 72) = 0.05$, $p = .82$. The home languages spoken by the bilingual learners in this study were Serbian (5, 14%), Arabic (4, 11%), Urdu (6, 16%), Somali (14, 38%), Bengali (2, 5%), Bulgarian (1, 3%), Sylheti (1, 3%), and Punjabi (4, 11%).

The children were tested individually at their schools over two sessions each lasting for about 25 minutes. The testing battery included the measures of general (matrix) reasoning, receptive vocabulary, reading comprehension, verbal short-term memory (digit span), syntactic awareness, and listening comprehension skills. With the exception of verbal memory, reading accuracy, and reading speed, the monolingual group scored reliably higher than the bilingual group on the general reasoning, oral language and comprehension measures and the effect sizes were large. Hence, the findings replicated the previous research and suggested that more bilingual learners tend to experience difficulties with oral language processing and text comprehension in comparison with their monolingual peers.

Following from this, a series of hierarchical multiple regression analysis was conducted to examine the predictive role of vocabulary and syntactic awareness skills in text comprehension levels. As anticipated, receptive vocabulary and syntactic skills emerged as the most powerful unique predictors of both reading and listening comprehension levels even when individual differences in general reasoning, verbal memory, and word reading skills were taken into account. The findings also suggested that the predictive effect of oral language skills were comparable between the

two language groups. In conclusion, the finding further echoed the call for a concerted effort on the close monitoring and supporting of children's oral language skills that seem to be even more vital for children from diverse language backgrounds (e.g., see Kamhi, 2009; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991).

References

- Droop, M. & Verhoeven, L. (2003). Language proficiency and reading ability in first- and second-language learners. *Reading Research Quarterly*, 38, 78-103.
- Hutchinson, J. M., Whiteley, H. E., Smith, C. D. & Connors, L. (2004). The early identification of dyslexia: Children with English as an additional language. *Dyslexia*, 10, 179-195.
- Kamhi, A. G. (2009). The case for the narrow view of reading. *Language, Speech, and Hearing Services in Schools*, 40, 174-177.
- Lesaux, N., Lipka, O. & Siegel, L. (2006). Investigating cognitive and linguistic abilities that influence the reading comprehension skills of children from diverse linguistic backgrounds. *Reading and Writing*, 19, 99-131.
- Lesaux, N., Geva, E., Koda, K., Siegel, L. & Shanahan, T. (2008). Development of literacy in second-language learners. In D. August & T. Shanahan (Eds.), *Developing reading and writing in second-language learners* (pp. 27-59). London: Routledge.
- SFR (2010). Department for Education. Statistical First Release (SFR 09/2010): Schools, pupils and their characteristics January 2010 (provisional) retrieved from <http://www.Dcsf.Gov.Uk/rsgateway/index.Shtml>.
- Snow, C. E., Barnes, W. S., Chandler, J., Goodman, I. F. & Hemphill, L. (1991). *Unfulfilled expectations: Home and school influences on literacy*. Cambridge, Mass: Harvard University Press.
- Stuart, M. (2004). Getting ready for reading: A follow-up study of inner city second language learners at the end of key stage 1. *British Journal of Educational Psychology*, 74, 15-36.

PAPER PRESENTATION

Phonological awareness, oral language proficiency and early reading in Hong Kong Chinese preschooler

Susanna Siu-sze Yeung, The Hong Kong Institute of Education, Hong Kong; Carol Chan, The University of Hong Kong, Hong Kong

This study examined the role of oral language proficiency and phonological awareness in Chinese and English word reading acquisition for Chinese ESL young children. Hong Kong preschool-age children (N = 97) were administered with measures of word reading, phonological awareness and oral language proficiency in both Chinese and English. The results indicated that, with age and general intelligence statistically controlled, both English expressive vocabulary and English phoneme awareness were significant predictors of English reading. Chinese tone awareness made significant contribution in predicting Chinese word reading but Chinese rhyme awareness and Chinese oral language tasks were insignificant predictors. In addition, English phonological awareness at syllable and rhyme levels significantly predicted Chinese word reading and Chinese phonological awareness (tone awareness) significantly predicted English reading after controlling for age and general intelligence. The findings demonstrate the unique and significant role of phonological awareness across languages among ESL children learning two very different writing systems and suggest that phonological awareness might be a shared competence across languages. Educational implications of the present study will be discussed.

Aims

The aim of this study is to explore the contribution of phonological awareness and oral language proficiency to Chinese and English reading development among Hong Kong Chinese ESL learners. We focused on two research questions. First, to what extent are second language (L2) phonological awareness skills and L2 oral language skills associated with English reading among young Chinese ESL children? Second, to what extent do Chinese and English phonological awareness skills predict Chinese and English reading in young ESL children? It is of our interest to examine the role of phonological awareness because it is largely overlooked in the current instructional approach of English reading for Hong Kong Chinese ESL learners. A better understanding on its role in early L2 reading development is necessary for researchers and educators to develop curricula and teaching strategies which may have long terms impacts on academic success for young ESL learners.

Method

In this study, English and Chinese phonological awareness tasks, oral language measures and English and Chinese reading were administered to 97 beginning readers in Hong Kong from four kindergartens with Cantonese as a medium of instruction. A measure of general intelligence was also administered as a control variable. The measures employed are summarized in Table 1 (See Appendix 1).

Results

Table 2 (See Appendix) presents the partial correlations among the measures after controlling for age and general intelligence. Results indicated that English word reading was significantly correlated with various oral language proficiency measures. It was also significantly associated with English phonological awareness measures at different levels. Chinese reading was significantly associated with Cantonese tone awareness but not with Chinese rhyme awareness. For the associations across L1 and L2, English word reading was significantly correlated with Chinese oral cloze and Cantonese tone discrimination whereas Chinese word reading was significantly associated with English phonological awareness at different levels.

Hierarchical multiple regressions were performed to examine the contribution of L1 and L2 phonological awareness and oral language proficiency to Chinese and English reading. We entered age and general intelligence in Step 1 to control for its effects on word reading. Then, we entered oral language proficiency measures in Step 2 because we are interested to explore to what extent English and Chinese word reading would be predicted by phonological awareness skills, which are the missing elements in the current English language curriculum in Hong Kong preschools, after controlling for proficiency level. As shown in Table 3 (See Appendix), picture naming, the measure of expressive vocabulary (picture naming) and phoneme awareness (phoneme identification) were two significant predictors of English reading. Both English oral language proficiency and English phonological awareness accounted for unique additional variance of English reading. For Chinese reading, oral language skills were not significant predictor of Chinese reading and only the Cantonese tone discrimination significantly predicted Chinese reading.

To examine the cross language associations, hierarchical regressions were conducted to predict English reading from Chinese phonological awareness and Chinese reading from English phonological awareness. As shown in Table 4 (See Appendix), Chinese tone discrimination was a significant predictor of English reading whereas English syllable deletion and rhyme detection significantly predicted Chinese reading but not phoneme identification. Cross-language transfer of phonological awareness skills was demonstrated.

Theoretical and educational significance

This study has provided initial evidence of the important role of L2 phonological awareness, particularly phoneme awareness, and oral language proficiency in early English reading development among Chinese ESL learners. The findings also show that phonological awareness skills transfer across languages which support the notion that phonological awareness is a shared competence across languages. Given that very little phonological instruction is provided in Hong Kong kindergarten, current study points to the need to further investigate the role of phonological awareness instruction in promoting English reading development for Chinese ESL young children.

PAPER PRESENTATION

Depth of Processing in Reading Comprehension

John Kirby, Queen's University, Canada; Bozena White J, Queens University, Canada

We investigated the role of depth of processing in the reading comprehension of 141 Canadian high school students. Items on three reading comprehension tests were classified into three levels of comprehension, Details, Main ideas, and Themes. Regression analyses indicated that the deep approach to learning was only predictive of the deepest, thematic level of comprehension. Further analyses identified students whose reading comprehension was lower than would be expected from their general and word reading abilities; these students performed worse than others at each level of comprehension, and continued to do so after controlling vocabulary, working memory, and the deep approach to learning. These results indicate that the depth of processing framework can be applied to reading comprehension and suggest a number of potential benefits. Students with low reading comprehension performance may benefit from help in basic skills or from instruction that orients them towards deeper levels of processing.

Aims

The purpose of this paper is to examine the role of depth of processing in high school students' reading comprehension. Current theories of reading comprehension (e.g., Kintsch, 1998) describe three levels of representation, which correspond to progressive levels of depth: a surface representation, a textbase representation (in which main ideas and details are distinguished), and a situation model in which text information is combined with prior knowledge to provide a dynamic and thematic representation of the events or material conveyed by the text. Kirby and Pedwell (1991) offered an alternative description, referring to the detail, main idea, and thematic levels of comprehension. However, measures of reading comprehension that are commonly used in schools do not assess these levels separately. Our first aim in this study therefore is to examine whether these levels can be reliably distinguished in commonly used tests.

Depth of processing in learning can be assessed by self-report measures of approaches to learning (e.g., Biggs, 1987; Entwistle, 1989). Although the deep as opposed to the surface approach to learning would appear to be desirable for better reading comprehension, there is a lack of evidence on this point. Approaches to learning may be constrained by lower-level skills (e.g., word recognition), and the deep approach may only be valuable for the deeper forms of comprehension (i.e., main ideas and situation model). Our second aim therefore is to examine the effects of approaches to learning on reading comprehension, after controlling basic skills.

Our third aim is to identify a group of unexpected poor comprehenders (students whose comprehension scores are much lower than would be expected from their intellectual and word reading abilities; e.g., Cain & Oakhill, 2006). We intend to determine whether their comprehension difficulties are confined to specific levels of comprehension or are apparent at all levels.

Method

The participants were 141 English-first-language Grade 10 students in a rural Ontario high school (mean age 15 years 4 months, SD 7.5 months; 80 girls and 61 boys), from a range of socio-economic backgrounds.

Three measures of reading comprehension were administered: (a) Test-R (Reading) of the Canadian Tests of Basic Skills (CTBS, Nelson, 1998), in which students answer multiple-choice questions after reading short passages; (b) the Ontario Secondary School Literacy Test (OSSLT), a government-mandated curriculum-based test, in which students read various forms of text and responded to multiple-choice and open-response questions; and (c) a Summary Writing task in which students read a 680-word text and later wrote a text-absent summary (similar to the task used by Kirby & Pedwell, 1991); this task yields scores at the relevant detail, main idea, and thematic levels.

Students' approaches to learning were assessed with the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F, Biggs, Kember & Leung, 2001), a self-report questionnaire consisting of 20 five-point Likert-type scale items. Deep and surface approaches are measured.

Measures of general nonverbal ability, vocabulary, working memory, and word reading accuracy were also administered.

Findings

Items from the three reading comprehension measures were classified separately by two coders into the three levels of details, main ideas, and themes. Classification was moderately consistent and differences resolved in discussion. (We will provide illustrative examples of items and their classification.) Based on these classifications, we formed three reading comprehension z-score variables: Details, Main ideas, and Themes.

To address our second aim, we carried out hierarchical regression analyses in which the Detail, Main idea, and Theme variables were the outcomes. We entered nonverbal ability, vocabulary, working memory, and word reading ability in the first step, and then deep and surface approaches to learning in the second step. Results indicated that the surface approach was not related to any level of comprehension, and that the deep approach was significantly related only to the Theme level of comprehension, $\beta = .228, p < .05$.

To address our third aim, we used White and Kirby's (2008) regression technique for identifying unexpected poor comprehenders (those whose reading comprehension is lower than expected, $N = 37$), expected average comprehenders (those whose comprehension is as predicted, $N = 34$), and unexpected good comprehenders (those whose comprehension was greater than predicted, $N = 21$). Analyses of variance and covariance (in which vocabulary, working memory, and the deep approach were controlled separately) demonstrated that the three groups were significantly different at each of the three levels of reading comprehension. Group profiles will be shown to illustrate these results.

Theoretical and Educational Significance

These results indicate that the depth of processing framework can be applied to measures of reading comprehension. The results should provide more detailed feedback to students and teachers about students' strengths and weaknesses, and should provide a stronger basis for intervention. We recommend that commercial test providers make greater effort to assess the different levels separately.

The finding that the deep approach to learning is associated with thematic comprehension suggests that interventions should address students' conceptions of learning. Further studies of this relationship are suggested, investigating, for instance, whether changes in tasks instructions produce deeper thematic comprehension.

The present results show that the problems of poor comprehenders are pervasive, across all levels of reading comprehension. Previous studies (e.g., Cain & Oakhill, 2006) have indicated that these students have weak semantic and inferential skills; our interpretation of the present results is that these semantic and inferential difficulties occur as the lowest levels of cognitive representation are being established and then spread to prevent the higher levels from being established. We recommend that intervention studies be designed to either address the basic semantic/inferential difficulties, or to circumvent those difficulties by focusing on deeper learning strategies (see Lawson & Kirby, in press).

PAPER PRESENTATION

Enhancing Teacher Education: The Case Method of Teaching to Promote Cross-Linked Thinking

Ralf Merkel, Humboldt Universität zu Berlin, Germany; Annette Upmeyer zu Belzen, Humboldt Universität zu Berlin, Germany

Student teachers experience difficulty in recognising problems of teaching in complex (teaching) situations (Well 1999). This paper presents an intervention study to foster cross-linked thinking in masters students to address this shortcoming. The module "subject specific teaching", which prepares students especially for teaching, will be targeted to include material on the case method of teaching (Shulman 1992, 1996, Levin 1995).

The model of cognitive complexity by Schroder et al. (1975) serves as the theoretical background of this study. It distinguishes three components: discrimination, differentiation and integration, which represent different aspects of cross-linked thinking.

The cases consist of teaching situations, specifically designed and generated for the targeted module in order to promote the students' capability to think in a cross-linked way. The focus of the cases will be on problems dealing with pedagogical content knowledge in the field of biology didactics.

The intervention's effectiveness will be measured by using a two-group pre/post-test design. The intervention and the test will be carried out between October 2010 and April 2011. The main focus will lie on the comparison of the intervention and the control groups' ability in cross-linked thinking. The measurement of the students' ability in cross-linked thinking will be evaluated on the basis of qualitative text analysis. The results are expected to be available in April 2011.

German teacher education is divided into three parts: specialised branches of science, general educational knowledge and specialised subject didactics. This reflects the division of professional teacher knowledge (based on Shulman 1987) into content knowledge (CK), pedagogical knowledge (PK) and pedagogical content knowledge (PCK) (Baumert & Kunter 2006, Park & Oliver 2008). In this context PCK can be seen as the link between CK and PK (Terhart 2000). The structure of teacher education in Germany can be one explanation for the students' fragmented knowledge (Terhart 2000). This is evident in the lack of student teachers' ability to comprehend complex problem situations and their reactions in such situations (Well 1999). To implement their knowledge, students have to bring together the separate parts of their professional teaching knowledge, necessitating an integration of theoretical parts in order to apply them in practice. This can be achieved by developing cross-linked thinking in the masters of education. Within this framework of integration and cross-linked thinking, the central aim is to develop students' cross-linked thinking abilities in the masters seminars of biology didactics.

The model of cognitive complexity (Schroder et al. 1975, Müller 1999), which distinguishes three components: differentiation, discrimination and integration, serves as the theoretical background of this study. The model represents different aspects of cross-linked thinking. Differentiation is the capability to split information found in a (teaching) situation into different dimensions. Dimensions are main categories, which can be identified in complex (teaching) situations. Therefore differentiation is a measurement of the quantity of main categories, which can be identified in a (teaching) situation. Discrimination is the capability to grade within one dimension (Müller 1999). The third component of the model is integration, which includes the capability to evaluate situations, to find alternatives, to compare and contrast solutions and advantages and disadvantages of the found solutions. An additional theoretical component employed in this study is the Angebots-Nutzungs-Modell (Helmke 2009), which describes a lesson's influencing factors. The model is adapted to be applicable to a university setting and is reduced to focus on the following components: Angebot (supply), Nutzung (use) and Ertrag (output).

For this study the seven categories of PCK specifically created for biology by Schmelzing et al. (2008) are modified and arranged into ten categories of PCK in the field of biology didactics.

To foster the ability to deal with complex and unforeseen problems in complex teaching situations, studies into the effectiveness of implementing the case method approach during teaching were conducted in the US teacher education program (Shulman 1992, Levin 1995). A teaching event is defined as a case (Shulman 1992). A case consists of theoretical and practical components and as such can be considered a piece of controllable reality. Therefore cases are particularly suited to be employed in teacher education programs.

The following research questions are posed, based on the described problems, the theoretical components of cross-linked thinking and the ten categories of PCK in the field of biology didactics.

To what extent can the case method of teaching in conjunction with the theoretical categories of PCK help to develop the cross-linked thinking model with its components of discrimination, differentiation and integration?

How can the developmental processes of the students, over several seminars, to analyse different cases in the context of cross-linked thinking be described qualitatively?

The case method of teaching will be implemented in the module: "subject specific teaching", which prepares students especially for teaching, in order to develop biology education students' cross-linked thinking. This module is divided into three parts: the preparatory seminar, the in-school practical component (four weeks) and the post processing consolidation seminar. In all three parts, cases specifically designed for the module will be implemented. They are designed and generated on the basis of the ten different categories of PCK, interviews with student and expert teachers and written cases from biology education students' practical experience during the summer semester of 2010.

The cases are divided into three acts (Shulman 1992). At first the content information is described (goals, the expected unfolding of the lesson and basic parameters). In the second act, the account of what actually happened is presented, including unanticipated problems and difficulties. Both acts are analysed by the students during their seminar and the problems are categorised into different aspects of PCK. In act three the students have to interlink the identified aspects of PCK. The aim of this act is to reflect on the case and find alternative possibilities to deal with the identified and classified problems.

The effect of the intervention will be evaluated by using a two-group pre/post-test design. A pilot study was carried out in the summer semester of 2010, to test the implementation of the case method and measuring instruments. The main study will be carried out in the winter semester of 2010/2011. To determine the students' ability in cross-linked thinking, the participants will analyse a case in the pre- and post-tests. The categories of PCK in the field of biology didactics in combination with the components of cross-linked thinking provide the basis for analysis; this is combined with Mayring's (2003) qualitative content analysis method. To ascertain information about the students' development process in their ability to think in a cross-linked manner, a learning diary will be kept, based on Helmke's Angebots-Nutzungs-Modell (2009).

The measurement of the pre- and post-tests as well as the learning diaries will be carried out on the basis of PCK in connection with the cross-linked thinking model and Mayring's qualitative text analyses (Mayring 2003).

The participants of the seminars are all master students in their first or third semester. All of them have successfully completed a Bachelor of Science or Bachelor of Arts. Therefore it is assumed that the students have detailed content knowledge of biology and a basic pedagogical and pedagogical content knowledge.

The results of the pilot study are currently being evaluated. The first results of the main study are expected to be available towards the end of April 2011.

PAPER PRESENTATION

Self-regulated learning of students' motivation by preservice teachers

Sylvie Frechette, Université du Québec à Trois-Rivières, Canada; Frederic Legault, Université du Québec à Montréal, Canada; Monique Brodeur, Université du Québec à Montréal, Canada

The study investigates self-regulatory processes used by preservice teachers to learn to motivate their students within the practicum. Data was collected from 79 trainees who posted a message describing a motivation problem in electronic discussion forums. Also, 15 trainees were prompted to describe in recall interviews a classroom situation where they learned to motivate their students. Twelve self-regulatory processes were found in interviews, and nine in forums. A description and frequencies of the processes will be presented. Some processes considered as crucial will be presented in details. Positive correlations were found among phases of self-regulation, and between the number of

different self-regulatory processes used by trainees within forums and the number of motivational strategies they proposed. Trainees who used more self-regulatory processes generated more motivational strategies.

Introduction

Given the growing body of evidence reflecting the benefits of developing self-regulatory skills on academic performances, concerns have been expressed regarding the development of self-regulatory processes preservice teachers (Kremer-Hayon & Tillema, 1999). This suggests that teacher education programs should focus more on the development of self-regulation to give preservice teachers greater control over their theoretical and practical knowledge acquisition within the context of life-long professional development. However, to our knowledge, no study has reviewed the self-regulatory processes used by preservice teachers within their practicum to learn a complex professional task such as motivating students.

Objectives

The objectives of the study are: 1) to identify and describe the self-regulatory processes used by preservice teachers to learn to motivate their students within the practicum and 2) to examine the relation between the trainees' use of self-regulatory processes and their capacity to propose motivational strategies.

Theoretical Framework

According to social cognitive theory, self-regulation is a process whereby students activate and sustain cognition, behavior and affects that are involved in the successful completion of learning tasks. Self-regulation consists of three successive and cyclical phases: forethought, performance and self-reflection. The forethought phase sets the stage for the efforts; it consists of goal setting, strategic planning, self-efficacy beliefs, goal orientation and intrinsic interest. The performance phase occurs during the efforts and acts on attention; it consists of attention focusing, self-instruction or imagery and self-monitoring. The self-reflection phase follows the efforts, affects, and the learner's response to efforts; it consists of self-evaluation, attributions, self-responses and adaptivity (Zimmerman, 1998). Preservice teachers and teachers can play a crucial role in their students' motivation (Pintrich & Schunk, 2002). They can affect motivation in many ways through the implementation of numerous strategies in class.

Methodology

a) Participants and procedure

The study took place within a classroom management course delivered to 129 students in the third year of a secondary education degree program of a well known university. This course was given concurrently with a five-week practicum; 115 students were completing the practicum. All trainees were given access to four different forums. They had to post messages of at least 200 words in a specific forum according to the subject addressed. Only the forums on students' motivation were used for this study, and 79 trainees posted a message describing a motivational problem. Additionally, in a one-hour recall interview, 15 trainees were prompted to freely describe a classroom situation where they learned to motivate their students.

b) Data source

The forum and interview transcripts were coded according to Zimmerman's model (1998). One procedure was used to score the interviews, and three for the forums. First, a frequency score was created by counting the number of times that a self-regulatory process appeared in the forum and interview transcripts. Second, a dichotomous score that describes whether a trainee used a process was also considered for the forums. Third, the motivational strategies appearing in forums were also counted. Using Miles & Huberman's formula (1984), a reliability index of 84% was obtained for the self-regulatory processes appearing in the interviews, 89% for the self-regulatory processes in the forums, and 91% for the motivational strategies generated by the forums.

Results and Discussion

Twelve self-regulatory processes were found in interviews. In general, trainees set both distal outcome and proximal process goals. Their self-efficacy beliefs were increased among other things by good planning for teaching. Trainees found interest in their relations with students. They mainly chose strategies in order to reach process goals. They monitored the use of these strategies by observing student behaviour in class. They reflected upon their actions: they evaluated it positively or negatively, made causal attributions and adapted their subsequent performance in the practicum. Some were satisfied, while others were unsatisfied or frustrated. A mastery learning goal orientation was reported by only one trainee. A detailed description of the more important process according to literature will be presented.

Nine processes were present in the forums. The processes most frequently reported were goal setting (46.9%), strategic planning (77.2%) and monitoring (98.9%). The other process frequencies include: 29.2% for adaptive

inferences, 27.9% for both self-evaluation and causal attributions, 11.4 % for self-reactions, 12.1% for self-efficacy beliefs and, finally, 8.9% for interest. Goal orientation, attention focusing and self-instructions processes were absent. Pearson's correlation coefficient was used to examine the relationship among the three self-regulation phases. Significant correlations were found between phases 1 and 2 ($r = 0.541$, $p = 0.001$) and between phases 2 and 3 ($r = 0.369$, $p = 0.001$).

178 motivational strategies ($M: 2.25$, $SD: 2.03$) were collected through the forums. Pearson's coefficient was used again to evaluate the correlation between the forum dichotomous scores and the motivational strategy numbers generated by the forums. A positive correlation was found ($r = 0.298$, $p = 0.005$).

Conclusion and Educational Significance of the Study

This study identifies the self-regulatory processes used by trainees to learn to motivate their students. Trainees used all self-regulatory processes at different levels in learning about students' motivation. Monitoring, which is considered by many authors as a vital one, is the most frequently used. Trainees who used more self-regulatory processes generated more motivational strategies. The description of self-regulatory processes used to learn to motivate students could help educators to support preservice teachers correctly in their learning.

References

- Kremer-Hayon, L. K. & Tillema, H.H. (1999). Self-regulated learning in the context of teacher education, *Teaching and Teacher Education*, 15, 507-522.
- Pintrich, P.R. & Schunk, D.H. (2002). *Motivation in education. Theory, research, and applications*, 2nd ed. Upper Saddle River, NJ: Merrill Prentice Hall.
- Zimmerman, B.J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D.H. Schunk and B.J. Zimmerman (Dir.), *Self-regulated learning: from teaching to self-reflective practice* (pp. 1-19), New York: Guilford.

PAPER PRESENTATION

Knowledge for teaching mathematics at the beginning and end of teacher education (TEDS-M option)

Erich Ramseier, PHBern – University of Teacher Education, Switzerland; Fritz Oser, Universität Freiburg, Switzerland; Horst Biedermann, University of Fribourg, Liechtenstein; Margit Kopp, University of Teacher Education Luzern, Switzerland; Sibylle Steinmann, PHZ Luzern, Switzerland; Christian Bruehwiler, University of Teacher Education St. Gallen, Switzerland; Samuel Krattenmacher, University of Teacher Education St. Gallen, Switzerland

The Teacher Education and Development Study in Mathematics (TEDS-M) undertakes an international comparison of mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) of future primary and lower secondary school teachers at the end of their teacher education. For an estimation of the quality of teacher education, it is necessary to determine the level of knowledge also at the beginning of teacher education, since this is a prerequisite for the separation of treatment and selection effects. Therefore, in a Swiss TEDS-M option, students were tested at the beginning of their teacher education ($N = 1405$). This paper examines the methodological prerequisites of the comparison of the two cohorts and presents its main result. For future primary teachers, application of the Rasch model shows that measurement invariance between the beginning and the end of teacher education is assured. Furthermore, MPCK and MCK can be distinguished empirically ($r_{\text{latent}} = .80$). The international TEDS-scale may be used since the international ability estimates of students at the end of teacher education can exactly be reproduced locally and these scores correlate highly with nationally established scores ($r \geq .98$). The MPCK mean is significantly higher at the end than at the beginning of teacher education, yet this is not true for MCK. This distinction is plausible since the focus in primary teacher education is on imparting teaching. The results allow for detailed Swiss analyses. They also show the difficulty to interpret international TEDS-M data which include measurement only at the end of teacher education.

Aims

Knowledge for teaching mathematics is essential for high-quality instruction and student progress at school (Baumert et al., 2010). It is therefore important to know what knowledge future primary and lower secondary school teachers have acquired at the end of their teacher education. The Teacher Education and Development Study in Mathematics (TEDS-M) internationally compares this knowledge (Tattoe et al., 2008; see also Blömeke, Kaiser, & Lehmann, 2010; Oser et al., 2010). Thereby mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) are distinguished and separately measured. The "overall goal of this study is to find better ways to help teachers learn what they need to know to teach mathematics well" (Tattoe et al., 2008, p. 8). For an estimation of the quality of teacher education and for proposing ways of improvement, it is not sufficient to know the characteristics of teacher education programs and the level of teaching knowledge attained at their end. Determining the knowledge

level at the beginning of teacher education is another prerequisite for the separation of treatment and selection effects. Therefore, in a Swiss TEDS-M option, students were tested at the beginning of their teacher education. This paper examines the methodological prerequisites of the comparison of the two cohorts and presents its main result. Research questions are: Is measurement invariance assured between the beginning and the end of teacher education? May the metrics of the international TEDS-M scales be used? Are MCK and MPCK separable dimensions? What is the mean level of MPCK and MCK at the beginning and at the end of teacher education in Switzerland (German speaking part)? Procedure TEDS-M developed different tests for future primary and lower secondary mathematics teachers. The Swiss project conducted a census in the German part of Switzerland using these tests. At the end of teacher education, 936 (76%) of all future primary teachers and 141 (81%) of all future lower secondary teachers participated. In parallel, 1226 future primary and 179 future lower secondary teachers were tested in their first term of teacher education applying the same test design.

Analysis and results

Preliminary results concentrate on future primary teachers. Swiss data were scaled based on the Rasch model and using Conquest (Wu, Adams, Wilson & Haldane, 2007). Since analyses for MCK and MPCK showed a good model fit (infit for all items between .92 and 1.07) and no differential item functioning between the beginning and at the end of teacher education, measurement invariance is granted. Swiss raw data of students in their final year were locally prepared and scaled based on information about the international procedure. This led to the same person ability estimates as in the international TEDS-M data base. Therefore, the procedure can reliably be applied to students in their first year of teacher education to produce internationally comparable estimates. Yet the nationally and internationally determined relative item difficulties show considerable differential item functioning for many items (see figure 1 for MCK items). The international item difficulties are therefore not best suited for describing the knowledge structure in Switzerland. Since there is a high correlation between person scores that are estimated using international item difficulties and those using national item difficulties, scores based on the international scale may nevertheless be used to analyse test results. As theoretically expected, the latent correlation between MCK and MPCK is high ($r = .80$, two-dimensional scaling model). Yet it demonstrates that these constructs are empirically distinguishable. The MCK mean at the end of teacher education ($M = 543$, international scale) is not significantly higher than at the beginning ($M = 539$, t-Test). Yet students at the end of teacher education score significantly higher on MPCK ($M = 537$, effect size $d = 0.17$, $p = .0001$) than at the beginning ($M = 527$). The final paper will show whether results are different for future lower secondary mathematics teachers.

Significance of the research

Although longitudinal data are absent, the analysis suggests that the mathematical content knowledge of future primary teachers is not appreciably growing during teacher education. The high Swiss results in the international TEDS-M comparison therefore do no proof that Swiss teacher education is of high quality in this respect. A high level of mathematics knowledge acquired in earlier stages of education is probably a better explanation. This uncertainty of the interpretation of results of TEDS-M might hold for other countries. There is more evidence for growth in mathematics pedagogical content knowledge. This is plausible since the focus in primary teacher education is on imparting teaching skills rather than mathematical knowledge. The research establishes the basis for analyzing in a next step whether differences between groups of students, in particular students enrolled in different teacher training institutions, are rather a consequence of differing selection or treatment within teacher education.

References

- Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., et al. (2010). Teachers' Mathematical Knowledge, Cognitive Activation in the Classroom, and Student Progress. *American Educational Research Journal*, 47(1), 133-180.
- Blömeke, S., Kaiser, G., & Lehmann, R. (Eds.). (2010). TEDS-M 2008. Professionelle Kompetenz und Lerngelegenheiten angehender Mathematiklehrkräfte für die Sekundarstufe I im internationalen Vergleich. Münster: Waxmann.
- Oser, F., Biedermann, H., Brühwiler, C., Kopp, M., Krattenmacher, S. & Steinmann, S. (2010). Deutschschweizer Lehrerbildung auf dem Prüfstand. Wie gut werden unsere angehenden Lehrpersonen ausgebildet? Ein internationaler Vergleich. Fribourg, Luzern, St. Gallen: Online unter: http://www.teds-m.ch/download/erste_ergebnisse.html.
- Tatto, M. T., Schwille, J., Senk, S. L., Ingvarson, L., Peck, R. & Rowley, G. (2008). Teacher Education and Development Study in Mathematics (TEDS-M): Policy, Practice, and Readiness to Teach Primary and Secondary Mathematics. Conceptual Framework. East Lansing, MI: College of Education, Michigan State University.
- Wu, M. L., Adams, R. J., Wilson, M. R. & Haldane, S. (2007). ACER ConQuest Version 2. Generalised item response modelling software. Melbourne: ACER Press.

PAPER PRESENTATION

Teachers' Professional Competences and Active Learning

The aim is to present how teachers' professional competences and active learning are related in Finnish teacher education. The theoretical framework is based on a concept that consists of a broad view of teachers' professional role in schools and society. The framework of active learning is based on theories that consider learning as constructivist and collaborative processes. Methods of the study are quantitative and qualitative. Student teachers in two universities (n=454) participated in the research. The quantitative data is analysed using descriptive statistics and using also ANOVA, correlate and multivariate methods and Factor Analysis (Principal axis method with Varimax and Promax rotations). The qualitative data are analysed using a content analysis techniques. The strongest relationships exist between active learning and the professional competences in the tasks that require a strong reflective orientation and commitment in teaching profession: Revising students' learning environments, Working as a change agent in a society, promoting Self regulated learning, Critical reflection of own work, and Critical assessment of teacher education. In open ended answers six main categories could be found: Collaborative working culture, Teaching practice with opportunities to experiments, Opportunities to make own to design or develop large units for own or pupil's learning, Research studies including writing BA and MA thesis. The large course units programs focusing on understanding phenomena in life and connections between different disciplines in a new and deeper way. Subject matter projects or subject matter pedagogy requiring independent inquiring or collaborative knowledge creation.

Objectives

The aim is to present how teachers' professional competences and active learning are related in Finnish teacher education.

Perspectives and theoretical framework

The theoretical framework is based on a concept that consists of a broad view of teachers' professional role in schools and society. It considers a teacher as a researcher and a reflective practitioner, and sees teacher education as an inquiry-oriented process (e.g. Darling-Hammond, 2010; Carr & Hatrnett, 1996; Hargreaves, A, 1994; Hargreaves, D, 2000; Smyth, 1995; Oser 1994; Tabachnick & Ziechner 1991; Schön 1991.)

The framework of active learning is based on theories that consider learning as constructivist and collaborative processes. Active learning consists of independent inquiry, structuring and restructuring of knowledge, a problem-solving orientation, a critical approach and an evaluation of knowledge. Learners can elaborate on applications of knowledge and s/he may also produce new knowledge individually and collaboratively (e.g. Scardamalia 2002; Sfard 1998; Nonaka & Toyama, 2003). Active learners develop inquiring their skills and to learn to reflect on, and control their own learning processes (e.g. Pintrich & McKeachie, 2003). Knowledge is not an individual possession, but socially shared and emerges from participation in sociocultural activities.

Methods and modes of inquiry

Methods of the study are quantitative and qualitative. Student teachers in two universities participated in the research. They assessed in the web-base survey how teacher education had provided them with professional competences needed in a high standard profession (40 questions with a scale 1-5). They also assessed what kinds of experiences on active learning they have had and how often these methods were used (20 questions with a scale 1-5). There were also open/ended questions about strengths and weaknesses of their TE from the view point of active learning. The quantitative data is analysed using descriptive statistics and using also ANOVA. In addition correlate and multivariate methods are applied. Data reduction methods such Factor Analysis were used (Principal axis method with Varimax and Promax rotations) in the analysis of the Active Learning questionnaire. The qualitative data has been analysed using a content analysis techniques.

Data sources

The data was collected by among students of class teacher and subject teacher education programs at the Universities of Helsinki and Oulu. The departmental mailing lists were used in the data gathering. The Students could assess their TE programs anonymously.

In web based surveys 605 students visited on Web sites, but the number of students who responded to all questions varies around 30-42% from the total number of student teachers. The total number of students in this study is 454.

Results

Professional competences

The highest professional competences have been achieved in the following skills: (1) Designing of instruction, (2) Critical reflection of own work, (3) Becoming aware of ethical basis of teaching profession, (4) Life long professional growth, (5) Self-evaluating of own teaching, (6) Using teaching methods, and (7) Development of own educational philosophy. They all have the Mean value at least 3.5 and standard deviation is less than 1.00. These all are high level professional skills and necessary for experts who develop their own work. The weakest skills student teachers have achieved for administrative tasks and management of tasks outside a classroom (keep on eye on students during recess, school festivals, trips, morning assemblies etc.). Also co-operation with parents, representatives of work life and cultural partners are weak as well as working in cooperative action research projects, student welfare groups and in other school community groups.

Active learning

The students assessed what kinds of active learning experience they have the most often. They worked intensively with their assignments, applied knowledge, and tried to understand matters and phenomena even though it would take time). They were tutored, if needed, but otherwise they worked independently or in peer groups. They discussed together about the best solution for the assignments and self-evaluated their own products. They also sought much additional knowledge. These experiences they had almost every week.

Relationships between professional competences and active learning

The strongest relationships exist between active learning and the professional competences in the tasks that require a strong reflective orientation and commitment in teaching profession. Active learning has the strongest correlations (.37 -.40) with the variables Revising students' learning environments, Working as a change agent in a society, promoting Self regulated learning, Critical reflection of own work, and Critical assessment of teacher education.

Students' responses to open ended questions

Writings of 253 students were analysed using content analysis techniques. Five main categories could be found. These are not separate but integrated with each others.

Collaborative working culture, active discussions with peers and professor/supervisors, knowledge sharing in coursework, examinations where a group is responsible for outcomes.

Teaching practice with opportunities to experiment, to work with pupils in schools and collaboration with student teachers, supervisors and teachers who are responsible for theoretical studies of pedagogy.

Opportunity to own applications, freedom to make own plans, design or develop large units for own or pupil's learning.

Research studies including writing BA and MA thesis, commitment to inquiry, learning critical approach to knowledge. The large course units programs that have been implemented through out with active learning methods focusing on understanding phenomena in life and connections between different disciplines in a new and deeper way. Subject matter projects or subject matter pedagogy requiring independent inquiring or collaborative knowledge creation.

Scientific and scholarly significance of the study

The study gives evidence that there is the relationship between active learning and high level professional competences. The best active learning experiences emerge in collaborative working and study culture, in teaching practice and research studies. Students appreciate to have freedom to experiment and design their own applications. If we want to have teachers as high professionals, also learning methods used in teacher education must be in line with this purpose. If we want to change schools towards more active learning in our global world, also teacher education should promote these methods. This study opens important scenarios for the development of teacher education.

PAPER PRESENTATION

Barriers and drivers of participants' satisfaction in CSCL environments Using the Kano model

Helga Dorner, Central European University, Hungary

This study examines Hungarian in- and pre-service teacher participants' satisfaction with the online mentoring experience in CSCL environments ($N_{in} = 43$; $N_{pre} = 116$). In the participant satisfaction analyses, the Kano model was employed, which contributed to identifying the relative priority of improving components of the online processes. We found that online communication is a one-dimensional attribute, which leads to linear increase of participant satisfaction. Results also showed that participants' skills and competences involved in general computer usage and their Internet abilities were must-be attributes. We thus concluded that online communication and effective

facilitation are inevitable constituents of the online mentoring process, and they lead to higher participant satisfaction and feeling of success. Additionally, successful learning experience is also dependent on participants' skills and competencies concerning general computer usage and their Internet abilities.

In their model of CSCL theory and research for instructional design, Brandon and Hollingshead (1999) identified participants' satisfaction with computer-supported collaborative learning (CSCL) as one of the crucial factors when evaluating teaching and learning processes. While early studies in the field focused on the comparison of online and face-to-face learning experience, researchers' attention later on turned to identifying factors that contribute to or decrease participants' satisfaction. Exploring satisfaction with the online learning experience included the study of interaction and the facilitator's role in enhancing online learner satisfaction (Arbaugh, 2001; Bolliger, 2004); investigation of positive relations between participant satisfaction, social interaction and collaborative learning (Gunawardena & Zittle, 1997; Richardson & Swan, 2003); and also the identification of factors that contribute to students' dissatisfaction (So and Brush, 2008). In general, studies in the field conclude that the extent to which participants are satisfied with online courses contributes to improving online learning achievement thus measuring satisfaction with online learning should be part of the instructional design. The Kano model to survey satisfaction The Kano model of consumer satisfaction is a research tool to identify and classify the product criteria and attributes that create more satisfaction than others (Kano, Hinterhuber, Baison, & Sauerwein, 1984). The model classifies product attributes into four categories (Xu, Jiao, Yang, & Helander, 2009): (1) must-be or basic quality attributes; (2) one-dimensional or performance attributes; (3) attractive or excitement attributes; and (4) indifferent attributes. The lack of must-be attributes leads to extreme dissatisfaction. One-dimensional attributes entail those for which better fulfilment leads to linear increase of satisfaction. Attractive attributes are in general unexpected by the customers, their presence can lead to satisfaction. Indifferent attributes are those that the customer is not especially interested in.

Aims of the research

The reason for measuring participant satisfaction with our online in- and pre-service teacher training scenarios was twofold. First, our aim was to identify factors that increase or hamper participants' satisfaction with the online learning experience i.e. drivers and barriers of satisfaction. We assumed that effective facilitation and online communication lead to higher participant satisfaction and feeling of success. Second, we intended to find and test a method that helps us deciding the relative priority of improving components of the teaching and learning process in a CSCL environment. According to our current knowledge, the Kano model has only been applied in consumer satisfaction studies thus, we also wanted to address the question whether it is applicable in education research contexts at all. Research methodology Hungarian in- and pre-service teacher communities ($n_{in} = 43$; $n_{pre} = 116$) were involved in the study. In both communities, the Mentored Innovation Model (Author, 2008) was utilised as the instructional context for the professional training exercise. This meant subject-specific online collaborations in small-groups, mentored and scaffolded by online facilitators who were experienced in delivering teacher professional trainings.

We used two research tools: (1) participant satisfaction survey and (2) ICT metrics (Török, 2007). Both tools relied on quantitative data and intended to collect self-perceived values. The former one is a Likert-type survey instrument (consisting of 25 items) for investigating and developing a model of participant satisfaction. The items used a 4-point response scale and focused on: (1) participants' global satisfaction, (2) satisfaction with the facilitator's activity, (3) online communication in the CSCL environments, and (4) the participants' perceived social presence. The latter tool aims at describing the (individual) participants' ICT-competence, which we divided into two groups of indicators: those focusing on (1) skills and competences involved in the general computer usage and (2) Internet abilities.

Results and Discussion

We identified online communication in the CSCL environment as a one-dimensional attribute ($p = .002$ and $p = .000$), which leads to linear increase of participant satisfaction. Accordingly, the higher is the value of participants' satisfaction with the online interactions scaffolded by the facilitators, the higher participant satisfaction grows.

Results concerning the participants' skills and competencies involved in the general computer usage ($p = .003$) and their Internet abilities ($p = .022$) were identified as must-be attributes. Thus, we claim that if participants lack these skills, it would lead to extreme dissatisfaction. Hence, our assumption that effective facilitation and online communication contribute to higher participant satisfaction and feeling of success was supported. Additionally, we found that successful participation is also dependent on the participants' competences in general computer usage and their Internet abilities. We also intend to discuss the limitations of the applied research tools and suggest further research methodologies applicable.

References

- Arbaugh, J. B. (2001). How instructor immediacy behaviours affect student satisfaction and learning in web-based courses. *Business Communication Quarterly*, 64(4), 42. ERIC Document Reproduction Service ID EJ638834.
- Bolliger, D. U. (2004). Key factors for determining student satisfaction in online courses. *International Journal on E-Learning*, 3(1), 61. ERIC Document Reproduction Service ID EJ723807.
- Brandon, D.P. & Hollingshead, A.B. (1999). Collaborative learning and computer-supported groups, *Communication Education*, 48(2), 109-126.
- Gunawardena, C.N., & Zittle, F. (1997). Social presence as a predictor of satisfaction within a computer mediated conferencing environment. *American Journal of Distance Education*, 11(3), 8-25.
- Kano, K.H., Hinterhuber, H.H., Baily, F. & Sauerwein, E. (1984). How to delight your customers. *Journal of Product and Brand Management*, 5(2), 6-17.
- Author (2008). Mentored innovation model in teacher training using two virtual collaborative learning environments. In J. Zumbach, N. Schwartz, N. Seufert, & L. Kester (Eds.), *Learning and Instruction with Computers. Beyond Knowledge: the Legacy of Competence Meaningful Computer-based Learning Environments*. (pp. 29-41) Wien: Springer Verlag.
- Richardson, J. C. & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived leaning and satisfaction. *Journal of Asynchronous Learning Networks*, 7(1), 68-88.
- So, H-J., & Brush, T.A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: relationships and critical factors. *Computers & Education*, 51, 318-336.
- Török, B. (2007). The process of ICT integration in schools – ICT-metrics measuring tool. Unpublished doctoral dissertation. ELTE University, Budapest.
- Xu, Q., Jiao, R.J., Yang, X. & Helander, M. (2009). An analytical Kano model for customer need analysis. *Design Studies*, 30, 87-110.

PAPER PRESENTATION

Being a teacher? No thanks. Motives for novice teachers not being willing to teach (anymore)

Katrien Struyven, University of Brussels (VUB), Belgium

Teacher shortages are partly explained by novice teachers who do not start or continue to teach: Who are they? And why are they not motivated to teach (anymore)? A survey investigation was conducted among 235 Flemish 'exited' teachers (from 2309 graduates). Exit attrition applies to 16%, however, more to males and Secondary school teachers. Interestingly, 1/3 of the exited teachers, never practiced teaching after graduation. Five sets of reasons explain exited teachers' rationale: 1) job satisfaction and relations with students, 2) school management and support, 3) workload, 4) future prospects and 5) relations with parents. Interestingly, the lack of future prospects and support by colleagues and management in the school are two 'lived experiences' that distinguish between teachers who never entered teaching practice and those who have had teaching experience after graduation. Implications are discussed.

Introduction

In many countries (e.g. UK, Belgium, the Netherlands, US), teacher shortages are eminent. Hence, it is important to attract students into teacher education and to encourage them to engage in a professional and enduring career in teaching. The fact, however, is that many student teachers never start teaching or leave education within the first five years following graduation; the problem of exit 'attrition' (i.e. teachers who change careers) (Ingersoll, 2001; Hahs-Vaughn & Scherff, 2008). The purpose of the present study is twofold. On the one hand, the study sets out to find out who these teachers are. On the other hand, it aims to understand why qualified, novice teachers in Flanders (Belgium) do not start teaching, or give up teaching within five years of graduation.

Method

A survey study was conducted. 370 teachers (of a sample of 2309 teacher education graduates) were not teaching (anymore), five years after graduation; that is 16.02%. These teachers were asked to fill out the questionnaire and return it, which 235 respondents successfully did (RR= 63.51%). Instrument A questionnaire was designed on the basis of the review of the international research literature on (exit) attrition. The main part of the questionnaire described 66 reasons that may have been decisive for not teaching (anymore). For each reason, respondents had to indicate on a 5 point-scale whether the reason had no effect (N.A.); whether it played a small part (+), a considerable part (++), a large role (+++), or a very significant role (++++ in their decision not to teach (anymore). Results show that male teachers (25.49%) tend to leave the teaching profession more readily than female colleagues (13.37%). Exit teachers are, in particular, secondary school teachers (24.27%), followed by elementary school novice teachers (11.42%) and graduates in kindergarten education (9.73%). For secondary education teachers, attrition rates are highest in following subject specialties: Physical training/Sports (31.9%), Languages (Dutch, French, English) (25.2%) and natural sciences (math, biology, chemistry) (14.8%). Intriguingly, 1 in 3 (33.47%, N=81) of the respondent teachers have never worked as a teacher after graduation. Here, sex does not make

a difference. Although a multitude of reasons were formulated, factor analysis demonstrates five clusters of reasons that best describe the rationale behind the teachers' exit attrition (explaining 52.92% of variance (VE)). The first factor is called 'job satisfaction' (VE=14.03%) and brings together the items that concern the teacher's motivation, enjoyment, expectations, with items concerning difficulties in the teacher-student relation: e.g. bullying by students, class management. The second factor is called 'school support' (VE=13.12%) and relates the items concerning the lack of support of teachers by principals, and colleagues, inadequate induction and difficult or unwelcome tasks. The third factor 'workload' (VE=9.04%) comprises reasons that have to do with time pressure, emotional tiredness and workload (including administrative work), often in the evenings or during holidays. The fourth factor, called 'future prospects' (VE=8.60%) encompasses the prospects for reassignment (after a temporary position), a long-term contract or a permanent position, associated guarantees of income and career growth. The last factor concerns 'relations with parents' (VE=8.13%). Lack of support from parents and conflicts with parents, are the arguments that are important – load highly – for this factor. On average, these five factors score high as arguments for leaving teacher education: future prospects (M=4.00; SD=1.66), parent relations (M=4.00, SD=0.27), workload (M=3.67; SD=0.89), job satisfaction (M=3.58; SD=0.66) and support (M=3.50; SD=0.60). Interestingly, two 'lived' experiences are convincingly more used by teachers' leaving the profession after a period of practice, compared to their colleagues who never enter teaching practice after graduation.

Discussion

Important implications that derive from this investigation, consequently concern ways of effectively dealing with exit attrition. Regarding limited prospects for the future, one may wonder whether the common Belgian tradition of granting permanent 'untouchable' positions to teachers is desirable. Sequential interims and insecurity of jobs of novice teachers are consequences. Alternatively, 'contracts for an indefinite periods' may offer a valid solution. In addition, the profession becomes more attractive if extra job opportunities or 'stepping stones' are created (Cochran-Smith, 2004; Macdonald, 1999). With respect to the lack of support in schools, however, also structural solutions may motivate teachers to stay, such as mentoring programs (Ingersoll & Smith, 2003). As such, teachers will experience less disappointed expectations. Here, sufficient teaching practice during pre-service teacher education is necessary (Kyriacou & Kunc, 2007). All with one purpose, namely establishing the contrary answer to the original question 'Being a teacher? Yes, I'd love to!'...

References

- Cochran-Smith, M. (2004). Stayers, leavers, lovers, and dreamers: Insights about teacher retention. *Journal of Teacher Education*, 55, 387-392.
- Hahs-Vaughn, D. L. & Scherff, L. (2008). Beginning English teacher attrition, mobility, and retention. *The Journal of Experimental Education*, 77, 21–53.
- Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal*, 38, 499-534.
- Ingersoll, R. M. & Smith, T. M. (2003). The wrong solution to the teacher shortage. *Educational Leadership*, 60(8), 30-33.
- Kyriacou, C. & Kunc, R. (2007). Beginning teachers' expectations of teaching. *Teaching and Teacher Education*, 23, 1246-1257.
- Macdonald, D. (1999). Teacher attrition: A review of literature. *Teaching and Teacher Education*, 15, 835-848.

PAPER PRESENTATION

Sharing experienced teachers' pedagogical practices with ICT to less-experienced colleagues

Minna Lakkala, University of Helsinki, Finland; Liisa Ilomäki, University of Helsinki, Finland

Several studies address the problem that pedagogically meaningful usage of information and communication technology does not seem to spread easily; new easier and peer-to-peer practices for teacher training are needed. One possible solution is to promote the transformation of experienced teachers' well-tried and cultivated practices to other teachers. The present study includes an experiment where two experienced primary school teachers supported their less-experienced colleagues in designing and implementing an educational unit with ICT. Experienced teachers' classroom practices were documented in materials (a written pedagogical scenario and related videos), which then were used in a tutoring process where the experienced teacher supported a colleague to implement similar practices. The first case was an inquiry project in biology, the second case focused on the practices of virtual publishing through making a Web journal. The pedagogical infrastructure framework, including technical, social, epistemological and cognitive component, was applied for comparing the pedagogical practices with ICT of the more- and less-experienced teachers as well as for evaluating the possibilities and challenges of transferring the practices through materials and tutoring. The results revealed that the expert model and tutoring from the more-experienced colleague encouraged and promoted the tutored teachers to try pedagogical practices that they would not have tried otherwise. Good

technological skills as such are not sufficient for teachers to develop their pedagogical practices with ICT, but other competencies for organizing and guiding pupils' learning activities with ICT in integrated and coherent ways are needed.

Introduction

Modern technologies are considered providing new, valuable possibilities for education. Yet research results indicate that pedagogical change in schools through information and communication technology (ICT) has not actualized as expected. Technology is still used infrequently, only by some teachers and often for prevailing pedagogical methods like sharing information or doing simple exercises instead of advancing collaborative work, creative activities, solving of complex problems, and supporting students' knowledge management skills (OECD, 2010; Smeets, 2005). In teacher training programs, technology, pedagogy and subject domain content are often separated, which does not necessarily provide teachers with competencies for integrating them adequately in classroom practice (Hyo-Jeong & Kim, 2009). Research findings indicate that teachers benefit from concrete examples about using ICT in teaching and from the integration of technical and pedagogical training (Condie et al., 2007; Pedersen et al., 2006). To develop new models for in-service teacher training we tested a model where experienced teachers supported less-experienced colleagues to implement ICT in their classroom practices through authentic examples and tutoring. The main idea was especially to spread examples that represent challenging pedagogical approaches, including rich use of technology and complex activities, and are based on experienced teachers' well-tried and cultivated practices. The aim of the study was to examine how two experienced primary school teachers supported their two less-experienced colleagues in designing and implementing an educational unit with ICT. The Pedagogical Infrastructure Framework, including technical, social, epistemological and cognitive component (Lakkala, 2010), was used as an analysis framework for comparing the pedagogical practices with ICT of four teachers as well as for evaluating the possibilities and challenges of transferring the practices through materials and collegial tutoring. We divided a teacher's role in setting up technology-enhanced collaborative educational settings in two main tasks: 1) Planning, organizing and structuring the overall activity by establishing the underlying pedagogical infrastructure conditions for the collective effort (overall design); and 2) participating in the activities as a guide and expert who provides adapted, situation specific guidance for the learners when needed (scaffolding). In the present study, both the overall design solutions and the scaffolding activities of the more- and less-experienced teachers were examined through the components of the Pedagogical Infrastructure Framework.

Research methods

The general methodological approach was multiple case study where two practice transfer processes between more- and less-experienced teachers concerning teaching with ICT were investigated. The cases represented the Finnish cases in an EU-supported project FICTUP (<http://www.fictup-project.eu>). The aim of the project was to create training materials (written scenarios and related videos) describing concrete pedagogical activities using ICT, experimenting with a close tutoring process among experienced and novice teachers, and providing training institutions with recommendations. The two experienced teachers were knowledgeable in the pedagogical use of ICT, they both trained other teachers to use various applications in teaching, and they had participated in various development projects. They both had also previously collaborated with educational researchers, and they were chosen for FICTUP because of their expertise in the pedagogical use of ICT. The cases represented the teachers' ordinary practices. The less-experienced teachers were the experienced teachers' younger colleagues in the same school. They had used ICT somewhat in their teaching but had not used the specific tools and practices applied in the example scenarios. The first case was an inquiry project in biology, the second case focused on the practices of virtual publishing through making a Web journal. All lessons constituting the pedagogical units conducted by the four teachers were observed and videotaped by one or two researchers. The teachers were shortly interviewed before and after each lesson, asking a few questions about it. An in-depth final interview was carried out at the end of the process. We also collected all documents, writings and other outcomes produced by the teachers and the pupils during the process in the virtual spaces and the Web. The primary data used in the study were the videotaped lesson observations, because we wanted to focus on the teachers' real practices in the classroom. All videotapes were examined and sections revealing the teachers' overall design solutions or scaffolding practices were categorized qualitatively using the components of the Pedagogical Infrastructure Framework. Other data were used as complementary source for interpreting the classroom activities and providing examples of the overall design and scaffolding practices of the teachers.

Results

Concerning the tutoring, the scenario descriptions and especially the videos were useful in orientating tutored teachers in new pedagogical practices with ICT, but still the most important support for the tutored teachers was discussions with the experienced teachers. The tutored teachers reported that the models and tutoring from their more-experienced colleague encouraged and promoted them to try pedagogical practices that they would not have tried otherwise. The comparison of more- and less-experienced teachers' pedagogical usage of ICT revealed clear

differences. Experienced teachers planned more long-term, goal oriented working processes consisting of well-organized activities where the various elements of pedagogical infrastructure were taken care of and smoothly integrated. In their units, the usage of technology served the overall goal and the activities provides pupils with a possibility to practice challenging technical and academic skills in a meaningful context. The overall designs of their less-experienced colleagues were not as integrated and coherent. In their scaffolding, they emphasized technological and content-related issues, whereas the organization of social aspects (pupils' collaboration) and especially the promotion of pupils' cognitive, metalevel awareness of the practices were less-evident.

Conclusions and educational significance

It is important that teachers share their tacit expert knowledge through personal connections, such as tutoring practices, for encouraging less-experienced teachers to use ICT in their teaching. It is necessary to understand the differences in pedagogical practices between more- and less-experienced teachers in order to better support less-experienced teachers in their difficulties. The study confirmed results of our previous studies (Ilomäki, Lakkala & Paavola, 2006) that technological skills as such are not sufficient for teachers to develop their pedagogical practices with ICT, but other competencies for planning, organizing, structuring and guiding pupils' learning activities with ICT in integrated and coherent ways are needed.

PAPER PRESENTATION

Do they really become smarter? The development of lesson planning ability in internships

Karl-Heinz Arnold, Universität Hildesheim, Germany; Andreas Bach, University of Hildesheim, Institute of Educational Science, Germany; Sarah Brodhacker, University of Hildesheim, Institute of Educational Science, Germany

During the university phase of teacher education, teacher students in Germany take part in a series of subsequent internships. Primary internships cover general aspects of classroom teaching and learning while internships in the second part of teacher education programs provide for subject specific teaching competence. Primary internships are mostly linked to studies in general school pedagogy including as a major part the German Tradition of General Didactics (Klafki; Schulz) which serves as a comprehensive theory of classroom teaching and student learning. Teaching competence is considered to evolve in applying Didactics' knowledge to the planning of a lesson and the subsequent analysis of the lesson delivered.

The research project ESIS (Entwicklung Studierender in Schulpraktika, engl.: Teacher Student Development in Internships, TSDI) assesses the ability to plan, deliver, and analyze lessons as it develops during two subsequent general internships in the university phase of teacher education. Although internships are highly appreciated by teacher students, only small learning gains occur. This can be explained partly by moderating effects of teacher self-efficacy that seems to slow down the self-appraisal of teaching ability. Internships also provide a more realistic view on the considerable demands of classroom teaching.

Internships can be conceptualized within the generic framework of professional teacher competencies spelled out by Baumert and Kunter (2006). Four aspects are distinguished: (a) beliefs/value orientations; (b) motivational orientations; (c) self-regulatory abilities; (d) professional knowledge. Following Shulman (1986), teachers' professional knowledge can be subdivided in five areas: (1) pedagogical knowledge; (2) content knowledge; (3) pedagogical content knowledge; (4) organizational knowledge; (5) advisory knowledge (cf. Baumert & Kunter 2006).

Pedagogical internships in the first phase of German university teacher education require students to apply mainly pedagogical knowledge (in German: Allgemeine Didaktik, Paedagogik) and to some extend also organizational knowledge (in German: Schulpaedagogik) whereas subsequent internships that focus on subject matter teaching mainly draw on content knowledge (in German: Fachwissenschaft) and its pedagogical aspects (pedagogical content knowledge; in German: Fachdidaktik). Teacher students' beliefs and motivational orientations function as variables mediating knowledge application in teaching experiences and knowledge acquisition by observing mentor teachers.

Teacher competencies can be assessed either by objective (distal indicators: cf. Kennedy et al., 2008; proximal indicators: e.g. TEDS, cf. Bloemeke, Kaiser & Lehmann 2010) or subjective approaches (e.g., self-ratings; cf. Frey, 2008; Rauin & Maier, 2007). Combined approaches also have been employed (e.g. COACTIV; cf. Krauss et al., 2008; Baumert et al., 2010).

In the so called German tradition, pedagogical knowledge on teaching and learning is framed by theories and models of "General Didactics" (cf. Westbury, Hopmann & Riquarts, 2000). The Bildung-centered resp. Critical-constructive approach of Klafki (1994) and the Learning-centered resp. Teaching-centered approach of Schulz (1965; 1980) are considered as the two major approaches in General Didactics. Internships in the first phase of university teacher education offer teacher students opportunities to observe and analyze classroom teaching (and learning). The second step is to plan lessons and to deliver the planned lesson which is followed by analyzing the lesson delivered. Both

planning and analyzing a lesson is bound to the theoretical background of planning models within the framework of General Didactics (cf. Arnold & Koch-Priewe in press). The provision of detailed written lesson plans seems to be a typical feature of student teacher internships. However, it can be shown that expert teachers do implicitly draw on the planning categories of Klafki's model (cf. Koch-Priewe, 2000).

The present study (Teacher Student Development in Internships, TSDI; in German: Entwicklung Studierender in Schulpraktika, ESIS) analyzes both intended and unintended effects of internships. Cumulative learning effects should occur during and between succeeding internships. Moderating effects of student characteristics (i.e. self-efficacy) are investigated.

Method

At the Hildesheim university, the teacher education program encompasses three phases of general pedagogical internships during the first three semesters and two subject matter related internships in the last quarter of the four year program. An entire cohort of 400 students is assessed after the completion of each of the three pedagogical internships. Students start with two subsequent one-day-a-week internships. In the first part they observe and analyze lessons delivered by the mentor. In the second part they themselves plan and deliver lessons that are analyzed afterwards by themselves, their fellow students, their mentor, and their university tutor. The students take also part in an assessment at the beginning of the first practicum and before entering the second major practicum. The second practicum, a four weeks in-a-block internship after third semester, is mainly supervised by the mentors. At least, to investigate long term effects a follow-up assesment is conducted three months later.

To capture learning gains, a self-assessment questionnaire has been developed measuring the ability to plan, deliver, and analyze a lesson (Lesson Planning, Implementation, and Analysis; LPIA) on the basis of the major models of General Didactics. The instrument comprises 16 items within three subscales representing the postulated three dimensional structure (planning, delivering, and analyzing a lesson) quite well (CFA satisfactory fit-indices, Cronbach's alpha ranging from .80 to .87 for the subscales, .93 for the total scale). Additionally, an achievement test is being developed measuring the ability to plan, deliver, and analyze a lesson by answering multiple-choice questions to vignettes that cover typical situations of teacher decision making on lesson planning and delivering and planning based lesson analysis.

Teacher self-efficacy beliefs (TSEB) are measured by using the 10-item scale provided by Schwarzer and Schmitz (1999). Data are analyzed within the framework of structural equation modeling. The LPIA-questionnaire can be integrated in the measurement model by its three subscores. Because it may be that not only learning gains but also losses may occur, latent-change modelling is employed. The teacher student self-efficacy is introduced into the measurement model by parcelling (subscores for the first and second half of the 10 items).

Results

First results at the descriptive level show moderate learning gains over four points of measurement and also a decrease of variance. Further data analysis using the mplus-software (Muthen & Muthen, 2010) is in progress.

PAPER PRESENTATION

Peer feedback in secondary education: Effects of peer-feedback training on learning

Jan-Willem Strijbos, Ludwig-Maximilians-Universitat, Germany; Dominique Sluijsmans, HAN University of Applied Sciences, Netherlands

The increased application of student-centered learning emphasises that students assume responsibility for their learning. Peer assessment is well-suited in this respect. Although peer assessment researchers stress the role of feedback, the evidence for peer-feedback effects is scarce. A recent study by Strijbos et al. (2010) investigated the impact of peer-feedback content (concise general (CGF) vs. elaborated specific (ESF) and sender's competence level (low vs. high) on peer-feedback perceptions and revision performance. ESF was perceived as more adequate than CGF and feedback by a high competent peer as more adequate than feedback from a low competent peer. Other recent studies examined the content of peer-feedback comments. Non-directive feedback was found to predict more complex revision (Cho & MacArthur, 2010) and justification improved revision performance (Gielen et al., 2010). In this study the effect of a training in peer-feedback is investigated. More specifically whether a training in providing CGF or ESF affects peer-feedback perceptions and revision performance differently compared to students receiving no

training. Forty-eight Dutch pre-university secondary education students were trained in providing CGF (N = 17), ESF (N = 17) or received no training (N = 14). Both peer-feedback conditions provided more comments than the control group. The ESF group wrote longer (elaborated) feedback compared to the CGF group. No differences were found for learning outcomes, however, consecutive experiences of CGF might be perceived as less adequate and decrease affect over time. In addition, consecutive experiences of CGF and ESF do not automatically increase application of comments.

The increased application of student-centered learning emphasises that students assume responsibility for their learning. Peer assessment is well-suited in this respect. Although peer assessment researchers stress the role of feedback, the evidence for peer-feedback effects is scarce. A recent study by Strijbos et al. (2010) investigated the impact of peer-feedback content (concise general (CGF) vs. elaborated specific (ESF) and sender's competence level (low vs. high) on peer-feedback perceptions and revision performance. ESF was perceived as more adequate than CGF and feedback by a high competent peer as more adequate than feedback from a low competent peer. Other recent studies examined the content of peer-feedback comments. Non-directive feedback was found to predict more complex revision (Cho & MacArthur, 2010) and justification improved revision performance (Gielen et al., 2010).

Purpose and research question

In this study the effect of a training in peer-feedback is investigated. More specifically whether a training in providing CGF or ESF affects feedback perceptions and revision performance differently compared to students receiving no training.

Method

Participants. The participants were 48 Dutch pre-university secondary education students of which 22 were boys and 26 girls (Mean age = 15.6).

Design and materials.

A quasi-experimental intervention was conducted with two experimental conditions and a control group. One-third of the students were trained in providing CGF (N = 17), one-third in providing ESF (N = 17) and one-third received no training (N = 14). Subsequently they wrote three business letters of complaint (unsolicited ringtone subscription, unsolicited gym subscription, torn pair of jeans). Each student received anonymous peer-feedback on each letter. Next they first applied the peer-feedback and subsequently rated the peer-feedback in terms of 'Perceived Adequacy of Feedback' (PAF), Willingness to Improve (WI) and Affect (AF) (Strijbos et al., 2010). School criteria (content, format, style, spelling) were used to assess the quality of the letters and revisions (interrater reliability: $\tau = .77$, p p

Procedure.

Prior to the intervention students first completed a baseline task (20 minutes). Next they received the training. Students were prompted to provide CGF, ESF or received no training (25 minutes). Subsequently they wrote the first letter (L1) (35 minutes) and provided anonymous peer-feedback to a fellow student (15 minutes). Subsequently they applied (20 minutes) and rated the feedback in terms of PAF, WI and AF. The same procedure was used for the second (L2) and third (L3) letter.

Results

Manipulation check. The control group provided the least and shortest comments (143 comments; 632 words). Students in the CGF condition provided 370 comments using 1318 words and the ESF group 306 comments using 2748 words. Both feedback conditions provided more comments than the control group. The ESF group wrote longer (elaborated) feedback compared to the CGF group.

Feedback perception.

All scales were sufficient to highly reliable for all assignments (L1: PAF $\alpha = .88$, WI $\alpha = .59$, AF $\alpha = .79$; L2: PAF $\alpha = .89$, WI $\alpha = .84$, AF $\alpha = .83$; L3: PAF $\alpha = .88$, WI $\alpha = .74$, AF $\alpha = .82$). A repeated measures ANOVA revealed no significant differences for PAF on the first and second letter, but a significant difference for the third letter, $F(2, 42) = 4.62$, $p = 0.15$, with the CGF group reporting the least perceived adequacy. No significant differences were found for WI. A repeated measures ANOVA for AF revealed a trend, $F(2, 42) = 2.37$, $p = .83$, with the CGF group reporting less positive affect after the third letter compared to the first letter.

Learning outcomes.

There were no significant differences between the research conditions in terms of the revision performance over time. However, all students improved over time signified by the difference between the first and third letter, $F(1, 43) = 26.45$, p

Peer feedback content.

Students in the ESF condition provided positive remarks in 45% of all cases, compared to 30% in the CGF condition and 17% in the control group. Students in the ESF condition provided a suggestion for improvement in 66% of all comments, 62% in the control group and 55% in the ESF condition. An explanation is provided by the control group in 20% of all comments, followed by 28% in the CGF condition and 55% in the ESF condition. When asked via self-report whether they applied the peer-feedback the control group indicated that they applied 90%, the ESF group 79% and the CGF group 76%. However, analyses of actual application revealed that the control group still applied comments most often but only for 54% of all comments (36% less compared to self-report), the CGF condition in 35% and the ESF condition in 36% of all cases. Application increases over time for the control group (L1 = 46%, L2 = 52%, L3 = 67%), whereas it decreases for CGF (L1 = 44%, L2 = 40%, L3 = 21%) and ESF (L1 = 42%, L2 = 38%, L3 = 26%).

Significance of this study

This study shows that students can be trained to provide specific types of feedback during a peer-feedback exercise. Although we did not find differences in learning outcomes, the results illustrate that consecutive experiences of CGF might be perceived as less adequate and decrease affect over time. In addition, consecutive experiences of CGF and ESF do not automatically increase application, which might be due to recipients identifying the incorrectness of a comment or recipients simply disagreeing despite its correctness. Students' arguments for applying comments requires closer scrutiny in follow-up studies.

References

- Cho, K., & MacArthur, C. (2010). Student revision with peer and expert reviewing. *Learning and Instruction*, 20, 328-338.
- Gielen, S., Peeters, E., Dochy, F., Onghena, P., & Struyven, K. (2010). Improving the effectiveness of peer feedback for learning. *Learning and Instruction*, 20, 304-315.
- Strijbos, J. W., Narciss, S., & Dýnnebie, K. (2010). Peer feedback content and sender's competence level in academic writing revision tasks: Are they critical for feedback perceptions and efficiency? *Learning and Instruction*, 20, 291-303.

PAPER PRESENTATION

Examining Media-Effect among Subgroups of Students with Different Ability Levels

Krisztina R. Toth, German Institute for International Educational Research, Germany; Gyongyver Molnar, University of Szeged, Hungary; Agnes Hodi, University of Szeged, Hungary; Beno Csapo, University of Szeged, Hungary

Due to the innovative possibilities provided by computers and the cost-efficiency of the system, technology-based assessment should displace paper-based testing (Csapo, Latour, Bennett, Ainley, & Law, 2010). If computer-based assessment is applied to replace traditional testing a number of questions arise regarding media-effect (see e.g. Clariana, & Wallance, 2002). In the past several media-effect studies were carried out focusing on different student and item-related variables, some of these studies attempted to identify the effect of background variables (gender, race/ethnicity, and ICT related factors) for the differences between paper- and computer-based test performance, however, less attention has been paid to the examination of paper-and-pencil test performance of different sample subgroups. The purpose of this paper is to investigate a comparison of data derived from two test delivery among subgroups of students based on paper-and-pencil performance. This paper argues that the media-effect is related to the ability level of test takers in low-stakes testing. Various age groups, measured context and research design validate our findings. Results indicate that different ability level students behave differently in traditional and computerized assessment. Low ability students performed significantly better in computerized environment than in traditional testing. The performance of students with average ability level was media independent, or they achieved higher scores in the computerized test delivery. High ability students were disadvantaged in the online assessment. These findings support that the comparison of paper-based and computer-based performance should consider the students' ability level realized in printed medium.

Theoretical background

Computer-based assessment (CBA) has been more and more widespread in every segment of educational assessment, including large-scale international projects, national and regional surveys, and formative and diagnostic evaluation. CBA opens new areas for assessment where technology is essential to define the construct (e.g. ICT literacy). In other

domains where CBA is applied to replace former paper-and-pencil testing, several questions arise (e.g. validity issues) during the implementation phase. This resulted in a number of media-effect studies in the last few years mainly focusing on subgroup analysis based on gender, race/ethnicity and computer familiarity (e.g. Clariana & Wallance, 2002; Bennett, Braswell, Oranje, Sandene, Kaplan, & Yan, 2008) to investigate students who achieve better or worse in the two media. However, less attention has been paid to the examination of different subgroups of the sample based on their performance on paper-and-pencil tests.

Aims

The purpose of this paper is to study the media-dependence of low, mean and high ability-students in different contexts and literacy domains, to control media-effect and make detailed comparisons of test results delivered by different media.

In this paper we

- (1) compare paper-and-pencil (PP) and computer-based (CB) achievements to study media-effect,
- (2) determine the impact of delivery media on low, mean and high ability-students' achievement,
- (3) examine the value of the difference between PP and CB achievement among subgroups.

Methods

The present analyses synthesize the results of three PP and three CB data collections aimed at measuring students' inductive reasoning and reading skills. The sample ($n=2398$) for the analyses was drawn from 4th to 6th graders (10 to 12 year-old). Different research design was applied in all cases. In the first study identical versions of a 58 item inductive reasoning test were administered to the same sample of 5th graders in printed and online formats. The test comprises three subtests: number analogies (14 open-ended items), number series (16 open-ended items) and verbal analogies (28 multiple choice items). In the second study identical versions of two different inductive reasoning tests were administered to a different sample of 4th, 5th and 6th graders and in the third study the same 6th graders took parallel reading comprehension tests in the two media. To characterise student-level differences in the second study match sample design was employed based on region, type of settlement and gender. The computer-based test versions were delivered via Internet with the TAO (Testing Assisté par Ordinateur – Computer-Based Testing) platform.

To the detailed person-level analyses five groups of students were formed based on their PP test results. The sample of a test was clustered based on the standard deviation and mean of test scores. Students in the first group achieved ? standard deviation lower scores than the mean, to the second group belonged students between ? and ? standard deviation distance below the mean. Students, whose achievement differed from the mean at most ? standard deviation belong to the average-ability (third) group. Examinees above the average ability-level were clustered in two subgroups: students whose average achievement was between ? and ? standard deviation distance above the mean, and high ability-level students achieved the best scores, above ? standard deviation, on the test.

Educational and scientific importance

The history of CBA shows that technology-based testing does not always provide equivalent results to traditional tests. One of the reasons is that solving certain tasks and problems displayed on screen requires completely different cognitive processes than working on paper. Thus to compare findings of different measurements based on various test delivery platforms and to counterbalance the media-effect, the transformation of paper-and-pencil achievements into computer-based performance has to be worked out.

Results and Discussion

The reliability index (Chronbach-?) of the tests varied from .76 to .91 in PP, and between .70 and .91 in CB test administration mode. The delivery mode did not influence the reliability indexes of the tests, however, it affected students' mean achievement. Independent from the measured grades and constructs students' achievement was significantly higher on printed medium.

The subgroup-level analysis based on PP achievements revealed a diverse picture. Students with low-ability level in each tests performed significantly better in computerized environment than during the paper-and-pencil test administration. Contrarily, average-ability students' performance was media independent, or they achieved higher scores during traditional testing than at online data collection. High-ability students were disadvantaged in the online assessment in all testing contexts.

Results indicated that not only the direction of media-effect differs among the subgroups but the value of PP and CB difference as well. The groups of students with the lowest performance in each sample (e.g. inductive reasoning in 4th grade $t=10.43$, $p<.05$) showed high media dependency, low-ability level examinees ($t=2.7$, $p<.05$) were also advantaged by the introduction of the new testing medium in the low-stakes testing. These findings suggested presumably greater persistence during CB testing. The achievement of average-ability students was media

independent ($t=-2.01$, $p=.05$), and the same tendencies ($t=-5.26$, $t=-11.02$, $p<.05$) were outlined in the two clusters of high-ability level test takers than in the low-achievers'.

In sum, subgroup-level analysis pointed out that students with different ability-level behave dissimilar in the two testing environments. Findings based on various age groups, research design and measured constructs observed the same tendencies in the direction and the change of the media-effect value independent from the research methods. These results suggest that the transformation of PP performance into CB achievement should consider test takers' ability-level realized in PP assessment.

References

- Bennett, R.E., Braswell, J., Oranje, A., Sandene, B., Kaplan, B., & Yan, F. (2008). Does it Matter if I Take My Mathematics Test on Computer? A Second Empirical Study of Mode Effects in NAEP. *Journal of Technology, Learning, and Assessment*, 6(9). Retrieved 10.10.2010 from <http://www.jtla.org>.
- Csapo, B., Latour, T., Bennett, R., Ainley, J. & Law, N. (2010). Technological Issues of Computer-Based Assessment of 21st Century Skills. Draft White Paper 3. Cisco, Intel, Microsoft. The University of Melbourne, Melbourne.
- Clariana, R. & Wallance, P. (2002): Paper-based versus computer-based assessment: key factors associated with test mode effect. *British Journal of Educational Technology*, 33 (5) 593-602.

PAPER PRESENTATION

Measuring learning outcomes over time in preschool science education

Claus H. Carstensen, University of Bamberg, Germany; Mirjam Steffensky, IPN, Germany; Eva-Maria Lankes, Technical University of Munich, Germany

Recent studies show that preschool children are able to develop scientific knowledge in different content areas (Samarapungavan, Mantzicopoulos & Patrick, 2008). However, little is known about the support of science learning at preschool age. The research project SNAKE compares learning outcomes across different instructional approaches in preschool science instruction. The scientific competencies of preschool children were assessed pre and post an instructional treatment as well as in a later follow up. In this paper the competence tests used for the three assessments will be outlined and the scaling and linking procedures will be reported and their results and appropriateness will be discussed. We report on the successful construction of a test for science competencies of preschool children to assess gains during experimentally varied instructions. We described and analyzed change in science competencies with respect to the experimental variation.

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Introduction & Questions

Within the project key questions are what instructional support is most helpful for preschool children to improve their understanding of scientific concepts from everyday knowledge towards scientific literacy. Within an experimental variation, the effect of hands-on activities, cognitive reflection and a combination of both as well as a control group with non scientific instruction and a control group without instructions are compared to each other.

The assessments of scientific competencies were constructed with regard to "water" as topic, and more precisely, focusing on the processes of melting and freezing, of condensation and vaporizing and (rather exploratory) of chemical solutions, since all preschool children will presumably have a good everyday knowledge of many of the related phenomena. The assessments as well distinguish between conceptual knowledge and some elements of knowledge about scientific methods. A third characteristic of the tasks was whether children are required to think of potentially everyday observations or activities in contrast to rather abstract cognitive operations.

To assess of scientific competencies a test was developed for each of the pre test, post test and follow up. The test were constructed as structured interviews asking the children to either point to the relate picture to concepts, choose the correct option or produce a short open response. The post test and follow up test used anchor items from the previous test as well as new items to match the competence level of the children in each assessment. We were able to

show that with the test for the first assessment we obtain a one-dimensional competence scale based on 29 homogenous items with a reliability of .75 and a sufficient variance to discriminate between children with higher or lower competence.

In this paper, questions of modeling a single competence from the different assessments will be addressed. Does every test measure a single competence? Do the three tests measure the same construct? How can the three assessment be linked onto the same metric?

Method

The responses to the test were scored 0, 1 or 2 points for wrong, partially correct or correct responses respectively. Note that only for about half of the items the partial credit was appropriate. To scale the item responses the ordered partition model OPM (Wilson 1992) was used. The OPM generalizes the partial credit model (Masters 1982) for data where categories are only partially ordered. In consequence, not every category may be observed and thus the model is able to handle missing categories.

Scale analyses were performed within each assessment, the fit of the models was evaluated using item fit statistics and comparing item difficulty parameters for different groups according to gender and score in science and cognitive abilities. To investigate whether the assessments measure the same construct, two-dimensional models with anchor items as one dimension and time specific items as second dimension were estimated and compared to one-dimensional models with CAIC, a likelihood based statistic for global fit.

To establish a link between the three time points, an item response model for longitudinal data (Embretson 1991) was fitted to all data simultaneously. The software used for all item response analyses is Conquest (Wu et al. 1997).

Results

For each assessment an OPM was found to fit the data with sufficiently high reliability of .75 for the first assessment, .80 for the second and .82 for the third, computed from point estimates (WLE). The observed variances indicate a sufficient discrimination between the children's competencies. The link between the scales was successfully established and change over time will be presented descriptively as difference between adjacent time points as well as through covariance analyses of the post-test and follow up assessments with regard to the experimental groups controlling for pre-test and cognitive abilities. For example, analyzing post-test results, only the experimental group with the combined instruction of hands-on activities and reflection showed a significantly higher increase in competency than the control group whereas in the other two experimental groups the gains were not bigger than in the control groups.

Discussion

With this presentation we report on the successful construction of a test for science competencies of preschool children to assess gains during experimentally varied instructions. We described and analyzed change in science competencies with respect to the experimental variation.

References

- Embretson, Susan E. (1991): A Multidimensional Latent Trait Model for Measuring Learning and Change. In: *Psychometrika*, Jg. 56, H. 3, S. 495–515.
- Masters, G. N. (1982): A Rasch model for partial credit scoring. In: *Psychometrika*, Jg. 47, S. 149–174.
- Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning science through inquiry in kindergarten. *Science Education*, 92, 868–908.
- Wilson, Mark (1992): The ordered partition model: An extension of the partial credit model. In: *Applied Psychological Measurement*, Jg. 16, H. 4, S. 309–325.
- Wu, M.; Adams, R. J.; Wilson, M. (1997): *ConQuest: Multi-Aspect Test Software*. Camberwell: Australian Council for Educational Research.

PAPER PRESENTATION

A multimodal analysis on consistency and item effect on children's astronomical conceptions

Cinzia Ronchi, Roma Tre University, Italy; Paola Perucchini, Roma Tre University, Italy

The present research was focused on analyzing consistency in children's understanding about the Earth, day-night cycle and seasons and on detecting if such conceptions could be affected by the item kind, as some authors suggested (Siegal et al., 2004; Vosniadou et al., 2004; Nobes et al., 2005; Straatemeier et al., 2008).

We found that primary school children express consistent conceptions about the shape of the Earth, as Vosniadou and Brewer (1992) previously found, while only a few of them held consistent conceptions about gravity. Similarly, not many children expressed consistent conceptions about day-night cycle and the seasons' cycle.

We also found that the item kind could affect children's responses, since it resulted that children generally scored significantly better after a forced-choice item than after an open-ended item for all investigated conceptions, as Siegal (et al., 2004) and Nobes (et al., 2005) argued. Children also scored significantly better further to item containing a factual question than an inferential question and further to item based on a geocentric perspective than on an external-to-Earth perspective, except for season's cycle conceptions.

In the current debate about conceptual change in astronomy domain, three main theoretical perspectives are present, each one elaborating an explanation about the nature and the development of children's ideas and about the proper instruments to investigate them. Authors following the mental models perspective (Vosniadou and Brewer, 1992; 1994; Samarapungavan et al., 1996) argue that children held a few consistent mental models built on the basis of experience and that only by reinterpreting the entrenched preconceptions which originated such models a child can understand the scientific model. On the contrary, authors following the fragmented knowledge approach (diSessa, 1998; Nobes et al., 2003; Nobes et al., 2005) claim that children's knowledge is initially constituted by unconnected pieces of knowledge, deriving from simple abstractions of everyday experience, and that the gradual acquisition of culturally-accepted scientific pieces of information would create links and connections until arriving to the consistency of the scientific notion. Authors following the contextual-based perspective (Caravita and Hållden, 1994; Shultz et al., 2001; Larsson and Hållden, 2009) suggest that conceptual development may be seen not only in terms of a concept substitution, but also as a possible coexistence of both intuitive and scientific conceptions in child's conceptual structure, who gradually would learn to use them consistently across different contexts (Caravita and Hållden, 1994; Larsson and Hållden, 2009).

With reference to the assessment methods, studies following the mental models perspective (Vosniadou and Brewer, 1992, 1994; Samarapungavan et al., 1996; Vosniadou et al., 2004; 2005) generally use a semi-structured interview protocol, mainly constituted by generative open-ended questions – also called inferential by Lightman and Sadler (1993) – which would allow the researcher to discover the mental model which is behind child's responses. Authors following the fragmented knowledge approach usually use forced-choice questioning methods based on adapted versions of Vosniadou and Brewer's original interview protocol (Siegal et al., 2004), or on multiple choice of images (Nobes et al., 2005; Straatemeier et al., 2008). Since from these last studies results show a much higher percentage of scientific conceptions than in Vosniadou and Brewer (1992), they argued that the mental models could be in some way connected to an open-ended questioning method or to the poor child's ability in drawing (Nobes et al, 2005). Vosniadou (et al, 2004) explained such differences by assuming that in the case of an open-ended method children's task is to elaborate an explanation, while in the case of a forced-choice method it is simply to recognize the correct responses between different alternative, and does not imply deeply understood it.

Most of the reviewed research investigating children's consistency and item influence concerned the Earth, while a few studies focused on day-night cycle. We did not find any research focusing on consistency and item effect in children's conceptions about seasons' cycle. It could be therefore interesting to compare consistency in conceptions expressed by children about the Earth, day-night cycle and seasons, and to understand if the modality of assessing could affect such conceptions.

Aims of the present study are:

(a) to determine if children's understanding of the Earth, day-night cycle and the seasons is made of consistent conceptions or unconnected pieces of knowledge; (b) to analyze the possible influence of the questioning methods in children's conceptions.

The sample was constituted by 199 primary school children, divided in 5 groups: 39 first-graders (16 female and 23 male, mean age 6,9); 37 second-graders (13 female and 24 male, mean age 7,9); 45 third-graders (24 female and 21 male, mean age 9); 36 fourth-graders (18 female and 18 male, mean age 9,8); 42 fifth-graders (19 female and 23 male, mean age 10,7). All children came from a school located in the suburb of Rome, Italy.

Children were administrated by a 22 item paper-and-pencil test, created on the basis of existing literature (Vosniadou and Brewer, 1992-1994; Baxter, 1989; Lanciano, 1996; Nobes, Martin and Panagiotaki, 2005; Straatemeier et al., 2008; Perucchini and Ronchi, 2008). The test allowed us to examine children's conceptions according to three aspects: the task, since some item required to make a draw or to choose an image; the question, since there were factual and inferential questions; the reference context, since some item were based on a geocentric perspective and other on an external-to-Earth perspective.

We analyzed consistency by comparing conceptual levels which appeared in all item investigating the same conception, and item influence by comparing conceptual levels which appeared according to the task, the question and the reference system.

In our study a big percentage of children consistently assigned the Earth the same shape across all the item of the test, while a lower percentage of them held a consistent conception about gravity. Children's consistency about Earth's shape significantly increased with age.

A little percentage of children held consistent conceptions about day-night cycle, and even if a higher percentage of children expressed consistent conceptions about seasons, such consistency significantly decreased with age.

Our results on consistency are therefore only partially in line both with Vosniadou and Brewer (1992; 2004) and Nobes and colleagues (2003; 2005) because even if children were mostly consistent about the shape of the Earth, their conceptions about day-night cycle and seasons were substantially inconsistent. Consistency in children's conceptions about seasons even decreased with age.

Concerning item effect, we found that children had higher scored when assessed with a choice-of-images item than with drawing-item and these results may confirm Nobes's hypothesis (et al., 2005) of a connection between the appearance of mental models and the poor child's ability in drawing. We also found that children generally showed more advanced conception when received a factual question than an inferential question, confirming therefore Siegal (et al., 2004) and Nobes (et al., 2005) findings. Moreover, children scored significantly better to item based on a geocentric perspective, while there was no difference in the case of seasons according to the reference system.

PAPER PRESENTATION

Attention and working memory as predictors of the formal thinking and school achievement

Risto Hotulainen, University of Helsinki, Finland; Helena Thuneberg, University of Helsinki, Finland; Jarkko Hautamaki, Helsinki University, Finland; Minna Kyttala, University of Turku, Finland

Our ability to remember locations in space (visuo-spatial working memory) and our ability to direct attention to those locations (attention) are two fundamental and closely related to developing cognitive processes. These developing cognitive processes can be seen within the Piagetian tradition as transitions through different levels of cognitive operations. These abovementioned variables are shown to make contributions to learning both by themselves and by meditating through other introduced variables. In our study we examine these effects by gender and age variation. The sample consisted of ninth-graders (N = 112, n=47 males, n=65 females; mean age 15,26 years) from 7 classes in the capital area in Finland. The path analyses showed the most powerful single predictor of the school achievement is cognitive thinking level. Regardless of the fact that attention and working memory both contributed outcome measures: attention effected both working memory and school achievement, and working memory cognitive thinking, in general, they added very little to the predictive validity supplied by cognitive thinking. Age predicted negatively both school achievement and especially in cognitive thinking indicating that the older students were having lower values. The schools have not been able to cover good-mentioned late start. In practice, the delayed start of the school should not be used and accordingly effective prevention and other interventions, especially cognitive ones, are needed.

Summary 1.

Introduction

In this study we present a framework in which we show how attention and working memory contribute cognitive thinking and accordingly school achievement. We assume that attention as measured in easy, prolonged working tasks presents measure of fundamental attentional capacity (Smit & Ven 1995, cf. Spearman 1927). In such meaning, attention should have corresponding effect on both working memory and cognitive thinking. Cognitive development was conceptualized as formal operational thinking, and more specifically on control variable schemata (CVS). The Neo-Piagetian criterion-based methodology has proved to be effective, and the operational thinking stages have been shown to have relevance on cognitive development of adolescence (Adey et al., 2007; Kuhn, 2008; Shayer, 2008).

1.1 School achievement and formal operational thinking. The effect of intellectual factors, measured by traditional intelligence tests on achievement have been confirmed (Gottfredson, 2002; Freudenthaler et al. 2008). Previous

studies have analyzed whether girls have higher scholastic achievements after the effect of the cognitive factor is controlled (Gibb & al., 2008). Here we use CVS as an indicator cognitive thinking when studying parallel effects.

1.2 Improving prediction by using measure of attention Attention is considered to be crucial for learning and it is also claimed to be an important factor of intelligence (Ven 2001). Here we use Attention Concentration Test (ACT) based on the Binocular rivalry theory (Ven et al. 2005) based on the basic assumption, that during the performance of any mental task the subject actually goes through a series of alternating states of distraction (non-work) and attention (work). Acquired measure by the ACT could be considered to be a high-order mental function which affects cognitive processes such as working memory and executive ones, and, thus, connects study of attention to Piagetian study of formal thinking (cf. Russell 1999).

1.3 Improving prediction by using measure of working memory (spatial). According to Baddeley's framework (1986), working memory (WM) both processes and stores information for a short time. Studies have shown that working memory tasks highly predict academic performance in various fields (Holmes & Adams, 2006; Jarvis & Gathercole, 2003). WM is also very closely related to both attention (Kane et al. 2006) and g (Demetriou, et al. 2010).

2. Aims of the study

In the current study, we examine whether variation in cognitive thinking and/or school achievement were each specifically associated with processing variability in working memory (visuo-spatial) and attention tasks. Moreover, the aim was to explore, whether the formal operational thinking equally strongly affected the achievements of boys and girls along with age-effect control. The research questions were:

1. What are the effects of attention and WM (visuo-spatial) on school achievement and CVS?
2. What is the relationship between CVS and school achievement?
3. What is the effect of gender or age group on school achievement and CVS?

3. Methodology and Participants

The sample consisted of ninth-graders (N = 112, n=47 males, n=65 females; mean age 15,26 years) from 7 classes in the capital area. About age variation in Finland: children should start school during the year when they turn seven. Parents of the child are allowed to apply change of the entry year according to psychological tests. There are relatively larger shares of immigrant students than native students among over-aged. Repetition of the class is rare, but possible.

Instruments

The Formal Operations Test is a test of scientific reasoning which measures the mastery of a control of variables. It is a second-generation modified group-version (Hautamäki 2000) of the original Science Reasoning Tasks, The Pendulum (Shayer & Wylam, 1978) based on one of the Inhelder-Piaget identified formal schemata (Inhelder & Piaget, 1958). In the test subjects are comparing F1 drivers, cars, tires and race tracks. Visuo-spatial working memory was measured with matrix task which is based on the tasks created by Wilson, Scott, and Power (1987). The task is expected to probe non-verbal working memory and was used to assess rather passive, short-term storage of simultaneous visuo-spatial information. The Attention Concentration Test (ACT) primarily measures attention or more specifically the attention of concentration (variation of series of reaction times). The test is based on the three assumptions: 1) knowledge should not play a part in the final test score: only simple problems should be used; 2) differences in previous experience with the task should not be allowed, 3) temporal feelings should not play a part: multiple trials. The test is computer-based.

School Achievement referred here as a GPA was an index of school achievement and was computed as a mean of school subjects common to all study subjects.

Analysis procedures

The path analyses were done with the AMOS statistical package (Version 16.1, Muthén and Muthén 1998-2007). The goodness of overall fit of the estimated models was evaluated by four indicators: χ^2 -test, CFI, RMSEA. 4. Findings The predicted model (attention – working memory – CVS – GPA – age – gender) emerged according to theory. Attention predicted ($\beta = .21$) WM (visuo-spatial) and WM predicted CVS ($\beta = .19$) and CVS grade point average (GPA) ($\beta = .52$). Attention predicted ($\beta = .18$) GPA. WM did not predict the GPA rather, its effects were fully mediated by CVS, resulting in a moderate overall prediction (GPA $R^2 = .35$). Age predicted negatively CVS ($\beta = -.36$) and gender (female = 2) predicted ($\beta = .19$) GPA. The resulting model fit the data well ($\chi^2 = 12.01$, $df = 9$, $p = .213$, CFI = .954, RMSEA = .055).

5. Conclusions

In this study we tried to introduce attention and WM (visuo-spatial) as predictive variables for CVS and GPA. The most powerful single predictor of the GPA is CVS. In general, attention and WM scores add very little to the predictive

validity supplied by CVS. Age had negative effect on CVS and GPA. The older students were behind both of the outcome measures. The schools have not been able to cover good-mentioned late start. In practice, the delayed start of the school should not be used and accordingly, more effective before school prevention and other academic interventions, especially cognitive ones, are needed.

PAPER PRESENTATION

Increasing anonymity in peer assessment using an electronic voting system

Ellen Vanderhoven, Ghent University, Belgium; Annelies Raes, Ghent University, Belgium; Tammy Schellens, Ghent University, Belgium

Students involved in peer assessment often state that they don't feel entirely comfortable with publicly evaluating their peers and peer-pressure might cause stress and a lack of accuracy of the assessment. Consequently, anonymity within peer assessment is an issue to consider. This study explores the use of classroom response technology, i.e. the electronic voting system TurningPoint, as a tool for anonymous peer assessment in higher education. Students had to score each others presentations on different criteria with infrared handset transmitters. The aggregated totals of votes were displayed as immediate feed[®]back. The technology appeared to be well-liked by the students. They especially liked the immediate visual feedback and they could also appreciate the fact that they could give their feedback anonymously. Moreover, they also reported to be less influenced by their peers in giving their scores than they were in traditional peer assessment. These results implicate that the use of a classroom response system as a tool for peer assessment can reduce peer pressure by making anonymous and immediate feedback possible in the classroom.

Theoretical background

The notion of assessment, which stresses the learning process and not only the result, is becoming more and more important in education. Different kinds of innovating forms of assessment have arisen, like self-assessment, peer-assessment and co-assessment. These forms of assessment has been shown many advantages.

In this study we will focus on peer assessment. Research has indicated that peer assessment assists students to create higher quality performances, as a consequence of better understanding of assessment criteria which they use when they play the role of assessors (Smith, Cooper, & Lancaster, 2002; Topping 2003). Moreover peer assessment has proven to be an accurate way of assessment, with high correlations between the ratings of peers and those of teachers (Dochy & Segers, 1999). Yet there have been some conditions put forward to guarantee this high accuracy, such as the presence of unambiguous criteria on which to evaluate (Nancy Falchikov & Goldfinch, 2000) and a necessary training in peer-assessment (Slujsmans, Brand-Gruwel, & van Merriënboer, 2002).

Nevertheless Stepanyan, Mather, Jones and Lusuardi (2009) pointed at a disadvantage of peer-assessment. They found that students experience more stress, because they don't feel entirely comfortable with publicly evaluating their peers. Peer-pressure might also cause a lack of accuracy of the assessment (N. Falchikov, 2003; Sung, Chang, Chang, & Yu, 2010).

In this respect, anonymity of the assessor is an important issue to consider because it is found that students are often concerned about that (Draper & Brown, 2004; Stepanyan et al., 2009). However, anonymous assessment within a face-to-face classroom setting is difficult to orchestrate whereas Stepanyan and colleagues (2009) pointed out that the allocation of marks and in-class activities are important in encouraging student involvement. Consequently anonymity within in-classroom peer assessment has rarely been researched.

Classroom response technology, e.g. the electronic voting system TurningPoint, may provide a solution to these given objections. A classroom response system is a system used in a face-to-face setting to poll students by means of individual infrared handset transmitters. The aggregated totals of votes are displayed as immediate feed[®]back. In this way, within peer assessment students can anonymously and immediately submit their score for every given assessment criterion. In this study we will go into the use of classroom response technology as a tool for peer assessment and more in particular we will focus on the impact of anonymity on reducing peer pressure and feeling comfortable with this kind of evaluation.

Methodology and Participants

Participants in this study were 58 third year Bachelor students in Educational Studies at Ghent University. Their mean age was 20,33. Most of them were female (87,5%). They participated as part of an obligatory course. All of the students had already been involved in traditional peer assessment.

Procedure

Students first had to make a set of criteria for evaluation in consultation with their teacher and then got a training in using them. Afterwards, during three consecutive weeks, students had to give presentations, which were evaluated by their peers using this criteria. The classroom response system, i.e. TurningPoint was used to score (1-5) every criterion. Finally, a questionnaire was administered about the students' experiences and attitudes toward peer-assessment using the classroom response system (items used a 5-point Likert-scale).

Results & Discussion

Students liked the use of TurningPoint for peer assessment. They especially liked the immediate visual feedback ($M=4.07$, which differs significantly from the neutral 2.5 on a 5-point Likert scale, $t(57)=15.53$, $pt(57)=13.09$, $pt(57)=11.08$, p

These results implicate that the use of a classroom response system as a tool for peer assessment can reduce peer pressure by making anonymous and immediate feedback possible in the classroom. The visual feedback is well-liked by students as well. In ongoing research, we are further examining the effects of anonymity in terms of accuracy of the scores and quality of the feedback.

References

- Bloxham, S., & West, A. (2004). Understanding the rules of the game: marking peer assessment as a medium for developing students' conceptions of assessment. *Assessment & Evaluation in Higher Education*, 29(6), 721 - 733.
- Dochy, F., & Segers, M. (1999). The Use of Self-, Peer and Co-assessment in Higher Education: a review. [Article]. *Studies in Higher Education*, 24(3), 331.
- Falchikov, N. (2003). Involving students in assessment. *Psychology Learning and Teaching*, 3(2), 102-108.
- Falchikov, N., & Goldfinch, J. (2000). Student Peer Assessment in Higher Education: A Meta-Analysis Comparing Peer and Teacher Marks. *Review of Educational Research*, 70(3), 287-322.
- Pope, N. K. L. (2005). The impact of stress in self- and peer assessment. [Article]. *Assessment & Evaluation in Higher Education*, 30(1), 51-63.
- Sluijsmans, D. M. A., Brand-Gruwel, S., & van Merriënboer, J. J. G. (2002). Peer Assessment Training in Teacher Education: Effects on performance and perceptions. *Assessment & Evaluation in Higher Education*, 27(5), 443 - 454.
- Smith, H., Cooper, A., & Lancaster, L. (2002). Improving the Quality of Undergraduate Peer Assessment: A Case for Student and Staff Development. *Innovations in Education and Teaching International*, 39(1), 71 - 81.
- Stepanyan, K., Mather, R., Jones, H., & Lusuardi, C. (2009). Student Engagement with Peer Assessment: A Review of Pedagogical Design and Technologies Lecture Notes in Computer Science, 5686, 367-375.
- Sung, Y.-T., Chang, K.-E., Chang, T.-H., & Yu, W.-C. (2010). How many heads are better than one? The reliability and validity of teenagers' self- and peer assessments. *Journal of Adolescence*, 33(1), 135-145.
- Topping, K. J. (2003). Self and peer assessment in school and university: Reliability, validity and utility. In M. Segers, F. Dochy, & E. Cascallar (Eds.), *Optimizing new modes of assessment: In search of qualities and standards* (pp. 55-87). Dordrecht: Kluwer Academic.

PAPER PRESENTATION

Financial literacy of adolescents: Setting the course for a competence-based assessment instrument

Carmela Aprea, Swiss Federal Institute for Vocational Education and Training, Germany

In modern economies, financial literacy, i.e. the ability to reasonably use financial resources, is becoming more and more essential not just for professionals in the sector of investment and banking but for everyone who is responsible for managing financial affairs in everyday life. However, citizens seem not to be very well prepared with respect to the prevailing demands. Thus, the promotion of financial literacy remains a core concern for every educational system. This, in turn, presupposes the availability of adequate tools which allow identifying existing learning needs. The research to be presented here addresses this need by exposing the conceptualisation as well as the drafting and the results from a field-testing of an instrument for assessing financial literacy of adolescents. The conceptualisation of the instrument is funded on a competence-oriented perspective as well as on action regulation theoretical and knowledge psychological approaches. Based on these considerations, in-depth task analyses were carried out and used to develop a draft questionnaire, which was then handed out to a total of 198 students from 8th and 9th grade of four secondary schools. Students' answers were submitted to psychometric item analyses as well as to descriptive and inferential statistical analyses. The results of these analyses indicate an acceptable fit of the current questionnaire. Additionally, they clearly point out students' weaknesses regarding the components of financial literacy. However, given the preliminary status of the research and the relatively small and restricted sample, cautious interpretations as well as further validation of the instrument are needed.

In modern economies, financial literacy, i.e. the ability to reasonably use financial resources, is becoming more and more essential not just for professionals in the sector of investment and banking but for every person who is responsible for managing his or her financial affairs in everyday life. This increasing importance of financial matters is mainly driven by diverse socio-economical factors which are currently challenging most of the European (as well as other industrialized) countries, and which, among others, include structural changes in the financial services and in the labour market, residualisation of the welfare state and demographic change (e.g., Reifner, 2006). However, other than required, citizens of all ages seem not to be very well prepared to effectively cope with the prevailing financial demands, as for example a research study from the OECD (2005) as well as several national or regional surveys conveyed (e.g., Lines & Schagen, 1996). Especially for the poor, this gap between the overarching significance of financial questions on the one hand, and their deficient preparedness on the other, has the potential to further divide them from their more fortunate fellow-citizens. Given this extremely undesirable and politically charged state of affairs, the promotion of financial literacy remains a core concern for every educational system. This necessity, in turn, presupposes the availability of adequate tools which allow identifying existing learning needs. Against this background, the aim of this paper is to expose the conceptualisation as well as the drafting and the results from a first field-testing of an instrument for assessing financial literacy of adolescents. These research activities are part of a research project which is focused on the development and validation of such an instrument,^[1] and particularly incorporate the following theoretical considerations and methodological courses of action, respectively:

(1) The conceptualisation of the intended assessment instrument should not only be free from commercial interests and ideological biases, but – first and foremost – also be based on a theoretically and pragmatically sound specification of the underlying construct. As scholars in the field of financial literacy (e.g., Pang, 2010) recently suggested, this specification should be considered from a more holistic stance, i.e. not only focus on single and detached knowledge portions but integrate behavioural, cognitive, motivational and attitudinal facets. In order to take account of this issue, we decided to adopt a competence-oriented perspective as expressed for example by Weinert (2001). Moreover, we espoused pertinent action regulation theoretical (e.g., Miller, Galanter & Pribram, 1960) as well as knowledge psychological approaches (e.g., Anderson & Krathwohl, 2001). With reference to these sources, we conceive financial literacy as a domain-specific potential that enables a person to effectively plan, execute and control financial activities. As such, it is based on the availability of individual dispositions, i.e. (different kinds of) knowledge, motivations and attitudes etc. In order to further substantiate this first construct definition, we did not only review already available tools for diagnosing financial literacy but also conducted an in-depth task analysis, which led to (a) a refined description of the sequential and hierarchical structure of the different phases of financial activities, and (b) an elaborated characterisation of the cognitive, motivational and attitudinal demands that these phases impose.

(2) Based on these analytical steps, a first draft of an assessment questionnaire was created. This questionnaire is divided into six parts (A-F) and contains subjective (i.e. self-reporting) questions on adolescents' perceived relevance of financial matters (A), their current financial situation (B) and their financial attitudes (C) as well as objective (i.e. performance test) items concerning their ability to effectively cope with the planning, execution and controlling demands of financial activities, including the respective knowledge and skills (Part D-F). The objective test items were inspired by an authentic assessment approach (e.g., Dochy, 2001) and were embedded in a sequence of realistic financial decision tasks. Both, the products of the task-analysis described above and the draft questionnaire were cross-validated by two content experts (one business school teacher and one lecturer in financial economics).

(3) In order to check the feasibility and comprehensibility of the questionnaire as well as to obtain a first validation of the instrument, the draft version was submitted to a field-testing. In this testing, a total of 198 students from 8th and 9th grade of four lower-level (n=101) and mid-level (n=97) secondary schools in Baden-Wuerttemberg (Germany) were involved. This target group is of specific interest with respect to financial literacy, since most of the students are expected to soon start an apprenticeship, and thus will be in charge of financial independence and responsibility. About one half of the participants were female and their age ranged from 14 to 17 years. According to the curricula, all of them should have mastered the basic (e.g., mathematical) prerequisites necessary to answer the test items. The compilation of the 16 page questionnaire took place during normal classes and encompassed about 60 minutes. Students' answers were submitted to psychometric item analyses. Moreover, descriptive and inferential statistical analyses were conducted. Except for a few items, the results of these analyses indicate a quite acceptable fit of the current questionnaire. Additionally, they clearly point out students' weaknesses regarding the components of financial literacy (e.g., compound computation of interest, risk assessment).

Given the preliminary status of the research and the relatively small and restricted sample, cautious interpretations as well as further validation of the instrument are needed. In the long term, however, the research data should be able to inform curriculum and instructional design as well as educational policy in European countries.

References

- Anderson, L. W., & Krathwohl, D. R. (2001). *A Taxonomy for Learning, Teaching, and Assessing*. New York: Longman.
- Dochy F. (2001). Educational assessment. In N. J. Smelser, & P. B. Baltes (eds.). *International encyclopedia of the social and behavioral sciences*. Oxford: Elsevier Science.
- Lines, A., & Schagen, S. (1996). *Financial literacy in adult life*. Slough: NFER.
- Miller, G. A., Galanter, E., & Pribram, K. A. (1960). *Plans and the structure of behaviour*. New York: Holt, Rhinehart, & Winston.
- OECD (2005). *Improving financial literacy*. Paris: OECD Publishing.
- Pang, M. F. (2010). Boosting financial literacy: benefits from a learning study. *Instructional Science*, 38(6), 659-677.
- Reifner, U. (2006). *Financial literacy in Europe*. Baden-Baden: Nomos Verlagsgesellschaft.
- Weinert F.E. (2001). Concept of competence. In L. H. Salganik (ed.), *Defining and selecting key competencies*. Seattle: Hogrefe, 45-65.

[1] The project was initiated at the University of Mannheim (Germany) and is to be expanded to Switzerland. The author wishes to specifically thank Ms. Dipl.-Hdl. Julia Holderbach who was involved in the project during her diploma thesis.

PAPER PRESENTATION

The 'mixed bag' of electronic portfolios: Can they be a form of standardized assessment?

Eva Bures, Bishop's University, Canada; Alexandra Barclay, Mount St. Vincent University, Canada; Philip Abrami, Concordia University, Canada; Elizabeth Meyer, Concordia University, Canada; Vivek Venkatesh, Concordia University, Canada

This study explores electronic portfolios' potential to assess student achievement across diverse classrooms, as do standardized tests including the Canadian Achievement Test (CAT). Assessment tools to measure SRL and literacy were developed and their inter-rater and validity were explored. The tools were applied to portfolios across two years, with $n=369$ participants in grades 4, 5 and 6. The tools included a holistic rubric which assigns a mark from 1 to 5 to SRL and literacy, and an analytical rubric measuring multiple sub-scales of SRL and literacy. During the first year Cronbach's alpha ranged from 0.70 to 0.79 for literacy and SRL overall, but some sub-scales were unacceptably weak. Preliminary results from the second-year analyses show improvement in Cronbach's alpha overall and especially for the sub-scales, partially reflecting improved implementation of the portfolios. Validity was explored by comparing the relationship of portfolio scores to other measures, including the government scores on the CAT4s, the scores we assigned to the CAT4s using our assessment tools, and scores on the SLSQ. The first year portfolio literacy scores correlated ($p<0.01$) to scores we assigned the CAT4s using our assessment tools, and to government preCAT4 scores, but the self-regulatory learning scores did not correlate to our measure of student's self-regulation.

Aims

One exciting aspect of technological pedagogical evolutions for assessing students are electronic portfolios: they can measure learners' literacies, content knowledge, and self-regulatory skills. As institutions lean away from standardized assessment, portfolios are appealing because they allow learners to choose work that showcases their learning. Portfolios may be a more accurate reflection of students' achievements at university (Chambers & Wickermsham, 2007; Zeichner & Wray, 2001) and at K-12 (Barrett, H. 2007). This study explores how to assess electronic portfolios across diverse elementary classrooms, investigating the potential of EPs as an alternative form of standardized assessment. PerspectivesPortfolios allow more authentic assessment than traditional paper-and-pen tests, which may not reflect the student's real abilities (Herman, 1992; Reeves, Herrington, Oliver, & Woo, 2004). EPs allow learners to substantiate their abilities by selecting evidence, reflecting real-life practices (Stiggins, 2002; Frey & Schmutt, 2007). Portfolios allow students to demonstrate the development of their literacy. EPs additionally allow learners to represent their understandings in multiple ways including voice and audio recordings, fitting with evolving conceptions of literacy (Carbonara, 2008). EPs may be linked to a learner's ability to self-regulate their learning (Wade & Abrami, 2005; Zeller & Mudrey, 2007; Hillyer & Ley, 1996). Self-regulated learners are individuals who are metacognitively, motivationally, and behaviourally active participants in their own learning (Zimmerman, 2002). To assess portfolios the literature recommends teacher/student portfolio conferences and rubrics. Numerous rubrics have been developed but inter-rater and validity are rarely explored. Can we develop assessment tools which provide

consistent results such that EPs from diverse classrooms could be assessed, offering an alternative form of standardized testing?

Research Questions:

- 1) Do our assessment tools have inter-rater reliability?
- 2) Do our assessment results correlate to other measures of literacy and SRL skills?

Research Methods & Participants

Participants are volunteer students in grades 4, 5 and 6 across several Canadian provinces whose parents have signed consent forms. Portfolios were created across two years, 2007-2008 and 2008-2009. During year one, a range of implementation was observed within 7 experimental classes ($n=149$). Our analyses drew on 3 classes where both SRL and literacy were assessable, $n=53$. In the year 2008-2009 the portfolios were better integrated so all schools were included in the analysis ($n=220$). Some individual portfolios were excluded, leaving $n=198$ portfolios in analyses. Data Sources The key data source are the EPs. All portfolios are made using ePEARL, a tool designed at the Centre for the Study of Learning and Performance (CSLP). See: <http://grover.concordia.ca/epearl/promo/en/epearl.php> The CAT-4 is the current version of the Canadian Achievement Tests (CAT). One part aims to measure literacy through 2 open-constructed tasks. The Student Learning Strategies Questionnaire (SLSQ) developed at the CSLP measures students' learning strategies.

Consultants.

Feedback from consultants was received via e-mail.

Design

This classroom-based research draws on qualitative and quantitative approaches. Tools were developed to assess the portfolios across several classrooms, exploring their inter-reliability and validity. Each portfolio is double-coded and the inter-rater reliability is explored. The same tools are applied to the CAT4s. Validity is explored looking at the relationship of portfolio scores to other measures, including the government scores on the CAT4s, the scores we assigned the CAT4s, and scores on the SLSQ.

Results and Discussion

After a preliminary attempt and failure, the tools were re-designed with feedback from literacy and assessment consultants from Quebec, Alberta and Manitoba and in light of our results. The completed tools include both a holistic analysis of literacy and SRL and an analytical rubric with 7 writing sub-scales and 3 SRL sub-scales. See Figure 1.

Inter-rater reliability:

We found a range of Cronbach Alpha scores in the high 70's for literacy and SRL. (Table 1). The SRL sub-scales show issues especially with strategies and reflection but this improves. (Table 2.) The literacy sub-scales display problems with two categories, 'voice' and 'organization and sentences,' which improved considerably in 2008-2009. (Table 3).

Validity of Literacy Assessment

Do our assessment tools relate to other measures of literacy? Our analyses are not complete for 2008-2009. For 2007-2008, the holistic scores for literacy correlated (p The rubric portfolio scores for literacy correlated to the holistic and rubric scores we assigned the CATs ($r=.603$ and $.479$ respectively). The holistic and rubric portfolio scores correlated to government pre-CAT scores ($r=.550$), but not the post-CATs.

Validity of Assessment of SRL

Do our assessment scores relate to other measures of SRL? Neither the holistic nor the rubric portfolio scores for SRL correlated to the SLSQ. The scores for SRL in the portfolios correlated to various measures of literacy. The holistic scores correlated to the holistic scores we gave the CAT4s ($r=.425$). Both holistic and rubric portfolio scores for SRL correlated to the pre-CAT4 government scores ($r=0.465$ and $r=0.593$ respectively).

Scholarly Significance

Inter-rater reliability is adequate and the validity is somewhat supported by our preliminary results. The second year data demonstrates markedly improved implementation. Nonetheless, our findings suggest it is advisable when judging portfolios across diverse classrooms to double-code the portfolios and discuss discrepant cases. The inconsistency of work in the portfolios remains troublesome: What score does one assign a 'mixed bag' such as the portfolio? We are currently exploring whether coding only the 'presentation' space improves the validity of the portfolio scores as it may better represent students' final achievements. Less traditional means of 'standardized assessment' beg the question of how to fairly assess them. The experience of coding the CAT IV's where the task demands and time constraints were

held constant contrasted sharply to coding EPs, but the very fact that the prompts are diverse and that students choose their own unique pieces is why this type of assessment compels us.

PAPER PRESENTATION

Transformations between different forms of representations in mathematics – analyzing students' ability

Marion Geiger, Ulm University, Germany; Ulrike Stradtman, Ulm University, Germany; Markus Vogel, University of Education Heidelberg, Germany; Tina Seufert, Ulm University, Germany

In mathematics learners have to deal with different forms of representations and more over with different levels of abstraction. Hence, learners often have to transform one type of representation into another one. In our study we investigated whether students with different educational background (middle or high level school, university; $n=129$) have difficulties with transformations between different sign systems (depictive or descriptive representations) and between abstract mathematical representations and real-world representations. Moreover we analyzed whether it is especially difficult to switch from one direction to the other or vice versa and we wanted to find out which type of representation is the most difficult to produce. With a set of 19 tasks in the mathematical domain of linear functions where one representation in a specific format had to be produced based on a given one in another format we analyzed the accuracy in form and content of the produced representations. We found that learners have especially problems when they have to transform between different levels of mathematical abstraction. Transformations between different sign systems were not difficult per se but depended on the type of representation that had to be produced. Especially the production of text or formulas had been difficult. The deficits were comparable for learners with different educational background, with the exception that university students struggled most with transformations between sign systems and considerably with verbalizations or abstractions in formulas. Overall, it seems fruitful to further investigate the processes of transformation and to develop instructional means to help students.

Introduction

In mathematics different representations like graphs or formulas play an important role. The effective use of multiple representations, i.e. the construction of an integrated mental model of the representations, can lead to deeper understanding. However, this requires to understand each representation as well as to integrate them, i.e. in many cases to translate between descriptive and depictive representations. Moreover, in mathematics learners often have to switch between the abstract mathematical and the real world, for example when word problems have to be solved by using a formula or a mathematical graph. A large amount of empirical research shows that learning with multiple representations is often difficult (Ainsworth, 1999) and even leads to lower learning outcomes than learning with single representations. This could be due to problems with the integration process and especially with the transformation process. In our study we analyzed transformation processes in the domain of mathematics. The aim was to find out which transformation process is most challenging and which representation is most difficult to produce. We assumed that based on empirical findings on learning with multiple representations and a pre-study on transformations in mathematics (Seufert, Vogel & Brýnken, 2008) learners will have difficulties with both types of transformation processes.

Method

To test our hypotheses we developed 19 tasks in the mathematical domain of linear functions for all types of transformations. Learners were given for example a graph and were asked to produce the formula of the underlying linear function. Before the test started, all learners were given basic information about linear functions in order to avoid prior knowledge effects. As dependent variable we evaluated the produced representations with regard to their form (e.g. correct labeling of the coordinate system) and content accuracy (e.g. right slope of the line). In a within-subject design we analyzed whether tasks with different requirements led to different results. To allow a broader generalization of the results we analyzed students with different educational background (46 eighth-grade students from middle-level school (A), 43 ninth-grade students from higher level school (B) and 40 natural-science-students from University (C); total $n = 129$).

Results

For transformations between mathematical and real-world-model we found a main effect in both subsamples A and C and by trend for subsample B: The tasks with transformation were more difficult than tasks without. Moreover we found that the change from mathematical to real-world model was more difficult than vice versa (for all results see table 1). Looking at the tasks with transformations between descriptive and depictive representations we found that university students had more difficulties to solve tasks with such a transformation whereas school students had more difficulties with tasks without transformation. Overall, we found for all subsamples that students had more difficulties

to solve tasks with a change from depictive to descriptive representations than vice versa. The analysis for different types of representation that had to be produced revealed the most interesting result: Especially the production of texts and formulas has been difficult in contrast to graphs and tables.

Summary and Discussion

Overall, we found that especially school students had enormous problems in transforming different types of representations. For half of the tasks the probability of task solution was less than 60%. Moreover, we found almost no differences between students of different educational level. However, despite our theoretical assumptions the difficulties were not that closely related to the type of transformation. Especially transformations between different sign systems seem to challenge learners with different background in a different way. It seems more important what type of representation had to be produced. Here we found that all learners (and especially university students) struggled with the production of text and formulas, i.e. with verbalisations or abstractions. Transformations between different abstraction levels also turned out to be difficult for all learners which support other findings from maths studies (see Vogel et al., 2006). As a next step we want to develop instructional aids for transformation with a special focus on the verbalization of the meaning of different mathematical representations.

References

- Ainsworth, S.E., (1999) A functional taxonomy of multiple representations. *Computers and Education*, 33(2/3), 131-152
- Seufert, T. (2003). Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13, 227-237.
- Seufert, T., Vogel, M. & Brýnken, R. (2008). Translation processes in learning with multiple representations - problem analyses in mathematics. *International Perspective in the Learning Sciences: Cre8ting a Learning World. Proceedings of the Eighth International Conference for the Learning Sciences - ICL 2008 (Volume 3; pp. 298-300). International Society of the Learning Science, Inc., Utrecht.*
- Vogel, M. (2006). *Mathematisieren funktionaler Zusammenhänge mit multimedibasierter Supplantation*. Hildesheim: Franzbecker. (Mathematical model of functional relationships with multimedia-based supplantations.)

PAPER PRESENTATION

An investigation on Chinese teachers' realistic problem solving ability and beliefs

Limin Chen, Shenyang Normal University, China , China; Wim Van Dooren, K.U. Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Fourteen word problems - half of which were problematic from a realistic point of view - were administered twice to 208 pre-service elementary school teachers from Shenyang Normal University in China. First, the teachers were asked to solve the word problems themselves, and, afterwards to evaluate different pupil answers to the same problems. The results revealed, first, that these future teachers behaved remarkably realistically not only when solving these problematic word problems themselves, but also when evaluating the pupils' answers. Second, we found a strong relationship between teachers' own problem solving performance and their evaluations of pupils' answers. We end this contribution with some theoretical, methodological and educational implications of the research.

Recent studies have provided ample evidence for a phenomenon whereby elementary school pupils, and even (pre-service) teachers, solving word problems in school, often produce answers without regard for realistic constraints (Greer, 1993; Verschaffel, De Corte & Lasure, 1994; Verschaffel, Greer, Van Dooren & Mukhopadhyay, 2009). The present study with Chinese pre-service teachers, which replicates Verschaffel, De Corte, and Borghart's study (1997), provides further insight into one of the instructional factors that are considered responsible for the development of this tendency among children, namely the teachers' own ability to solve these problems realistically and their beliefs about the role of real-world knowledge and realistic considerations in school mathematics. Because there is ample evidence that different countries are characterized by different classroom cultures and practices (Cai & Hwang, 2002), and because the teacher is a pivotal factor in the establishment of the classroom and practice, Verschaffel et al. (1997) made a strong plea for replicating their study in other countries.

In the present study, a problem solving test consisting of 14 word problems - half of which were problematic from a realistic point of view - and a corresponding problem solving questionnaire were administered to 208 pre-service elementary school teachers from Shenyang Normal University in China. The following problem is an example of such a problematic item: "John's best time to run 100 meters is 17 seconds. How long will it take him to run 1 kilometre?". A typical non-realistic answer (NA) to this item is " $17 \times 10 = 170$ seconds"; examples of realistic answers (RA) are "more than 170 seconds, because John will run slowly by slowly during running 1000 meters." or "it is impossible to give a

precise answer, because I don't know John's average velocity of running 1000 meters" (Verschaffel et al., 1997). In the problem solving test the teachers were asked to solve the word problems themselves, whereas in the problem solving questionnaire they had to evaluate different pupil answers to the same problems by giving them a 1, $\frac{1}{2}$ or 0 score. These pupil answers always included the typical NA and a typical RA (see Enclosure 1). The administration of the test and the questionnaire and the data analysis were done in the same way as in the original study of Verschaffel et al. (1997).

Compared to the student-teachers from the study of Verschaffel et al. (1997), Chinese pre-service teachers firstly behaved much more realistically while solving the problematic items themselves. Indeed, 76% of all reactions to the seven problematic items could be considered as realistic, which is considerably higher than the percentage of realistic reactions (48%) that Verschaffel et al. (1997) observed for Flemish pre-service teachers. Secondly, compared to their Belgian counterparts, Chinese pre-service teachers' evaluations of pupils' realistic and non-realistic reactions to the same problematic items also revealed a more positive attitude toward pupils' reactions that involved realistic considerations. Specifically, in 70% of cases did the RA receive a score of 1 (versus only 47% in the Flemish study); 11% of the RAs received a $\frac{1}{2}$ -score and in only 19% of the cases the RA was scored with a 0. On the other hand, the NA was scored with a 1 in only 23% of the cases (versus 56% in the Flemish study), whereas 55% and 22% of the NAs received respectively a $\frac{1}{2}$ - and 0-score. Thirdly, there was a rather strong relationship between teachers' own performance on the problem solving tests and their evaluations of pupils' realistic and contextually inappropriate reactions in the questionnaires. Most participants who answered a problematic item in a non-realistic manner themselves tended to score the non-realistic pupil answer with 1 and the realistic answer with 0 in the problem solving questionnaire; and those who answered a problematic item in a realistic manner themselves had a very strong tendency to score the realistic answer with 1 and the non-realistic answer with $\frac{1}{2}$ or 0 in the problem solving questionnaire.

We end this contribution with some theoretical, methodological, and educational considerations.

First, although this study shows a strong link between how the pre-service teachers solve word problems themselves and how they evaluate pupils' answers, it reveals also how various kinds of pedagogical content knowledge and beliefs interfere in this relationship and make this link less simple and straightforward than one might expect at first sight. In this respect, we emphasize that we did not assess (pre-service) teacher's actual evaluation behaviour in a real classroom, but only a kind of simulation of this important part of their teaching task. It would, therefore, be interesting to investigate how (pre-service) teachers actually react to different kinds of pupil responses in the dynamic complexity of a real classroom situation.

Second, Chinese pre-service teachers behaved much more realistically towards problematic word problems than their Flemish counterparts. At the same time we know, from previous research (Verschaffel, Greer & De Corte, 2000; Verschaffel, Greer, Van Dooren & Mukhopadhyay; 2009) that Chinese elementary school pupils do not behave more realistically to the same problems than their Western peers. This raises the intriguing question for further research of how to explain the weak results of Chinese pupils, if they can't be explained by teachers' weak realistic problem solving capacities and beliefs. Alternative explanations referring to the broader (mathematics) educational contextual constraints wherein these teachers have to operate (Cai & Nie, 2007), might then help to explain what emerges from these contrastive data.

Finally, even though the Chinese (pre-service) teachers demonstrated a relatively strong tendency towards realistic problem solving, still a quarter of all problematic items was solved non-realistically during the problem solving test. So, it remains recommendable to further stimulate and help Chinese (pre-service-) teachers to construct the proper concepts, skills, and beliefs that are needed for realistic problem solving in the teacher training program.

PAPER PRESENTATION

Students' reported reasons for their representational choices in linear-function problems

Ana Acevedo Nistal, K.U.Leuven, Belgium; Eva Ceulemans, K. U. Leuven, Belgium ; Wim Van Dooren, K.U. Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

This study aimed at obtaining a comprehensive picture of students' justifications for their representational choices when solving linear-function problems. Thirty-six students aged 14-17 took a computerised test in which they solved twelve linear-function problems by selecting a table, a graph, or a formula to solve each problem. Then, each student solved three more problems (parallel to those in the computerised test) during a videotaped interview in which they were asked to think aloud while problem solving, and to justify their representational choices. A cluster analysis grouped students in four distinct clusters with regards to their representational choices in the computerised test: formula-only, table-only, graph + formula, and graph + table. The interview protocols showed that students of all four

groups tended to base their choices on subject-related reasons (e.g. their perceived fluency with the different representations) and context-related reasons (e.g. their mathematics teacher focusing on the use of formulae for problem solving). Students did not often report specific task characteristics as influencing their choices, which suggests that they might have not been aware of differences between tasks and how these relate to different representations. Further research is suggested in the form of an intervention aimed at actively encouraging students to reflect on their representational choices while solving linear-function problems. Such an intervention could reveal whether active reflection on representational choice actually improves the chances of students making more appropriate representational choices.

Aims

As Diezmann and Lowrie (2009) explain, the twenty-first century citizen is exposed to diverse quantitative data (stock-market prices, government budgets, etc) presented in various representational formats (tables, graphs, etc). Not surprisingly, teaching students to interact with external representations is an important goal in today's mathematics education. In a previous study (Acevedo Nistal, Van Dooren, Clarebout, Elen, & Verschaffel, 2010) we adopted the choice/no-choice method (Siegler & Lemaire, 1997) to evaluate students' representational choices while solving linear-function problems. While this study provided valuable information concerning the impact of representational choices on problem-solving performance, students' reasons to make specific choices remained unclear. This study aimed at obtaining a more comprehensive picture of the cognitive processes underlying representation selection:

Which reasons do students report to justify their representational choices?

Based on a literature review of previous work on representational choice (Acevedo Nistal, Van Dooren, Clarebout, Elen, & Verschaffel, 2009), we expected students' reasons to relate to three categories: task (e.g. choosing a particular representation because of characteristics of the to-be-solved problem), subject (e.g. avoiding a representation because of one's low fluency with it), and context (e.g. selecting a representation because the mathematics teacher uses this representation the most).

Methodology

Thirty-six students aged 14-17 took a computerised pretest. They solved twelve linear-function problems about the concepts of slope, y-intercept, and intersection between two functions. To solve each problem, students had to choose a table, a graph, or a formula. Three days later, students were interviewed. During the interview, which was videotaped, they solved three problems parallel to those in the pretest while thinking aloud. For each problem, the student selected his preferred representation, justified his choice, and finally solved the problem with that representation. This procedure was repeated two more times until the student had solved the problem with all three representations

Findings

A cluster analysis of the pretest data revealed four distinct clusters with regards to representational choice: formula-only (n=3), table-only (n=16), graph +formula (n=9), and graph+table (n=8).

Formula-only cluster(n=3)These students' main reason to choose the formula was subject-related: They believed they were proficient with it. However, in reality only two students were actually proficient (75% accuracy with the formula in the pretest), but not the third (25% accuracy). Surprisingly, this group did not show a preference for the formula in the interview despite doing so in the pretest. One student argued that tables and graphs are more appropriate to explain how to solve a problem (i.e. in the interview), whereas the formula is more appropriate to actually solve the problem (i.e. in the pretest). Clearly, her choices were influenced by context-related reasons.

Table-only cluster(n=16)Subject-related reasons were also the most popular here (n=10), e.g. "I understand tables very well, and that's why I trust them the most". This group displayed 80% accuracy with the table in the pretest, so their perception about their table fluency was accurate. Only four students reported task-related reasons to choose the table – in an intercept problem, three mentioned that they expected to find a 0-point in the table; in a slope problem, one student remarked that he could easily find the increment per unit in the y-column.

Graph+formula cluster(n=9)Three students reported task-related reasons to justify their choices – for intersection problems they preferred the formula, for the other problems the graph. Two students reported subject-related reasons (e.g. "I prefer to work with formulae in general"), one by context-related reasons (e.g. "In class we use the formula much more often than the other two"), and three by a combination of subject and context-related reasons (e.g. "We work more often with formulae. I get to practice more, that's why I am better at them").

Graph+table cluster(n=8)Two students referred to task-related reasons to justify their choices (e.g. "The problem asks you about the relationship between two variables, that's why I chose the table"). The remaining six students invariably referred to subject-related reasons to explain their preference for graphs and tables (e.g. "I am good at using graphs, that's why I chose it"). None of the students in this cluster mentioned context-related reasons.

Theoretical and educational significance

Adopting a combination of quantitative and qualitative methods to study problem solving with external representations allowed us to explore the reasons that (reportedly) underlie students' choices. This study revealed that students do not always have a realistic conception of their own fluency with representations, which may lead them to misjudge their chances of solving a problem with a specific representation. Students do not often report task characteristics as influencing their choices, and this could actually mean (at least in some cases) that they are not aware of differences between tasks and how these relate to different representations. This could be partially due to the fact that, in Spain, mathematics instruction traditionally focuses on using formulae for problem solving, regardless of problem type. Further research could be conducted in the form of an intervention where students could be encouraged to reflect on their representational choices, the purpose being to evaluate whether such reflection improves students' chances of making more appropriate representational choices in subsequent problems.

References

- Acevedo Nistal, A., Van Dooren, W., Clarebout, G., Elen, J., & Verschaffel, L. (2009). Conceptualising, investigating, and stimulating representational flexibility in mathematical problem solving and learning: A critical review. *The International Journal of Mathematics Education*, 41, 627-636.
- Acevedo Nistal, A., Van Dooren, W., Clarebout, G., Elen, J., & Verschaffel, L. (2010). Representational flexibility in linear-function problems: A choice/no-choice study. In L. Verschaffel, E. De Corte, J. Elen, & T. De Jong (Eds.), *Use of representations in reasoning and problem solving*. UK:Routledge.
- Diezmann, C. M., & Lowrie, T. (2009). The role of fluency in a mathematics item with an embedded graphic: interpreting a pie chart. *The International Journal on Mathematics Education*, 41, 651-662
- Siegler, R. S., & Lemaire, P. (1997). Older and younger adults' strategy choices in multiplication: Testing predictions of ASCM using the choice/no-choice method. *Journal of Experimental Psychology: General*, 126, 71-92.

PAPER PRESENTATION

Low attaining children's understanding and use of the additive composition principle

Chronoula Voutsina, University of Southampton, United Kingdom

The paper presents findings from a project which aimed at exploring low attaining children's sensitivity to problem relationships based on additive composition and possible variations in children's understanding and capability to use such relations in problem solving. Fifteen 6-7 year-old children solved conceptually related and unrelated addition problems in individual sessions. All problems involved single-digit additions up to 20 with two or three addends ranging between 1 and 9. Conceptual relations between problems were constructed to reflect aspects of the principle of additive composition. Children's understanding of additive composition relations was explored by analysing children's strategy use and explanations of the equality between conceptually related problems. The findings indicate high within-group variation in children's capability to recognise and use numerical relations between problems. Children who used mainly basic calculation procedures were able to explain retrospectively why two problems had the same answer by recognising the numerical, part-whole relations between problems. Prompting children to use a previously solved problem did not have a considerable effect in children's noticing of the numerical relations but the requirement to explain the problem equality evoked greater sensitivity to additive composition relations. The findings highlight the need for pedagogical approaches that enable low attaining children to operationalise their capabilities into their learning.

Background

Understanding of the additive composition principle, that is, knowing that numbers can be decomposed in different parts which can then be recombined in different ways in order to create the whole is fundamentally linked to children's mathematical achievement (Cowan 2003). Canobi et al. (1998) found that children's ability to spontaneously recognise additive composition relationships when solving conceptually-linked addition problems is useful in defining conceptual understanding. The researchers concluded that for the children who failed to recognise problem relationships, "insensitivity to relationships may lead to a reliance on inefficient problem-solving strategies that, in turn, may restrict their opportunities for development in conceptual understanding" (p. 890). This paper reports

findings from a project that sought to answer the research question: to what extent the reported insensitivity to additive composition relations is a unifying characteristic of children who typically use inefficient strategies?

Methods

The current pilot study aimed at examining low attaining children's sensitivity to problem relationships based on additive composition. The participants were fifteen 6-7 year-old children (8 girls, 7 boys) attending Year 2 classes in four inner-city schools in southern England. Near the end of Year 2 the children had been assessed by their teachers as working within the National Curriculum sub level 1c which is below the average expectation (The National Curriculum 1999).

In individual video-recorded sessions children solved twelve pairs of conceptually-linked addition problems and six pairs of unrelated problems. All problems involved single-digit additions up to 20 with two or three addends between 1 and 9. For example, in pairs of related problems $8+5=$ was followed by $8+4+1=$; and $5+2+4=$ was followed by $7+4=$. Each problem was presented on a 5cm'20cm laminated card. Once solved, the first problem remained visible while the second problem was presented. Canobi et al.'s (1998) problem solving and judgement tasks were adapted to develop a single task in which children were prompted to notice and use numerical relations not only through the problem structures but also through the interviewer's instructions. The children were asked consistently to look at the previously solved problem and think how they could use it to solve the current problem.

Children's counting and non-counting strategies were classified following Geary's (2003) typology of addition strategies. We ascribed the 'equality' approach to children who reported that they solved a problem by noticing the numerical relations and equality between that and a previously solved related problem. $5+6+1=$ was presented to Kyle after solving $5+7=$. He said: " It's the same, 12, ?cause that's 5 and 5 (shows 5 as first and second addend in both problems) and 6 add 1 I know is 7 and that's 7" (shows 7 in preceding problem). Report of the 'equality' approach was used as a measure of conceptual understanding. When, despite being prompted, children did not refer to a related problem but used other methods (e.g. counting), the researcher asked them to explain why they thought the two problems had the same answer. Children's ability to explain the equality between problems by referring to the numerical relations was used as a second measure of understanding additive composition. Children's use of the 'equality' approach in related problems and explanations of the equality between problems are reported below.

Outcomes

Despite the prompts, children reported the use of the 'equality' approach in only 19.4% of their answers. Its emergence indicates the ability of some of the children to use, when prompted, a concept-based approach.

Figure 1 (appendix). Percentages showing individual children's use of 'equality' as solving approach and explanations for the equality between problems when 'equality' had not been used.

The graph shows that the majority of children were able to recognise additive composition relations when explaining the equality between problems, even when they had not used these. Mina solved $5+7=$, using counting-on with fingers from 5. When presented with the related problem $5+6+1=$, she used counting-on from 5 again. When asked to explain why the two problems had the same answer she explained: "You've got 5 and 7 (shows the first sum) and you've got 5 there again (shows the 5 in the $5+6+1$) and 6 and 1, Oh! that's... 6 add 1 is 7, isn't it? It is 5 add 7 (shows the first sum) and that's 5 add 7 if you stick them together! (shows the 6 and 1 in the second sum)". Our data indicate high within-group variation in children's capability to recognise and use numerical relations between problems. Children who used mainly basic calculation procedures were able to explain retrospectively why two problems had the same answer by recognising the part-whole relations between problems.

Discussion

Within the context of the same task, prompting children to use a previously solved problem did not have a considerable effect in children's noticing of the numerical relations. Conversely, the requirement to explain the problem equality seemed to evoke greater sensitivity to additive composition relations. Sophian (1997) discussed differences between competence and performance on the basis of children's cognitive goals and the changing nature of these as children grow older. Children's changing sensitivity to additive composition relations could perhaps be explained on the basis of triggering a change or development of goals. On these grounds, differences in cognitive goals could explain performance differences within the same-age group and not only between younger and older children. Given the dynamic relation between conceptual knowledge and goal-based activity (Sophian, 1997), future research needs to explore more widely the aforementioned suggestion and the extent to which educational activities can shape low attaining children's goals to support their learning.

References

- Canobi, K.H. Reeve, R.A. and P. E. Pattison. (1998). The role of conceptual understanding in children's addition problem solving. *Developmental Psychology*, 34, 5, 882-891.
- Cowan, R. (2003). Does it all add up? Changes in children's knowledge of addition combinations, strategies and principles. In *The development of arithmetic concepts and skills*, ed. A.J. Baroody and A. Dowker, 35-74. Mahwah: LEA.
- Department for Education and Employment. (1999). *The National Curriculum*. London: DfEE and QCA.
- Geary, D.C. (2003). Learning disabilities in arithmetic: problem-solving differences and cognitive deficits. In *Handbook of Learning Disabilities*, ed. H.L. Swanson, K.R. Harris, and S. Graham, 199-212. NY: The Guilford Press.
- Sophian, C. (1997). Beyond competence: the significance of performance for conceptual development. *Cognitive Development*, 12, 281-303.

PAPER PRESENTATION

Changing the way students interpret the phenomenal sign of algebraic expressions

Konstantinos P. Christou, University of Crete, Greece; Stella Vosniadou, National and Kapodistrian University of Athens, Greece

The purpose of the present study was to investigate the effect of a short intervention in the form of direct instruction on the remediation of the phenomenal sign bias in algebra. The phenomenal sign bias is students' tendency to interpret the phenomenal sign of algebraic expressions to be the actual sign of the numbers they can only represent (i.e., $2x+1$ stand only for positive numbers, $-2x-1$ stand only for negative numbers). We interpret this phenomenon to be a by-product of students' tendency to interpret literal symbols to stand for natural numbers only (Christou & Vosniadou, in press). In the present study a short instructional intervention was based on the principles of direct instruction and also using the refutational argumentation methodology. Refutational argumentation consists of directly stating students' erroneous conceptions and then refuting them, using specific examples and counter examples. The participants were 20 10th graders. Students' phenomenal sign bias errors were measured before, immediately after the intervention and one month later, using mathematical tasks from the domain of algebraic inequalities, square root functions, and absolute values. The results showed that the students performed significantly better in the immediate post-test compared to the pre-test, but not in a delayed test conducted after a month. In addition, the high achieving students profited more by the intervention than the low achievers. The value of short term direct instruction for producing conceptual change learning will be discussed.

Purpose and theoretical considerations

The aim of the present study was to investigate the effect of a direct, refutational type, instructional intervention on the remediation of the phenomenal sign bias in the way students interpret algebraic expressions, and to test of the robustness of this bias. The phenomenal sign bias lies in students' tendency to interpret the phenomenal sign of an algebraic expression not as a superficial characteristic of its form but as the actual sign of the numbers that the expression represents. In other words, students tend to think of expressions such as $2x$ to stand for positive numbers only, and expressions such as $-2x$ to stand for negative numbers only.

Previous research has shown that from an early age students have organized their conceptions about number into a framework theory of number which resembles the mathematical concept of natural number (Ni & Zhou, 2005; Vosniadou, Vamvakoussi, & Skopeliti, 2008). Students' framework theory of number affects their beliefs about what numbers are and how they behave (Vosniadou, et al., 2008). Previous studies have showed that students' initial framework of number affects the way they interpret the use of literal symbols to stand for variables in algebra. More specifically, the students tend to think of literal symbols to stand for natural numbers as opposed to any real number (Christou & Vosniadou, in press). As a result, they interpreted the algebraic expression $4g$ to stand for natural numbers multiplicatives of 4, or expressions such as a/b to stand only for positive fractions. Recent studies also showed a tendency on the part of the students to think of positive-like algebraic expressions to stand for positive numbers only and negative-like expressions to stand for negative numbers only, namely the phenomenal sign bias. We have argued that students' phenomenal sign bias is probably related to students' tendency to interpret literal symbols to stand for natural numbers only (Christou & Vosniadou, in press).

If the phenomenal sign is a byproduct of the whole number bias, then it would be difficult for students to overcome, because, as other studies have shown, removing the whole number bias is a difficult and time consuming process (Ni & Zhou, 2005). However, it could also be argued that the phenomenal sign bias is not a deep seated bias but, rather,

that it is caused by an oversight on the part of the students, a rather casual error. If this bias is a casual oversight, then a short, direct-type of instruction intervention should be adequate to remedy it.

A direct instruction/refutational lecture intervention

The direct instruction was organized around the refutational argumentation methodology. This methodology tries to alert students about their inadequate existing ideas, it argues against them, and it proposes another perspective which is presented as more adequate. Research has shown that such methodologies are effective on increasing students' metaconceptual awareness which supports learning that requires the revision of inadequate initial conceptions (Palmer, 2003). The teaching intervention had the form of a lecture which was designed using the main principles of direct instruction. More specifically, it used clear definitions of the concepts, examples and counter examples to denote the phenomenal and the actual sign of the expressions, and also specific strategies were suggested such as to try with as many different kinds of numbers as possible in order to check the sign of an expression.

Method

The participants were 20 10th grade students. The phenomenal sign bias was measured with three multiple choice questionnaires: a pre-test before the intervention, a post-test immediately after the intervention, and a delayed post-test one month after the intervention. The questionnaires included tasks from the domain of square root functions, algebraic inequalities and absolute values. The direct instruction refutational lecture took place in students' classroom by one of the researchers and lasted about 20'.

Results and Discussion

The results showed significant differences between the pretest and the immediate posttest. The students made significantly fewer mistakes due to the phenomenal sign bias in the posttest (Wilcoxon Signed Ranks Test: $Z=2.074$, p Wilcoxon Signed Ranks Test: $Z=2.310$, p , but their performing rates were maintained high in the delayed test. Overall, the results of the present study support the view that the phenomenal sign bias is robust, is based on the more general whole number bias, and that it is not easy for students to overcome. Teaching interventions like the one we used can be helpful on the remediation of such biases. However, for more permanent results, that would affect also the low achievers, instructional interventions should take a more long term perspective and try to enrich students' concept of number from the narrow focus on whole numbers to rational and real numbers.

References

- Christou, K. P., & Vosniadou, S. (in press). Transitioning from arithmetic to algebra: Interpreting literal symbols as representing natural numbers. *Mathematical Thinking and Learning*.
- Ni, Y., & Zhou, Y.-D. (2005). Teaching and learning fraction and rational numbers: The origins and implications of whole number bias. *Educational Psychologist*, 40(1), 27-52.
- Palmer, D. H. (2003). Investigating the relationship between refutational text and conceptual change. *Science Education*, 87, 663-684.
- Vosniadou, S., Vamvakoussi, X., & Skopeliti, E. (2008). The framework theory approach to conceptual change. In S. Vosniadou (Ed.), *Handbook of research on conceptual change* (pp. 3-34). Mahwah, NJ: Lawrence Erlbaum Associates.

PAPER PRESENTATION

A new one-year intervention program for 4-year-old children with low numeracy: first results

Pekka Rasanen, Niilo Maki Institute, Finland ; Minna M Hannula-Sormunen, University of Turku, Finland;
Aino Mattinen, Niilo Maki Institute, Finland; Erno Lehtinen, University of Turku, Finland

There are still very few evidence-based remedial programs for children at the age of 3 to 5 years, which would include one of the key components in thinking and cognition: numeracy.

"The Teddy Bear Math" was designed to be an easily implementable once a week group program with the aim to improve children's numerical skills and executive functioning. The program contains weekly small group session, bridging to daily life, as well as materials for co-operation with parents.

A four months pilot study with 24 children with mild cognitive delay was conducted. Children were divided into two subgroups: 14 (mean age 4 years) started from the first phase of the program and 10 (mean age 4.7 years) from the phase two of the program. Children were divided into these groups based on the pre test results. A post-test and a delayed post-test (5 months) were used. The effectiveness of the intervention was analysed with three summary

scores: (1) numerical skills and (2) executive functioning (working memory and comprehension) as target skills, and (3) Phonological-linguistic skills as a control measure. There was a significant improvement in numerical skills and executive functioning (p

Aims

The aim of this study was to get information about specific effects of a new intervention program designed to improve 4 to 5 year old children's numerical and cognitive skills. "The Teddy Bear Math" (TBM) was designed to be an easily implementable once a week group program with the aim to improve children's numerical skills and executive functioning. The program contains a small group session, bridging to daily life, as well as materials for co-operation with parents.

The theoretical background of the program rests on the socio-cultural views of teaching-learning interaction within the proximal zone of development (e.g. Rogoff, 1990; Vygotsky, 1978). The structure of the program and its activities remind those found in several enrichment programs (e.g. Ashman & Conway, 1989; Feuerstein, Rand, Hoffman & Miller, 1980; Greenberg, 2000; Haywood, Brooks & Burns, 1992). The main difference is that in the TBM training of more general learning prerequisites is done in the context of early number skills (Mattinen, Räsänen, Hannula & Lehtinen, 2008).

Methodology

In this first (pilot) study only an experimental group was used. To analyse the immediate intervention effects, improvement from pre-test to post-test (intervention) was compared to that from post-test to delayed post-test (no-intervention). The logic of this kind of a comparison comes from the findings that for children with cognitive difficulties long-lasting intervention effects would require maintenance and without this a decline in improvement can be found (Ramey & Ramey, 1998). Therefore we expected a larger improvement effect during the intervention than in an as long time period after it without any maintenance activities.

Participants

The day-care personnel who were given a short checklist type of cognitive skills analysis did the initial selection. After this a thorough assessment was done and 24 children were selected to the study: 14 of them (mean age 4.0 years) started from the phase 1 of the TBM program and 10 (mean age 4.7 years) from the phase 2. Both phases last 5 months. The children were divided into groups of 4 and trained assistants from their own day-care centres conducted the intervention sessions.

Assessments

Three scores were used to analyse the intervention effects. Numerical skills and executive functions were the target variables and phonological-linguistic skills were a control variable, i.e. area where intervention effect was not expected. The tasks and their reliability are presented in Table 1.

The numerical tasks were experimental, all other cognitive measures were from the NEPSY: A Developmental Neuropsychological Assessment battery (Korkman, Kirk, & Kemp, 2008) and were presented in a standard fashion.

Findings

First we standardised all scores, calculated summary scores and from those we calculated standardised gain scores (later assessment – previous assessment / standard deviation of the first assessment). This score corresponds to Cohen d effect size. Due to a small sample size we used 99% as a criteria for a significant result.

Children's development both during the intervention and after it differed from 0 ($p F(4,19)=1.559, p = .226$) or after it ($F(4,19)=.820, p = .528$). Therefore the subgroups were combined in the last analysis.

We analysed whether there was more improvement during the intervention than after it without intervention. As can be seen from Figure 1. there was a large improvement in numerical skills and executive functioning ($d > .50$) during the intervention but only a small development in phonological-linguistic skills. The improvement in the first two cognitive skill areas was significantly larger during intervention than after it (p

Educational significance

The TBM program is the first attempt to develop remedial numeracy program for children with developmental cognitive delays. The first study on the effectiveness of the TBM program to improve numerical and more general cognitive skills gave promising results. However there would be many things that would increase the effectiveness of the program.

First, the intensity of the remedial program is critical factor. The TBM program has only one session a week. It might produce even better results if it were more intensive. However, this feature is a compromise between effectiveness and usability. Too intensive programs cannot be taken as a standard part of day-care activities.

Secondly, bridging the intervention into everyday life is a critical factor. The TBM program contains activities outside the weekly session. Likewise the program contains weekly letters to be sent home to activate parents to interact with their children on similar topics. Additional questionnaire data showed that only a small proportion of parents took constantly those ideas into reality. This is critical issue to be developed.

Third, more research is needed to find out the how the activities should be designed. The biggest problem in small group activities is to get everyone equally attentive and participatory. Analysing the videotaped sessions from this study helped us to modify many activities to the final version of the program, but training the day-care personnel is as critical.

Finally, controlled studies with larger groups are needed to confirm the effectiveness. Currently we are conducting a broader study with mathematical age and chronological age comparison groups with a control intervention. The early results of this broader study will also be shortly introduced in the presentation.

PAPER PRESENTATION

Factors influencing the acquisition of science knowledge in grade 4

Erzsebet Korom, University of Szeged, Hungary; Erzsebet Antal, University of Szeged, Hungary

This paper presents initial findings from a longitudinal study on a nationally representative sample. Launched in 2003, the study follows students through their time in public education (grades 1-12), collecting data on their development annually and in important areas. The first assessment of science knowledge took place in May 2007, when students arrived at the end of the foundation period of their education in grade 4. The sample included 4,428 students (from 113 schools and 220 classes). The science test targeted one element of science knowledge, namely, declarative knowledge, by focusing on the developmental level of the most important basic concepts. Analyses were performed to establish the extent to which cognitive and non-cognitive variables affect, determine, perhaps define later performance on the science test. No gender-related differences were found in performances. However, between-school differences were significant. From among the basic skills assessed in grade 1, elementary arithmetic proved to be the major predictor of grade 4 science acquisition levels. The greatest contributors to explaining the variance of performance on the science knowledge test were elementary arithmetic (15.6%) and inductive reasoning (14.2%), but considerable effects could be attributed to reading comprehension (11.9%) and mathematical reasoning as well (8.4%). These findings highlight the importance of thinking skills in the acquisition of declarative knowledge.

Summary

A fundamental objective in science teaching is that, as a result, students have a well organised knowledge, a scientifically based view of the world. One condition for this to happen is that they acquire basic scientific concepts, facts, relationships. A deeper understanding of the factors influencing conceptual development may contribute to curricular and methodological advancement. This paper presents initial findings from a longitudinal study, in which basic science knowledge is regularly assessed, and relationships are investigated between students' performance and other related information (e.g. their basic skills, reading, mathematical reasoning, inductive reasoning, academic attitudes, academic achievement).

Theoretical background

Research on concept formation and the acquisition of concepts is an important area where science education and cognitive developmental psychology overlap. A great body of data have been gathered on the processes of conceptual development and conceptual change in early childhood, their domain-specific characteristics, as well as the cognitive, affective and social factors that influence concept formation. The findings show a connection between the developmental level of thinking abilities and content/conceptual knowledge. There is also evidence that in conceptual development, in addition to cognitive factors, affective ones (mastery motivation, academic self-concept, and self-efficacy) also play an important role (Pintrich, Marx and Boyle, 1993). Students' performances are fundamentally affected by their knowledge, abilities, attitudes and the experiences, genetic inheritance (White, 1988; Biemans, Deel and Simons, 2001). Studies on the acquisition of science knowledge have mostly been cross sectional examinations, targeting different age groups and subject areas. Recently, longitudinal studies have been receiving more attention, because they offer the opportunity to follow students' development and also to diagnose problems in comprehension,

to predict difficulties in knowledge acquisition, and to analyse the effect of individual factors and the changes of influences in multifactor systems.

Objectives and research questions

This paper presents initial findings from a longitudinal study on a nationally representative sample. Launched in 2003, the study follows students through their time in public education (grades 1-12), collecting data on their development annually and in important areas. The first assessment of science knowledge took place in May 2007, when students arrived at the end of the foundation period of their education in grade 4. The sample included 4,428 students (from 113 schools and 220 classes). The science test targeted one element of science knowledge, namely, declarative knowledge, by focusing on the developmental level of the most important basic concepts. The test consists of two parts (biology and physics-chemistry) and involves both closed and open ended questions. The development of basic science concepts is measured biennially with expanding test-series.

Other test results, besides those of this knowledge test, are also available with this sample. At the beginning of the longitudinal project, in grade 1, the level of basic skill development was measured with the help of a diagnostic test system, including measures of social skills, writing movement coordination, relation vocabulary and deduction. Tests of mathematical thinking, knowledge in mathematics, reading comprehension and inductive thinking have been administered to the sample several times, beginning in grade 2. The test of knowledge in mathematics is adjusted to the subject-matter and the test of mathematical thinking primarily investigated proportional thinking. The test of reading comprehension measured information search and interpretation in continuous and discontinuous texts. The test of inductive reasoning contained subtests with number analogies, word analogies and sequences. In addition to the tests, background data was also collected on parents' qualification, sociocultural background, attitudes to school and school subjects and school achievement.

It was hypothesized that (1) no gender-related differences can be detected in the development of basic science concepts, (2) significant between-school differences can be found, (3) the level of basic science concept development is more closely related to other investigated cognitive factors (mathematical thinking, inductive thinking, text comprehension) than to the level of parents' qualification and (4) subtests of cognitive skills have different correlations with the results of the science test.

Results

The science test proved to be reliable (Cronbach's α : .94). The mean achievements on the test were satisfactory ($x=46.8\%$, $sd=18.7\%$), but the results of the two subtests were significantly different (physics-chemistry: $x=34.6\%$, $sd=18.8\%$; biology: $x=52.9\%$, $sd=20.7\%$). The comprehension of biology concepts were less difficult to the students. The analysis of conceptual development was presented in the previous EARLI conference, therefore this presentation concentrates on its relations with other variables. The findings supported our hypotheses: no gender-related differences were detected, but significant between-school differences were found. The mean achievements of schools covered a broad interval. The best and worst achieving schools reflected a difference of two standard deviations. Weak, yet still significant correlation was found with parents' qualification ($r=.24$) and medially significant correlations with level of basic skill development (writing movement coordination $r=.21$, relation vocabulary $r=.31$, experimental deduction $r=.33$, elementary arithmetic $r=.39$, sociality $r=.36$). Elementary arithmetic was the one of all the basic skills measured in grade 1 that prognosticated the level of science knowledge the most appropriately. Also, medially significant correlations were found with mathematics tests administered in grade 2 and 4 ($r=.38$, $r=.63$) and with mathematical thinking measured in grade 3 ($r=.55$). From all the tasks of text comprehension, science knowledge correlated most strongly with discontinuous text comprehension (poster, time-table) and with the operation of information interpretation. The degree of correlation was similar in all three cases of text comprehension measurements (in grade 2, 3 and 4). The closest connection was detected in case of the word analogies subtest in inductive reasoning ($r=.52$).

The greatest contributors to explaining the variance of performance on the science knowledge test were elementary arithmetic (15.6%) and inductive reasoning (14.2%), but considerable effects could be attributed to reading comprehension (11.9%) and mathematical reasoning as well (8.4%).

These findings highlight the importance and prognostic force of thinking skills in the acquisition of declarative knowledge. The data gained from further measurements might make it possible to observe the changes of influencing factors as well.

Literature

Biemans, H. J. A., Deel, O. R. and Simons, P. R. J. (2001): Differences between successful and less successful students while working with the CONTACT-2 strategy. *Learning and Instruction*, 11. 265-282.

Pintrich, P., Marx, R. W. and Boyle, R. A. (1993): Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research*, 6. 167-199.

White, R. T. (1988): *Learning science*. Blackwell Publishers, Oxford, UK and Cambridge, USA

PAPER PRESENTATION

DYAD-COMMUNICATION MODEL FOR REPRESENTING PARENT & CHILD INTERACTIONS

Orit Hetzroni, University of Haifa, Israel; Adi Neeman, University of Haifa, Israel

Aim:

The first interaction of a newborn is usually with the parents. Through this significant bond, the child practices interactions, which are the first building blocks in the development of communication and social skills (Harrist & Waugh, 2002; Bowlby, 1969). The purpose of this study was to investigate a proposed dyad-communication model designed to represent parent-child interactions, and compare between dyads of children with and without communication difficulties and their parents using representations based on a proposed model

Method:

5 parents of toddlers with communication difficulties and 5 parents of infants without communication difficulties were selected for the study. All intelligible communication behaviors produced by parent and toddlers were transcribed from videotaped sessions. Ten sessions were videotaped to record communication dyads between parent and child at their home environment. Video sessions were analyzed to assess dyads and to determine the efficiency of the model

Results:

Results demonstrate a significant difference in the observable pattern of dyadic interactions between parents and children with and without communication disorders, in synchrony and structure

Conclusion:

Understanding the uniqueness of the dyad between a parent and a toddler with communication disorders could lead to the development of suitable interventions in order to empower the dyad. Presenting the dyads in a model could enhance understanding of such communication and increase development of intervention processes

Introduction

The first interaction of a typically developing newborn is usually with parents. Through this significant bond, the baby practices interactions, which are the first building blocks in the development of communication and social skills (Harrist & Waugh, 2002). These significant bonds, called Dyads, are defined as a mutual relationship that is usually based on verbal communication (Fonagy, Gergely & Target, 2007). Dyads are typically represented in models describing behavior and affect. The majority of these models are derivatives of studies based on typically developing children. Unlike typically developing children, these individuals have great difficulties understanding and producing language and communication, which influence their abilities to interact and express needs. Inability to experience vocal interaction affects opportunities to practice language and develop communication skills. Infants and toddlers that do not produce sound, engage in less significant interactions with the environment (Downing, 1999). Such limited interactions present fewer opportunities for feedback which may gradually decrease parental interactions (Danon-Boileau, 2006). As a result, receptive language skills are in danger as infants and toddlers engage less in communicative acts and decrease practicing their listening, which in turn reduces understanding of their needs (Mercer-Young, & Hauser-Cran, 2006). Such scenarios portray inefficient communication and restrictions that evolve into limited parent-child dyads. Communication is the basis of any relationship; the child begins to understand the world while developing communication skills, integrating in social acts and manipulating the environment. These experiences assist the child's development and dyad building with parents (Gowlett, 1994). It is strenuous and often unfeasible to attain a good dyad when one of the partners has difficulties in conveying messages. Poor dyads between infants and parents can delay development of emotional, psychological, and cognitive aspects later in life. (Brazelton & Cramer, 1990). The purpose of this study was to investigate a proposed dyad-communication model designed to represent parent-child interactions, and compare between dyads of children with and without communication difficulties and their parents using representations based on the model.

Method

Ten parents of toddlers with and without communication difficulties were selected for the study. Toddlers ranged from 18 to 30 months, all diagnosed or suspected of significant language difficulties and a parent report indicating

difficulties in understanding their toddler. Infants ranged from 6-12 months with no apparent disabilities. All intelligible communication behaviors produced by parents and toddlers were transcribed from videotaped sessions using a software program created for this study that for recording continuity, tempo, and direction. Ten sessions were videotaped to record communication dyads between parent and child at their home environment. Sessions included free-play and pre-set sessions including games, feeding, and diaper change. Parents were encouraged to act freely with their child using naturally occurring activities. Video sessions were analyzed to assess dyads and to determine the efficiency of the model. Both populations were compared using the model to determine different patterns of communication. Two independent observers coded 20% of all video sessions. Reliability was established based on 90% accuracy level using inter-observer agreement.

Results

Results demonstrate a significant difference in the observable pattern of dyadic interactions between parents and children, with and without communication difficulties, both in synchrony and structure. Infants without communication difficulties had a similar number of communicative behaviors, initiations and responses as parents, including gestures, eye gaze, and voice acts. Many attempts were made by both communication partners, and most of them were acknowledged. All behaviors of the infants were presented in the model. More than 50% of communicational attempts of the infants were recognized by their parent and vice versa. Results demonstrate stability in Dyad continuity; a tempo of an average of 20 utterances responses per minute, and a unified form in the direction of the utterances. Interactions between toddlers with communication difficulties and parents revealed few interactions with a very limited range of behaviors, most of which were demonstrated by the parent. There were many gaps and misinterpretations of the communicative acts. All data were recorded and presented in the model. Results revealed diversity between dyads regarding the aspects of continuity, tempo and direction of the utterance. Dyads between toddlers with communication difficulties and their parents presented a slow rate of communicative behaviors and fewer occurrences of exchanges. Less than 50% of the communicative attempts presented by the toddler were recognized by the parent and vice versa. Continuity was poor, there was an average tempo of five utterances per minute, and the direction of the utterances between the parent and toddler and vice versa often had a non-unified form. When comparing between dyads, the main differences lay in the synchrony and structure with a significant difference in the dyad density considering continuity, tempo and direction of utterance transfer.

Discussion

There are a limited number of studies investigating communication as a dyad between a parent and an infant or a toddler with communication difficulties (e.g., Mercer-Young, & Hauser-Cran, 2006). The goal was to represent both dyads in the dyad communication model for obtaining a better understanding of the differences between the dyads. The current study revealed that there is a significant difference between dyads of parents and children with and without communication difficulties as represented in the model. Results demonstrate that infants without communication difficulties have a general smooth flow (Harrist & Waugh, 2002), while toddlers with communication difficulties presented dyads that were characterized with a disjointed style (Harrist & Waugh, 2002). Understanding the uniqueness of the dyad between a parent and a child with communication difficulties could lead to the development of suitable interventions in order to empower the dyad. Presenting the dyads in a model could enhance understanding of such communication and increase development of intervention processes. This presentation will address the theoretical and empirical data, and present the proposed dyad communication model.

Reference

- Brazelton, T. B., & Cramer, B. G. (1990). *The earliest relationship*. USA: Addison-Wesley Publishing Company INC.
- Danon-Boileau, L. (2006). *Children without Language*. (pp. 35-71). New York: Oxford
- Downing, J. E. (1999). *Teaching communication skills to student with severe disabilities*. Baltimore, Maryland : Paul H. Brookes Publishing Co.
- Fonagy, P., Gergely, G., & Target, M. (2007). The parent–infant dyad and the construction of the subjective self. *Journal of Child Psychology and Psychiatry*, 48, 288-328.
- Gowlett, J. A. J. (1994). *Communication and language*. London : Routledge.
- Harrist, A. W. ,& Waugh, R. W. (2002). Dyadic synchrony: Its structure and function in children's development. *Developmental Review* ,22, 555–592.
- Mercer-Young, J., & Hauser-Cran, P. (2006). Mother-child interaction as a predictor of mastery motivation in children with disabilities born preterm. *Journal of Early Intervention*, 28, 252–263.

PAPER PRESENTATION

Supporting students' strategy development for solving basic chemistry problems

Sascha Bernholt, IPN Leibniz-Institute for Science Education, Germany; Andrea Anschuetz, Universitat Oldenburg, Germany

Scientists use a precise language and domain-specific concepts and terms to grasp their ideas, share their thoughts, and solve problems. In addition, prototypical symbolic systems as chemical formulae are crucial for chemists, but also one of the most difficult and unpopular topics in chemistry education. Research indicates that novices and experts apply different strategies when interpreting chemical formulae.

In order to develop successful didactical approaches, more data and results about learning strategies and difficulties are required. A computer-based learning environment was developed to answer the questions, how students' strategies evolve over time and how different supporting tools can facilitate the formation or adjustment of strategies. Students (aged 10 to 13 years) responded to tasks that required the matching of formulae with their respective names and appropriate particle models (N=418). While working on the tasks, they had the chance to use different supporting tools. Students' performance in the learning environment was analyzed based on detailed logfiles. Additionally, students' strategies were extracted based on open-ended questions and interviews.

The results show that the quality of students' strategies increased slightly, but significantly over the course of the learning environment. The use of supporting tools increased answer probabilities, but learning gains are better predicted by strategy quality. Separate path analysis were conducted to investigate the contribution of the different supporting tools to students' development of strategies.

Theoretical background

Scientists use a precise language and domain-specific concepts and terms to grasp their ideas, share their thoughts, and solve problems (Krajcik & Sutherland, 2010). As scientific and everyday language partly interfere with each other, students often have difficulties in developing, applying, and interpreting specific aspects of scientific language. In addition, prototypical symbolic systems as chemical formulae are crucial for chemists, but also one of the most difficult and unpopular topics in chemistry education for students in school and even freshman students, as numerous studies revealed (Schmidt, 1997). In this particular case, problems are mainly referred back to students' difficulties in connecting different levels of representations (macroscopic, submicroscopic, symbolic/mathematical). However, these problems do not only pertain to the use of chemical formulae but to a large array of topics and concepts across the science domains (DeJong & Taber, 2007).

Research indicates that novices and experts apply different strategies when solving science problems (Williams & Noyes, 2007). Accordingly, strategy use is a major predictor for achievement in scientific problem solving situations (Taasobshirazi & Glynn, 2009). Different approaches, among these the use of analogies (Gentner & Kurz, 2006) or the use of worked examples (van Gog, Paas, & van Merriënboer 2004), were developed to support students' problem solving strategies.

Research method and design

In order to develop successful didactical approaches, more data and results about learning strategies and difficulties are required. Therefore, we focused at first on students in introductory chemistry courses as higher order thinking skills and complex problem solving activities require multiple strategies, leading to a large variety of individual pathways and solution methods. A computer-based learning environment was developed to answer the questions, how students' strategies evolve over time and how different supporting tools can facilitate the formation or adjustment of strategies.

Students (aged 10 to 13 years) responded to tasks which required the matching of formulae with their respective names and appropriate particle models (intervention time: 90 min; N=418). They were asked for the strategies they used to identify the underlying rules of this symbolic language after each of three difficulty levels within the learning environment (open-ended questions) and in additional interviews (N=8).

While working on the tasks, they had the chance to use different supporting tools. Scale and depth of the supporting tools increased, starting with a general hint to focus on a certain aspect or offering an analogy and ending with the proper answer including an explanation. The choice whether and which supporting tools are used was up to the students.

Students' performance in the learning environment was analyzed based on detailed logfiles (responses, use of supporting tools, reaction times, etc.). Different strategies were extracted with regard to their responses to the open-ended questions and the interviews. Additionally, the learning environment was framed by pre- and post-test to investigate students' learning gains.

Results

The results show that students without prior knowledge and training in chemistry classes are able to understand the basic characteristics of chemical formulae and simple particle models and enjoy working with them. The students expressed 25 indicators to match formula and names (partially combinations). These were categorized into six levels of strategy quality. Over the course of the learning environment, the strategy quality increased slightly, but significantly (one-way repeated-measures ANOVA, $\eta^2 = .98$, $F(1.96, 777.9) = 108.54$, $p < .001$). In addition, the quality of the applied strategy correlates with the obtained scores ($r = .22$, $p < .001$).

The assumption of increasing task complexity is confirmed by gradually declining answer probabilities. These can be raised considerably by the use of the different supporting tools. As expected, the increasing amount of information within the supporting tools (from a general hint to an explanation) resulted in increasing answer probabilities. However, the students' learning gains (standardized residuals from pre- to post-test) is not directly predicted by the general use of supporting tools but by the quality of their strategies (ANOVA, $F(5,412) = 1.64$, $p < .05$, $R^2 = .06$).

Separate path analysis were conducted to investigate the contribution of the different supporting tools to students' development of strategies and their obtained scores over the course of the learning environment. Satisfactory fit indices for the impact of the supporting tools on strategy quality and scores were revealed only for the model including "analogies" as supporting hints ($\chi^2/df = 1.52$, $p > .05$, CFI = .978, RMSEA = .34, AIC = 117,55).

The results show possible approaches to identify students' strategies when solving problems in a self-paced manner. However, further research is needed to develop descriptive and prescriptive models of student learning and their development of strategies. Further interviews accompanied by eye-tracking are currently in preparation to gain insights into students' course of action when working on formulae and submicroscopic structures. First results will be presented on the conference.

References

- De Jong, O. & Taber, K. S. (2007). Teaching and learning the many faces of chemistry. In S. K. Abell, N.G. Lederman, Handbook of research on science education (pp. 631-652). Mahwah, NJ: Lawrence Erlbaum Associates.
- Gentner, D. & Kurtz, K. (2006). Relations, objects, and the composition of analogies. *Cognitive Science*, 30, 609-642.
- Johnstone, A. H. (2010). You can't get there from here. *Journal of Chemical Education*, 87(1), 22-29.
- Krajcik, S. & Sutherland, L. M. (2010). Supporting Students in Developing Literacy in Science. *Science*, 328, 456-459.
- Schmidt H.-J. (1997). Students' misconceptions - looking for a pattern, *Science Education*, 81(2), 123-135.
- Taasoobshirazi, G. & Glynn, S. M. (2009). College students solving chemistry problems: A theoretical model of expertise. *Journal of Research in Science Teaching*, 46(10), 1070-1089.
- van Gog, T., Paas, F., & van Merriënboer, J. J. G. (2004). Process-oriented worked examples: Improving transfer performance through enhanced understanding. *Instructional Science*, 32(1-2), 83-98.
- Williams, D. J. & Noyes, J. M. (2007). Effect of experience and mode of presentation on problem solving. *Computers in Human Behavior*, 23, 258-274.

PAPER PRESENTATION

Dialogue, the social brain and creative thinking

Neil Mercer, University of Cambridge, United Kingdom; Karen Littleton, Open University, United Kingdom

Several fields of investigation, including developmental psychology, educational research and neuroscience, have begun to converge in stressing the essentially social quality of human creativity. Research has also begun to reveal the importance of certain forms of social interaction for the intellectual development of children as creative individuals. In this theoretical paper we will discuss the findings of such research for our understanding of creative processes and the role of interpersonal dialogue within them. Focusing particularly on the role of spoken language as a tool for collective and individual thinking, we will draw out implications not only for theoretical accounts of creativity, but also for educational policy and practice.

Taking a view of creativity as having a fundamentally and necessarily social basis, and in many cases being the outcome of an explicitly collaborative endeavour, this theoretical paper will offer new insights for our understanding of creative thinking and activity and how creativity can be promoted through education. It is essentially based on an extended version of sociocultural theory (the neo-Vygotskian perspective which is sometimes called 'cultural-historical activity theory'), but it also resonates with recent neuroscience research on the 'social brain' (e.g. Frith & Singer, 2008).

The paper will explore the growing body of work regarding how people act creatively together and it will draw on our own research data (and associated analyses) as part of this exploration. It will not focus solely on the processes of collective creative endeavour, but aims to reconcile them with notions of individual creativity. The suitability of sociocultural theory as a basis for understanding both individual and joint creative activity will be critically examined, by showing how such activity is predicated on the shared historical knowledge of communities and the use of language (as a cultural and psychological tool) which is used with other communicative tools for pursuing and achieving communal goals. Sociocultural theorists have argued that the relationship between social (intermental) and psychological (intramental) activity underpins cognitive development (Vygotsky, 1962), and we suggest that this relationship is also crucial to the success of creative endeavours.

One effect of the growing influence of socio-cultural theory in developmental psychology and educational research has been to bring closer together some previously separate strands of research, for example that on metacognition and self-regulation (e.g. Whitebread et al., 2007; Dignath et al., 2008) and that on collaborative learning and pedagogy (e.g. Howe, 2010; Mercer & Hodgkinson, 2008). Crucially, the paper will explain how concepts such as 'interthinking', the 'intermental development zone', and 'exploratory talk' (see for example Mercer and Littleton, 2007) can be used to develop sociocultural theory and so help shed light on the nature and significance of collective, creative thinking in real-life settings. In this context consideration will be given as to how space for dialogue can be opened up, extended and deepened – drawing on established ideas such as the importance of establishing and maintaining 'dialogic space' (Wegerif, 2010). Our theoretical discussion will be grounded in empirical examples from various settings including family homes, primary schools, art collectives, musical rehearsals and workplaces. A key focus will be how people use language (and other modes) to achieve creative solutions to problems, generate new ideas and produce new objects together. Thus our exploration will foreground the processes by which people not only appropriate ideas and their cultural heritage but: 'through their contributions to collaboratively undertaken activities, transform in small or large ways, the situations in which they act and the resources that mediate those activities, thereby opening up possibilities for transforming, even if only slightly, the culture as a whole' (Wells and Claxton, 2002 p.8). Our concern is thus with the renewal of culture as well as its reproduction. Furthermore, through our consideration of how people modify, refine and improve culturally valued resources we will explore a tension in socio-cultural theory: between education as enculturation and education for originality, creativity and autonomy. We will thus be discussing how the concept of creative agency can be reconciled with the predominant emphasis on appropriation and enculturation that is a central feature of socio-cultural theory (Wells and Claxton, 2002 p.8), and with recent ideas about the essentially social nature of human intelligence (the 'social brain').

A second focus will be on how an understanding of creativity as social and communicative, as well as cognitive, should influence pedagogy and educational practice more generally. We will explore how teachers can be enabled to foster and encourage the development of learners' ideas and conceptual understanding whilst meeting their responsibilities to ensure that students master the knowledge and skills that are culturally valued. We will also argue for the crucial importance of education developing children's metacognitive awareness of learning and creative endeavour as skilled, collective pursuits. The relevance for this field of study of socio-cultural theory, and methods for analysing talk and interaction derived from that theory, will be critically discussed.

References

- Dignath G., Buettner, G. & Langfeldt, H-P. (2008) How can primary school students learn self-regulated learning strategies most effectively? A meta-analysis on self-regulation training programmes. *Educational Research Review*, 3, 101-129.
- Frith, C & Singer, T. (2008) The role of social cognition in decision making. *Philosophical Transactions of the Royal Society*, 363, 3875-3886.
- Howe, C. (2010) *Peer Groups and Children's Development*. Oxford: Wiley-Blackwell.
- Mercer, N. and Littleton, K. (2007). *Dialogue and the development of children's thinking: a sociocultural approach*, London: Routledge.
- Mercer, N. & Hodgkinson, S. (2008) (Eds) *Exploring Talk in School*. London: Sage.
- Wegerif, R. (2010) 'Dialogue and teaching thinking with technology: opening deepening and expanding the interface', in K. Littleton and C. Howe (eds) *Educational Dialogues: understanding and promoting productive interaction*, London: Routledge.
- Wells G. and Claxton, G. (2002) *Learning for Life in the 21st Century*, Oxford: Blackwell.
- Whitebread, D., Bingham, S., Grau, V., Pino Pasternak, D. & Sangster, C. (2007) Development of Metacognition and Self-Regulated Learning in Young Children: the role of collaborative and peer-assisted learning, *Journal of Cognitive Education and Psychology*, 3, 433-55.
- Vygotsky, L.S. (1978) *Mind in Society*. London: Harvard University Press.

PAPER PRESENTATION

Differently Structured Advance Organizers Lead to Different Learning Outcomes

Johannes Gurlitt, University of Freiburg, Germany; Sebastian Dummel, University of Freiburg, Germany; Sylvia Schuster, University of Freiburg, Germany; Matthias Nuckles, University of Freiburg, Germany

Does the specific structure of initially presented advance organizers make a difference for learning outcomes? Two experiments challenge the view that effects of advance organizers can be explained solely by assimilation theory. The first experiment presents evidence that the construction of proto-schemata through specifically structured advance organizers facilitates learning outcomes, compared to a less structured advance organizer. The second experiment extends this claim and presents evidence that specifically structured and embellished advance organizers do not only facilitate close but also far transfer. These results support the view that well structured and embellished advance organizers can facilitate the construction of proto-schemata and thus can be more than the activation of specific concepts in long-term memory.

What would be a beneficial way of beginning a lesson on different statistical tests? Using specifically structured advance organizers is one possible answer. Advance organizers can be conceptualized as pedagogic tools that bridge the gap between what learners already know and what learners need to know (Ausubel, 1968, 2000). From a theoretical point of view, this study poses the question whether different structures of advance organizers using similar concepts lead to different learning outcomes after a text study phase. This would challenge the view that effects of advance organizers can be explained solely by the activation of concepts. Instead we propose the view that in addition to the activation of available concepts, specific structures of advance organizers facilitate the construction of a preliminary schema (later referred to as a proto-schema) about the topic to be learned.

Overview about the experiments and hypotheses

Varying the structure of the advance organizers, the following competing hypotheses about effects on learning outcomes are proposed: The concept activation hypothesis would predict no differences in learning outcomes assessed after a text study phase, because the advance organizers include similar concepts. The proto-schema facilitation hypothesis is based on the idea that well structured advance organizers should facilitate inductive processes to construct proto-schemata - and thus outperform less structured advance organizers. The related but more detailed focused proto-schema facilitation hypothesis is based on the idea, that even though the paragraphs of the advance organizer are structured in a way to facilitate inductive processes, some learners may not process or see the defining key-features of the respective problem categories. This hypothesis would predict that in addition to the well structured organization of the advance organizer, guidance towards the processing of specific key-concepts may be necessary to enhance learning outcomes compared to a less structured advance organizer.

Method

Forty-eight undergraduate psychology students advance organizer, 2) a well structured and key-concept emphasizing advance organizer and 3) a less structured advance organizer used as a baseline condition. Firstly, learners completed a pretest. One week later, learners studied one of three different advance organizers, completed a sorting task, read an instructional text and finally completed the posttest. Quilici & Mayer (1996, 2002). This paradigm is basically a contrasting cases approach: For the well-structured condition, the same surface story is used for different categories and thus facilitates the differentiation based on deep-level features. In addition, different surface stories are used inside the same category, thus emphasizing the invariant of the specific category despite different surface stories. In the less structured condition, six different cases were used thus making it more difficult to infer similarities within and differences between the respective categories. To emphasize certain key-concepts in the well structured and key-concept emphasizing group, we adapted a paradigm used by McDaniel and Einstein (1989) where letter-completion tasks were used to facilitate the processing of individual idea units to complement relational processing. Following the study of the advance organizers, all three groups completed a sorting task to assess potentially constructed proto-schemata. Then the statistics text was studied, followed by a posttest.

Results and Discussion

As an effect size measure, we used partial η^2 (Cohen, 1988). Based on the hypotheses, a priori contrast weights were assigned to the experimental conditions and a contrast analysis was conducted (Rosenthal, Rosnow, & Rubin, 2000). Following the proto-schema construction hypothesis, an increase in the sorting score as a measure for the degree to which students possess or acquired structure-based schemas for the statistics problems were observed after reading the well structured advance organizers but not or less in the less structured advance organizer condition, $F(1,44) = 5.08$, $p = .03$; $\eta^2 = .10$. The primary interest of this study was whether the well-structured advance

organizers fostered learning outcomes in the posttest compared to the less structured advance organizer. The results of the analysis was in line with the proto-schema construction hypothesis: the planned contrast showed that the well structured advance organizer groups outperformed the less structured advance organizer group in the posttest $F(1,44) = 4.47, p = .09$. Supporting the role of proto-schemata for the final learning outcomes, the correlation between the sorting scores assessed after studying the advance organizer and the final learning outcomes was significant $r(48) = .43, p = .001$. The "pure" well structured advance organizer was not enough to yield a reliable advantage compared to the less structured advance organizer in the posttest $F(1,44) = 2.80, p = .10$. However the well structured and key-concept emphasizing advance organizer showed a reliable advantage compared to the less structured advance organizer in the posttest $F(1,44) = 4.1, p = .09$. In summary, the comparison of well structured and less structured advance organizers indicated that well structured advance organizers facilitated the construction of proto-schemata and learning outcomes. This supports the value of the proto-schema construction view about advance organizers. In addition, the results of this experiment support the hypothesis, that a focused processing of relevant key-concepts was necessary to yield a reliable effect on learning outcomes and thus supports the more detailed focused proto-schema facilitation hypothesis. These results were replicated and extended (e.g. close and far transfer learning outcomes) in a second study that will also be presented. In conclusion, both experiments indicated that prior knowledge activation can be more than the activation of concepts. Different structures of advance organizers using similar concepts lead to substantial differences in learning outcomes. Therefore advance organizers should be differentiated according to the specific structure and task to be completed.

Selected References

- Ausubel, D. P. (2000). *The acquisition and retention of knowledge: A cognitive view*. Dordrecht, Boston: Kluwer Academic Publishers.
- Quilici, J. L., & Mayer, R. E. (1996). Role of examples in how students learn to categorize statistics word problems. *Journal of Educational Psychology*, 88(1), 144–161.

PAPER PRESENTATION

Singing against the tide? Gender beliefs, and expectations of conformity in school activity choice.

Penelope Watson, The University of Auckland, New Zealand; Christine Rubie-Davies, University of Auckland, New Zealand; John Hattie, The University of Auckland, New Zealand

Peer beliefs and expectations about gender identity, gender role and gender-role conformity can limit participation in school activities, mediate stereotype threat, and prompt awareness of it in targets when blatantly expressed. Whereas previous research on stereotype threat has concentrated on helping targets alleviate its effects, this study sheds light on the perpetrators' experience, revealing the need to challenge deep-seated beliefs which lead to stereotyping and prejudice. A new scale comprising both qualitative and quantitative items was employed, to explore how participant groups (out-group peers, teachers, choir director, and choristers), in nine participating school populations varied in terms of sex-typing, beliefs and expectations about gender-role and gender-role conformity, the extent of awareness of prevailing stereotypes, the extent to which those stereotypes were endorsed, and perceptions of the beliefs and expectations of others with regards to gender-role and gender-role conformity. The findings identified how beliefs and expectations about gender identity related to attitudes towards gender-role transgression within different school cultures, and ultimately limited choice of school-based activities for adolescents. This evidence reveals implications for change to practices which may currently augment gender-role conformity in schools and limit pupil outcomes. As well, it adds to research conducted in the field of stereotype threat in a real world setting and importantly, explores the link between stereotypic beliefs and wider held prejudices.

Stereotype threat research (e.g., Schmader, 2010; Steele, 1997; Steele & Aronson, 1995) has focussed almost exclusively on the target's experience. Other research has revealed the effect of beliefs and expectations on student outcomes (Rubie-Davies, Hattie, & Hamilton, 2006), and the importance of peer expectations in adolescence (Wigfield & Wagner, 2005). In two previous studies conducted with boys in choirs, this researcher revealed that beliefs and expectations of adolescent out-group peers had the power to mediate stereotype threat, and when made blatantly salient triggered awareness of it in targets. Moreover, while overt prejudice and stereotyping declines, but subtle stereotypic forces persist (Wolfe & Spencer, 1996), it seems timely to extend the investigation of stereotype threat to the experience of the perpetrators.

This present study aimed to identify beliefs about gender identity and gender role, and expectations of gender-role conformity in terms of school-based activity choice, by addressing three research questions:

1. Do beliefs about gender identity and gender roles, and expectations of activity-based gender-role conformity differ between four participant groups (out-group peers, staff, choral directors and choristers)?
2. To what extent do participant groups endorse stereotypical comments about gender roles?
3. To what extent are participant groups aware of stereotypical gender-roles associated with activities?

Participants (n = 1215) from nine high schools, comprised four groups: teachers (n = 95), choir directors (n = 10), out-group peers from all levels in each school (n = 743), and choristers drawn from eleven male, female and mixed choirs across the nine schools (n = 367). A new four-part scale (The Gender-Role Beliefs and Expectations Questionnaire) was administered yielding both quantitative and qualitative data. All alphas were above .65 providing confidence in using the data in subsequent analyses.

A moderate positive correlation between two factors comprising Part A of the scale (Gender Self-Definition and Gender Self-Acceptance), $r = .60$, n 1215, p Pacific Island males), and weaker for females (but not Pacific Island and Maori females), diminished with age, and was weakest for rural females. Qualitative data triangulated these data confirming that stereotypical ideas of females as objectified and males as agentic prevailed among adolescents.

Cross-tabulations for Part B of the scale revealed the perception that some activities are gendered exclusively male e.g., rugby, and exclusively female e.g., netball (both national games in New Zealand). However, other activities were perceived to be engaged in by both sexes, but felt to be predominantly feminine domains e.g., choir, or predominantly masculine domains e.g., football. Participants perceived that 'others' held a more rigid expectation of gender conformity and would be less likely to desire change than themselves in terms of gender equity in activity choice. Males in single sex male choirs had the most gender-equitable view toward activity choice of all participant groups, females in single sex female choirs were the strongest supporters of gender-role conformity in activity choice, and males in mixed choirs registered the sharpest awareness of the stereotypical views of 'others'.

Ten stereotypical comments comprising Part C of the scale yielded interesting predictive correlations. Where there was a significant endorsement of a comment which supported males' engagement in a feminine domain, this was often associated with indications of support for males' engagement in other feminine domains. Similarly, where a comment reflecting a stereotypical expectation of gender-role conformity was endorsed, this was often associated with endorsement of other such comments. Out-group peers registered the highest mean for endorsing the comment that 'boys in choirs are sissies [weaklings]', and males in single-sex choirs showed the least inclination to endorse comments supporting gender-role conformity.

Cross-tabulations were calculated for the data comprising Part D of the scale: participants reported that a Physical Game scenario was related strongly to boys (71.4%), minimally to girls (4.8%), and moderately to both sexes (23.8%), and that a Vocal Performance scenario was strongly linked to girls (63.7%) minimally to boys (8.3%), and moderately to both sexes (28%). Males (notably Pacific Island and Maori males) strongly confined their scenario choices to gender boundaries, and females much less so. Chi-Square tests for independence indicated significant differences between responses for both scenarios, by gender, ethnicity and age level.

The findings of this study shed light on beliefs and expectations about gender roles which limit choice for young people, the interface between gender stereotyping and adolescent identity formation, and add to stereotype threat research in a real world context, across a range of cultural settings and with a substantial sample. Little research has investigated the connection between stereotypic beliefs and wider prejudicial attitudes (Sherman, Stroessner, Conrey, & Azam, 2005). Thus, it seems fruitful to address not only the lot of the targets, of stereotype threat but also investigate the perpetrators' beliefs and expectations in order to attack both stereotype threat, and the globally-felt limitations of gender prejudice at their roots.

References

- Rubie-Davies, C. M., Hattie, J. A., & Hamilton, R. (2006). Expecting the best for students: Teacher expectations and academic outcomes. *British Journal of Educational Psychology*, 76, 429-444.
- Schmader, T. (2010). Stereotype threat deconstructed. *Current Directions in Psychological Science*, 19, 14-18.
- Sherman, J. W., Stroessner, S. J., Conrey, F. R., & Azam, O. A. (2005). Prejudice and stereotype maintenance processes: Attention, attribution and individuation. *Journal of Personality and Social Psychology*, 89, 607-622.
- Steele, C. M. (1997). A threat in the air: How stereotype threat shapes the intellectual identities and performance. *American Psychologist*, 52, 613-629.
- Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69, 797-811.

Wigfield, A., & Wagner, A. L. (2005). Competence, motivation, and identity development during adolescence. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of Competence and Motivation*. New York: Guilford Press.

Wolfe, C. T., & Spencer, S. (1996). Stereotypes and prejudice: Their overt and subtle influence in the classroom. *American Behavioural Scientist*, 40, 176-185.

PAPER PRESENTATION

Students Leaving the STEM Pipeline

Hanke Korpershoek, University of Groningen, Netherlands; Hans Kuyper, University of Groningen, Netherlands; Greetje Van der Werf, University of Groningen, Netherlands; Roel Bosker, University of Groningen, Netherlands

The main aim of the present study was to find an answer to the question why some suitably qualified students do not continue their education in science-oriented studies in higher education, despite their previous interest in science-related topics in secondary education. The research was based on the multi-attribute utility theory, using an approach related to the theory of reasoned action (Fishbein & Ajzen, 2010). The study included 477 students who had taken basic or advanced math/science courses in secondary education, but who did not choose a STEM study in higher education (STEM stands for science, technology, engineering, and mathematics). The attitudes of these students towards STEM studies were compared with their attitudes towards their current (non-STEM) study, while also taking the influence of significant others on these students' study choices into account. As expected, most non-STEM students had chosen the best "suitable" option as regards their attitudes. However, one out of ten non-STEM students had a more favourable attitude towards STEM studies than towards their current study. Particularly girls who had taken advanced math/science courses in secondary education belonged to this group. However, the hypothesis that these students had left the STEM pipeline because of the advice of significant others was not confirmed.

Choosing a study in higher education is an important decision in the light of a student's future career. We therefore expected that this choice is a fairly rational one. At some occasions however, people diverge from making rational choices (Kahneman & Tversky, 2000). These are usually situations in which it is impossible to make a full assessment of the situation due to uncertainty about the consequences of certain behaviour. Study choice in higher education is such a situation. Our main interest is why many students who had taken math/science courses in secondary education did not choose a STEM study in higher education (STEM stands for science, technology, engineering, and mathematics).

Aims & theory

We looked into non-STEM students' attitudes towards STEM as compared to their attitudes towards their actually chosen study to find out whether they had opted for the best suitable option as regards their attitudes. The attitude towards math/science has been found to be a significant predictor of students' enrolment in math/science classes and STEM studies (e.g. Second Phase Advisory Point, 2005). Moreover, we searched for the characteristics of students who had chosen a less suitable option as regards their attitudes. In addition, we investigated the influence of significant others (e.g. parents, teachers, and peers) on these students' study choices.

The study was built on the multi-attribute utility theory (MAUT; e.g. Keeney & Raiffa, 1993) on the basis of an approach related to the theory of reasoned action (TRA; Fishbein & Ajzen, 2010). Multi-attribute utility (MAU) models are based on the assumption that the desirability of an alternative depends on how its attributes are evaluated, particularly, the subjectively most important attributes. TRA states that attitudes towards certain behaviour are the result of balancing all advantages and disadvantages associated with this behaviour. It suggests that if people evaluate certain behaviour as positive and want to comply with significant others who want them to exhibit this behaviour, their intention to do so will be stronger than when their attitude is less favourable and/or when they perceive the social influence as weaker.

Method

The data used in the present study were collected as part of a large-scale longitudinal study in the Netherlands, the "Cohort Studies in Secondary Education" (VOCL'99). In this cohort study students are being followed in their educational career from the 7th grade onwards, until they have completed their full-time education. The current study included students that had chosen a non-STEM study in higher education (e.g. medicine, law, economics) and met the criteria for entering a STEM study in higher education (e.g. they had taken their Final School Examinations in advanced mathematics, chemistry, and physics). This procedure resulted in a sample of 477 students of which 340 were girls and 137 boys.

A follow-up questionnaire was used to collect information regarding students' study choices and several attitudinal variables. We used some constructs from TRA to measure the non-STEM students' attitudes towards STEM studies in higher education. We have focussed on students' attitudes towards the study they actually opted for, towards science studies (e.g. mathematics, physics, and chemistry), and towards technical studies (e.g. industrial engineering, architectural engineering, and electrical engineering). We searched for the students' "optimal" choices as regards their attitudes towards the three alternatives. We used several Likert-scale items, measuring students' stereotypes of science-oriented studies (e.g. "I think a technical study is [very easy – very difficult]") and their perceptions of their current (non-STEM) study (e.g. "Do you find your study difficult or easy?"). Moreover, we measured the importance they ascribed to items as regards choosing a study ("I find the difficulty level of a study [not at all important – very important], their motivation to comply with advice from significant others, and their normative beliefs (i.e. their perception of other people's recommendations).

Results

As expected, most non-STEM students had chosen the best "fitting" option as regards their attitudes. For most students, a STEM study was not an attractive alternative as compared to the study they had actually chosen. However, one out of ten non-STEM students, particularly girls who took the more advanced math/science courses in secondary education, had a more favourable attitude towards STEM studies than toward their current study (mainly with regard to choice-options, content, and expected achievement). In addition, we found that non-STEM students' attitude towards technical studies was more favourable than their attitude towards science studies.

Furthermore, we investigated whether the non-STEM students who would fit STEM studies were more strongly influenced by significant others to choose a non-STEM study than the other non-STEM students. Our hypothesis that significant others had advised these students to leave the STEM pipeline was, however, not supported by our data. Although we expected a stronger influence with respect to the current non-STEM study among the STEM candidates, we found that they were more strongly influenced than other non-STEM students to choose science or technical studies. However, they had nevertheless chosen a non-STEM study despite the advice of significant others.

In conclusion, the procedure of combining MAUT and TRA is new in the research field. It has proven to be a valuable and useful approach to enhancing our general understanding of why some suitably qualified students do not continue their educational career by choosing a STEM study. The results of our analyses indicate that there are specific student groups, such as girls who took advanced math/science courses in secondary education, which would fit STEM studies in terms of their attitudes and abilities. This information could be used in offering these STEM candidates adequate counselling in the future.

References

- Fishbein, M., & Ajzen, I. (2010). Predicting and changing behaviour. The reasoned action approach. New York: Psychology Press.
- Kahneman, D., & Tversky, A. (Eds.) (2000). Choices, values and frames. Cambridge, UK: Cambridge University Press.
- Keeney, R. L. & Raiffa, H. (1993). Decisions with multiple objectives: Preferences and value tradeoffs. Cambridge, UK: Cambridge University Press.
- Second Phase Advisory Point. (2005). Zeven jaar tweede fase, een balans; Evaluatie tweede fase [Seven years second phase, an audit; Evaluation second phase]. Den Haag, The Netherlands: Tweede Fase Adviespunt.

PAPER PRESENTATION

Validation of a German version of the Epistemological Beliefs Inventory (EBI)

Bjoern Mokwinski, School of Computing Science, Business Administration, Economics, and Law, Germany; Karin Rebmann, Business Administration, Economics and Law, Germany; Manuela Paechter, Karl-Franzens-University Graz, Austria; Yvonne Hanekamp, Carl von Ossietzky University Oldenburg, Germany; Daniel Macher, Karl-Franzen-Universität Grz, Austria

Up to now, German researchers experience the investigation of domain-independent epistemological beliefs as an unsolved problem, since there is a lack of reliable and valid questionnaire. Therefore, the Epistemic Beliefs Inventory (EBI) - an Anglophone questionnaire developed by Schraw, Bendixen, and Dunkle (2002), which showed an invariable factorial structure in several samples and had satisfactory retest reliability – was translated into the German language. Afterwards, its psychometric properties were investigated in a series of pilot studies. Since this translated version showed unsatisfactory psychometric properties, new items were developed for a revised questionnaire version. The

development of these items was based on content analyses of 90 qualitative interviews with students. The psychometric properties as well as the factorial structure of the newly derived questionnaire were investigated in a sample of 471 students in Germany. Exploratory factor analyses showed a structure with four factors. This structure could be confirmed by means of confirmatory factor analysis in a sample of 364 students in Austria. Also, the questionnaire showed satisfactory retest-reliability (measured in a subsample of 222 students one month after initial testing). Another aim of the survey was to analyze criterion-related validity. Besides the revised EBI, the German students filled in a questionnaire on cognitive learning strategies. As expected, students with more sophisticated beliefs tend to use higher order cognitive learning strategies, while students with less sophisticated beliefs prefer the use of less complex strategies. Taken together, the empirical results argue in favor of the new instrument with regard to its reliability and validity.

Overview and aims of the research

Epistemological beliefs are personal beliefs about knowledge and the acquisition of knowledge. As subjective theories of an individual, they have the function of directing and controlling actions. Therefore, they are linked to numerous aspects of academic learning, e.g., to how students approach learning processes or how they view their role as learners. Researchers investigating epistemological beliefs have encountered the problem of developing a reliable and valid measure of these beliefs. Schraw, Bendixen, and Dunkle (2002) developed a questionnaire EBI (Epistemic Beliefs Inventory) that assumes that epistemological beliefs can be described by five dimensions: omniscient authority, certain knowledge, quick learning, simple knowledge, and innate ability. In a validation study, Schraw, Bendixen, and Dunkle (2002) could confirm these five dimensions by means of explorative factor analysis. In comparison to other epistemological beliefs instruments, the EBI was one of the few instruments which showed an invariable factorial structure in several samples and which had satisfactory retest reliability. When transferring questionnaires into a different language and cultural context it is necessary to investigate their psychometric quality. For a study in German-speaking countries the EBI was translated and its psychometric properties were investigated in a first series of pilot studies. In these studies, the translated version showed partly unsatisfactory psychometric properties (e.g., item difficulties or varying factorial structures). One factor assumed by Schraw, Bendixen, and Dunkle (2002) consistently did not show in the factor analyses, namely certain knowledge. Due to these difficulties, new items were developed for a revised version of the EBI. First, a pilot study was conducted in which qualitative interviews with 90 students were carried out. Based on the results of content analyses of the interviews, new items and a revised German version of the EBI were developed. It consisted of 14 items of the original questionnaire and 17 new items (altogether 31 items). The aim of the present research is to analyze the psychometric properties of this revised EBI version by four steps: Investigation of (1) item properties and factorial structure, (2) retest reliability, (3) the invariability of the factorial structure in another sample, and (4) criterion-related validity. For step 4, it was investigated to what extent epistemological beliefs correlate with the use of cognitive learning strategies. As a result of the present research, a German questionnaire for measuring epistemological beliefs in student population was to be developed.

Methodology

Item properties and factorial structure: Psychometric properties and the factorial structure of the revised EBI were investigated in a sample of 471 university students in Germany from social sciences and economics. All items showed satisfactory item difficulties between 0.20 and 0.80. Orthogonal exploratory factor analysis with Varimax rotation was carried out to uncover the underlying structure of the variables. As a criterion factor loadings of ≥ 0.30 were defined as significant. Factor analysis showed a solution with 15 items and four factors: Quick learning (five items), omniscient authority (three items), simple knowledge (four items), and innate ability (three items). These factors explained 41,59 % of the variance.

2) Retest reliability: For the analysis of the retest-reliability, 222 students of the former investigation filled in the revised EBI version (one month after the first testing). The four factors showed satisfactory retest reliability coefficients which resembled those of the original EBI questionnaire.

3) Invariability of the factorial structure: The stability of the revised EBI version was investigated in a German-speaking sample of 364 university students in Austria from different majors from social sciences and economics. Confirmatory factor analysis was used to test the model fit of the factorial structure found in the German sample. The factor analysis showed satisfactory model fits when one variable of the factor "structure" was removed (RMSEA=.046, CFI=.974, SRMR=0.047). These results recommend measuring the factor structure by three items (instead of four as recommended by the factorial structure of step 1).

4) Criterion-related validity: It was investigated how the four factors of the revised EBI version correlate with the application of cognitive learning strategies. In order to investigate the application of cognitive learning strategies a German inventory (LIST) was used. To analyze this relationship a canonical correlation was performed between the

epistemological beliefs scales and identified cognitive learning strategy scales. The results show that the scales are related to each other. Altogether, the results indicate that students with more sophisticated beliefs tend to use higher order cognitive learning strategies, while students with less sophisticated beliefs prefer the use of less complex strategies.

Theoretical and educational significance

The questionnaire measures four dimensions of epistemological beliefs presented in this research, quick learning, omniscient authority, simple knowledge, and omniscient authority. The factor "certain knowledge" could not be found in the analyses. The items of this dimension describe whether knowledge is stable over time. Probably, these items did not reflect the learning experiences of students who are confronted with changing knowledge in their fields of study and who might be faced with the task to permanently acquire new knowledge. The four factorial structure of the revised EBI version could be confirmed in another German speaking sample. Retest reliability of the factors were satisfactory and it could be shown that the factors correlate with different types of learning strategies. Altogether, one may conclude that a questionnaire has been developed which enables the assessment of epistemological beliefs in German speaking samples. The newly derived questionnaire can be used by researchers to measure general, domain-independent beliefs about knowledge and the acquisition of knowledge. The questionnaire may also be useful for practitioners in the field of education. Knowledge about epistemological beliefs gives teachers a chance to gain an insight into their students' learning processes and motivation. Consequently, students' epistemological beliefs give teachers an important starting point to encourage their students to learn – both at school and in higher education.

References

Schraw, G.; Bendixen, L. D. & Dunkle, M. E. (2002). Development and Validation of the Epistemic Belief Inventory. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal Epistemology* (261-275). Mah-wah: Erlbaum.

PAPER PRESENTATION

Investigating text features of online information affecting laypeople's perception of scientificness

Eva Thomm, University of Muenster, Germany; Rainer Bromme, Universitat Muenster, Germany

If laypersons search the Internet in order to make a knowledge-based decision on issues of daily life (healthcare, environment protection), they often come across a vast amount of information which contain scientific concepts and thus are frequently beyond their own everyday knowledge. Therefore, laypeople rely on the knowledge of experts. Identifying and accurately evaluating online information of experts demands for an understanding of the narrative conventions of scientific discourse. Studies examining individuals' judgments about the veracity and credibility of online information demonstrate that users particularly attend to superficial features. Since text features may work as cues for 'scientificness', it is crucial to analyze individuals' grasp of narrative norms of scientific discourse and its influence on the evaluation of online information. The present study investigates laypeople's understanding of characteristics of scientific discourse examining whether features typical for scientific discourse affect laypersons' perceived 'scientificness' of online information and whether they recognize these attributes as indicators of adequate discourse. Undergraduates read scientific and factual presentations of texts about phenomena of either global warming or medicine, each embedded within a scenario which required participants to judge the perceived scientificness of the online text. The results are analyzed regarding differences in perceived scientificness depending on the presentation. Its relationship to text credibility, acceptance of text contents and behavior dealing with online information is assessed. Educational implications for fostering laypeople's understanding of conventions of scientific discourse as part of science are deduced and discussed with regard to its meaning for the evaluation of online information.

Within modern societies, the rapid growth of available knowledge comes along with the increasing differentiation of scientific knowledge. To make knowledge-based decisions about issues of private and public life (i. e. health care or forming an opinion about environment protection), individuals have to handle scientific concepts which are far too complex to be deeply understood by a layperson (Kienhues, 2010). Therefore laypersons must rely on experts based on their own fragmentary understanding of such issues (Keil et al., 2008). The Internet simplifies the accessibility and availability of expert information about any science-based topic. It offers many useful documents, but it also provides documents of questionable quality and doubtful authorship. Thus, its use reinforces the necessity to evaluate the veracity of the retrieved information as well as the pertinence and credibility of the author (Bromme et al., 2010). The evaluation of science-based information may demand for a –at least coarse- understanding of the norms of scientific discourse which are shared and expected within the expert community. However, most studies which examined individuals' judgement of online information focussed on the question whether individuals check the author of online texts (sourcing) or attend to the surface features as for example website design and scientific language of text

(Eysenbach & K hler, 2002; Eysenbach, 2008; Flanagin & Metzger, 2007; Fogg et al., 2002). It has been less often analyzed whether laypersons have a coarse understanding of what makes a text a scientific one and if such features contribute to veracity judgements (but see Ackermann & Leiser, 2010; Weisberg et al., 2008). We are especially interested in those features of scientific texts which reflect the discursive and social nature of scientific knowledge production (Goldman, 2003; Longino, 2002). Examples are: Citations (Harr  , 1990), combining knowledge claims with references to the methods used, and a wording which emphasizes the establishment of facts by the researcher ("it has been observed that there is a relationship between amount of traffic and CO 2"), instead of a pure factual statement ("there is a relationship between....").

The present study focuses on laypeople's notions about characteristics of scientific discourse and addresses two goals: Firstly, the study aims to analyze whether features typical for scientific discourse affect laypersons' perception of the 'scientificness' of online information concerning science-based topics.

Secondly, it investigates whether laypeople recognize and identify these text features as being indicators of true scientific discourse, showing a coarse understanding of the narrative norms.

Furthermore the relationship between perceived scientificness, text credibility and acceptance of text contents is examined.

Undergraduates studying different subjects participated in the study. They were equally assigned to four experimental conditions in a 2x2-repeated measurement design with the between-subject factor scientific domain (medicine vs. global warming) and the within-subject factor text type (factual presentation vs. scientific presentation). Expository texts about two phenomena of global warming and of medicine were created. For each text, two versions were generated depicting a factual or a scientific presentation of the phenomena: The scientific presentation was enriched with citations and mentioned applied scientific methods depicting scientific accomplishment as a result of discourse, in contrast, the factual presentation contained neither citations nor methods describing research results as given facts. While text type varied, content information remained the same. Participants read one version of both text types of either phenomena of global warming or medicine, each embedded within a scenario which required participants to judge the perceived scientificness of the online text. Furthermore, they were instructed to mark text passages which indicated the scientificness of the text from their point of view. Text credibility and acceptance of text contents were measured. Participants additionally answered items asking for their behavior dealing with scientific online information.

The results are analyzed regarding differences in perceived scientificness depending on text type. Its relationship to text credibility, acceptance of text contents and behavior dealing with online information is assessed. The data are compared across scientific domains and text types.

Educational implications for fostering laypeople's understanding of conventions of scientific discourse as part of science and of scientific culture are deduced and discussed with regard to its meaning for evaluating online information.

References

- Ackermann, R. & Leiser, D. (2010). Meta-comprehension bias generated by illustrated text. 4th Biennial Meeting of the EARLI Special Interest Group 16 Metacognition, M nster, Germany.
- Bromme, R., Kienhues, D., & Porsch, T. (2010). Who knows what and who can we believe? Epistemological beliefs are beliefs about knowledge (mostly) attained from others. In L. D. Bendixen & F. C. Feucht (Eds.), *Personal Epistemology in the Classroom: Theory, Research, and Implications for Practice* (pp. 163-193). Cambridge: Cambridge University Press.
- Eysenbach, G. (2008). Credibility of Health Information and Digital Media: New perspectives and Implications for Youth. In M. Metzger & A. J. Flanagin (Eds.), *Digital Media, Youth and Credibility* (pp. 123-154). Cambridge: MIT Press.
- Eysenbach, G. & K hler, C. (2002). How do consumers search for and appraise health information on the world wide web? Qualitative study using focus groups, usability tests, and in-depth interviews. *British Medical Journal*, 324, 573-577.
- Flanagin, A. J., & Metzger, M. J. (2007). The role of site features, user attributes, and information verification behaviors on the perceived credibility of Web-based information. *New Media & Society*, 9, 319-342
- Fogg, B. J., Soohoo, C., Danielson, D. R., Marable, L., Stanford, J., & Trauber, E. R. (2003). How do users evaluate the credibility of Web sites? A study with over 2,500 participants. Paper presented at the Proceedings of the 2003 conference on Designing for User Experiences, San Francisco, CA. Available from the Association of Computing Machinery's web portal

Goldman, A.I. (2003). *Knowledge in a social world*. Oxford: Oxford University Press.

Harr  , R. (1990). Some Narrative Conventions of Scientific Discourse. In C. Nash (Ed.), *Narrative in Culture. The Uses of Storytelling in the Sciences, Philosophy and Literature* (pp. 81-101). New York: Routledge.

Keil, F.C., Stein, C., Webb, L., Billings, V.D., & Rozenblit, L. (2008). Discerning the Division of Cognitive Labor: An Emerging Understanding of How Knowledge is Clustered in Other Minds. *Cognitive Science*, 32, 259-300.

Kienhues, D. (2010). Whom to blame - the source of information or myself? Personal epistemology and personal ability in dealing with medical information on the Internet. Berlin: Logos.

Longino, H. (2002). *The fate of knowledge*. New Jersey: Princeton University Press.

Weisberg, D. S.; Keil, F. C.; Goodstein, J.; Rawson, E.; & Gray, J. (2008). The seductive allure of neuroscience explanations. *Journal of Cognitive Neuroscience*, 20(3), 470-477.

PAPER PRESENTATION

Development of an instrument measuring interpersonal trust in Dutch schools

Maren Thomsen, University of Amsterdam, Netherlands

The aim of the present study was to develop an instrument to measure trust between teachers and between teachers and supervisors in SSVE schools in the Netherlands. Most measurements predominantly measure the belief of the trustor about the trustworthiness of the trustee, asking about characteristics of the trustee, this indicates a problematic mixture of antecedents of trust and the concept itself in the operationalization. Two scales to measure interpersonal trust in SSVE schools between teachers (Trust-T) respectively teachers and supervisors (Trust-S) were developed, based on earlier work of Gillespie (2003). The scales contained questions about teachers' willingness to take a risk in situations that are important to them and in which they are vulnerable and dependent on the other party. 113 SSVE school teachers filled in a questionnaire which included the two trust scales. The average age of the respondents was 50 years (SD=9.5) and 46% was female. A confirmatory factor analysis, using structural equation modeling, was conducted. After model modifications a satisfactory model fit was reached. The model indicates a good construct validity of the used measure of trust.

Aims

This study is part of a larger study about the impact of trust in schools for senior secondary vocational education (SSVE) in the Netherlands on the relationship between organizational characteristics and teacher's work-related behaviors. The present study aims to develop an instrument to measure trust between teachers and between teachers and supervisors in SSVE schools in the Netherlands. Trust is a construct that has been studied for a long time and in different disciplines (Dietz & Den Hartog, 2006). It is a very complex concept and up to date there is no consensus about the definition of trust. However, most definitions include the willingness to be vulnerable of the trustor in the relationship with another party (e.g. Tschannen-Moran & Hoy, 1998). Trust between people is usually referred to as interpersonal trust and trust in an institution as system trust (Luhmann, 1979). This study focuses on interpersonal trust. There is a great variety of different operationalizations of interpersonal trust. On the one hand this may reflect the large multidisciplinary interest in the concept; however, on the other hand, it may reflect dissatisfaction with the existing measurements (Dietz & Den Hartog, 2006). Most measurements predominantly measure the belief of the trustor about the trustworthiness of the trustee, asking about characteristics of the trustee (e.g. Nyhan & Marlowe, 1997; Robinson, 1996; Hoy & Tschannen-Moran, 2003). Depending on the definition of trust, this indicates a mixture of antecedents of trust and the concept itself in the operationalization. These measures usually have good internal reliability but they actually do not capture the willingness of the trustor to be vulnerable to the trustee, a core element of most definitions of trust. One of the exceptions is the instrument developed by Gillespie (2003). In her work trust is designed specifically to assess the decision to trust. The items are worded as behavioral intentions (Dietz & Den Hartog, 2006). Dietz and Den Hartog (2006) recommend to include measures of the decision to trust in trust measurements. Hence, to measure the intention to act based on trust, which should be a consequence of the belief that the trustee is trustworthy.

Taking these considerations into account, the aim of this study is to further develop and verify Gillespie's trust measurement to measure interpersonal trust in an educational context.

Methodology

Two 10-item scales to measure interpersonal trust in SSVE schools between teachers (Trust-T) respectively teachers and supervisors (Trust-S) were formulated, based on earlier work of Gillespie (2003). The items were formulated in Dutch. The scales contained questions about teachers' willingness to take a risk in situations that are important to the teacher and in which they are vulnerable and dependent on the other party. The trust scales were rated on a 5-point Likert-type scale, ranging from 1 (completely disagree) to 5 (completely agree). For item inclusion in the final scale the

items were first critically examined by three expert professionals. On the basis of their comments, three items were eliminated, and four questions were reworded. The final Trust-T scale consists of 9 items and the final Trust-S scale of 8 items. A complete list of items can be found in table 2. A questionnaire was distributed to 430 teachers of seven SSVE schools. 26% of the teachers returned the questionnaire (N=113). The average age of the respondents was 50 years (SD=9.5) and 46% was female. The questionnaire included, next to other items, the Trust-T scale and the Trust-M scale. A confirmatory factor analysis, using structural equation modeling with Mx (MxGui Version 1.7.03), was conducted to further evaluate the suitability of the items, and whether the proposed dimensions had some attributes that could provide a coherent interpretation of the construct. A two-factor model was fitted to the covariance matrix. To guide model modifications when the fit of the factor model was poor, next to the standardized factor loadings, the difference between the observed and the estimated correlations (correlation residuals) were used as well as theoretical considerations.

Results

The data fitted the simple two-factor model poorly: $\chi^2_{(118)} = 270.71$, $p = 0.000$ and RMSEA=0.116 (90% CI [0.0979, 0.1343]). After adjusting the model step by step using correlation residuals as indicator for poor representation of the data and considering possible theoretical explanations and validations for the changes the model showed a satisfactory fit: $\chi^2_{(110)} = 161.138$, $p = 0.001$ and RMSEA=0.070 (90% CI [0.0448, 0.0918]). The model indicates a good construct validity of the used measure of trust. All standardized factor loadings are significant and most of them are around 0.7, indicating high indicator (item)- factor correlations. The parameter estimates are presented in table 2. The relatively high standardized factor loadings suggest convergent validity and the relatively low factor correlation (0.3429) indicates discriminant validity (Kline, 2005). The internal validity of the measure in the current sample, expressed in Cronbach's alpha is very good (Trust-S scale: 0.91 and Trust-T scale: 0.89). Further, the model supports the assumption, that trust has two sources, the characteristics of the trustee and a general willingness of the trustor to trust others. The former can be found in the clear distinction between the two factors, trust in the supervisor and trust in colleagues. Support for the second assumption is reflected in the significant correlation between the two factors. This correlation indicates that both factors measure a dimension of trust that is independent of the trustee. It is possible that the sample size influenced the results: An upcoming second measure by a larger sample will clarify that.

Relevance

Within this study a measure of trust has been further developed and verified for the educational context. In contrast to commonly used instruments, this measure takes the core element of trust, the willingness to be vulnerable to another party, into account. Using structural equation modeling it has been shown that the instrument is a robust tool to measure interpersonal trust with high convergent and discriminant validity.

PAPER PRESENTATION

Promoting moral development: comparison of two teaching methods

Ulrike-Marie Krause, Saarland University, Germany; Robin Stark, Dept of Education, University of the Saarland, Germany

In this research project, we intended to promote moral development of high school students. One of the most influential approaches of moral education is Lawrence Kohlberg's dilemma discussion which encourages students to systematically reflect on moral conflicts and decisions. This method is based on Kohlberg's cognitive-developmental model of moral stages. New works in the field of moral development and moral education highlight the relevance of emotions for moral judgment and moral action. In the present study, we implemented modified versions of the dilemma method. In a quasi-experimental field study, we compared two teaching methods: One was more cognitively oriented (with a focus on moral argumentation; e.g. discussion of moral decisions), and the other one was more affectively oriented (with a focus on empathy, e.g. in role plays). The study was conducted in two high school classes (9th grade; students were around 15 years of age). In one of the classes ($n = 28$), the cognitive approach was implemented, in the other class ($n = 27$), the affective method was used. The two classes did not differ concerning relevant student characteristics (age, gender ratio, moral stage according to Kohlberg etc.). Results indicated that the affective approach was superior: Students' moral argumentation and perceived performance were better in this group. This study can stimulate further research on affective activation and support (as a supplement to cognitive activation and support) in moral education.

Aims

In this research project, we intended to promote moral development of high school students. One of the most influential approaches of moral education is Lawrence Kohlberg's dilemma discussion which encourages students to

systematically reflect on moral conflicts and decisions (Blatt & Kohlberg, 1975). This method is based on Kohlberg's (e.g. 1984) cognitive-developmental model of moral stages. New works in this field highlight the relevance of emotions (especially of empathy) for moral judgment and moral action (e.g. Haidt, 2001; Hoffman, 2000; Keller, Brandt & Sigurdadottir, 2010). Against this background, we developed two modified versions of the dilemma method: One had a cognitive focus, whereas the other one was more affectively oriented (see below). These two approaches were examined in an intervention study. The following research questions were addressed:

- (1) To what extent do the teaching methods promote moral judgment?
- (2) To what extent do the teaching methods influence motivational aspects?

Methodology

We conducted a quasi-experimental field study in two high school classes (9th grade; mean age: 14.62 years, SD = .62). In one of the classes (n = 28), the cognitive approach was implemented, in the other class (n = 27), the affective method was used. The teaching unit was conducted by social studies teachers, based on a written guide; besides, research assistants were present in the classrooms during the entire intervention. The study was conducted within a time frame of three weeks (six times 45 min, i.e. two 45 min sessions per week).

In the first session, a pretest and a questionnaire were administered. In the pretest, students had to analyse a moral dilemma; based on students' analyses, moral stages according to Kohlberg were determined. The questionnaire was used to measure motivational aspects. Topic interest was recorded by a 4-item scale (e.g. "I am interested in moral issues"; Cronbach's alpha = .69), the students' self-concept concerning moral issues was gathered by a 3-item scale (e.g. "I have an idea of what is relevant for moral decisions"; Cronbach's alpha = .82).

In the second to fifth session, the two dilemma-based teaching methods were implemented. The cognitive approach mainly consisted of moral argumentation, reflection and discussion, whereas the affective approach embraced role plays and other creative tasks that required empathic activity.

In the last session, a posttest was administered. As in the pretest, students had to analyse a moral dilemma, and moral stages were determined. Each statement of the students' analyses was coded; then the highest acquired stage and the most frequent stage were identified. Besides, the moral maturity score (Blatt & Kohlberg, 1975) was calculated, which is the sum of the products "percentage x number of the stage"; for example if 50 % of a student's statements can be allocated to stage 1 and 50 % to stage 2, the student gets a moral maturity score of $50 \times 1 + 50 \times 2 = 150$. Moreover, students were asked to evaluate the teaching unit (3 items, e.g. "I liked the lessons on moral decisions"; Cronbach's alpha = .76) and to assess their own performance during the teaching unit on a 15-point scale ranging from "very bad" to "very good".

Findings

The two high school classes did not differ concerning relevant student characteristics, such as age, gender ratio, moral stage t1, topic interest and self-concept (all $p > .20$).

Posttest results revealed a superiority of the affective approach concerning moral stages (see table 1).

A MANOVA with the dependent variables "highest stage", "most frequent stage" and "moral maturity score" indicated a significant effect of the factor "teaching method" ($F(3, 51) = 3.49$, $p = .02$, $\eta^2 = .17$). For each dependent variable, t-tests were calculated which confirmed the significant superiority of the affective approach (highest stage: $t(53) = 2.80$, $p = .01$, $d = .75$; most frequent stage: $t(53) = 2.50$, $p = .02$, $d = .67$; moral maturity score: $t(53) = 2.57$, $p = .01$, $d = .69$).

Tables 2 displays the results on acceptance of the teaching unit and perceived performance.

T-tests showed that there was no significant group difference in acceptance ($t(51) = -.89$, $p = .38$), whereas the difference in perceived performance was significant ($t(38.33) = 2.07$, $p = .04$, $d = .58$).

Theoretical and educational significance

Our findings indicate that dilemma-based moral education can be enhanced by affective methodical elements that are geared towards empathic activity, such as role play or comparable creative tasks (e.g. writing a letter or an e-mail from the perspective of another person). This study can stimulate additional research on affective activation and support (as a supplement to cognitive activation and support) in moral education. In further studies, we will try to replicate our findings and to gain deeper insight into relevant cognitive, affective and social processes.

References

Blatt, M. & Kohlberg, L. (1975). The effects of classroom moral discussion upon children's level of moral judgment. *Journal of Moral Education*, 4, 129-161.

Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, 108, 814-834.

Hoffman, M. L. (2000). *Empathy and moral development: Implications for caring and justice*. Cambridge, UK: Cambridge University Press.

Keller, M., Brandt, A., & Sigurdadottir, G. (2010). "Happy" and "unhappy" victimizers: The development of moral emotions from childhood to adolescence. In W. Koops, D. Brugman, T. J. Ferguson, & A. F. Sanders (Eds.), *The development and structure of conscience* (pp. 253-268). Hove: Psychology Press.

Kohlberg, L. (1984). *The psychology of moral development: The nature and validity of moral stages*. San Francisco/CA: Harper & Row.

PAPER PRESENTATION

Teaching practices, self-efficacy, value, peer acceptance, and engagement: A multilevel analysis

Virginie Hospel, Université catholique de Louvain (UCL), Belgium ; Benoit Galand, Université catholique de Louvain, Belgium

This study uses a multilevel framework to investigate the effects of teaching practices (classroom level) on facilitators and indicators of engagement (student level), controlling for classroom composition and individual characteristics, and to test if the effects of teaching practices on indicators of engagement are mediated by facilitators (Skinner, Furrer, Marchand & Kinderman, 2008). Seven hundred and forty-one French-speaking 9th graders from 51 classrooms completed a questionnaire about facilitators of engagement (self-efficacy, task value, peer acceptance), indicators of engagement (emotional, cognitive, behavioural) and dimensions of teaching practices (provision of choice, invitation of student expression and participation, clarity and structure, formative feedback, supportive teacher-student relationships, equality of treatment). Results show that student self-efficacy is higher in classrooms with more provision of choice, perceived task value is higher in classrooms with more formative feedbacks, and peer acceptance is higher in classrooms with more equality of treatment. Moreover, they indicate that equality of treatment has an effect on emotional, cognitive and behavioral engagement above the effects of self-efficacy, task value and peer acceptance. These results are quite consistent with research pointing to the detrimental effects of performance goal structure on student motivation. They also underscore the relevance of separating facilitators and indicators of engagement to better understand the motivational dynamic of the students.

Background and aims

A growing number of studies pointed to the importance of student engagement for achievement and persistence in educational settings (Appleton, Christenson & Furlong, 2008; Janosz, Archambault, Pagani & Morizot, 2008). Engagement is a multidimensional construct including emotional, cognitive, and behavioral components (Fredricks, Blumefeld & Paris, 2004). Recently, Skinner, Furrer, Marchand and Kinderman (2008) introduced a distinction between facilitators (self-related perceptions regarding an activity) and indicators (emotional, cognitive and behavioral reactions during an activity) of engagement. They hypothesised that the effects of contextual factors on indicators of engagement are mediated by facilitators of engagement.

Among potential facilitators, a large number of studies have documented the positive effect of self-efficacy (Bandura, 1997; Linnebrink & Pintrich, 2003), task value (Simpkins, Davis-Kean & Eccles, 2006; Wigfield, Tonks & Klauda, 2009) and peer acceptance (Ladd, Herald-Brown & Kochel, 2009; Juvonen, 2007) on engagement. Among potential contextual factors, several studies have investigated the role of teaching practices. Their results pointed to the positive effect for student engagement of (a) supportive teacher-student relationships and equality of treatment (Roeser, Urdan & Stephens, 2009; Wentzel, 2009), (b) clarity, structure and formative feedback (Guthrie, Wigfield & Perencevich, 2004; Skinner & Belmont, 1993), (c) provision of choices and invitation of student expression and participation (Deci & Ryan, 2000; Reeves & Jang, 2006). However, most available studies related individual perceptions of teaching practices with engagement rather than using a multilevel framework. Doing so, they did not take into account the nested structure of the data (students nested in classrooms and/or schools) and did not allow assessing the contextual or idiosyncratic nature of these links (Marks, 2000).

In the present study, we wanted to use a multilevel analytical framework (a) to assess the magnitude of classroom effect on facilitators and indicators of engagement toward a specific course, (b) to examine the effects of teaching practices in this course (classroom level) on facilitators and indicators of engagement (student level), controlling for classroom composition and individual characteristics, and (c) to test the mediation of engagement facilitators between teaching practices and engagement indicators.

Method

Sample and procedure

Seven hundred and forty-one French-speaking 9th graders from 51 classrooms completed an anonymous questionnaire about their language course.

Measures

Individual socio-demographic characteristics: Gender, age, grade retention, socio-economic status (SES), ethnicity.

Indicators of engagement: Emotional, cognitive and behavioral engagement during language lessons.

Facilitators of engagement: Self-efficacy, perceived task value, and peer acceptance in language course.

Teaching practices: Student perceptions of provision of choice, invitation of student expression and participation, clarity and structure, formative feedback, supportive teacher-student relationships, and equality of treatment between high and low achievers, from their language teacher.

Classroom composition: number of students, school track, gender ratio, ratio of retained students, mean SES.

Results

Multilevel analyses were performed with the HLM6 software, using a stepwise procedure. First, models without predictors were run to estimate the partition of variance between and within classrooms. These analyses indicated significant between-classroom variance for facilitators (from 4 to 16 % of total variance) and indicators (from 12 to 17 % of total variance) of engagement.

Second, models including individual socio-demographic characteristics and classroom composition were run. Girls and students from higher socio-cultural background reported higher self-efficacy, higher task value, and higher emotional, cognitive and behavioral engagement. Moreover, self-efficacy was lower in classrooms with higher mean SES, peer acceptance was lower in classrooms with a larger proportion of retained students, and behavioral engagement was higher in classrooms with a larger proportion of girls. Taken together, these variables generally had only a small effect on between-classroom variance.

Third, perceptions of teaching practices aggregated at the classroom level were added in the models, controlling for the variables introduced at step two. Results showed that student self-efficacy was higher in classrooms with more provision of choice, perceived task value was higher in classrooms with more formative feedbacks, and peer acceptance was higher in classrooms with more equality of treatment. Emotional, cognitive and behavioral engagement were also higher in classrooms with more equality of treatment. At this step, between-classroom variances were largely reduced, but remained significant for self-efficacy, peer acceptance, and cognitive engagement. Fourth, facilitators of engagement were introduced as mediators between teaching practices and indicators of engagement. The effects of equality of treatment on the three indicators of engagement were reduced when controlling for self-efficacy, task value, and peer acceptance, but remained significant for emotional and behavioral engagement. Self-efficacy and task value were significantly associated with the three forms of engagement, but peer acceptance was associated only with emotional engagement. Among all predictors, task value displayed strongest relationship with each component of engagement.

Discussion

The results of the present study support the idea that between-classroom variations in student engagement could be related to variations in teaching practices. Concerning the effect of provision of choice on self-efficacy, results suggest that students interpret choices as a sign of teacher confidence in their capacities and teacher high expectations regarding their progress (Schunk & Pajares, 2009). Concerning the effect of formative feedbacks on perceived task value, results suggest that forms of assessments communicating that making errors is part of the learning process and providing cognitive guidance to master the material help students to value this material (Wigfield et al., 2009). Concerning the effect of equality of treatment on peer acceptance, results suggest that stressing social comparison and fostering competition between students reduce social support among peers (Midgley, 2002). In our sample, equality of treatment seems to be especially important for the three indicators of engagement investigated. This kind of teaching practices has a direct effect on engagement above the effects of self-efficacy, task value and peer acceptance. These results are quite consistent with research pointing to the detrimental effects of performance goal structure on student motivation (Roeser, Eccles & Sameroff, 1998). They also underscore the relevance of separating facilitators and indicators of engagement to better understand the motivational dynamic of the students (Skinner et al., 2008).

PAPER PRESENTATION

Maria Weurlander, Karolinska Institutet, Sweden; Max Scheja, Stockholm University, Sweden; Hakan Hult, Karolinska Institutet, Sweden; Annika Wernerson, Karolinska Institutet, Sweden

Students in medical education have to face suffering and death during their studies. The aim of this study was to explore medical students' experiences of an emotionally strong learning situation: the autopsy. Written accounts from 17 medical students were collected after their first and their third or fourth autopsy. Using a qualitative content analysis, data was coded and grouped into themes. The experience of the first autopsy can be described in terms of 'closeness' and 'distance'. For many students, the human body came very close, either their own physical reactions or reactions to the exposed corpse. For others, who could distance themselves, the autopsy allowed in depth studies of anatomy or pathology. The context was important and the teacher's guidance through the procedure helped generate a positive experience.

Introduction

Research on student learning in higher education have a strong focus on cognitive aspects of learning researching for instance approaches to learning (Marton et al 1985) or experiences of understanding (Entwistle 2009). However, students in medical and health care education meet patients with severe diseases, and have to face suffering and death during their undergraduate education, factors that may influence the learning process compared to a normal "class-room" context. Such situations make a strong impression and can be a very unpleasant experience that students need to process in order to learn what is intended in these situations (Smith & Kleinman 1989, Loftus 1998, Kelly & Nisker 2010). Moreover, the students often have to deal with the unpleasant emotions alone without the support from teachers (Smith & Kleinman 1989, Kelly & Nisker 2010). On the other hand, if these situations are handled well by the teacher, they could be a very good learning experience important in their future profession. A learning situation that is known to have a strong emotional impact on students is the autopsy. However, studies investigating students' experiences of autopsies are rare. Traditionally, autopsies have been a common learning activity in medical education but during the last decades the autopsy rates have been decreasing, resulting in fewer opportunities for students to participate (Hill & Anderson 1991). Clinical teachers and pathologists consider autopsies important for several reasons; to help students consolidate knowledge in anatomy and to understand mechanisms of diseases in different organs, but also to learn how a dead body is taken care of, to get an insight into how an autopsy is conducted and why autopsies are important to learn about disease and treatments (Hill & Anderson 1991, Burton 2003).

The aim of this study was to explore medical students' experiences of an emotionally strong learning situation: the autopsy. During a course in pathology in the second year of undergraduate medical studies, students have the opportunity to attend up to four autopsies.

The research questions were:

How do student experience autopsies?

In what ways are autopsies important learning opportunities?

The research was conducted within an interpretive research tradition and an explorative research design was used to capture students' experiences (Denzin & Lincoln 2003). Qualitative data was collected by means of written accounts from 17 students after attending their first and their third or fourth autopsy (34 accounts in total). The students were asked to describe their experiences of the autopsy and explain if and if so, in what way they were a learning experience. Using a qualitative thematic content analysis, data was coded and grouped into themes (Graneheim & Lundman 2004)

.Preliminary findings

The experience of the first autopsy can be described in terms of 'closeness' and 'distance'. For many students, the first autopsy was an emotionally strong experience where the human body evoked strong feelings. Students felt their own body react to the situation by for example nausea, or described that the dissected corpse with blood and the smell became very close and "real". Other students described it as a surreal experience or that they distanced themselves and tried not to involve their own emotions. For students, who managed to distance themselves from the unpleasantness of the situation, it was an opportunity engage in depth in the study of anatomy or to learn pathology and develop understanding of how diseases manifest themselves in the human body and how a decreased function in one organ affects other parts of the body. Furthermore, the context was important for students' experiences and the teacher had a central role in guiding the students through the procedure, which helped to generate positive learning experiences. Attending the first autopsy seemed to have a strong emotional impact on many students and they needed to process their experiences in order to cope with the situation and learn what was intended by the teachers. Some students coped by focusing on their own emotions and reactions while others tried to adapt to the situation and related to the purpose of the autopsy. The first autopsy seemed mainly to help students to understand the autopsy procedure, and it was during the following autopsies that many students learned to focus on anatomy and pathological changes in the organs. Students got used to the situation and became more and more interested in the

pathologists' search for the cause of death. These findings confirm that the autopsy is an important learning opportunity for students, if they are guided through the procedure and have time to get used to the situation.

Educational significance

The findings of this study suggest that students react differently to autopsies, but find them important. Teachers have a central role in guiding students through the procedures and clarifying the purpose of autopsies to students. This could help students cope successfully with the situation and create better opportunities for learning.

References

- Burton, J.L. (2003) The autopsy in modern undergraduate medical education: a qualitative study of uses and curriculum considerations, *Medical Education* 37:1073-1081.
- Denzin, N. K. & Lincoln, Y.S. (2003) *Collecting and Interpreting Qualitative Materials*, Thousand Oaks, CA:SAGE Publications.
- Entwistle, N. (2009) *Teaching for Understanding at University: Deep Approaches and Distinctive Ways of Thinking*, New York:Palgrave Macmillan.
- Graneheim, U. & Lundman, B. (2004) Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness, *Nurse Education Today*, 24(2):105-112.
- Hill, R.B. & Anderson, R.E. (1991) The uses and value of autopsy in medical education as seen by pathology educators, *Academic Medicine* 66:97-100.
- Kelly, E. & Nisker, J. (2010) Medical students' first clinical experiences of death, *Medical Education* 44:421-428.
- Loftus, LA (1998) Student nurses' lived experience of the sudden death of their patients, *Journal of Advanced Nursing*, 27:641-648.
- Marton, F., Hounsell, D. & Entwistle, N. (1985) *The Experience of Learning*, Edinburgh: Scottish Academic Press
- Smith, AC & Kleinman, S (1989) Managing emotions in medical school: Students' contacts with the living and the dead, *Social Psychology Quarterly*, 52(1):56-69

PAPER PRESENTATION

Student-teacher relationships, motivation, and transition into secondary school

Roch Chouinard, University of Montreal, Canada; Normand Roy, University of Montreal, Canada; Francois Bowen, University of Montreal, Canada

The purpose of this study was to document the impact of student-teacher relationships on achievement motivation in the context of the transition into secondary school. A questionnaire was administered three times to 1158 students: At the end of 6th grade (elementary school), at the beginning and the end of 7th grade (secondary school). Latent growth models estimated trajectories for competence beliefs, performance anxiety, utility-value, interest, and mastery goals considering the evolution of student-teacher relationships (increasing or decreasing). Analyses showed that students' achievement motivation in the transition into secondary school largely covariates with student-teacher relationships. Results also support stage-environment fit theory and highlight the link between attachment, connectedness, and achievement motivation.

Previous researches have shown that students' achievement motivation significantly declines during the transition into secondary school. Researchers have documented a general drop of interest for school (Harter, 1996; Simmons & Blyth, 1987) and a rise of performance anxiety in this period (Hirsch & Rapkin, 1987). Domain specific motivation also declines: drop of interest and mastery goals (Eccles, 2007), and of competence beliefs and utility-value of mathematics, language arts and sciences were reported (Harter, Whitesell, & Kowalski, 1992). Some authors have emphasized that the lesser quality of student-teacher relationships in secondary school compared to elementary school partially explains this phenomenon (Eccles et al., 1991; Lynch & Cicchetti, 1997). However, students are affected differently by the transition into secondary school. Some show a large decrease of their motivation; others do not seem to be much affected, while some report an increase of their motivational orientation (Harter, 1996; Wigfield et al., 2006). Can positive student-teacher relationships be a protective factor in the context of transition from elementary to secondary school? To answer this question, we examined the impact on motivation of the quality of student-teacher relationships in the transition from elementary into secondary school.

Method and data sources

Participants were 1158 French-speaking students from 56 public schools of the Montreal region (Quebec, Canada). Participants completed three times a self-reported questionnaire measuring their achievement motivation (Competence Beliefs, Performance Anxiety, Utility-Value, Interest, and Mastery Goals) and the perceived quality of their relationships with their teachers. Although there are many dimensions to student-teacher relationships, we

focus here on students' perception of the support they receive from their teacher and overall students' perceptions of the quality of student-teacher relationships in their classroom. Times of measurement were at the end of 6th grade (Time 1, last year in elementary school) and at the outset and the end of 7th grade (Time 2 and Time 3, first year in secondary school in Quebec). Participants expressed their opinion on a Likert type scale ranging from 1 (Totally disagree) to 6 (Totally agree). All these scales showed good validity and reliability. Firstly, we calculated a measure of participants' perception of student-teacher relationships by subtracting individual score taken by the end of 7th grade by the score obtained at the end of 6th grade. This new variable was considered continuous in the subsequent analyses, but for the purpose of the figures included in this proposal, we identified four types of student-teacher relationships based on the scores obtained at the times of measurement (25th and 75th percentiles): higher relationships increasing, higher relationships decreasing, lower relationships increasing, lower relationships decreasing. HLM (Bryk & Raudenbush, 1992) was used to model achievement motivation changes according to the evolution of student-teacher relationships and produce latent growth curves. Separate growth models were estimated for competence beliefs, performance anxiety, utility-value, interest, and mastery goals.

Results, Competence Beliefs

As illustrated in Figure 1, in 6th grade participants reporting higher student-teacher relationships also reported higher competence beliefs ($p < .05$) and maintained these kind of relations in 7th grade also maintained higher competence beliefs overtime ($p = .45$). Figure 1

Changes of Students' Competence Beliefs

Performance Anxiety Analyses showed an overall increased of performance anxiety between times of measurement ($p < .05$) Figure 2

Changes of Students' Performance Anxiety Utility-Value Overtime, we observed a decline of utility-value for students reporting a decrease of the quality of their relationships with teachers ($p < .05$) and maintained these kinds of relations in 7th grade also reported higher utility-value overtime ($p < .05$) Figure 3

Changes of Students' Utility-Value Interest Our analyses indicate a significant decline of interest ($p < .05$) and increased in 7th grade ($p < .05$) Figure 4

Changes of Students' Interest Mastery Goals Participants who reported superior student-teacher relationships in 6th grade also reported higher mastery goals ($p < .05$) and increased in 7th grade maintained the same level of mastery goals overtime ($p < .05$) Figure 5

Changes of Students' Mastery Goals Discussion Our results clearly indicate that student-teacher relationships can be a risk factor or a protective factor, depending on students' perception of the quality of these relationships while they transit from elementary to secondary school. Our findings also support Eccles' Stage-environment fit theory according to which secondary school does not allow teenagers to satisfy their psychological needs (Eccles et al., 1993) and highlight the link between attachment, connectedness, and achievement motivation. Finally, our results suggests that transitions themselves are neither good nor bad, what count most is the supportive nature of the environment where the students transit.

The results of the present study could be used to create more developmentally supportive school environments. For example, the size of secondary schools, student-teacher ratio and the number of teachers seen by each student should be minimized. Smaller communities of learners within larger schools building should be created. Measures of personalized follow-ups and tutorials should be installed and the number of activities promoting social connectedness at school should be increased. Instructional practices that keep a group of students with the same teachers for consecutive years (looping) could foster closer connections between teachers and their students should also be considered.

PAPER PRESENTATION

What does "positive school behaviour" mean? Dimensions (not) shared by students and teachers

Valentina Grion, University of Padova, Italy; Rossella Giolo, University of Padua, Italy

Like other European countries, recent Italian school legislation has turned the attention of the education community to the importance of student behaviour in school, and asks for a precise and detailed evaluation of this behaviour. In this light, schools have begun to look for appropriate evaluative tools. During the preliminary phases of creating a behaviour evaluation rubric in a high school, research was carried out with the aim of exploring and identifying the meanings given by teachers and students to the idea of "positive school behaviour", and whether these concepts are shared. Using a mixed method design, researchers have individuated some dimensions of the construct of "positive school behaviour" in teachers and students. Analyses highlight that, in this context, the idea is a construct comprising

dimensions which are not always shared by students and teachers. In this light, there is an emerging need for schools to activate processes of sharing, as a preliminary moment in the behaviour assessment process, and to work towards a "sustainable evaluation".

Over the last few years, the education policies of some of the larger European countries have focused on "school behaviour" and have placed "good conduct" among the necessary requirements for creating effective school contexts that promote student wellbeing. Any action aimed at improving "school behaviour" is considered "a shared responsibility between government, schools and other local partners together with parents and pupils themselves" (Steer, 2009, p. 5). Though later than other European countries, Italy too has recently focused on "school behaviour", within the frame of school reform processes, by issuing some rules aimed at assessing students' school behaviour. Schools have therefore been forced to consider this issue and to construct appropriate assessment instruments. In this context, research on "positive school behaviour" was carried out in a high school in the north of Italy, within a set of activities aimed at building an assessment rubric (Andrade, 2000). A document issued by the English Department for Education and Skills (2005) outlined that, in the school context, the first steps towards improving the wellbeing of its members, are those aimed at sharing consensus on the terminology and its meaning. "It is important to explore popular beliefs and misconceptions that may be held, and secure a whole-school understanding and recognition of the terms' existence and impact" (p. 5).

In the light of these issues, and in the context of the above-mentioned process of building a behaviour assessment rubric, some important research questions have emerged. Researchers are evaluating the following questions: a) what does "positive school behaviour" mean for teachers and students, i.e. what dimensions characterise it? b) if the idea of "positive school behaviour" is shared by teachers and students, does it refer to common dimensions that are considered during the assessment process?

The research took place in a high school specializing in Foreign Languages, Social Sciences and Human Sciences. The participants were 898 students, subdivided in 41 classes from 1st to 5th class, and 101 teachers. All classes and all teachers were involved in the research. The research design was based on the mixed methods design of Tashakkori and Teddlie (2003).

The following research instruments were used:

- a) an open, written question posed individually to each participant, such as: can you outline the main features of a student with "positive school behaviour"?
- b) a Likert scale of "sense of positive school behaviour" with 17 items, each assessed on a scale of four value intervals, to investigate the attitude of participants towards the idea of "positive school behaviour". The items were identified on the basis of their content validity, by a group of experts (15 teachers of different subjects and 2 researchers) who analysed a wide-ranging set of behaviour assessment rubrics.

These materials were collected during in depth research of the documents made available on the Internet by several national and international schools. For each of the two instruments, 825 protocols were collected from students and 31 from teachers. These numbers reflect the school population in the classes in which the research was administered. Given the natural "already given" school context, we have a non-random sample. The research therefore aimed to achieve significant findings from a theoretical-conceptual, rather than a statistical, point of view. By using the SPSS (Statistical Package for the Social Sciences), we submitted the data collected from the Likert-scale instrument to descriptive statistics, a factor analysis and a T-test. Data was submitted to a qualitative content analysis using the Atlas.ti qualitative analysis software. For this kind of analysis, it was decided that not all answers to the open question should be examined, but only a limited number, selected according to a random criterion, in order to decrease the answers to be analysed.

The analysis highlights how, in the specific school context, the idea of "positive school behaviour" refers to a wide range of dimensions, which are not entirely shared by teachers and students. The factor analysis on quantitative data outlined three "macro-dimensions" describing "positive school behaviour": "respect for others and the environment", "participation in school activities" and "school organisation". Among these, the first two are elements of a shared model of "positive school behaviour". As well as these common aspects, the qualitative analyses highlighted, in particular, some heterogeneities between the teachers' model of "positive school behaviour" and that of students. Teachers have a "simple" model, mainly characterised by the 3 macro-dimensions outlined by the factor analysis. Students, on the other hand, show a more complex model which is characterised by a strong sense of personal responsibility as a student, and is described by the following dimensions: a) commitment to good results; b) moral duty of the student as a student; c) caring for peers. If "any assessment act must contribute in some way to learning beyond the immediate task [...] and [it must prepare] students to meet their own future needs" (Boud, 2000, pp.8-9),

the process of building a behaviour assessment rubric described here may make a useful contribution in this perspective. We believe that the project, aimed at acquiring socially shared rules of "positive behaviour", is the result of participants' awareness and co-responsibility, and may represent a possible realisation of what Stobart (2010) defined as "sustainable assessment".

PAPER PRESENTATION

Student perceptions of school climate in an era of reform

Shirley Yates, The Flinders University of South Australia, Australia

Positive relationships between school climate and academic achievement are well established but few studies have examined these relationships at either class or school levels in an era of reform. Two studies were conducted over three and five years, with 309 and 640 elementary and secondary students respectively following the reformation of two schools from single sex to coeducation. Students' perceptions of the climate of their coeducational classrooms were measured annually in Study 1 and of the school in Study 2, with both studies using the same academic achievement measure. Statistically significant increases in student achievement following the introduction of coeducation were evident in both studies. In Study 1 boys perceived their coeducational classrooms to be significantly more Personalized. In Study 2, girls perceived less friction, were more cohesive and satisfied with life in the coeducational school than boys. However, once the hierarchical nature of the data was taken into account, only satisfaction with school life related directly to academic achievement for cohort and grade groups, with more satisfied cohorts making better progress over time. The measures of teacher personalisation at the classroom level and satisfaction at the school level are both derived from Moos (1974) Relationship Dimensions and relate to students' experiences of the nature and intensity of personal relationships in the environment. Results from these two studies indicate students' experiences of coeducational relationships extended beyond the classroom door to the wider school environment and were related positively to increases in achievement. These findings have implications for policy and practice.

Students' perceptions of the school climate were measured with My School Inventory (MSI), adapted from My Class Inventory (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982) or School Learning Environment Inventory (SLEI), adapted from the Learning Environment Inventory (Anderson & Walberg, 1974; Fraser et al., 1982).

Academic achievement in Studies 1 and 2

Academic achievement was measured with Word Knowledge Test 1 (WK1), Test 2 (WK2) or Test 3 (WK3) (Thorndike, 1973). Each test contains 40 word pairs, rated as the same or opposite in meaning.

Procedure

Study 1 was conducted annually over 3 years (Times 1, 2 & 3) (T1, T2 & T3) before during and after the introduction of coeducation. Study 2 was conducted annually over 5 years (Times 1, 2, 3, 4 & 5) (T1, T2, T3, T4 & T5), with coeducation introduced at T1 for secondary students and T2 for elementary students. All questionnaires and WK tests were administered to students in their classrooms with WK1 administered to Grades 3-7, WK2 to Grades 8-10 and WK3 to Grades 11-d 12. All students in Study 1 completed the ICEQ. In Study 2, Grades 3-9 were administered MSI, with SLEI given to Grades 8-12.

Findings

Statistically significant increases in student achievement over time were evident in both studies. An ANOVA in Study 1 revealed that overall, there was a significant increase in Personalization from T1 to T2 (paired t (308) = 3.96, p Participation, Independence, Investigation and Differentiation scales between T1, T2 and T3. While gender was not a significant direct factor in student educational achievement in Study 2, structural equation modelling analyses revealed that over the five years following the introduction of coeducation, the girls were more cohesive, satisfied with life in the CE school and perceived less friction than boys. However, once the hierarchical nature of the data was taken into account with Hierarchical Linear Modelling, only satisfaction with school life was related directly to academic achievement for cohort and grade groups, with more satisfied cohorts making better progress over time.

Educational significance of the research

The last forty years have witnessed an unprecedented number of reforms of single sex schools but despite the pervasiveness of these reforms and the profound changes they have brought to the school life experiences of countless numbers of students in several countries, the reforms have passed almost without notice. In her discussion of the numerous school reforms in England Sutherland (1985, p 155) noted there must be few instances where such a radical change in education has occurred in such an absent-minded way and further what remains regrettable is that

changes in educational organization take place without monitoring to judge their effects (Sutherland, 1985, p 161). Results from these two studies indicate the major organisational change from single sex to coeducation in the two schools did have an effect on relationships between student achievement and experiences of the Relationship Dimensions of life at classroom and school levels. In the coeducational classroom boys perceived greater opportunities to interact with their teacher and of his/her concern for their personal welfare and social growth. At the school level students increased satisfied with life in the coeducational school was related to increased achievement. Taken together, evidence from these two studies extends the well established relationship between students' experiences of school life and achievement (Cohen et al. 2009) to include eras of organisational change but also lends support for the argument that a return to single sex classrooms and schools is contraindicated, at least for boys. Further research into the effects of group level factors on school climate is required for boys and girls at elementary and secondary school levels in single sex and coeducational settings.

Acknowledgment

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PAPER PRESENTATION

What matters at school? The Finnish pupils' perceived competence, belonging and well-being

Janne Pietarinen, University of Eastern Finland, Finland; Kirsi Pyhalto, Helsinki University, Finland; Tiina Soini, University of Tampere, Finland

Research on pedagogical practices have shown that pupils' sense of competence, belonging and experienced well-being are the crucial preconditions for pupils' learning, academic mastery in school and success in their future educational track. In this paper we are focusing on exploring how the pupils' self-reported competence is regulated by their sense of belonging and well-being in the school community.

Altogether, 170 pupils (91 fifth and 79 seventh graders) from three case schools responded to the survey. The total response rate was 95%. BCW questionnaire was developed by authors and it embodied 39 statements about different aspects of belonging including two complementary scales, the peer group scale and 2) teacher-pupil interaction scale, competence consisting of statements about perceived competence in studying, academic achievement and assignments given by the teachers and well-being.

A stepwise regression analysis showed that both pupils' perceived well-being and teacher-pupils interaction predicted the pupils' academic competence [$F(2,167)=128,2$, $p=.000$, $\text{Adj-}R^3=.601$]. However, the relation between perceived belonging in peer group and academic competence did not exist in this regression model. The results pointed out that pupils' commitment and persistence in studies are regulated by the perceived fit between the pupil's capacity to manage their own learning and teachers' expectations about the pupils' resources to cope with multiple and parallel learning tasks and -contents.

Introduction

School is a central developmental context for pupils (Eccles 2004). School provides various opportunities for pupils learning, growth and well-being. Pupils also evaluate and monitor their success in coping with social, cognitive and emotional challenges set by the school (Anderson et al., 2000). Research on pedagogical practices have shown that pupils' sense of competence, belonging and experienced well-being are the crucial preconditions for pupils' learning, academic mastery in school and success in their future educational track (Deci & Ryan, 2002; Midgley & Edelin, 1998; Ryan & Deci, 2001; Pyhältö, Soini, & Pietarinen 2010). Coherent, meaningful and functional perceptions of school's pedagogical and social activities are likely to facilitate pupil's capacity for intentional and responsible management of new learning, both at an individual and community level. Yet, little is known about how pupils themselves experience the school in terms of interaction with teachers and peer group, well-being and studying. This study focuses on exploring the interrelation between perceived competence as a student, experienced well-being and sense of belonging to the school community. The study is a part of a larger national research project on learning and well-being in comprehensive school (2004 - 2014).

Aims

This study aims to gain better understanding about the preconditions that may lead to pupils' commitment and persistence in studies. More specific, in this paper we are focusing on exploring how the pupils' self-reported competence is regulated by their sense of belonging and well-being in the school community. Our hypothesis is that a precondition for meaningful learning and experienced competence as a student is that pedagogical practices of school promote pupils' sense of belonging and experienced well-being.

Methods and analysis

Altogether, 170 pupils (91 fifth and 79 seventh graders; 55% girls and 45% boys) from three case schools responded to the survey. The criteria for selecting the fifth and seventh graders were that primary-secondary school sift have found to provide significant challenges and opportunities for pupils' learning, well-being and social relations at school (Pyhältö, Soini & Pietarinen, 2010; Pietarinen, Pyhältö & Soini, 2010). The total response rate was 95%. The data presented here is a part of (first measurement) the longitudinal research design that focuses on exploring pupils' learning and well-being in educational transitions.

BCW questionnaire was developed by Pyhältö, Pietarinen & Soini and it embodied 39 statements about different aspects of belonging including two complementary scales, 1) the peer group scale and 2) teacher-pupil interaction scale, competence consisting of statements about perceived competence in studying, academic achievement and assignments given by the teachers and well-being measured using a modified and complemented versions of exhaustion scale (Maslach & Jackson, 1981) and anxiety and lack of interest scales (Mäkinen et al., 2004) as well as school burnout scale developed by Salmela-Aro et al. (2009). Pupils rated all the items on a 5-point scale (1 strongly disagree; 5 strongly agree).

Statistical analyses included the reliability analysis of the BCW sub-scales and regression analysis. First, the internal consistency of sub-scales was calculated with Cronbach's α for direct sums of items. After this, a stepwise regression analysis was carried out to investigate to what extent perceived well-being and sense of belonging in peer group and in teacher-pupil interaction influenced pupils' perceived competence as a student.

Results

The reliability analysis showed that consistency of the sub-scales was sufficient. The items related to pupils' perceived competence ($\alpha=.84$, 6 items), experienced belonging to peer group ($\alpha=.73$, 5 items) and with pupil-teacher interaction ($\alpha=.84$, 8 items) and well-being ($\alpha=.84$, 6 items) made possible to form adequate sum variables for the further analysis. A stepwise regression analysis showed that both pupils' perceived well-being and teacher-pupils interaction predicted the pupils' academic competence [$F(2,167)=128,2$, $p=.000$, $\text{Adj-}R^2=.601$]. More specific, experienced burdening including lack of interest, inadequacy at school and cynicism predicted pupils' decreased sense of competence at school. In addition, the regression model confirmed that experienced belonging in the pupil-teacher relationships seems to reinforce the pupils' capacity to regulate their learning and develop their participatory skills at school's multiple social environments. Pupils especially valued teacher's expertise in teaching, dialog with teachers, constructive feedback, fairness and emotional support received in pupil-teacher relationship. However, the relation between perceived belonging in peer group and academic competence did not exist in this regression model.

Discussion

The results pointed out that pupils' commitment and persistence in studies are regulated by the perceived fit between the pupil's capacity to manage their own learning and teachers' expectations about the pupils' resources to cope with multiple and parallel learning tasks and -contents. Hence the findings suggested that, pupils' sense of competence is a relational phenomenon that is clearly connected with sense of belonging with teachers, but not directly to the peer group interaction. A reason why peer interaction was not included in the model may be that the influence of peer group interaction on the perceived competence is indirect and mediated by other constructs (Pyhältö, Soini & Pietarinen, 2010). Finally, results showed that promoting pupils meaningful learning, commitment and persistence in studies are highly dependent on the quality of interaction in teaching-learning processes and more broadly pedagogical practices adopted by the teachers in school's everyday life.

PAPER PRESENTATION

Can Grades in a Teacher Preparation Program Predict Teacher Effectiveness?

Stelios Orphanos, Frederick University, Cyprus

Teachers are highly influential to student achievement and researchers have been trying to identify the teacher characteristics most predictive of student achievement. This study explores the relationship between teachers' academic performance during pre-service preparation and future teacher effectiveness. The main research hypothesis is that controlling for measures of teacher quality and school context teachers' academic performance has a positive effect on teacher effectiveness.

The sample includes 229 elementary school teachers in Cyprus. Surveys administered to teachers, principals and parents provided information on teacher effectiveness, teaching practices and contextual factors. Teachers' transcripts provide grades in education courses taken and were matched to teacher survey data. Teachers were rated by principals and parents on nine dimensions of teacher effectiveness.

Structural equation modeling techniques were used during data analysis. Controlling for teacher experience, advanced degrees and contextual factors, teachers' grades are a significant predictor of teachers' effectiveness. One st.dev increase in academic performance is associated with a 0.678 st.dev increase in teachers' effectiveness as measured by the average effectiveness rating. Also, better grades are positively associated with teachers putting forth more effort, using innovative assessment methods more frequently and more preparation time.

The results show that teachers' grades can be linked to teacher quality and effectiveness. Teachers' grades partially reflect demonstrated knowledge and skills that seem related to subsequent teacher effectiveness. Finally, the context of teaching plays an important role in determining the nature of the relationship between teachers' academic performance and effectiveness.

1. Objectives

Can teacher effectiveness be predicted? Teachers are highly influential to student achievement therefore researchers have been trying to identify the teacher characteristics most predictive of student achievement. In this study, I examine whether teachers' academic performance during pre-service preparation can predict teacher effectiveness.

The research questions are the following:

What is the contribution of teachers' academic performance during pre-service preparation to teacher effectiveness controlling for personal teacher characteristics and contextual factors (teacher collaboration, principal's instructional leadership)?

Which component of teachers' academic performance during pre-service preparation matters the most to teacher effectiveness?

What is the relationship between teachers' academic performance during pre-service preparation and teachers' use of effective teaching practices?

2. Theoretical framework

The study postulates that teachers' academic performance (measured by grades in four areas of teacher preparation curriculum), measures of teacher quality (experience, advanced degrees) and context (school leadership, teacher collaboration) have a direct and an indirect (through teaching practices) effect on teacher effectiveness. It is hypothesized that teachers' academic performance has a positive direct influence on the use of effective teaching practices and on teacher effectiveness. It is also hypothesized that teaching experience, advanced degrees and the context of teaching positively influence teacher effectiveness.

A number of researchers support the development of multiple data sources in teacher evaluation because multiple measures are more likely to yield fair teacher evaluations (DiPaola & Stronge, 2003). In this study, I use multiple teacher ratings collected from school principals, parents and teachers as indicators of teacher effectiveness.

3. Methods

This study utilized a cross-sectional survey design. The sample includes 229 elementary school teachers who are graduates of the same preparation program in Cyprus. Surveys administered to teachers, school principals and parents provide information on teacher effectiveness, teaching practices and contextual factors. Teachers' transcripts provide grades in education courses taken in various content areas and were matched to teacher survey data. Teachers were rated (on a scale of 1-10) by principals and parents on nine dimensions of teaching effectiveness (examples include level of preparation, classroom management, ability to improve student achievement etc).

Structural equation modeling techniques were used to investigate the relationship between academic performance and teacher effectiveness. Appropriate measurement models for latent variables were constructed and two SEM models with two outcome variables (teachers' absolute overall effectiveness rating and teachers' relative ranking within schools) were estimated.

4. Results and conclusions

Table 1 shows the results of the SEM analysis. Controlling for teacher experience, advanced degrees and contextual factors, teachers' grades are a significant predictor of teachers' effectiveness. One st.dev increase in academic

performance is associated with a 0.678 st.dev increase in teachers' effectiveness as measured by the average effectiveness rating.

All four components of teachers' academic performance are positively associated with teacher effectiveness. Teachers' GPA in pedagogy has the strongest effect and GPA in practice teaching has the smallest -but still substantial- effect on teacher effectiveness. In addition, academic performance is positively related to teachers' relative ranking within schools. Collectively, these results support the positive association between GPA in education coursework and teacher effectiveness reported in earlier studies (Ferguson & Womack, 1993; Guyton & Farokhi, 1987; Nelson & Wood, 1985).

Table 2 shows the effects of teachers' academic performance on the use of effective teaching practices.

Better grades are positively associated with teachers putting forth more effort in their work, using innovative assessment methods more frequently, involving parents and spending more time on daily planning and preparation. Also, teachers with better grades believe that teachers and not students' background has the greatest influence on student achievement.

Several conclusions emerge from these results. First, grades can be linked to teacher quality and effectiveness. Crude measures of teacher quality such as degrees, amount of coursework or certification status, used in previous research, may be not be the right variables to use. Second, knowledge demonstrated in education coursework is relevant to teacher effectiveness. Teachers' grades partially reflect demonstrated knowledge and skills that, according to the results, are related to subsequent teacher effectiveness. Third, the context of teaching plays an important role in determining the nature of the relationship between teacher quality and effectiveness. Simply providing teachers with coursework and opportunities to act on what they learn may not be enough unless the right political and educational context is in place.

6. Scientific and scholarly importance

The title of the paper asks if teacher effectiveness can be predicted. Results show that, at least in Cyprus, teachers' undergraduate academic performance may be used to predict teacher effectiveness. The analysis shows that it is more likely for teachers with a high GPA to receive higher effectiveness ratings from the school principal and parents. The study is important for two more reasons. First, it is the first study in Cyprus to explore the relationship between teachers' academic performance and teacher effectiveness. In addition, similar studies outside the USA are rare. Second, this is the first study that combines the use of teachers' grades and three different teacher ratings in exploring the relationship between teachers' academic performance and teacher effectiveness.

References:

- DiPaola, M. D., & Stronge, J. (2003). *The handbook on superintendent evaluation*. Lanham, MD: Scarecrow Press.
- Ferguson, R., & Womack, S. (1993). The impact of subject matter and education coursework on teaching performance *Journal of Teacher Education*, 44, 55-63.
- Guyton, E., & Farokhi, E. (1987). Relationships among academic performance, basic skills, subject matter knowledge and teaching skills of teacher education graduates. *Journal of Teacher Education*, 38, 37-42.
- Nelson, B., & Wood, L. (1985). The competency dilemma. *Action in teacher education*, 7(1), 45-57.

PAPER PRESENTATION

Fostering counseling competence of pre-service teachers

Silke Hertel, German Institute for Internat.Educational Resarch, Germany; Johannes Naumann, Geman Institute for International Educational Research, Germany; Bernhard Schmitz, Technical University of Darmstadt, Germany

Recent conceptions of teacher professionalism include counseling knowledge in what is seen as a core set of teachers' professional competencies (e.g. Baumert & Kunter, 2006), but an explicit training of counseling skills is rarely included in teacher education. Until now there are no findings whether pre-service teachers can already acquire counseling competence during their courses of study at university. Within the scope of this study it was examined, whether - and if so - which aspects of the counseling competence can already be acquired by pre-service teachers. Following Hertel (2009) five di-mensions of counseling competence were distinguished: personal resources, social co-operation, counseling skills and pedagogical knowledge, solution and process orienta-tion, and coping. The participating pre-service teachers (N=40) were enrolled in teacher education programs at the university. The study is based on a quasi-experimental design, participants in the experimental group were trained in counseling skills, partici-pants in the

control group received training on teachers' general pedagogical knowledge. Self-ratings and knowledge tests were applied to assess participants' competence gain in a multi-method-fashion. MANOVAs and ANOVAs were conducted to analyze the data. The results show that pre-service teachers can acquire specific aspects of counseling competence already in their university education. Concluding from that, training of counseling skills should be included in (pre-service) teacher education. Additional research for the development of counseling competence in a teacher's career is necessary to better adjust the interventions to the needs of (pre-service) teachers.

Scientific issue

Teachers' professional responsibilities are constantly changing in a world where education is an increasingly important resource. Parents demand teachers' advice how to support their children at home (e.g. Cooper, Lindsay & Nye, 2000; Trautwein & Ludtke, 2009). Positive effects of a frequent parent-teacher-communication and teachers' counseling activities are well documented (e.g. Lengua & McMahon, 2000; Manz, Fantuzzo & Power, 2004). In line with this, recent conceptions of teacher professionalism include counseling knowledge in what is seen as a core set of teachers' professional competencies (e.g. Baumert & Kunter, 2006), but an explicit training of counseling skills is rarely included in teacher education. Until now there are no findings whether pre-service teachers can already acquire counseling competence during their courses of study at university. Within the scope of this study it was examined, whether - and if so - which aspects of the counseling competence can already be acquired by pre-service teachers.

Theoretical and empirical background

In the latest conceptions of teacher professionalism counseling competences are explicitly specified within the core set of teachers' professional competences (e.g. Baumert & Kunter, 2006; Terhart, 2002). According to Hertel (2009) five dimensions of counseling competence can be distinguished: personal resources, social co-operation, counseling skills and pedagogical knowledge, solution and process orientation, and coping. Frequently, teachers perceive their relations to parents as an extremely difficult part of their job, and as a major source of job dissatisfaction (Vickers & Minke, 1995). Also, when teachers are not educated in counseling tasks, they are likely to develop attitudes and professional beliefs that do not endorse the importance of counseling as part of their job (e.g. Wild, 2003). Teachers' professional beliefs, in turn, are known to have a major influence on teacher practice (e.g. Deemer, 2004; Hoy, Davis & Pape, 2006; Pajares, 1992). In particular, teachers' professional beliefs predict behaviors relating to counseling tasks, such as the arrangement of learning environments, promoting students' motivation, and responding to special learning needs (Ozgun-Koca & Sen, 2006; Hall, 2005; Richardson, 1996). Counseling talks are an important starting point for an intensive collaboration with parents and therefore they provide an individual support for pupils. Many studies were able to indicate positive effects of the collaboration of teachers and parents for the performance and the school achievement of pupils (e.g. Epstein, 1991; Arunkumar, Midgley & Urdan, 1999; Lengua & McMahon 2000; Wild, 2003).

Applied empirical research methodology

Within the scope of a quasi-experimental experimental-control-group-design with a pre-post test, the effectiveness of an intervention, developed to support the counseling competence, was investigated. Participants were N=40 students enrolled in a teacher trainee program at university. Students in the experimental group visited a counseling competence seminar; students in the control group visited a seminar on teachers' general pedagogical knowledge. For the pre- and posttest, self-ratings of perceived counseling competence were collected. Although subjective in nature, self-ratings have been shown to validly tap on participants' factual abilities in a number of areas, such as inter-cultural skills (Ward, Fisher, Lam, & Hall, 2009), creativity (Kreitler & Casakin, 2009), computer skills (Ballantine, Larres, & Oyerle, 2007), counseling (First Author, 2009), and even personnel selection (Randall, Ferguson, & Patterson, 2000). Also, meta-analytic results indicate the validity of self-reports of abilities, especially under circumstances as given in this study, such as confidential treatment of the data, or subjects knowing that some objective measure would be collected in addition to the self-reports (Mabe & West, 1982). Participants were asked to rate their counseling competence (e.g. self-reflection, communication-skills, coping competence) on six-point rating scales. These measures were combined into an over-all measure of perceived counseling competence. Cronbach's α for this measure was .77. Participants' counseling knowledge was assessed with a four-item declarative knowledge test covering topics that were addressed in the training. The training was part of the regular semester and consisted of 13 sessions of 90 minutes. The main topics addressed were communication theory, communication strategies and self-regulated learning theory. The communication strategies were trained in role-plays. Four parent-teacher counseling talks with realistic scenarios were simulated in the course of the training. Knowledge about processes of learning in general and learning strategies in particular were covered by introducing a model of self-regulated learning (Schmitz & Wiese, 2006). This model included learning strategies and supportive strategies that teachers could use in counseling tasks. Multivariate and univariate ANOVAs were conducted to analyze the collected data.

Research results

The analyses prove statistically significant interactions of time by treatment for the competence dimension “personal resources” [$F(1,21)=5.6$, $p<.05$, $Eta^2=.21$] and the counseling knowledge [$F(1,21)=4.5$, $p<.05$, $Eta^2=.18$]. For students in the experimental group an increase in these competence aspects was observed. Statistically significant differences between the control group and the experimental group also appear in the area of “the perceived increase in competence” [$F(1,38)=18.2$, $p<.01$, $Eta^2=.32$] and “the self-efficacy in relation to counseling talks” [$F(1,20)=5.5$, $p<.05$, $Eta^2=.22$]. As expected, higher values for the participants under experimental condition were observed on these scales.

Theoretical and practical conclusions

Already within the scope of university education, pre-service teachers can acquire counseling knowledge and counseling competence. Thus, already from the present results, but even more given that they might be replicated and extended, there is good reason to give increased attention to teachers’ competence in parent counseling and include respective trainings both in their primary education, and on the job. Additional research for the development of counseling competence in a teacher’s career is necessary to better adjust the interventions to the needs of (pre-service) teachers.

PAPER PRESENTATION

Understanding teachers as learners: a postmodern reading of current explanations.

Aileen Kennedy, University of Strathclyde, United Kingdom

At the heart of this paper is a desire to use theoretical insights derived from postmodern thinking to practical advantage in the consideration of how teacher professional learning can be supported. It starts from the premise that teachers’ dispositions towards their own learning are not fixed, rather they are dynamic, contingent and responsive to experience, environment, personal lives and professional demands.

It is argued that existing literature on teacher professional learning is epistemologically narrow, relating most commonly to notions of managerialism and effectiveness. This argument put forth in this paper draws on postmodern thinking in analysing the possibilities and multiple interpretations of existing literature on teacher professional learning, taking into account writing on teacher development theory, empirical research into career-stage CPD needs and the growing body of literature which advocate a more socially-situated view of teacher learning. It also draws on career development theory, in particular the notion of employees’ ‘psychological contracts’ with their employers, in coming to a conclusion that a much wider and dynamic conception of teachers’ ‘needs’ is necessary.

At the heart of this paper is a desire to use the theoretical insights derived from postmodern thinking to practical advantage in the consideration of how teacher professional learning can be supported.

The understanding of teacher professional learning that I develop in the paper draws on postmodern thinking which rejects the notion that situations can be explained by grand narratives or theories (Lyotard, 1984), and rather seeks to interpret and reinterpret situations from a range of different perspectives. Inherent in this argument is an explicit attempt to expose power, or what Foucault would call ‘regimes of truth’; the dominant discourse which shapes acceptability of what is deemed to be ‘truth’. It is important, however, to ensure that such theoretical discussions are used to inform thinking about policy and practice, and do not to serve to disconnect them further. In this regard, I consider a range of contemporary literature on teacher professional learning, with a view to identifying and exposing the epistemological assumptions on which they are based. In doing this, it is hoped that a wider, more nuanced view of teacher learning can be promoted as a challenge to the dominant view which in effect limits understanding of teacher professional learning to a series of standards, frameworks and career stages in order to allow for ‘effective management’.

Early attempts to classify stages of teacher development, e.g. Dreyfus & Dreyfus (1986) have been discredited for their linear and narrow focus, with more recent attempts paying more attention to the importance of context (Huberman, 1993; Day et al., 2007; Fraser et al., 2007). However, even the most recent, research-informed attempts at explaining how teachers learn across the career course remain partial and inadequate for the purposes of supporting meaningful, career-long professional learning. At the root of this, I argue, is the obvious, yet often overlooked fact that teachers are human beings, with complex and unique life experiences, histories, values, expectations and aspirations, which change and develop as they interact with the world. In essence, teachers are dynamic beings and cannot easily be captured by static, neatly defined categories.

In much of the literature focusing on teacher professional learning, the notion of 'career stage' is used in a relatively uncritical way, generally suggesting post or role-related stages in a teacher's professional life. There is a plethora of studies, often Government-funded, which seek to uncover lists of 'CPD needs' that can be associated with teachers at particular career stages (Kennedy et al., 2008; Karstanje & Webber, 2008; Woods et al., 2009;). The rationale behind this is usually that identifying teachers' perceived needs will allow CPD provision to be more appropriately organised. The paper challenges this, suggesting that the answers to the questions asked in such research are usually framed within dominant discourses which stop teachers even considering alternatives to role-focused CPD which is 'provided by the employer.

A growing body of literature on professional development has coined terms such as 'professional evolution' (Huberman, 1993) and 'professional life phase' (Day et al., 2007) which convey a more socially-situated conception of teacher career stages relating to both professional and personal influences which go beyond consideration of mere occupational preparation for a specific role. These explanations, while helpful, are still limited by their attempts to categorise teachers within certain parameters and to associate these parameters with particular CPD needs. The complexities of workers' engagement with their professional learning is an area of investigation which has long been considered in career development research, albeit not specifically in relation to school teaching, and it is to this body of literature that I look to seek ways of understanding the complexities of teachers' attitudes to their own professional learning, and ultimately to help inform policy and practice in supporting teacher professional learning by advocating alternative views of thinking about processes.

Interestingly, literature on teacher professional learning seems to inhabit a separate world from general career development theory. In career development theory, the term 'career development' is subject to debate and reinterpretation, mirroring the developments in literature on teacher development which has moved from an occupationally focused and very linear construction of development to a more socially-constructed, complex one where factors wider than the immediate employment situation are acknowledged as influential. However, many career development theorists argue that it is not simply our growing understanding of the wider personal and social influences that have forced new areas of exploration, but also a sociological change in the way that careers are configured, experienced and lived; something that appears to have been sidelined in literature on teachers and teaching. Amundson, Parker & Arthur (2002) describe the experience of contemporary career development as one of 'continuing tensions between leveraging past experience and positioning for future opportunity' (p. 27). And Patton & McMahon (2006) argue that workers, especially younger workers, now have to focus on 'employability rather than job security' (p. 6), in a world where most workers will change career at some point in their lives. Patton & McMahon (ibid.) go on to outline a number of emerging ways of conceiving career development, concluding that key elements of any definition would attend to 'the individual, the environment, interaction and change' (p. 7), thereby acknowledging the dynamic nature of career development.

Hess & Jepson (2009) point to the growing need for research which attempts to 'define the twenty-first century employment relationship' (p. 261) which they argue has changed as a result of 'an increasing number of older workers alongside younger workers in organizations with flatter structures' (ibid.). They focus on the concept of the 'psychological contract' which is an implicit understanding between an employer and an employee of the extent and parameters of their respective responsibilities and commitments to each other. If the employer is seen to have compromised their side of the PC, the workers' engagement is likely to decrease, and conversely, if employers are perceived to have kept their end of the contract then employees are more likely to report job satisfaction and to be prepared to 'go the extra mile' (Shen, 2010), which includes engagement in furthering professional learning. This provides another interesting, yet overlooked lens through which to explore teacher disposition towards professional learning.

In conclusion, the paper offers a range of perspectives on teacher professional learning, all of which are deserving of consideration in both theoretical and practical senses, and which go some way towards deepening understanding of the complexities of teachers' engagement with professional learning.

PAPER PRESENTATION

Sharing Data in International Research – A Theoretical Discussion on Pros, Cons, and Solutions

Eveline Gutzwiller-Helfenfinger, The Institute of Pedagogical Professionalism and School Culture, Switzerland; Anna Tapola, Linnaeus University, Sweden

International, collaborative, and comparative research is often viewed in very positive terms, as being especially powerful or fruitful regarding its outcomes, not least in terms of education for a global networked society (EGNS). However, such research endeavours are not unproblematic. This paper aims to identify and discuss potential advantages and difficulties of sharing data in international research projects, for example The Linnaeus Project (TLP)

but also other research initiatives on EGNS. Additionally, we suggest solutions to how the difficulties can be overcome. One of the issues concerns the very nature of data (e.g. interviews) collected by a project partner, which will also be analysed by researchers in other national groups. Since the data are embedded in a specific national context, and might also be presented in a language which is not the analysts' mother tongue, such data sharing needs to be carefully prepared. For example, the translation of transcripts goes beyond simply transferring utterances from one language into another; the translation needs to be sensitive to contextual aspects, and the analyst needs to be very familiar with the contextual circumstances of the initial data collection. Another option might be to analyse all data in the original language only, thereby making translation unnecessary. This means that a specific national partner project needs to include members who are familiar with other national contexts, including the original language. Although these issues are discussed in the context of TLP, they are highly relevant to other projects, especially in terms of research on EGNS.

Aim

This paper aims to identify and discuss potential advantages and difficulties of sharing data in international research projects, for example, the Linnaeus Project, or other research initiatives on education for a global networked society (EGNS). The paper also aims to provide solutions to how difficulties can be solved. Research Questions1. What potential advantages can be identified with respect to data sharing in an international research project?2. What potential difficulties can be identified with respect to data sharing in an international research project?3. How can potential difficulties be prevented or solved? The problem and its relevance to international research within EARLI International, collaborative, and comparative research is often thought of in very positive terms. It is considered as being especially powerful or fruitful regarding outcomes, not least in terms of EGNS. Thus, covering more than one national and cultural context and being able to include different educational systems enable researchers to study more closely various conditions and contexts of teaching and learning. However, such research also involves a number of difficulties that must be addressed: Dealing with different languages, geographical distances, and differing settings and infrastructure are some of the very basic difficulties involved. The issue of data sharing is very prominent, because accessing and using data generated by several project partners is one of the core activities of international collaborative research. Several domains can be identified within the issue of data sharing, e.g., the legal context (Fitzgerald & Pappalardo, 2007); infrastructure planning and data curatorial responsibilities (Ruusalepp, 2008); data accessibility and safety (Axelsson & Schroeder, 2009); and representation format (Makedon, Steinberg, Rahme, Tzika, Wishart, & Wang, 2003). The topic addressed in the present paper is the representation format of data, and includes both the mode of representation (e.g., verbal or visual) and the language used. Successful data sharing is the basis for subsequent analyses and enables researchers to gain new and important insights. Accordingly, research within EGNS investigating the influence of the globalization of education is dependent on accessible, useable, and highly qualitative national and international data. The Linnaeus Project represents one such international research project within EGNS, and will be used as an example to identify and discuss potential advantages and difficulties of sharing data in international research projects.

Context

The Linnaeus Project is a new international research initiative, which currently includes seven national groups and 25 European researchers. The Linnaeus Project as a whole aims to analyse the preconditions for integrative approaches in teacher education that integrate morality, democratic aspects, and subject matter into new entirities. Its focus lies on contemporary challenges against humanity and human living conditions.

Pragmatic grounding

The topic addressed in this paper has a clear pragmatic grounding; investigating advantages, difficulties as well as potential solutions to the difficulties encountered in international, collaborative, and comparative research projects. Accordingly, the paper especially deals with how successful international research collaboration aims to gain new and important insights in the field of EGNS. The basic idea of data sharing promoted here states that it is beneficial for national groups to have access to data from other national groups as well, particularly within comparative studies. When data collected by a project partner will also be analysed by researchers in other national groups, questions of safe data storage, data accessibility, data format, etc. arise. Since the data are embedded in a specific local and national context, it is possible that they are rendered in a language other than the analysts' mother tongue. Consequently, this language difficulty must be overcome. One possible option might be to translate the data. In this case, the translation needs to be sensitive to contextual aspects, and the analyst needs to be very familiar with the contextual circumstances referred to the initial data collection. Translation may be a good option for verbal data derived from questionnaires, especially if mainly closed (as compared to open-ended) questions are used. In the case of interview data, high-quality, context sensitive translations may be required, and the costs for such translations

must be included in the research budget. Another option might be to analyse all data in the original language only. This means that a specific national partner project interested in the (foreign language) data needs to recruit members who are very familiar with other national contexts, including the original language, and have the necessary analytic skills. These researchers will then have to collaborate with the project partner who collected the data and analyse the data in the original language.

Conclusions

Collaborative international research projects must consider the nature of the data to be shared, especially their representation format. Since national research groups often differ with regard to language, both data collection and analysis are affected by the difficulty of coordinating different languages. Accordingly, researchers must decide whether data will be translated into their national language and then analysed or analysed in another language by a skilled member of the research team. Both options require careful planning and are accompanied by specific costs, which in turn must be included in the research budget.

References

- Axelsson, A.-S., & Schroeder, R. (2009). Making it Open and Keeping it Safe. *Acta Sociologica*, 52(3), 213-226.
- Davidson Frame, J., & Carpenter, M. P. (1979). International Research Collaboration. *Social Studies of Science*, 9(4), 481-497.
- Fitzgerald, A., & Pappalardo, K. (2007). Building the infrastructure for data access and reuse in collaborative research: an analysis of the legal context. Canberra, Aus: Elect Printing. Retrieved from: <http://eprints.qut.edu.au/8865/Makedon, F., Steinberg, T.,>
- Rahme, L. G., Tzika, A., Wishart, H., & Wang, Y. (2003, June). Multi-functional data collection interfaces for biomedical research collaboration. Paper presented at the 10th International Conference on Human-Computer Interaction (HCI), Crete (Greece).
- Ruusalepp, A. (2008). Infrastructure planning and data curation: a comparative study of international approaches to enabling the sharing of research data (Report for the Digital Curation Centre and JISC Version 1.6). Retrieved from: http://www.dcc.ac.uk/docs/publications/reports/Data_Sharing_Report.pdf

PAPER PRESENTATION

Relative Judgment of Graphics in the Interpretation of Meaning

Robert Danielson, California State University, Chico, United States; Neil Schwartz, California State University, United States; Jessica Stanley, California State University, Chico, United States; Sevil Gonen, California State University, Chico, United States; Erica de Vries, Universite Pierre-Mendes-France, France

Previous research has shown that humans often make judgments in relation to the context surrounding them. This context may either be internal representations of previous knowledge (eg. about prices of items or previous self-history), or may be in reference to previously or concurrently presented visual stimuli. The present study highlights these referential effects on judgments specifically related to visual media. Graphics were presented in one of two ways; with one definition and other graphics as the reference, or alone with multiple definitions as references. Results suggest that when participants are presented with one definition and asked to rate multiple graphics on the definition-graphic correspondence, the graphic which matches the definition is rated as more similar compared to the same graphic when judged against multiple definitions. The findings are discussed in the context of frames and the theory of rationale choice relative to learners' interpretation of the graphics they view when accompanying text.

Aims

Previous research has shown that when humans make judgments of presented stimuli, they often do so in the context of other stimuli. Whether it is the case that buyers are referencing prices presented with internal prices derived from experience (Yadav & Seiders, 1998) demand for items when scarcity and previous demand are presented (Worchel & Adewole, 1975); or judgments of subjective happiness in reference to previous life experiences (Parducci, 1995) the context of the judgment is just as important as the judgment itself. This phenomenon bears relevance to the judgments learners make when interpreting the visualizations that accompany text.

Tversky, & Kahneman (1981) found that when presented with identical survival ratios, the framing of the ratio (1/3 will live vs 2/3 will die) had a significant effect on the decision individuals made. Tversky (2004) contends that "when presented with two stimuli, the variant is more similar to the prototype than vice versa". This is clarified by the statement "an ellipse is more similar to a circle than a circle is to an ellipse" (Tversky, 2004). We suggest that the same types of judgments are made by learners when they attempt judgments about the relation between visualizations and

the conceptual content of text. For example, learners may view abstract visualization as more concrete, but concrete stimuli will not be seen as more abstract.

Previous research has focused on the degree to which graphics have influenced learning when paired with text. Schnotz & Bannert (2003) have demonstrated that unique graphics, paired with identical texts, create different mental representations of the textual information, and poorly selected graphics interfere with mental model construction. Thematic graphics have been found to influence a learner's cognitive interaction with a passage (Schwartz, Battinich, Lieb & Mortensen, 2008; Schwartz, Lieb, Battinich & Kuinke, 2007), and can increase recall of both literal details as well as deeper level themes (Mortensen & Schwartz, 2009).

Yet, Tversky & Kahneman (1981) found that when participants were asked to make specific decision about problems, the framing of the question could change the outcome of the answer. We expect the framing effect to operate with visual stimuli as well. Thus, in the present investigation, we examined two specific ways to understand if a thematically related graphic would be interpreted differently based on the contextual frame in which learners' were asked to make a choice about meaning. We expected that if frame theory operates to influence learners' interpretive choice about graphics, then the graphics learners view are prone to contextual relativity. That is, a graphic, when paired with multiple definitions, should be evaluated differently than multiple graphics evaluated against a single definition. If the interpretation of graphics is contextually independent and distinct—and immune to interpretive relativity—then judgments of meaning should be immutable given variations of correspondence.

Methods

Design

Two factors, Presentation Format and Graphic Metaphor were crossed to yield 6 experimental cells. The resulting design was a 2 Presentation Format (Multiple Graphics vs. Multiple Definitions) by 3 Graphic Metaphor (Civil War vs. Genocide vs. Geographic Location) ANOVA.

Participants

Participants were 99 undergraduate volunteers randomly assigned to the experimental groups.

Materials

Experimental graphics. Three metaphorical graphics were designed. The first graphic was a topographical representation of a region. The second was a graphic depicting the concept of Civil War and shown with two lions of similar color and size engaged in combat. The third graphic depicted the concept of Genocide and consisted of two lions of similar color and size devouring a third lion of a dissimilar color and size.

Experimental Website. An experimental website was created to convey the experimental materials. This website contained 6 hypermedia pages displaying the definitions and graphics, as well as a routing page designed to assign participants into one of two conditions.

Procedure

Participants navigated through an experimental website where they were routed into one of two conditions. In condition one, participants were presented with the definition of genocide. They were then presented with all three metaphorical graphics. In condition two, participants were presented with the definition of genocide, civil war, and geographic location. They were then shown the metaphorical graphic depicting genocide. Their task was to determine if the graphics corresponded well to the definition by rating the correspondence on a scale from one to five.

Findings

Preliminary results revealed an interaction between Presentation Type (Multiple Graphics, Multiple Definitions) and Graphic Metaphor (Genocide, Civil War, Geographic Location) on graphic rating, approaching significance $F(2, 99; MSe = 1.996) = 2.82, p = .06$. Specifically, the graphic depicting the metaphor of genocide was rated as more like the definition of genocide when presented alongside two other graphics ($M = 3.71, SD = 1.38$) then when presented alongside two other definitions ($M = 2.92, SD = 1.53$).

Theoretical and Educational Significance

These results support a diverse set of findings of relative choice behavior as they apply to visualizations. When participants are presented with one definition and asked to rate multiple graphics on the definition-graphic correspondence, the graphic which matches the definition is rated as more similar compared to the same graphic when judged against multiple definitions. The findings are discussed in the context of frames and the theory of rationale choice relative to learners' interpretation of the graphics they view when accompanying text. The findings are important for research on visualizations because it suggests that the interpretation of graphics is not contextually

independent and distinct. Instead, the interpretive judgments learners make of graphics are relative to the frame of reference in which they are embedded.

PAPER PRESENTATION

Learning from pictures: the role of physical similarity

Lisanne van Weelden, Tilburg University, Netherlands; Alfons Maes, Faculty of Humanities Tilburg University, Netherlands; Joost Schilperoord, Tilburg University, Netherlands

Visual metaphor is a well-known template in genres like cartoons, advertisements and study books. Several studies on visual metaphors suggest that physical similarity between object representations facilitates finding meaningful relations between them. The present study investigates how viewers draw attributive and relational information from representations of objects and how physical similarity helps finding relations between metaphorically related concepts. Our starting point is the idea that similarity in shape leads to the interpretation of both objects being of the same type, which subsequently facilitates creating a joint conceptual category.

In our experiment, forty-two 11 year-olds compared two pictures (a source and a target, e.g. a leopard and a motorcycle), which were either physically similar or physically dissimilar. When the source picture was presented (e.g., a leopard), the participants had to call out as many features as came to mind. When the target picture was presented (e.g., a motorcycle), participants had to mention as many correspondences between source and target as they could. The analyses focused on the number and types (attributive or relational) of correspondences, the number of repetitions of predicates, and the number of explicit comparative expressions.

Preliminary results show that physical similarity between objects results in more comparative expressions based on relational predicates. For example, when 'fast' was already mentioned for the leopard, we found more comparisons like 'the motorcycle and the leopard both go very fast' when the motorcycle and the leopard were physically similar than when they were not.

One of the reasons why pictures are often used in learning situations is that they enable learners to draw propositional information from them. Drawing information from multiple objects within one visual array, however, is far from straightforward, as pictures lack real syntax. Physical similarity and alignment between object representations can be used to suggest meaningful relations between depicted objects.

The present paper investigates the role of physical similarity between objects in finding meaningful relations between metaphorically related concepts. We presented forty-two 11 year-old children with pairs of metaphorical pictures, which were either physically similar or not, and asked them to produce as much correspondences as they could. Metaphor is a matter of finding meaningful relations between two concepts, in an attempt to understand one concept (the target) in terms of another (the source) (Bowdle & Gentner, 2005; Lakoff & Johnson, 1980). By using metaphoric picture pairs, for example, a motorcycle (target) paired with a leopard (source), we created a natural elicitation task situation, which enabled us to investigate the basic processes in metaphoric conceptualization: comparison and categorization. According to Lakoff and Johnson (1980), metaphor is not so much a matter of language, but a matter of mental conceptualization, which implies that other representational modes (like pictures) are equally well able to elicit metaphoric processing. This is confirmed by the use of metaphoric visuals in many genres like advertisements, cartoons and learning materials. However, little is known about how viewers and learners construct metaphoric conceptualizations on the basis of visual input. In studying metaphor processing based on language, two types of correspondences between source and target are distinguished: low level attributive relationships (e.g., the leopard and the motorcycle having a similar slender shape) and higher level conceptual-relational relationships (e.g., the ability of leopards and motorcycles to run/ride very fast). We expect that the mere physical similarity of objects in metaphoric pictures affects finding these relationships. By using physically similar vs. dissimilar pairs (see figure 1), we exploit this typical characteristic of the visual medium. Hence, the main questions we address in the present study are how viewers draw attributive and relational information from representations of objects and how perceiving physical similarity between objects stimulates viewers to find metaphorical relationships between them. Based on the idea that 'the nature of an entity is its shape', we hypothesize that similarity in shape leads to the interpretation of both objects being of the same type, which subsequently facilitates creating a joint conceptual category. Hence, we predict that it is easier to find a metaphorical relationship between two objects when they are physically similar than when they are not. So, we expect physical similarity between objects to stimulate not only low level attributive

correspondences, but also higher level conceptual relations (Phillips & McQuarrie, 2004; Schilperoord, Maes, & Ferdinandusse, 2009; Teng & Sun, 2002)

.For our experiment we created 14 picture pairs, each consisting of a source, e.g. the leopard (either physically similar or dissimilar), and a target object, e.g. the motorcycle. The source objects were always natural objects (like a leopard, a giraffe, the sun, a hand), whereas the target objects were artifacts (like a motorcycle, a lighthouse, a clock, a computer mouse). The source and target picture were successively shown. When the source picture was presented, the participants had to call out as many things as came to mind within a 15 second time span. When the target picture was presented, they had to mention as many correspondences between target and source as they could within a 20 second time span. To control for any interference effects between the picture pairs, participants played a word-finding-game in between each picture pair.

The analyses focused on the number and type (attributive or relative) of predicates mentioned for the source and target, on the number of repetitions of predicates as compared to the source, and the number of explicit comparative expressions in the mentioned correspondences. Preliminary results show that physical similarity between picture pairs leads to more comparative expressions based on repetitions of relational predicates. For instance, when 'dangerous' was already mentioned for the leopard, we found more comparisons like 'the motorcycle and the leopard are both dangerous', when the motorcycle and the leopard were physically similar than when they were not.

References

- Bowdle, B. F., & Gentner, D. (2005). The Career of Metaphor. *Psychological review*, 112(1), 193-215.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Phillips, B. J., & McQuarrie, E. F. (2004). Beyond visual metaphor: A new typology of visual rhetoric in advertising. *Marketing Theory*, 4(1/2), 113-136.
- Schilperoord, J., Maes, A., & Ferdinandusse, H. (2009). Perceptual and Conceptual Visual Rhetoric: The Case of Symmetric Object Alignment. *Metaphor and Symbol*, 24, 155-173.
- Teng, N. Y., & Sun, S. (2002). Grouping, Simile, and Oxymoron in Pictures: A Design-Based Cognitive Approach. *Metaphor and Symbol*, 17(4), 295-316.

PAPER PRESENTATION

An intervention study on Mind Mapping skills and text processing in fifth and sixth grade

Emmelien Merchie, Ghent University, Belgium; Hilde Van Keer, Ghent University, Belgium

Due to the exponential increase of knowledge in our information society, the need arises to support students in dealing with this information and engaging in self-regulated learning (SRL). This especially becomes essential from the age of 11-13, when children spend increasingly more time on learning from texts. The present study is embedded within the cognitive component of SRL, focusing on learning strategies and tactics students can apply for effectively processing, acquiring, and learning information. Working with graphic organizers, such as Mind Maps, seems promising in supporting students in this domain. This study addresses two main research questions by means of a repeated measures design in authentic fifth and sixth-grade classes (N = 62 students). We first focused on whether a positive evolution in Mind Mappings skills can be realised through a ten weeks during Mind Mapping intervention. Secondly, we investigated whether children make a significant progress in processing textual information by Mind Mapping throughout the intervention. The results of the repeated measures analyses reveal a significant evolution in Mind Mapping skills, indicating that Mind Mapping can be learned by fifth and sixth graders in a relatively short period of time. Children improve significantly in applying different Mind Map rules and in processing textual information in a Mind Map in a structured way.

Theoretical background

The exponential knowledge increase in our information society requires skills and strategies for realising efficient and effective processing and acquisition of information (Crick, 2007). In this respect, self-regulated learning (SRL) plays a growing role in educational research. SRL can be defined as a planned and cyclical way of regulating thoughts, feelings, and actions to meet personal goals (Boekaerts, Pintrich, & Zeidner, 2000) and includes a motivational, metacognitive and cognitive component (Zimmerman, 1990). The present research focuses on the cognitive component, referring to learning strategies and tactics students apply (Pintrich, 2004). The focus lies on cognitive processes and strategies for effectively processing and acquiring new information and linking it to prior knowledge (Cornford, 2002). In this domain, researchers call for approaches supporting children in processing, acquiring, and learning texts in a structured way (Novak, 2002). These skills play an important role, especially from the age of 11-13 when children spend more time on learning from texts (Rawson & Dynlosky, 2007). The use of graphic organizers, more specifically Mind Maps

(MM) (Buzan, 1974), seems promising in helping children in this respect (Vekiri, 2002). MM are typified by specific characteristics (e.g. dimensionality, colours, and images) determining the effectiveness of how well the text information is structured and learned (Buzan & Buzan, 1995). Several theoretical models underpin the use of graphic organizers, e.g. the Dual Coding Theory (Paivio, 1991) and Cognitive Load theory (Sweller & Chandler, 1994).

Research questions

We first focus on whether there is an evolution in Mind Mapping skills. Since it is important to respect the specific characteristics of MM determining their effectiveness, we investigate whether children significantly improve in applying the MM rules (Buzan & Buzan, 1995). Furthermore, we investigate whether children make a significant progress in processing textual information by using Mind Mapping.

Research method

Design. The study consisted of a ten weeks during intervention (one session of 50 minutes per week) in authentic classes and addresses the research questions by means of a repeated measures design (pretest, intermediate test, and posttest). In the intervention, children gradually learned how to Mind Map from a trained researcher.

Participants. A total of 62 primary school children of fifth and sixth grade participated in the study (4 classes from 2 different schools).

Instruments. The repeated tests consisted of independently making a MM of an informative text within 30 minutes. For each measurement occasion a different, but equivalent text was used. Afterwards, the characteristics and the quality of the collected 186 MM were scored. Therefore, an analytic scoring rubric containing two broad categories ('shape and organisation' and 'content') was used. Within these categories, subcomponents were identified based on the Mind Map rules (e.g. using a radial structure) and relevant content elements (e.g. relevance of key words) (Taricani & Clariana, 2006).

Data Analysis. The scores on the rubric were analysed quantitatively with One-Way Repeated-Measures Analyses of Variance.

Results

As to the first research question, a significant evolution was found on the use of capitals on the main branches and little letters on the other branches ($F(2,58)=8.754$, $pF(2,58)=5.609$, $p=0.006$). Further, the readability of the MM is significantly better ($F(2,58)=6.314$, $p=0.003$), keywords are better positioned ($F(2,58)=3.281$, $p=0.045$), and children make significantly more clusters at the end of the intervention ($F(2,58)=9.469$, $pF(2,58)=11.238$, p

As to the second research question regarding the processing of textual information in the MM, the children use significantly more information ($F(2,58)=82.990$, $pF(2,58)=14.397$, $p=0.000$). Words in a branch are better matched and associated ($F(2,58)=10.390$, $pF(2,58)=14.397$, $pF(2,58)=15.451$, $p=0.000$) and the children get overall better scores on their MM ($F(2,58)=125.468$, p Figure 1 illustrates the evolution of one participant's MM (pretest, intermediate, and posttest).

Significance of the research

The present study is significant for both educational research and practice. As regards the relevance for research, the study works on the existing gap in the current literature on effective approaches for supporting primary school children to structurally process and learn textual information. In this respect, the study enters upon an undeveloped research domain for this age group and might inspire other educational researchers to investigate the use of MM in primary school grades more thoroughly. As to educational practice, the present study demonstrates that elementary school children are able to learn to process informative texts by means of MM. Further, the results imply that by using MM in daily educational practice, teachers can stimulate and evaluate SRL-activities of children.

References

- Boekaerts, M., Pintrich, P.R., & Zeidner, M. (2000). *Handbook of self-regulation*. London: Elsevier
- Buzan, T. (1974). *Use your head*. London: BBC Books
- Buzan, T. & Buzan, B. (1995). *The Mind Map Book*. London: BBC Books
- Cornford, I.R. (2002). Learning-to-learn strategies as a basis for effective lifelong learning. *International journey of lifelong education*, 21, 357-368
- Crick, R.D. (2007). Learning how to learn. *The Curriculum Journal*, 18, 135-153
- Novak, J.D. (2002). Meaningful learning: The essential factor for conceptual change in limited or inappropriate propositional hierarchies leading to empowerment of learners. *Science education*, 86, 548-571
- Paivio, A. (1990). *Mental representations. A dual coding approach*. Oxford: Oxford University Press
- Pintrich, P.R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16, 385-407

- Rawson, K.A., & Dunlosky, J. (2007). Improving students' self-evaluation of learning for key concepts in textbook materials. *European Journal of Cognitive Psychology*, 19, 559-579
- Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction*, 12, 185-233
- Taricani, E.M., & Clariana, R.B. (2006). A technique for automatically scoring open-ended concept maps. *Educational Technology Research & Development*, 54, 65-82
- Vekiri, I. (2002). What is the value of graphical displays in learning? *Educational Psychology review*, 14, 261-312
- Zimmerman, B.J. (1990). Self-regulated learning and academic achievement. *Educational psychologist*, 25, 3-17

PAPER PRESENTATION

Learning from Text with Instructional Pictures: Tracing Cognitive Processing Through Eye Movements

Nicola Ariasi, University of Padova, Italy, Italy; Lucia Mason, University of Padova, Italy; Patrik Pluchino, University of Padova, Italy; Caterina Tornatora, University of Padova, Italy

This study first investigated whether an illustrated text would be more effective than a non-illustrated text in promoting a better learning performance. Secondly, it examined whether reading a text with a schematic picture or a text with a detailed picture would induce different cognitive processing, as revealed by eye movements, and learning outcomes.

As concerns the cognitive processing during reading, two fine-grained indices of eye movements were computed and used in the analyses: look-from fixation time to trace the integration of verbal and pictorial information, and look-back fixation time to examine the extent to which a particular area of interest was reinspected. Individual differences, such as prior-knowledge, reading comprehension, verbal and visuo-spatial working memory, and spatial ability, were also considered.

Sixty-five eighth graders were involved in a pretest, immediate posttest, and delayed posttest design. They were randomly assigned to a different reading condition. Findings revealed that, overall, an illustrated text was more effective in enhancing readers' learning performance compared to a non-illustrated text. Furthermore, readers of the text with the detailed picture outperformed readers of the text with the schematic picture at the immediate but not delayed posttest. Eye-movement analyses revealed that readers of the text with a schematic picture went further a simple rereading of some parts of the materials, attempting more to integrate verbal and pictorial information. The differential roles played by a schematic vs. a detailed picture in the cognitive processing of an illustrated scientific text are discussed.

Theoretical Framework and Aims

Research investigating learning from verbal and visual material is particularly important since textbooks, especially in domains like science, contain various kinds of instructional pictures. They are supposed to enhance learning (Mayer, 1989; Mayer & Gallini, 1990) but research has indicated that it is not always true that "a picture is worth a thousand words" (Mayer & Sims, 1994). Research has also posited that successful learning from illustrated text requires the information provided by the pictures to be integrated with information provided by the text, which can make high cognitive demands on learners (Ainsworth, 2006; Bartholome & Bromme, 2009; Florax & Ploetzner, 2010; Schnotz & Bannert, 2003). In agreement with Mayer (2001), Schnotz (2002) has used separate processing systems for verbal and pictorial information. However, he focused on the essential differences between the two sign systems and conceived the process of integration of verbal and pictorial information as a structure-mapping process (Gentner, 1989). The corresponding elements of the two different representations, and their relationship, are mentally mapped (Schnotz, 2002).

Based on these research issues, this study compared two kinds of potentially useful pictures, detailed vs. schematic, which illustrate the same text in order to examine the integration process of verbal and pictorial information. A detailed picture is an illustration that depicts the theme of a text in a rich representational, but not decorative, way since its function is to convey information. Therefore, it does not include seductive details (Harp & Mayer, 1998). A schematic picture is a simplified illustration of the text content, which does not resemble the thing it represents, but is also not so abstract as to require interpretation. The process of information integration was traced through fine-grained eye-movement analysis (Hyona, 2010; Hyona, Lorch, & Rinck, 2003; Inhoff & Radach, 1998). Most research on learning from text and pictures has investigated outcomes. Fewer studies, however, have focused on the cognitive processes, and almost all have used thinking-aloud methodology (e.g. Butcher, 2006; Cromley, Synder-Hoga, & Luciw-Dubas, 2010). Even the few recent multimedia studies that have measured eye fixations have not used fine-grained

indices of visual attention allocation to trace the process of integration between text and illustration (Jarodzka, Scheiter, Gerjets, & van Gog, 2010; Sanchez & Wiley, 2006; Schwonke, Berthold, & Renkl, 2009).

To extend current research, the following research questions guided the study: (1) Is a text with a picture, either schematic or detailed, more effective for learning than the same non-illustrated text? In particular, is a schematic picture more effective than a detailed picture? (2) Does reading a text accompanied by a schematic picture induce cognitive processing which is different from reading a text with a detailed picture, as revealed by eye-movement measures? For research question 1, we first hypothesized that an illustrated text would be more effective than a non-illustrated text. We also expected that the schematic picture would be superior since it would facilitate the mapping process of the corresponding elements of the two kinds of representation. In other words, this correspondence would become more salient. For research question 2, we expected that the two pictures would induce different processing. The schematic illustration should require shorter reinspection time than the detailed, but should stimulate more the integration of text and picture through structure mapping.

Method

Sixty-five eighth graders (mean age=13.8; girls=33) were involved in a pretest, immediate posttest and delayed posttest design. They were randomly assigned to one of three reading conditions: text only, text with a schematic picture, or text with a detailed picture illustrating the structure of volcanoes. The text and pictures were presented in the same position on a computer screen, taking into account the spatial contiguity principle. The pictures were of the same size. Participants' prior knowledge, verbal working memory, visuo-spatial working memory, spatial ability, and reading comprehension were measured. The integration of text and picture was measured by means of a specific fine-grained measure of eye movements, look-from time, that is, the time a learner spends refixating the text information while inspecting the picture. We also computed look-back time, that is, the time a reader spends refixating the text information or picture after the first pass, which reflects delayed, strategic processing (Hyona, Lorch, & Kaakinen, 2002).

Results

Preliminary analyses revealed the equivalence of the three groups for all the examined measures.

Off-line Products

Findings showed a significant time x reading condition interaction, $F(4,120)=3.597$, $p=.008$, $\eta^2p=.11$. At immediate posttest, readers in the text only condition ($M=10.96, SE=1.30$) learned less than readers of the schematic picture text ($M=13.77, SE=1.40$) and readers of the detailed picture text ($M=16.85, SE=1.28$). Regarding the delayed posttest, the learning performance of readers of the schematic picture text ($M=11.73, SE=1.24$) was slightly better than readers of the detailed picture text ($M=11.24, SE=1.16$).

On-line Processes

Regarding the integration between pictorial and text information, only readers in the two illustrated conditions could be compared. Findings revealed a significant reading condition x reading time interaction on look-back, $F(2,37)=7.130$, $p=.002$, $\eta^2p=.28$, and look-from fixation times, $F(2,37)=4.662$, $p=.016$, $\eta^2p=.20$. Readers of the text illustrated with the detailed picture ($M=10.52, SE=3.04$, in sec) backtracked the picture for longer (looks-back) than students who were given the schematic picture text ($M=5.50, SE=3.26$, in sec). On the other hand, the latter ($M=8.00, SE=1.77$, in sec) made longer returning fixations from the picture to the text information (looks-from) compared with students who inspected the detailed picture ($M=7.87, SE=1.65$, in sec).

Scientific and educational significance

This study has scientific significance in that it seeks to extend current research by providing evidence of the differential roles played by a schematic vs. a detailed picture in the cognitive processing of an illustrated scientific text. The study is also of educational significance as it indicates the different benefits associated with the two kinds of instructional pictures that are often provided in science textbooks. More detailed or schematic illustrations could be used in keeping with the purpose of presenting visual aids to support the construction of scientific knowledge through the appropriate cognitive processing of information.

PAPER PRESENTATION

Seductive details in multimedia messages

Gunter Daniel Rey, Institute of Psychology, Germany

The seductive detail principle asserts that people learn more deeply from a multimedia presentation when interesting but irrelevant adjuncts are excluded rather than included. However, the results of previous studies about this principle are inconsistent and these studies contain methodological problems. The recent experiment attempts to overcome these problems. Students ($N = 108$) used an introductory text to learn fundamental concepts about the development of stars and then took a retention and transfer test as dependent measures. Each learner was randomly assigned to one cell of a 2 (with or without seductive text passages) \times 2 (with or without seductive illustrations) between subjects factorial design. Students who did not receive seductive text passages spent less time with the multimedia presentation and performed better on retention, but not on transfer than did learners receiving seductive text passages. Seductive illustrations did not significantly influence learning performance or time spent with the instructional material.

Introduction

Seductive details are interesting but irrelevant details, which are not necessary to achieve the instructional objective (Mayer, 2005). On one hand, many teachers, text book writers and multimedia designers add these details in an instructional message hoping to energize a learner to pay more attention to the material and to foster learning outcome (cf. Harp & Mayer, 1997). On the other hand, the seductive detail effect assumes that removing seductive details improves learning outcome, for example, by shifting learners' attention from irrelevant to relevant details.

A review concerning seductive details reveals that several results exist that either support or contradict the seductive detail effect. First, for seductive text passages, two out of 11 experiments clearly support the seductive detail effect. Four out of 11 studies contain mixed results concerning the effect, while five experiments clearly did not support the effect. Second, for seductive illustrations, four out of 12 studies included results clearly supporting the negative impact of seductive details. Six out of 12 experiments contain mixed findings, while another two studies clearly contradict the seductive detail effect.

Critics could argue that the inconsistent findings in previous studies about the seductive detail effect could be to some extent attributed to three methodical problems. First, studies indicating a significant effect for seductive illustrations included different confounding factors. For example, studies did not compare a seductive illustration group with a control group, but combined seductive illustrations with seductive captions for these illustrations. Second, students' prior knowledge of the instructional material and time spent with the instructional material were only rarely used in the statistical analysis (e.g., considering these variables as covariates). Third, most studies investigating the seductive detail effect forego to conduct and report power analyses. Without power information the null hypothesis cannot be accepted on the basis of a nonsignificant finding. The present study tried to overcome these three methodological problems.

Method

Participants

The participants were 108 undergraduate students recruited from the University of Trier (Germany). The mean age of the participants was 22.3 ($SD = 4.3$) years and the percentage of women was 70.4%. Results of a pretest indicated that students had low experience in the presented instructional material.

Materials and Design

For each participant, the computer materials contained an instructional page, the pretest, an introductory text about the development of stars, as well as a retention and a transfer test. The pretest included four multiple choice questions (five response options per question where one to four answers per question could be correct) about the life cycle of a star. The multimedia presentation contained 20 slides, where 4 slides included the heading and three subheadings of the text (i.e., origin of a star, course of life of stars and death of a star). The 16 text slides contained exact 700 words in the condition without seductive text passages.

The retention test consisted of 15 multiple choice questions. Each of the questions included five response options where one to four answers per question were correct. All retention questions could be answered with the information that was given in the text material without the inference of additional information. The transfer test consisted of five multiple choice questions (five response options per question where one to two answers per question were correct). In all transfer questions inferences had to be drawn from the presented information in the visualization.

Each student was randomly assigned to one cell of a 2 \times 2 between subjects factorial design (27 participants for each cell). The seductive text passages (i.e., the first between-subject factor) consisted of about two additional sentences per slide (overall 448 additional words). The seductive illustrations (i.e., the second between-subject factor) consisted of 19 pictures, where only one picture per slide was presented. Seductive text passages as well as seductive illustrations were chosen with regard to interestingness on the basis of six raters in the fore field of the study.

Procedure

The participants processed the instructional material at their own pace and without any time limit. On average, they spent about 10-15 minutes with the instructional material. First, they worked on the pretest followed by the (illustrated) text material. Immediately after the instructional material, they answered the same retention and transfer questions within an abundant time limit of 15 minutes (all participants finished before time was called).

Results & Discussion

Learners who did not receive seductive text passages spent less time with the instructional material and performed better on retention, but not on transfer than did learners who received seductive text passages. Seductive illustrations did not significantly influence retention and transfer performance or time spent with the multimedia presentation. Using prior knowledge scores as well as the time spent with the multimedia presentation as covariates assures that learning differences cannot be attributed to differences in prior knowledge or solely to time differences in the different groups. The sufficient power of the experiment warrants that null hypotheses can be accepted for all nonsignificant findings (for an effect size of $f^2 = .15$).

Learners receiving seductive illustrations could presumably rapidly recognize that a seductive illustration contains no relevant information and therefore skip these illustrations. On the contrary, seductive text passages probably contain a higher amount of information content than seductive illustrations. In addition, seductive text passages were embedded in the relevant text with the same layout and typeface. Therefore, learners cannot neglect the seductive text passages and spent considerably more time with the instructional material when these text passages were included.

Possibly, the difference between retention and transfer performance with regard to the experimental conditions could be explained with differences in the sensitivity of the two measures (e.g., using only five items for the transfer test in contrast to 15 items for the retention test). On the practical side, the recent findings show that seductive text passages can not only increase time needed to process a multimedia instructional message, but also can impair learners' retention performance. On the theoretical side, the present results partly confirm the coherence principle (Mayer, 2005) of the cognitive theory of multimedia learning.

References

- Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology*, 89, 92-102.
- Mayer, R. E. (2005). Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles. In R. E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (pp. 183-200). Cambridge, MA: Cambridge University Press.

PAPER PRESENTATION

A picture among pictures: A classification system for instructional visualizations

Halszka Maria Jarodzka, Open University of the Netherlands, Netherlands; Birgit Karoline Imhof, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

The use of instructional visualizations has become very popular in the last decades, especially due to the rapid development of technical solutions. Visualizations do not only vary with regard to their structural features (e.g., dynamism, interactivity), but they also have different functional features (e.g., decoration, representation, organization). Research has investigated these two dimensions particularly in learning contexts. In addition, a third dimension of visualizations, namely the depicted contents, has been identified. However, the high variability of visualizations is challenging with regard to generalizability of empirical research results found with a specific type of instructional visualization. Therefore, a generic classification system is needed to be able to structure the wide body of research. Although, some attempts to address the classification of visualizations have already been made, those focus only on either structural or functional dimensions of visualizations. The current work reviews educational literature on all three aforementioned dimensions aiming at developing a classification system covering the structural features, the functions, and the depicted contents and thereby allowing to assign visualizations to classes of similar visualizations regarding these aspects. The classification system (in form of a questionnaire) was evaluated with ten subjects classifying six different visualizations in order to test the interrater reliability, to assess the usability during filling in the questionnaire, and to investigate its applicability to different types of visualizations. Data analyses revealed high, or

close to high interrater reliabilities for all six visualizations. These results indicate that a questionnaire-based classification system can be used to objectively classify visualizations.

The use of visualizations for depicting real life objects and relationships of objects has a long history. Given the technological development in the last decades, we are confronted with more and more visualizations in our everyday live ranging from simple black-and-white line drawings or paintings to highly realistic animations, photographs, films, or 3D-visualizations, to only name a few. Especially, in the context of education visualizations like diagrams, illustrated textbooks, educational films, and multimedia products play nowadays a stronger role. Despite the large use of visualizations in instructional contexts, it is still not clear, whether and when we benefit from visualizations or whether and when they are rather harming for learning. Therefore, it is crucial to identify the conditions under which specific instructional visualizations are beneficial.

Deciding about the usefulness of visualizations in a certain learning context requires to consider and to investigate various aspects of visualizations in a systematic way. Therefore, a classification system for visualizations is needed to identify possible moderators for the effectiveness of visualizations. Such a classification system can be used to categorize visualizations into classes of similar and dissimilar visualizations in order to transfer important decisions about, for example, the usefulness of visualizations in given contexts from one visualization of the class to another.

Research has already identified several important aspects of visualizations, as the structural features or the functions of visualizations (e.g., Lohse, Biolsi, Walker, & Rueter, 1994). Unfortunately, in existing taxonomies only one of these aspects is regarded, whereas other dimensions of visualizations are disregarded or even ignored although it is important to consider all aspects of a single visualization in order to make statements about its usefulness. We assume that a successful classification system has to be extended by adding a third dimension, namely the content depicted in the visualization. Many instructional obstacles, approaches, or goals are closely tied to content domains. Therefore, we propose a classification system for visualizations that comprises not only structural and functional features of visualizations, but also its contents and that is based on recent literature (Imhof, Jarodzka, & Gerjets, 2009). In order to provide a practicable and reliable classification system we chose a questionnaire format which allows researchers, developers, and users to characterize different aspects of visualizations that might contribute to their instructional effectiveness. The development of a classification system for visualizations is a first step in clarifying the question under what circumstances what kinds of visualizations are effective. We choose a broad approach, including relevant features of visualizations identified in current multimedia research as well as in other research fields, as for instance film and text comprehension, or research on television. As structural features we define the dimension of visualizations that focuses on the form and the physical aspects (e.g., color, dynamism) of the visualizations and is objectively observable. As functional features we define the intended uses and purposes of visualizations (e.g., motivating, guiding attention, representing). And besides these structural and functional features, visualizations have a certain content that can be described with regard to its genre, target audience and other aspects.

The usability of the proposed questionnaire was tested with ten independent raters, who rated six different visualizations. The visualizations comprised a computer animation about cancer, an impressionistic painting, a static text-picture combination, an animated cartoon, a section from a silent film, and a section from a television movie. To test the interrater reliability for all possible 45 pairwise comparisons between the ten raters Craméers V (ranging from 0-1) was calculated for each of the six visualizations. Four of the six tested visualizations (computer animation, painting, silent film, and movie), reached high interrater reliabilities for the ten independent raters ($V > .60$). The remaining two visualizations (static text-picture combination and animated cartoon), reached a close to high interrater reliability (both V s = .57).

A first evaluation of the developed classification system revealed a high or almost high interrater reliability for six different test visualizations. Interestingly, the two visualizations that achieved only a medium interrater reliability entailed a rather low amount of realistic detail compared to the four visualizations with high interrater reliability. This result indicates that schematic visualizations might be seen more diverse than realistic ones. This effect can go to the fact that realistic visualizations are more similar to our everyday experience that provides a common ground for the interaction with our peers. In contrast, schematic visualizations are only encountered in specific situations (e.g., learning contexts) and thus, their familiarity and, consequently, their assignment to classes might differ more among different expertise levels. Moreover, the two visualizations with medium interrater reliability differed from the other visualizations also with regard to the following features: the static text-picture combination was the only test visualization that (a) was combined with written text, that (b) consisted of multiple static pictures, and that (c) conveyed procedural instructions. The animated cartoon was different from the other visualizations in that it was (a) longer than the other ones and entailed (b) more different sections than the other dynamic visualizations. A longer,

respectively information-rich visualization might promote more possibilities for misinterpretations. This might lead to different classifications.

To identify specific difficulties in classifying certain types of visualizations further research is needed. In particular, the interrater reliabilities for the three dimensions of the classification system and the individual items should be investigated separately to identify problematic items. Eventually, the classification system may be a helpful step towards identifying individual learner competences and beneficial circumstances that are important for the effectiveness of different types of visualizations. It might also help to shed some light on inconsistent results concerning the effectiveness of instructional visualizations. In particular, a meta-analysis using this type of classification to review previous research on visualization effects might substantially contribute to future research on instructional visualizations.

References

Imhof, B., Jarodzka, H., & Gerjets, P. (2009). Classifying instructional visualizations: A psychological approach. *IMAGE. Journal of Interdisciplinary Image Science*, 10, 99-123.

Lohse, G. J., Biolsi, K., Walker, N., & Rueter, H. H. (1994). A classification of visual representations. *Communications of the ACM*, 37, 36-49.

PAPER PRESENTATION

The Role of Textual Information on Dynamics in Learning with Dynamic or Static Visualizations

Tim Kuhl, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany

An advantage of dynamic visualizations for learning is that they can directly depict dynamic features like changes in velocity. In contrast, when using static visualizations, learners need to infer these dynamic features by themselves, at least if these are not conveyed by an additional external source such as text. To address these issues, the effectiveness of learning with either text-only, text with dynamic visualizations, or text with static visualizations was investigated in 2 experiments, which differed with regard to the information presented in the text. While in Experiment 1, all dynamic information was explicitly described in the text, in Experiment 2 this information was not described, but had to be inferred. In both Experiments, learners were assigned to one of the three conditions specified above, and learning outcomes were measured by means of factual knowledge tests, transfer tasks as well as static and dynamic pictorial tasks. In Experiment 1, results revealed that learners in the two visualization conditions outperformed learners in the text-only condition solely for pictorial tasks. No differences were observable for any learning outcome measure between the two visualization conditions. In Experiment 2, results revealed that learners in the two visualization conditions outperformed learners in the mere text condition for transfer tasks and for pictorial tasks. Moreover, the dynamic visualization condition was superior to the static visualization condition for transfer tasks and for dynamic pictorial tasks. These findings of both experiments point to the importance of textual information on dynamic features when comparing dynamic and static visualizations.

Introduction

There is strong empirical evidence that people learn better with text and visualizations than with text alone (Mayer, 2001). This effect seems to be more pronounced for transfer than (verbal) factual knowledge tasks (Mayer, 2001). Moreover, with respect to factual knowledge tasks, the instructional advantage of text and visualizations has been shown to be especially accentuated for pictorial tasks, but less accentuated and sometimes even non-existent for verbal tasks (cf. Baker & Dwyer, 2000).

Instructional Advantages of Dynamic and Static Visualizations

When comparing the effects of static to dynamic visualizations (e.g., animations), it is suggested to take a closer look at the conditions under which dynamic visualizations might be best suited for instructional purposes (cf. Schnotz & Lowe, 2008). A crucial difference in the processing of dynamic compared to static visualizations might refer to the fact that dynamic visualizations directly depict dynamic features like changes in velocity, so that this dynamic information can be simply read-off. In contrast, when learning with static visualizations these dynamic features have to be inferred by the learner (Experiment 2) if they are not conveyed by an additional external source such as text (Experiment 1). However, integrating textual information on dynamic features with static visualizations - or even inferring this information - may be considered as a resource-intensive process (cf. Schnotz & Lowe, 2008). Therefore, dynamic visualizations should be best suited to convey a content in which the understanding of dynamic interrelations is crucial (congruence principle, Tversky, Bauer-Morrison, & Béêttrancourt, 2002).

Hypotheses

To summarize, we expected learners in the two visualization conditions to outperform learners in the text-only condition. This superiority should be more pronounced for pictorial and transfer tasks as opposed to verbal factual knowledge tasks. Moreover, we expected learning with dynamic visualizations to be superior to learning with static visualizations, particularly with respect to transfer, as well as dynamic pictorial tasks (see below for a description). This superiority should be even more accentuated, if dynamic features have to be inferred and are not given by text when learning with static visualizations.

Method for Experiments 1 and 2

Forty-six University-students in Experiment 1, and 55 University-students in Experiment 2, respectively, were randomly assigned to one of three conditions: a text-only, a text with dynamic visualizations, and a text with static visualizations condition. In both Experiments, learning outcomes were measured by means of verbal factual knowledge, transfer, and pictorial tasks. The pictorial tasks were further divided in static and dynamic pictorial tasks. For the dynamic pictorial task, the correct movement of a planet around the sun had to be recognized.

The chosen domain (Kepler's second law) dealt with changes in the velocity of the planetary motion around the sun. For this instructional material, the direct depiction of these dynamic features is basically the sole important dimension in which static and dynamic visualizations differ.

The main difference between Experiment 1 and 2 was the information conveyed by the text: In Experiment 1, the dynamic features were explicitly described in the text, whereas in Experiment 2, we used a reduced text version, in which the dynamic features were not explicitly described, but had to be inferred (see Figure 1).

Results

Experiment 1

Planned contrasts between the two visualization conditions and the text-only condition revealed no differences for verbal factual knowledge ($p = .20$) or transfer tasks ($p = .33$), but for the static ($p = .10$). However, learners in the dynamic visualization condition identified the correct movement in the dynamic pictorial task faster than learners in the static visualization condition ($p = .04$).

Experiment 2

Planned contrasts between the two visualization conditions and the text-only condition revealed no differences for verbal factual knowledge tasks ($p = .40$), but for transfer ($p = .01$), for static (p

Summary & Discussion

When using an enriched text in which the dynamic information was explicitly described (Exp. 1), we observed learners in the two visualization conditions to outperform learners in the text-only condition solely for pictorial tasks. The latter might be interpreted as learners receiving text only might have difficulties in building an adequate pictorial mental model of the topic. However, since text was sufficient to solve the transfer tasks (and the addition of visualizations was obviously not necessary), the finding of the instructional equality of dynamic and static visualizations for transfer tasks is consistent.

However, when the dynamic information in the text was reduced and this information had to be inferred, our hypotheses were mainly confirmed: Learners in the two visualization conditions performed better than learners in the text-only condition, and learners receiving dynamic visualizations outperformed learners receiving static visualizations for transfer and dynamic pictorial tasks.

Taken together, these results suggest that the information described in the text might moderate the instructional effectiveness of dynamic and static visualizations and thus determines under which conditions dynamic visualizations might be particularly helpful.

References

- Baker, R., & Dwyer, F. (2000). A meta-analytic assessment of the effect of visualized instruction. *International Journal of Instructional Media*, 27, 417-426.
- Mayer, R. E. (2001). *Multimedia Learning*. Cambridge: Cambridge University Press.
- Schnotz, W., & Lowe, R. K. (2008). A unified view of learning from animated and static graphics. In R. K. Lowe & W. Schnotz (Eds.), *Learning with animation: Research and design implications* (pp. 304-356). New York: Cambridge University Press.
- Tversky, B., Bauer-Morrison, J., & Béêttrancourt, M. (2002). Animation: Can it facilitate? *International Journal of Human-Computer Studies*, 57, 247-262.

PAPER PRESENTATION

Does external rotation facilitate recognition of a spatial structure?

Stefan Munzer, Saarland University, Germany

Animations may facilitate understanding of spatial structures. The present study investigated whether an external rotation as opposed to internal (mental) rotation of a spatial structure enhanced recognition memory for rotated test exemplars. In addition, the study examined whether external rotation compensated for low mental rotation ability. Participants were shown simple 3-D building structures. In the external rotation condition, animation was presented with the building structure rotating from 0° to 180° . In the internal rotation condition, a static picture was shown. Subsequently, participants had to decide from memory whether a test picture of a rotated (50° , 90° , 170°) building structure represented a structure identical to the studied one. A large facilitating effect of external rotation was found for reaction times. No effects were found for accuracy. Based on reaction times and accuracy in a chronometric mental rotation test, participants were divided in high vs. low mental rotation ability groups. Both groups benefitted from external rotation. With animation, low ability individuals reacted as fast as high ability individuals who had studied static pictures. It is concluded that external rotation can facilitate the understanding of a spatial structure, compensating for low spatial ability.

Aim of the study

Animations may facilitate learning by supplanting internal (mental) visual-spatial processes (Salomon, 1994). Animations can externalize processes that change views on a spatial structure, substituting potentially difficult internal processes (e.g., mental rotation). On the other hand, animations are transitory and may be distracting. Visual-spatial mental abilities play an important role for learning from external visualizations. This is apparently true for learning with animations (e.g., Cohen & Hegarty, 2007), implying that higher abilities are required for using animations efficiently. However, if animations actually support visual-spatial processing, then animations should be able compensate for low visual-spatial ability.

The present study examines whether the external rotation of a spatial structure facilitates the recognition of the spatial structure from memory. It is hypothesized that the external rotation of a spatial structure will enhance recognition (H 1). It is furthermore hypothesized that external rotation can compensate for low mental rotation ability (H 2).

Method

Participants. Thirty-six participants (students, 18 women) took part in the study (age $M = 23.31$, $SD = 3.66$).

Materials. A chronometric mental rotation test was constructed similar to a test developed by Jansen-Osmann and Heil (2007), using PMA symbols (Thurstone, 1958). Participants decided whether a rotated (0° , 45° , 90° , 180°) symbol shown on the right was the same as the symbol shown on the left (Fig. 1). The test comprised 60 items presented in random order.

--- Figure 1 ---

The experimental study and test materials comprised simple 3-D building structures (Fig. 1). In the external rotation condition, participants studied a video that showed a clock-wise rotation from 0° to 180° . In the internal rotation condition, participants studied a static picture. The screen was cleared. Then a static test picture was presented showing a building structure (rotated to 50° , 90° , or 170°) which represented either the same structure or a mirrored version of it (Fig. 1). Participants decided on the identity of the spatial structures from memory. Fifty-four items were presented. Half of the test pictures were same. Each viewing angle (50° , 90° , 170°) was shown equally often.

The chronometric mental rotation test was administered first. Internal vs. external rotation conditions of the experiment were blocked and presented to all participants. Half of the participants first received the internal rotation block, the other half first received the external rotation block.

Results

A one-factorial analysis of variance with repeated measurement on the rotation angle factor (45° , 90° , 180°) was performed for the chronometric mental rotation test data. No effects were found for accuracy. A significant effect was obtained for reaction times which increased almost linear with rotation angle, $F(2,68) = 15.354$, p

Preliminary analyses of the experimental data revealed that participants were accurate and fast with external rotation when tested with the 170° test picture. Participants presumably accessed visual sensory memory of the 180° rotated view (the final state of the external rotation) to make the decision for the 170° test picture. Effects based on this phenomenon were considered trivial. Therefore, the data were analyzed without the 170° viewing angle.

--- Figure 2 ---

Considering group differences in mental rotation ability in addition to rotation conditions and viewing angle resulted in a 2 (50° vs. 90° viewing angle) $\times 2$ (internal vs. external rotation) $\times 2$ (high vs. low mental rotation ability) mixed three-factorial design. No significant main effects and no interactions were found for accuracy (ability, $F(1,34) = 2.522$, ns; all other F 's ns). For reaction times, a large main effect of rotation condition was found, $F(1,35) = 23.223$, $p < .001$, F ns,

and no interaction between viewing angle and rotation condition was revealed, F ns. In addition, a marginally significant main effect of ability was found, $F(1,34) = 4.143$, $p = .05$, partial eta square = .11. No interaction was found between ability and rotation condition, F ns.

It is concluded that external rotation facilitated processing of the spatial structure as indicated by faster reaction times, supporting hypothesis H 1. Furthermore, with external rotation, low mental rotation individuals performed at the level of high mental rotation individuals after studying static pictures (see Fig. 2), supporting hypothesis H 2. High mental rotation ability individuals also benefitted from external rotation. The effects of ability and external rotation were additive.

Theoretical and educational significance

In many domains (biology, geography, mechanical systems, etc.), the understanding of the spatial configuration of components of a system is a precondition for understanding causal processes. Results of the present study show that the understanding of spatial structures can be facilitated through well-directed animations in multimedia learning. In addition, individuals with low visual-spatial abilities can benefit from well-directed animations.

References

- Cohen, C. A., Hegarty, M. (2007). Individual differences in use of external visualizations to perform an internal visualization task. *Applied Cognitive Psychology*, 21, 701-711.
- Jansen-Osmann, P., & Heil, M. (2007). Suitable stimuli to obtain (no) gender differences in the speed of cognitive processes involved in mental rotation. *Brain and Cognition*, 64, 217-227.
- Salomon, G. (1994). *Interaction of Media, Cognition and Learning*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Thurstone, T. G. (1958). *Manual for the SRA primary mental abilities*. Chicago: Science Research Associates.

Figure Captions

Figure 1. Sample items of the chronometric mental rotation test and of the experimental study and test materials.

Figure 2. Reaction times depending on rotation condition, viewing angle, and mental rotation ability.

PAPER PRESENTATION

The Circle of Change: Experienced Early Childhood Teachers as Graduate Students Who Became Leaders

Miriam Mevorach, Levinsky College of Education, Israel

The Circle of Change: Experienced Early Childhood Teachers as Graduate Students Who Became Educational Leaders

This paper explores perceptions of professional identity among experienced early childhood educators (ECEs) who are novice students in a new master's degree program in early childhood education. We seek to examine the changes experienced by these educators. The study used qualitative content analysis, which included two level procedures: a) at the beginning of the first year of the program the students were asked to write freely their definition and description of the role of an ECE. At the end of second year of the program the same participants were asked to define and describe once again their role perception; b) 8 students from the above group were interviewed in-depth narrative interviews at the end of the program. The findings indicate a change in the participants' perceptions of their multi-dimensional professional identity. They began to examine the early childhood educational system with a critical point of view based on their academic and pedagogical conceptual vision, and aware of the contingent political consequences. We believe this study will enable us to advance the early childhood education system and promote academic research conducted by professionals.

The Circle of Change: Experienced Early Childhood Teachers as Graduate Students Who Became Educational Leaders

The study examines the professional identity of graduate students who are professional and experienced early childhood educators (ECEs) and at the same time novice graduate students. This study is anchored in two points of view: a global perspective, finds expression in the importance that many countries worldwide attribute to early childhood education and, a local perspective, examines the local context, (most kindergarten classes -ages 4-6- in Israel operate as autonomous neighborhood institutions, and the kindergarten teachers are independent in terms of administration and management) and in particular the students studying in the ECE master's degree program.

We attempt to clarify how the combination of advanced studies and experience in education affects the possibilities for change in the early childhood educational system (Sammons, et al., 2005) by examining students' perceptions of their professional identity.

Experienced early childhood educators who decide to return to academic studies after many years of practice already have a formulated perception of their professional role, usually based upon beliefs accumulated during their professional careers (Fairbanks et al., 2010; Saracho & Spodak, 2006). We examined their role perceptions and changes in these perceptions from the beginning of the program to the end.

Method

The study is a qualitative research based on a phenomenological research tradition, aiming at pointing to the changes at experienced ECE, and narrative research, aiming at exposing their perceptions of change in their professional lives. The research participants included 36 students in the master's degree program in ECE. All the student participants hold B.Ed. degrees and are certified to teach early childhood education (birth to age 8).

Procedure

We conducted two level procedures: a) at the beginning of the first year of the program the students were asked to write freely their definition and description of the role of an ECE. At the end of second year of the program the same participants were asked to define and describe once again their role perception; b) 8 students from the above group were interviewed in-depth narrative interviews at the end of the program.

The interviewees were asked to tell their own professional "story of change". The interview model adhered to the narrative interview model of Libliech, Tuval-Mashiach, and Zilber (1998). The texts were analyzed by content analysis, as is common in qualitative research (Creswell, 1998). Researchers analyzed the texts independently and then compared notes until they reached agreement about the final categories. The categories were presented to the participants and they were asked to respond to the classifications. The agreements between the participants and researches were rather high.

Results

The first participants' written texts that were collected at the begging of their studies and were analyzed by content analysis, revealed two major domains: educational-pedagogical and organizational-managerial. Most of the references in the text as a whole were in the educational-pedagogical domain (32 students).

The most frequent category in the prevalent educational-pedagogical domain was concern for the children's wellbeing. The participants mentioned terms such as nurturing, creating, giving, providing "to create an atmosphere in which the children feel secure." They also spoke metaphorically in terms of "ground": "to cultivate safe ground for growth, development and learning" or "to create fertile ground for the children and an accepting and loving environment."

In the other domain, organizational-managerial, five categories emerged. The most frequent category represented the participants' efforts to cope with staff management in the kindergartens.

The second participants' written texts that were collected toward the end of their studies were analyzed at the same procedure as the first one. This time we found that the texts were for the most part planned and structured and that they reflected the writers' awareness of the structure and complexity of their role perception.

The findings revealed: a) a change in the frequency of utterances for all the categories; b) the addition of a new category – leadership – to the organizational-managerial domain; c) a marked reduction in utterances in the "preparing for life" category; and d) high frequency in the "management" category in the organizational-managerial domain. We identified three categories in the new domain of ecological systems. The most frequent category by far was the ecological system role.

The in-depth interviews provided us opportunity to illuminate participants self esteem change and their expanded role perception. Their discourse with themselves was rich, complicated, judgmental and critical.

For example one student pointed to her leadership abilities, her ability to carry everyone who comes to the kindergarten along with her. "Today, after studying and observing myself as an individual, I know that I am a leader. I lead the staff that works with me, the parents and the children. Not only do I manage the money and the reporting in the kindergarten, I am a leader who carries along the staff, the parents and the children."

In conclusion, the major findings representing the change in the participants' perception of their professional identity emerged in their multidimensional observations and their critical examination of their role, as well as their conscious ability to declare their importance as managers and educational leaders in the ECE system.

Discussion

The major finding, the change in the participants' perception of their professional identity, emerged in their multidimensional observations and their critical examination of their role perception as a bricolage (Kinchelone & McLaren, 2005) of their diverse responsibilities, as well as their conscious ability to declare their importance as managers and educational leaders in ECE (Muijs et al., 2004; Rodd, 2006). As a result, they became self-researchers capable of examining their practices as well their professional beliefs and thus promoting their confidence in their educational leadership within their multi-agent community (Genishi et al., 2001).

By the end of their studies, they realized that their professional discourse had changed and that they were now able to critically examine their ecological system (children, staff, parents. and community) (Bronfenbrenner, 2005).

These new abilities to crystallize their observation of explicit decision-making policies and to raise their voices to declare the need for improving the early childhood educational system have the potential to initiate new waves of actual change.

PAPER PRESENTATION

Is there a gap between teachers' conceptions and ICT competencies to teach in an online environment

Teresa Guasch, Universitat Oberta de Catalunya (UOC), Spain ; ANNA ESPASA, UNIVERSITAT OBERTA DE CATALUNYA, Spain

How many studies highlight the benefits of designing learner supports, as e-feedback, particularly in an online learning environment? As you may presume, there is a great number of authors who have studied educational supports in an environment based on written and asynchronous communication, as this context calls for specific teaching and learning competencies. Nevertheless, despite the evident need found in the literature, teachers' educational supports are not commonly used throughout the teaching and learning process in an online environment, but are usually only employed towards the end of the process. The aim of this research is to ascertain if the explicit lack of learner supports in an online teaching environment is due to the gap between teachers' conceptions and their ICT competencies to teach in this specific environment. A questionnaire was answered by 696 university teachers from a virtual university. The close correlation between conceptions of teaching and learning in a transmissive way and low competencies to teach in an online environment on the one hand, and the high level of competences shown by teachers within the profile of facilitators of learning on the other hand, clearly highlight the need to design specific teacher training proposals for an specific learning context based on written and asynchronous communication.

Theoretical approach and aims

How many studies highlight the benefits of designing learner supports, as e-feedback, particularly in an online learning environment? As you may presume, there is a great number of authors (i.e. Thorpe, 2002; McLoughlin, 2000; McLoughlin & Marshall, 2000; Coll, Engel & Bustos, 2009) who have studied educational supports in an environment based on written and asynchronous communication, as this context calls for specific teaching and learning competencies to teach (Guasch, Alvarez & Espasa, 2010). Nevertheless, despite the evident need found in the literature, teachers' educational supports are not commonly used throughout the teaching and learning process in an online environment, but are usually only employed towards the end of the process (Espasa & Meneses, 2010).

Following Thorpe (2002), learner support "refers to the meeting of needs that all learners have because they are central to high quality learning—guidance about course choice, preparatory diagnosis, study skills, access to group learning in seminars and tutorials, and so on". In particular, McLoughlin notes that educational supports in online environments should promote reflective thought and provide opportunities for interaction between teachers and students. McLoughlin and colleagues also understand that supports must be oriented to facilitate self-learning, self-evaluation by the student, flexibility to identify the learning strategy more appropriate to resolve each situation and should enable students to become aware of their own learning process. We consider that these supports do not differ from a face-to-face environment, but they ought to be considered specifically as we have already mentioned there is a lack in the practice.

This study has been designed with a view to address the discrepancy between what is expressed in the literature and the lack of evidences in the practice.

The aim of this research is to ascertain if the explicit lack of learner supports in an online teaching environment is due to the gap between teachers' conceptions of the same and their ICT competences to teach in this specific environment. Our hypothesis lies on the idea that there is an important group of teachers adhering to a transmission view of education because of their lack of competencies as an online educational professional (the teacher is often an expert in a field of knowledge, but not in didactic-pedagogic skills that allow them to know how to teach).

Methodology

The study was carried out at the Universitat Oberta de Catalunya. This university is a fully virtual university. The teaching and learning process takes place within virtual courses, and the communication is written and asynchronous. 696 university teachers from different disciplines (Economy, Law, Psychology, Computer Science, Education, and Politics) answered an online questionnaire. There were 303 females (43.53%) and 393 males (56.46%).

The questionnaire had two parts: 1) Teachers' conceptions: specific questions and different situations based on experiential learning theory. There were 14 items (e.g. "Virtual learning is mainly based on the students' independent work", "Students in a virtual environment are sufficiently self-organized") (Cronbach's $\alpha = .67$). These items were measured using a 5 point Likert scales (totally agree- totally disagree). 2) Teachers' competencies in teaching and learning in virtual environments. For this purpose, the competency framework defined in the European project Elene-TLC <http://www.tlcentre.net/competencyFramework.cgi> was adopted.

To assess the competencies two scales were adopted: a scale that measures planning with items like "To design guidelines to learn" (Cronbach's $\alpha = .740$) and a scale that measures development with items like "To promote collaboration among students" (Cronbach's $\alpha = .791$). There were 6 items per scale.

Findings and final remarks

Two teacher profiles were identified: a profile close to the transmission view of education, where "the student is autonomous on the learning process (teachers and/or peers' supports are not necessary to learn)" versus a profile where the "teacher is a facilitator of learning". These two profiles were distributed into four groups statistically different (cluster analysis) in relation to: teaching discipline, years of experience in a face-to-face environment, years of experience in an online environment, ICT competencies.

It was established that the teaching discipline influences both the conceptions and competencies teachers hold about teaching in an online learning environment.

There are also significant differences between teachers' conceptions about learner supports and their perceptions of their level of knowledge about the ICT available in the virtual campus. University teachers that consider themselves as having very high knowledge of teaching ICT are less identified with the profile of teacher as a transmitter of knowledge.

We consider that these results are relevant for the design of teacher training proposals with the aim to develop competencies to teach in online environments. The close correlation between conceptions of teaching and learning in a transmissive way and low competencies to teach in an online environment on the one hand, and the high level of competences shown by teachers within the profile of facilitators of learning on the other hand, clearly highlight the need to design specific teacher training proposals for an specific learning context (based on written and asynchronous communication).

References

- Coll, C., Engel, A. & Bustos, A. (2009). Distributed Teaching Presence and Participants' Activity Profiles: a theoretical approach to the structural analysis of Asynchronous Learning Networks. *European Journal of Education*, 44(4), 521-538.
- Espasa, A. & Meneses, J. (2010). Analysing feedback processes in an online teaching and learning environment: an exploratory study. *Higher Education*. 59-3, 277-292.
- Guasch, T.; Álvarez, I. & Espasa, A. (2010). University teacher competences in a virtual teaching/learning environment: Analysis of a teacher training experience. *Teaching and Teacher Education*, 26, 199-206.
- McLoughlin, C. (2002). Learner support in distance and networked learning environments: Ten dimensions for successful design. *Distance Education*, 23(3), 149-162.
- McLoughlin, C. & Marshall, L. (2000). Scaffolding: A model for learner support in an online teaching environment. In A. Herrmann & M.M. Kulski (Eds.), *Flexible Futures in Tertiary Teaching*. Proceedings of the 9th Annual Teaching Learning

Forum. Retrieved 09/09/2008 from Curtin University of Technology:
<http://lsn.curtin.edu.au/tlf/tlf2000/mcloughlin2.html>
Thorpe, M. (2002). Rethinking learner support: The challenge of collaborative online learning. *Open Learning*, 17(2), 105-119.

PAPER PRESENTATION

How do students try to overcome academic procrastination? A qualitative interview-study

Justine Patrzek, University of Bielefeld, Germany; Carola Grunschel, Bielefeld University, Germany; Stefan Fries, University of Bielefeld, Germany

Academic procrastination (AP), the tendency to postpone study related tasks, is a prevalent phenomenon within the university context. AP may result in negative consequences and up to 60% of students wish to reduce their dilatory behaviour. Until now, little is known about what students actually undertake to reduce AP in their daily life. However, investigating this issue allows formulating ideas how to support students effectively in reducing AP. To address this question we conducted interviews with 24 highly procrastinating students concerning their efforts to overcome AP. Interestingly, the students mentioned starting points (what they want to change) and not only methods (how they want to change) for reducing AP. By conducting a qualitative content analysis a category system emerged in which we differentiated on the topmost level between starting points and methods. Further, we classified the mentioned starting points into five categories and 11 themes, like time-management (e.g. begin of work), self-regulation (e.g., distractibility), and circumstances (e.g., double burden). Additionally, six categories and 11 themes emerged for the methods, e.g., methods regarding time-management (e.g., writing to-do lists), behavioural (e.g., self-reinforcement) and cognitive methods (e.g., self-instruction). According to the students' statements, they use a variety of methods to overcome AP. However, they seem to neglect using more sophisticated methods concerning affects and cognitions. A problem of students procrastinating academic tasks could be that they know what they need to work on but do not know how to accomplish it. Implications for academic counselling and university teaching will be discussed.

Aims

Academic procrastination (AP) has been defined as "intentionally deferring or delaying work that must be completed" (Schraw, Wadkins, & Olafson, 2007, p. 13). Different studies showed that AP is a highly prevalent phenomenon among students (e.g., Solomon & Rothblum, 1984). Overall, AP can lead to negative consequences like stress and lower grades (Tice & Baumeister, 1999). Further, up to 60% of students report wishing to reduce AP (Solomon & Rothblum, 1984). As a result, many universities offer counselling for students supporting them to overcome their dilatory behaviour (e.g. Schouwenburg et al., 2004). However, until now little is known about students' own efforts to reduce their dilatory behaviour in their daily lives. In our study we aimed at investigating how students reduce their dilatory behaviour in their daily life. Exploring this perspective promises to result (1) in an inventory of the students' efforts to overcome AP and (2) thereby, in identifying implications for student counselling as well as for university teaching.

Method & Sample.

The students were recruited by announcements and by student counsellors at a German university. The recruitment resulted in interviews with 24 participants, 13 of which were female. On average, the students were 27.9 (SD = 6.3) years old and studied different subjects (e.g., sociology, biology). The students' mean study duration was 7.7 (SD = 6.6) semesters. In order to assure that the students were versant with AP their tendency to procrastinate was measured by the Tuckman Procrastination scale adapted to the academic context (Tuckman, 1991) and amounted to $M = 3.8$ ($SD = .5$). Procedure. The interviews were conducted by two of overall seven trained interviewers who kept to a standardised interview-outline. Within the interview the students were questioned about their experience with AP. In a first part of the interview students were to refer to reasons and consequences of AP to sensitise the students to the topic. In a second part they were asked whether they wish to reduce their dilatory behaviour and what they actually do to reduce it. The second part of the interview was analysed in order to encounter the above mentioned aims.

Analyses.

The interviews were transcribed and content-analysed (Mayring, 2000) by three coders. As qualitative content analysis is a rule-guided and structured process (Mayring, 2000), we performed the following steps: First, the interviews were segmented into 226 interview segments. Second, the coding was performed through an iterative process of deducing categories from existing literature and inducing categories from the interview content. A category system with 11 categories and 30 themes emerged. Third, the quality of the coding was investigated by calculating the inter-coder agreement, which was good (Fleiss' Kappa = .89).

Results

As the students did not mention only methods (how they reduce AP), but also potential starting points (what they want to change to reduce AP) for interventions, we differentiated between starting points and methods on the topmost level of the category system. On a second level we structured the students' statements concerning the starting points into five categories and 11 themes and concerning the methods into six categories and 19 themes. Regarding the starting points the students mentioned we differentiated between the following categories as well as themes: time-management (e.g., begin of work), self-regulation (e.g., distractibility), thoughts (e.g., beliefs), experience (e.g., feeling of success), and circumstances (e.g., double burden). An exemplary student's statement for the last theme is "[...] less double burden [...] would be good, but it all happens at the same time: university, working, leisure time". Concerning the methods the students mentioned we distinguished between methods regarding time-management (e.g., writing to-do lists), behavioural methods (e.g., self-reinforcement), cognitive methods (e.g., self-instructions), methods enhancing the knowledge about AP (e.g., reading self-help books), methods involving the social environment (e.g., working in teams), and methods relating to the study context (e.g., regular checking of standard of performance). An exemplary student's statement for the last mentioned theme is "I had to write a term paper and before I did this the lecturer offered an exam and I decided to take this exam so I could evaluate what I have already learnt [before starting to write]".

Theoretical and educational significance of the research

In sum, students did not only mention methods, but also starting points for potential interventions. The methods the students mentioned ranged from methods applying to their time-management to methods involving the social network (e.g. learning in groups). However, the students did not seem to know more sophisticated cognitive methods, like the ABC analysis, which could help them to reduce AP. Besides, they did not broach the issue of emotions and the importance to control them in the learning process. As the students' statements contained starting points for interventions as well as methods it can be speculated that some students seem to know what they could enhance concerning their learning process but do not know how to do it. The results of the study point to the need to enhance the students' knowledge about different methods for overcoming AP in daily lectures as well as in student counselling. Thereby, the students' learning efficacy could be fostered.

References

- Mayring, P. (2000). Qualitative Content Analysis. *Forum: Qualitative Social Research*, 1.
- Schouwenburg, H. C., Lay, C. H., Pynchyl, T. A., & Ferrari, J. R. (Eds.) (2004). *Counseling the procrastinator in academic settings*. Washington: American Psychological Association.
- Schraw, G., Wadkins, T., & Olafson, L. (2007). Doing the things we do: A grounded theory of academic procrastination. *Journal of Educational Psychology*, 99, 12–25.
- Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology*, 31, 503–509.
- Tice, D. M. & Baumeister, R. F. (1997). Longitudinal study of procrastination, performance, stress, and health: The costs and benefits of dawdling. *Psychological Science*, 8, 454–458
- Tuckman, B. W. (1991). The development and concurrent validity of the Procrastination Scale. *Educational and Psychological Measurement*, 51, 473–480.

PAPER PRESENTATION

Learning from incidents in organisations

Dane Lukic, Glasgow Caledonian University, United Kingdom; Anoush Margaryan, Glasgow Caledonian University, United Kingdom; Allison Littlejohn, Glasgow Caledonian University, United Kingdom

Every organisation experience problematic situations not necessarily termed incidents. It is important to understand these situations and learn from them so that they do not reoccur or to draw points for novel problems that might arise. However there are different factors which might contribute to the effectiveness of the approaches to learning from incidents. The aim of this paper was to explore the factors that are important in choosing and developing approaches to learning from incidents in the safety context at two sites. The study surfaced five areas of importance which form a proposed framework for learning from incidents in organisations:

1. Learning context -Informal and formal learning.
2. Learning participants -inclusion and individual agency and represent the breadth of learning.
3. Type of incident– the relation between the complexity of the incident influence the learning approach employed
4. Type of knowledge- conceptual, procedural, dispositional and locative knowledge.
5. Learning processes- single or loop double learning processes are considered and represent the depth of learning.

Introduction

Every organisations experiences problematic situation, not necessarily termed incidents. It is important to understand these situations and learn from them so that they do not reoccur or to draw points for new problems that might arise. Organisations usually have less or more formalises approaches to learning from incidents (LFI). However there are different factors which might contribute to the effectiveness of these approaches. The aim of this paper was to explore the factors that are important in choosing and developing learning approaches in the safety context at two sites.

Method

37 interviews semi structured interviews were conducted at two large intentional energy sector companies. The sample was derived through a combination of stratified and convenience approaches where people at different levels of the organisation were included in the study to represent the variety of viewpoints. The participation was voluntary and interviewees were familiarised with the project. Interviews were transcribed and anonymised before analysis. The qualitative analysis included the FrameWork[i] approach where both individual case and thematic analysis can be conducted complimentary.

Theoretical framework

There were five areas of importance arising from the literature review and the data analysis. These 5 areas were underpinned by theoretical concepts which served as analytical lenses in analysing the qualitative data (Figure 1)

Figure 1. Framework for learning from incidents in organisation [Appendix image 1]

Formality of learning approaches represents considerations as to what degree the learning initiatives should be a part of formalise procedures, having in mind the characteristics of formal and informal learning. (Beckett & Hager, 2002)

For participants of learning it is necessary to understand who is to be included in the process of identifying solutions and to what extent they should participate in the learning process. Both individual and organisational aspects should be taken into account. Here the concept of inclusion and individual agency are of relevance (Billett & Pavolva, 2005).

Type of incidents represents the relation between the nature of the problems causing incidents is and the learning solutions. Cynefin framework provides an understanding through four areas of complexity used for sense making: 'simple' and 'complicated'- orderly domain; 'complex' and 'chaotic' -'un-orderly' domain. Problems may arise when solutions for orderly cases are applied to un-orderly incidents (Snowden, 2002)

Under the type of knowledge four types were discussed: conceptual, procedural, dispositional, and locative knowledge. Conceptual knowledge ("knowing why" and "knowing what") comprises facts, concepts and propositions (Anderson, 1982). Procedural knowledge ("knowing how") comprises techniques and skills that enable one to enact conceptual knowledge. Dispositions underpin conceptual and procedural knowledge and comprise attitudes, values, emotions, interests and personal motivations (Perkins et al, 1993). And lastly locative knowledge represent "knowing where" to find knowledge and information (Nicholls-Nixon, 1997).

Learning process was looked at through Argyris and Schon's theory of single and double loop learning (Argyris & Schön, 1996). In this context, single-loop learning includes solutions to errors and mishaps in the organisation by correcting the superficial elements of the problem. Double-loop learning is based on open inquiry into deep-rooted causes, system failures and values. The main obstacle for double-loop organisational learning is the 'win-lose' frame of thought and ego-protection as dominant features of organisational life.

Results

Formality of learning Our study indicated that the benefits of formal learning initiatives include structure and the number of people they can impact as well as perception of higher validity. Informal discussions and communication, although happening in a more spontaneous way, were deemed individual-specific and could be lost if a person changes position or leaves. It can be concluded that it is important to take the degree of formality of initiatives into consideration in developing approaches that would benefit from both the broad accessibility and verified nature of formal learning, as well as building on natural and open inquiry typical of informal learning.

Learning participants

The level of inclusion in learning approaches appeared to be fairly high at both sites. Interviewees ascribed high importance to the opportunity to participate fully in an LFI initiative. Therefore, employee individual agency was

deemed an essential component of learning from incidents and important in ensuring employees ownership of the safety processes and motivation for learning. However, the social aspect of agency and pathways for participation that an organisation opens was very relevant for the functioning of individual agency

Type of incident

Only full investigations managed to look into the relation of the nature of the problem and the learning approach undertaken. Moreover, they reported a tendency to condense the learning points into simplistic, 'bullet points' or one sentence long key learning points. Such oversimplification may result in the loss of deep contextual meaning and a limited transferability of learning points arising from an incident.

Type of knowledge

Our data indicates that the majority of the LFI initiatives address primarily conceptual and procedural knowledge. Locative knowledge was mainly reflected in informal communications. Dispositional knowledge does not seem to be considered by organisations when selecting a learning approach. LFI at both sites appears to focus primarily on rather decontextualised procedural and conceptual knowledge.

Learning process

Most learning initiatives displayed characteristics of single loop learning. The inconsistency of actions following an investigation was highlighted as particularly important by the respondents. Interviewees also highlighted the impact of ego-protection routines, and, consequently, pointed out lack of incentive to share openly information about small-scale events. However, the data also provided some examples of individuals exhibiting a level of inquiry by reflecting on the learning initiatives and also taking their concerns to those responsible for learning in their organisation.

Few of the initiatives at the sites examples addressed the five areas discovered through the study. The proposed framework encourages a holistic view of learning from incidents, in the context of the whole cycle of an incident. Moreover it promotes contextualised learning from safety incidents coupled with sense making and reflection, which were found to be lacking at the two sites. The findings could be relevant not only to the energy sector but also to learning from problematic situations in all organisations.

[i] <http://www.framework-natcen.co.uk/>

PAPER PRESENTATION

Diversity in teams

Regina Mulder, Universitaet Regensburg, Germany; Maria Rupprecht, University of Regensburg, Germany; Hans Gruber, University of Regensburg, Germany

Cooperation in teams is supposed to facilitate learning of individuals through knowledge exchange with colleagues about relevant topics. Consultancies try to organise and elaborate knowledge through teamwork. As a consequence of internationalisation, consultancies are challenged to operate at a global market. Consultancies thus are increasingly characterised by diversity in their social demographic, informational, and cognitive background. Diversity in teams can lead to more unconventional solutions, but can also increase misunderstandings and conflict. To deal with the problems of diversity and to exploit the potentials of diversity, consultants need to develop a common frame of reference (in our study: a team mental model TMM) and a common view of an ideal future state (in our study: a shared vision) within their team. Aim of this study is to answer the question: What is the relation between team learning behaviour, TMM/shared vision and innovative behaviour in diverse consulting teams? Data were collected in a survey (October 2009–January 2010) among 403 consultants of 110 European consulting teams that worked currently together on a project. Data were analysed on individual and team level (multi-level analyses). The results show that innovative behaviour was (1) positively related with team learning behaviour, (2) positively related with TMM/shared vision, (3) not significantly related with demographic diversity, (4) positively related with informational diversity, and (5) negatively related with cognitive diversity. This pattern of results has many implications for professional learning and work which will be discussed in the presentation.

Learning is no activity that occurs before one enters the workplace or separately from being engaged in productive activity; learning is the heart of productivity (Felstead, et al., 2005). Especially in consultancies, performance depends highly on the quality of knowledge of the consultants. Therefore, informal learning at the workplace plays a key role in

everyday work of consultants. As consultancies are under strain to be innovative, they try to organise knowledge through teams as informal learning settings. It is assumed that teams can better adapt to requirements of various situations and generate more creative strategies than individuals. As a consequence of internationalisation, consultancies are strongly affected by increasing diversity in the background of its employees. Research on team work and collective learning shows that it is not sufficient that individuals engage in creative processes. Information and accompanying learning processes must be transferred at the team level. To enable innovative team work, the consultants need to develop a common frame of reference defined as team mental model (TMM). A TMM is an organised, mental representation and shared understanding on key issues among its members (Klimoski & Mohammed, 1994). Similarly, a common view of an ideal future state can be defined as a shared vision. The development of TMM/shared vision is understood as a collaborative learning process. Demographic and informational diversity in teams can lead to cognitive diversity. Cognitive diversity can enlarge the available information (Van der Vegt & Janssen, 2003); however it can also lead to stereotypes involving negative effects on team performance. Research on diversity and innovation highlights the importance of team diversity to foster innovative performance. However, there are inconsistent results on diversity in teams and its positive or negative influence on innovative behaviour. Aim of this study is to answer the research question: What is the relation between team learning behaviour, TMM/shared vision and innovative behaviour in diverse consulting teams?

The hypotheses are:

- (1) Demographic diversity is negatively related with team learning behaviour, TMM/shared vision and innovative behaviour.
- (2) Informational diversity is positively related with team learning behaviour, TMM/shared vision and innovative behaviour.
- (3) Cognitive diversity is positively related with team learning behaviour, TMM/shared vision and innovative behaviour.

Sample

The sample comprised N=471 consultants of n=121 consulting teams from Germany, Austria and Switzerland that worked currently together on a project. 418 consultants (response rate: 88.8%) participated in the survey. Eleven teams with response of only one team member or a response rate below 50% were excluded from further analyses. A total of 403 consultants from 110 teams remained in the sample. A team consisted of at least two members.

Instrument

An online-questionnaire with a five-point Likert scale was developed. The questions comprised general information on the project, team, organisation, and team related context factors (team potency, team identification, task interdependence, individual differentiation) and the following scales: (1) team learning behaviour (knowledge development, reflective behaviour), (2) TMM/shared vision, (3) diversity (demographic, informational, cognitive), (4) innovative behaviour (teamwork behaviour during the idea generation, creative behaviour during the idea generation, activities during the idea promotion, activities during the idea realisation). The questionnaire was tested and refined in a pre-study.

Analysis

Descriptive statistics and correlations were computed. Based on a formula by Teachman (1980), a mean diversity index of demographic and informational diversity was calculated for each team. Furthermore, a within-group-agreement analysis rwg (James, Demaree, & Wolf, 1984) was computed for cognitive diversity to examine the appropriateness of aggregating individual ratings to team level. This within-group agreement analysis yielded a median value of .92. Given the hierarchical structure of the data, a multilevel analysis was conducted to decompose the total observed variance into individual-level and team-level residual variances and to examine intra-class correlations and within- and between-group variances.

Results

The intra-class correlations (ICC) for team potency (.12), team identification (.20), individual differentiation (.12), team learning behaviour (.35), TMM/shared vision (.30), cognitive diversity (.20), innovative behaviour: teamwork behaviour during the generation of ideas (.29), innovative behaviour: creative behaviour during the generation of ideas (.28), innovative behaviour: promotion of ideas (.27), and innovative behaviour: realisation of ideas (.18) show that the between-group differences were substantial. The ICC of zero for task interdependence indicates that task interdependence is not directly influenced by group-level predictors. ICCs of all aspects denote that differences within groups are larger than those between groups.

Team potency and team identification had positive relations with innovative behaviour, task interdependence has a positive relation with teamwork behaviour during the generation of ideas, the promotion of ideas and the realisation of ideas, individual differentiation had a negative effect on teamwork behaviour during the generation of ideas and the realisation of ideas. Team learning behaviour and TMM/shared vision had positive relations with innovative behaviour. Concerning diversity, differences in demographic attributes revealed no significant effects on innovative behaviour, differences in informational attributes showed a positive effect on creative behaviour during the generation of ideas and the promotion of ideas, and difference in cognitive attribute were negatively related to teamwork and creative behaviour during the generation of ideas, and the promotion of ideas.

Discussion

In knowledge intensive businesses diversity in the background of its members plays a minor role for professional learning and team work. More important for innovative work in projects seems the practised learning behaviour within the teams and the shared understanding on key issues among its members. Consequently, members of teams need to spend time on individual learning and engage in learning activities together with their colleagues in order to develop a common understanding within the team and thus to generate creative solutions.

References

- James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.
- Klimoski, R., & Mohammed, S. (1994). Team mental model: Construct or metaphor? *Journal of Management*, 20, 403-437.
- Teachman, J. D. (1980). Analysis of population diversity. *Sociological Methods & Research*, 8, 341-362.
- Van der Vegt, G. S., & Janssen, O. (2003). Joint impact of interdependence and group diversity on innovation. *Journal of Management*, 29, 729-751.

PAPER PRESENTATION

Implementing supervised placement - reflections on the unity of a concept

Lars-Erik Nilsson, Kristianstad University, Sweden; Carola Aili, Kristianstad University, Sweden

Different forms of work-based learning have for a long time been considered important in academic programs. Some argue that it is the most important part in any vocational training, even in academic programs educating for professions. The aim of this paper is to discuss the variation in how work-based training is described and performed in different academic programs. Every year, for three years, heads of academic programs have been interviewed about their implementation of work-based training. The interviews have been conducted at a university that has placement in all programs. Curriculums, course plans and syllabus have been collected and analyzed. Our findings suggest that there are major differences in how to think "where education is good". Some programs have course plans where student placement is imbedded in progression through the program. Some programs "just place" students at the workplace or involve them in projects together with the organization where they are placed. Other programs have "theory driven" placement. Some programs have a placement organization that train staff to receive students while other programs leave it up to students to find a placement. We discuss the variation in viewpoints that can be found between programs-from the perspective of where education is good to think. How do different forms of placement relate to the ideas about what are the characteristics of a specific profession, to different ideas about education of professions and more general ideas about where it is best to learn?

A higher education, often carried out at universities, has been considered a hallmark of professions, one that lend legitimacy to claims to autonomy and jurisdiction over work tasks. Jurisdictions are since decades intimately associated with holdings of scientific knowledge (Abbott 1988). Collins (1979) has made the argument that science main importance is symbolic. The symbolic value of holding scientific knowledge obscures the fact that professional knowledge to a high degree has been acquired through processes of socialisation in work places (Collins, 1979). Svensson (1989) suggests that professionals' most important cultural capital consist of the ability to master the social practise of professional work where theories from the professions centre of knowledge transmission are being intertwined with experience into an inseparable whole. The act of educating professionals does not consist of setting up training programs alone, but involves choosing the appropriate forms for training. Whether controlled by professions, legal entities or market forces education involves choosing how to educate, what to incorporate in education and where to educate.

Our interest in this study concerns with reference to Levi-Strauss (1962, p. 128) but in our words "where education is good to think". This may seem far fetched since Levi-Strauss talked about what animals where good to think with for different tribes. The notion that academics can form tribes with their own symbolic capital to think with has gained some currency (Becher and Trowler, 2001). Whether this capital is primarily science based in higher education has been debated. Different forms of work-based learning have for a long time been considered important when learning a trade. Learning at work, when skills are passed from father to son, mother to daughter, experienced worker to inexperienced and more formally from master to apprentice present ways of representing "where education is good to think". Educating professionals can be considered to represent another way. Fransson (2009, p 22) argues that "professional autonomy in its traditional form requires a university with a position as exclusive and distanced in relation to other dominant social and cultural spheres". Today's academic programs, also hold other representations about "where education is good to think". Concept such as practice, internship, placement, work integration, clinical laboratories and business laboratories provide alternative representation. Some argue that these forms are the most important part in any vocational training, even in academic programs educating for professions and other occupations. Bridging theory and practice has in some quarters acquired a symbolic value.

One aim of this paper is to start a discussion about the variation in how work based training is described and performed in different academic programs. Every year, for three years, heads of academic programs have been interviewed about their implementation of work-based training. The interviews have been conducted at a university that have placement in all programs. Our interest has concerned a wide array of aspects from motives behind implementation of work-based learning to its part in the program, how examinations are carried out, how the program has organized placement and what contracts with receiving organizations involve. In addition curriculums, course plans and syllabus have been collected and analyzed for learning goals, methods of examination, assignments and supervision.

Our findings suggest that there are major differences in where heads of academic programs state that education is good to think. Some programs have course plan where student placement is imbedded in progression through the program. These programs have varied placements covering different aspects of students' future jobs. They may start with students observing moving on to them taking almost full responsibility. Some programs try to overcome the duality between theory and practice. They have "theory driven" placement. Students arrive at their placement with theories that they are required to use as they observe aspects of their work place. Some programs "just place" students at the workplace or involve them in projects together with the organization where they are placed. Some programs have assignments that they are assessed on. Other programs leave it to the supervisor at the work place to assess students. The differences in organization are vast. Some programs have a placement organization that train staff to receive students while other programs leave it up to students to find a placement for work based learning. Different programs have different ways of thinking good education. This includes where to educate. In the terms of Becher and Trowler (2001) they form different tribes with different ways of conceptualizing the good place for being educated. Work based learning in such a perspective seem to mean many things. We discuss this variation from four viewpoints. Differences that can be found between disciplines that dominate different programs. Diversity that can be found in what various types of professionals to be are expected to do during their supervised placement. The circumstances under which the program implement placement. How different forms of placement relate to different ideas about education of professions and more general ideas about where it is best to learn.

PAPER PRESENTATION

Towards reconceptualising professional agency at work from a subject-centred socio-cultural stance

Anneli Etelapelto, University of Jyväskylä, Finland; Paivi Hokka, University of Jyväskylä, Finland; Katja Vahasantanen, University of Jyväskylä, Finland; Susanna Paloniemi, University of Jyväskylä, Finland; Kaija Collin, University of Jyväskylä, Finland

The concept of agency has become widely used in working life research, especially in studies addressing workplace learning and creativity. However, there are various understandings of what the term actually means, and hence a need to elaborate how the concept is used within different theoretical frameworks. In this study we critically review recent notions of professional agency, and discuss how it can be reconceptualised from a subject-centred socio-cultural stance. We refer to literature from the social sciences and education, mentioning also approaches taken in gender studies and anthropology. We trace discussion on agency, and the ways in which discussion has moved towards understanding agency as related to the socio-cultural contexts of work communities, and as encompassing workplace practices, dominant discourses, power relations, and subject positions. In recent discussion on work-related learning, agency has been seen as closely related to professional identities. Agency is needed for reshaping

and renegotiating work identities. Moreover, subjects' sense of their professional self influences how they practise agency at work. In our conceptualising of professional agency it is understood as subjects' individual and collective capacity to make intentional choices, and to act on these choices in ways that will make a difference to their professional lives.

Aims

The concept of agency has become fairly widely used in working life research, especially in studies addressing workplace learning and creativity. However, there are various understandings of what the term actually means, and hence a need to elaborate how the concept is used within different theoretical frameworks. In this study we critically review recent notions of professional agency, and discuss how it can be reconceptualised from a subject-centred socio-cultural stance. In our discussion we selectively address those approaches which we consider relevant to research on professional learning and competence development at work.

Theoretical background

Based on a reading of scholarly literature and on prior research, we distinguish the following four notions, embodying different approaches to the concept of agency: i) the social science notion (Emirbauer, M. & Mische, 1998; Giddens, 1984), ii) the post-structural discursive notion (Fennwick & Somerville, 2006; Weedon, 1997; Wetherell, 2005), iii) the socio-cultural notion (Billett, 2006; Edwards, 2005; Holland et al, 1998; Wertsch, Tulviste & Hagstrom, 1993), and iv) the temporal life-course notions (Biesta & Tedder, 2007; Ecclestone, 2007; Elder, 2003; Emirbayer & Mische, 2007).. These approaches are widely used in multidisciplinary working life research, and we believe they can all contribute to an understanding of professional agency.

Research questions

The four notions are analysed in relation to the following questions: i) How do they define the relationships between the work context (structures) and working subjects (e.g. separated, autonomous, subjugated, interdependent, mutually interdependent)? And furthermore, what does this imply for the ontological understanding of human agency (individual/collective, power relations included/excluded, consideration given/not given to workplace practices, cultures, and dominant discourses)?

ii) What is the nature and degree of agency assigned to working subjects (e.g. agency as an option in choosing between at least between two alternative strategies of working; or agency as an option in influencing the power relations of the work community)?

iii) Is the intentionality of an action seen as a necessary condition for human agency? For example, is individual-level intentionality seen as a necessary condition for the practice of agency? Or is it sufficient if the action merely makes a difference to the subject's professional life, e.g. through collective changes?

iv) What kinds of manifestations of agency can there be, in terms of human actions (e.g. discursive, social, individually meaningful, embodied)? And how can these manifestations be captured by the methodological approaches applied?

v) How are the relationships between professional agency and professional identity understood? For example, is professional agency seen as closely intertwined with the subject's professional identity, and is agency seen as required for the reshaping and renegotiation of this identity? Or alternatively, is professional agency seen as separated from subjects' sense of their professional self?

Methodology

We refer to recent literature and to multidisciplinary research studies. Our discussion is derived from databases on working life research, where the focus has been on professional agency, work-related identities, professional learning, and competence development.

Findings

From a critical analysis of recent discussions in these domains, we put forward suggestions for a research agenda, with conclusions on how professional agency should be conceptualised in order to capture the relevant aspects of i) the authentic socio-cultural context, ii) the subjective side of the phenomenon, and iii) the mutually constitutive relationships between these two. From these starting points we conceptualise professional agency from a subject-centred socio-cultural perspective: we regard it as subjects' individual and collective capacity to make intentional choices, and to act on these choices in ways that will make a difference to their professional lives.

From our own empirical studies on professional agency we demonstrate how (in particular) narrative (Vähäsantanen & Eteläpelto, 2009; Vähäsantanen, Saarinen & Eteläpelto, 2010), discursive (Häkkinä, Eteläpelto & Rasku-Puttonen, 2009), and ethnographic research strategies (Collin, Paloniemi & Mecklin, 2010) can grasp different aspects of professional agency, encompassing the socio-cultural conditions of the workplace and subjects' professional identities.

Practical and theoretical significance

Based on our findings, we emphasise the need to investigate tools for the promotion of professional agency at work. We suggest that researchers on workplace learning should have a more active role in the research-based development of educational interventions aimed at promoting professional agency at work. Two kinds of interventions are seen as promising in this regard, especially in boundary-crossing situations, and in inter-professional work. These are complementary to each other and include a) the work conference and democratic dialogue method suggested by Gustafsen (1992); and b) the identity workshop, utilising narrative methods (e.g. Hänninen & Eteläpelto, 2008). We further draw practical conclusions regarding the promotion of professional agency, where the aim is to develop professional learning, competence, and creativity in organisational and working life.

References

- Collin, K., Paloniemi, S. & Meckelin, J-P. 2010. Manifesting inter-professional teamwork and learning – the case of the surgical operation theatre. *Journal of Education and Work* 23, 1, 43-63.
- Eteläpelto, A. 2008. Perspectives, prospects and progress in work-related learning. In S Billett, C. Harteis, & A. Eteläpelto (Eds.) *Emerging Perspectives of Workplace Learning*. Rotterdam: Sense Publishers, 233-247.
- Hänninen, S. & Eteläpelto, A. 2008. Promoting professional subjectivities and personal agency at work: The long-term influences of an empowerment programme. In S. Billett, C. Harteis & A. Eteläpelto (Eds.) *Emerging Perspectives of Workplace Learning*. Rotterdam: Sense Publishers, 97-112.
- Häkkinen, P., Eteläpelto, A. & Rasku-Puttonen, H. 2009. Recent tensions and challenges of teacher education as manifested in the curriculum discourse. *Teaching and Teacher Education* 26, 4, 845-853.
- Vähäsantanen, K., Saarinen, J., & Eteläpelto, A. 2010. Between school and working life: vocational teachers' agency in a boundary-crossing setting. *International Journal of Educational Research* 48, 395-404.

PAPER PRESENTATION

Intended Learning Outcomes as a tool for university teachers learning

Linda Barman, Karolinska Institutet, Sweden; Charlotte Silen, Karolinska Institutet, Sweden; Klara Bolander Laksov, Karolinska Institutet, Sweden

Due to the Bologna declaration Sweden introduced new governmental regulations for Higher Education. This meant a shift towards outcome based education and requirements for teachers to formulate intended learning outcomes. In relation to the reform we have studied how teachers at a medical and health university reason about teaching and learning and how they approached the new outcome based curricula. We made a content analysis of course documents from 14 courses within different educational programs to capture changes between the last and the first course before and after the reform. After the second course round, we interviewed Course Directors responsible for designing the courses. We use a hermeneutic approach to analyse the interviews.

The preliminary findings show that teachers have high expectations of students' understanding of the ILO's and how ILO's may help students learning process. For most teachers in our study, the reform meant going from tacit objectives of what a course would give, to become more explicit expressing learning outcomes. Some teachers have taken on a more elaborated approach and involve students actively in discussions of what the learning outcomes mean and how to become more self-directed in their learning. However, constructing intended learning outcomes seem to facilitate teachers own learning foremost.

Background, Aims and Methodology

Due to the European collaboration within the higher education area, Sweden introduced new governmental regulations for higher education in 2007. The reform meant a shift towards outcome based education with a supposedly stronger emphasis on student learning (SFS 2006:1053; Weurlander, 2006).

A core feature of outcome based education is the emphasis on learning outcomes rather than process. According to Harden (1999) the communication of intended learning outcomes provides a clear framework for students to guide and encourage self-directed learning. Thereby teachers and students get a shared responsibility for learning (Harden, 1999).

At Karolinska Institutet, a university with a wide range of medical and health education, teachers were required to formulate intended learning outcomes. Leaning on the model of Constructive Alignment by Biggs (1996), the new policy included recommendations for alignment in course design, expressed through formal course documents (Weurlander, 2006). Formulating Intended Learning Outcomes (ILO's) requires teachers to be explicit with how

students should use the knowledge, skills and attitudes they learn from each course, e.g. to be able to perform a certain test or to communicate with patients in a defined context.

In relation to the reform we have studied how teachers from 14 different educational programmes at Karolinska Institutet reason about teaching and learning and what changes they performed in practice. The purpose of the study was to understand how policy may influence university teachers' ways of practice and their understanding about teaching and learning. In this study, teaching practice is represented by course design, e.g. what forms of assessments and learning activities that are planned. Teachers included in the study all had a role as Course Director with responsibility to plan the course. We made a purposeful sampling; one criterion was to get a variety of courses given within the university campus and within the health organizations.

To study differences in course design, course documents were gathered from the same course given both before and after the new regulations were implemented. After the second course round was finished, semi-structured interviews were held with the 14 teachers. An hermeneutic approach (Ricoeur, 1993) is used to analyse the interviews in order to understand how teachers may have changed or developed their reasoning about teaching and learning in general, but also how they come to understand and approach the new regulations with an emphasis on outcome based education. The course documents have been analysed with a thematic content analysis (Graneheim & Lundman, 2004) to capture the changes in course design before and after the new regulations.

Preliminary findings

For several teachers in our study, constructing the ILO's made them reflect upon, reason and together with other teachers discuss "what learning really means" and how learning may be assessed. As a consequence changes of the assessment methods were made towards more divergent assessments (Torrance & Pryor, 2001). Teachers used open questions where students have the possibilities to express what they know and understand instead of showing a predefined correct answer to a larger extent. Constructing the ILO's had become a mean for teachers' development of understanding more about learning.

In the interviews teachers refer to ILO's as "useful controllers" for course design. ILO's were used in an iterative process as a "marker" and gave clearance towards the teachers themselves of what the course was really about. Making the ILO's explicit made teachers change course content, learning activities and assessments to various degrees.

The ILO's were explicitly used by most teachers in the study to communicate the essence of the course towards different stakeholders. As many teachers put a lot of effort in the construction of ILO's, the teachers had hopes that this would help students in their studies. Teachers express high expectations of the students' understanding of the ILO's.

For most teachers in our study, the reform meant going from tacit objectives or aims of what a course would give, to be more explicit of student learning outcomes. However teachers also reflect upon the need to share and discuss the meaning of the ILO's and what it means for students own learning, together with the students. To explain this development we will use the framework suggested by O'Donovan et al. (2008) put forward to illustrate approaches to developing student understanding of assessment standards. The framework illustrates a movement from informal activities and inputs with passive student engagement onto formal activities and inputs with active student engagement.

Within the courses we studied, we find examples where efforts were made by teachers to get students more actively involved in understanding the ILO's and become more empowered in their own learning process. However the most existing change was going from tacit aims to explicit articulated ILO's that were passively presented to students. ILO's may be used as a "technical tool" for course design without adopting a social constructivist approach towards teaching and learning. Though, the collaborative construction of intended learning outcomes, seem to have facilitated teachers own learning about teaching and learning.

References

- Biggs, J.B. (1996). Enhancing teaching through constructive alignment. *Higher Education*. 32,1-18.
- Graneheim, U.H & Lundman, B (2004) Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24(2):105-112.
- Harden, R. M; Crosby, J. R & Davis, M. H. (1999) AMEE Guide No. 14: Outcome-based education: Part 1- An introduction to outcome-based education. *Medical Teacher*. 21(1), 7-14.

O'Donovan, B; Price, M & Rust, C (2008) Developing student understanding of assessment standards: a nested hierarchy of approaches. *Teaching in Higher Education*. 13(2), 205-217.

Ricoeur, P. (1993) *Från text till handling*. Stockholm: Brutus Östlings Bokförlag Symposion AB.

Torrance, H & Pryor, J (2001) Developing Formative Assessment in the Classroom: Using action research to explore and modify theory. *British Educational Research Journal*. 27(5), 615-631.

SFS 2006:1053 Förrordning om ändring i högskoleförrordningen (1993:100). Swedish ordinance for Higher Education.

Weurlander, M (2006) *Designing a course for meaningful learning. A step by step guide*. CME Guide 1. Stockholm: Centre for Medical Education, Karolinska Institutet.

PAPER PRESENTATION

The effect of instruction of control on perception of control.

Mieke Vandewaetere, University of Leuven - Campus Kortrijk, Belgium; Geraldine Clarebout, University of Leuven, Belgium

Learner control as instructional technique is not equally effective for all learners. Three conditions are assumed to play a role in the effectiveness of learner control: the learners' skills, the learners' perceptions and the cognitive load that is experienced by learners. This study investigates the effect of instruction of learner control on learning outcomes, mental effort and motivation, by comparing learners that received additional instructions on learner control with a group of learners that did not receive additional instructions. Self-regulated learning skills and working memory capacity are incorporated in the model. Results show that simply offering instruction of learner control is not enough to affect motivation, mental effort ratings and learning outcomes. One reason for this might be that instruction as such does not suffice, and that additional support or advice is necessary for learners in order to deal with LC.

Introduction

Learner control (LC) is an instructional technique that can be considered as an opportunity to improve learning. However, learners do not always grasp the opportunities they are offered (Perkins, 1985). Corbalan, Kester, and van Merriënboer (2009) defined three conditions that should be met for an effective use of LC. Firstly, learners must have the necessary skills to deal with LC. LC is also strongly interwoven with prior knowledge (Williams, 1996), self-regulation (SR) and motivation (Kinzie, 1990). The interaction pattern between SR and LC was also demonstrated in that learners with low SR skills perform better when they are in a condition with program control, compared to a LC condition (Eom & Reiser, 2000; Winters, Greene, & Costich, 2008).

A second condition is that LC must be perceived by the learners. Empirical research has demonstrated the importance of perception of LC (Cordova & Lepper, 1996). Even though the offered choices are illusory or seem trivial, choice becomes meaningful if the learner experiences it as such (Katz & Assor, 2007).

Finally, there is the assumption that LC demands free cognitive resources since it posits an additional load on cognitive processing. Makany et al. (2007) demonstrated that, as learner control (in terms of navigational control in a hypermedia environment) required more cognitive resources, short term learning performances decreased.

To conclude, rather than the questions whether or not to provide LC, it is more important to support learners in maximizing the use of available LC (Merrill, 1984)

This research

The aim of this study is to shed light on the mechanisms behind the three conditions mentioned by Corbalan et al. (2009). We want to sketch (1) the role of self-regulated learning (SR; condition 1: learners need to have the necessary skills to deal with LC), the effect of instruction (condition 2: LC must be perceived by the learners) and model the relation between LC and cognitive load, as measured by working memory capacity (WMC; condition 3: LC demands free cognitive resources).

Method

All 156 participants were first year Educational Sciences students. Prior to the experiment we assessed prior knowledge, self-regulated learning skills (SRQL; Black & Deci, 2000) and WMC (GOSPAN; De Neys, d'Ydewalle, Schaeken, & Vos, 2002). Participants were randomly assigned to one of the three conditions: (1) no control, in which participants had to complete 40 preselected exercises on English tenses; (2) LC without additional instruction, in which participants had to complete 40 exercises on English tenses, but they could freely choose 40 exercises out of 102

based on their interests or learning goals; (3) LC with additional instruction, similar to condition two, but with additional instruction of LC.

After the experiment, we assessed the mental effort participants had invested in completing the exercises (mental effort rating scale; Paas, Tuovinen, Tabbers, & Van Gerven, 2003) and all participants completed the post-experimental motivation inventory (IMI; McAuley, Duncan, & Tammen, 1987). Other dependent variables are learning outcomes as defined by course score and posttest score.

The experiment was administered by using Moodle[™], wherein 102 exercises were created on English tenses. Exercises were labeled according to their difficulty level, their theme (the tense), and type (multiple choice, translation or fill-in).

Results

For all analyses, the significance level was set to .05. Pre and posttest questionnaires showed good to very good reliability statistics, with Cronbach's α ranging from $\alpha = .75$ to $\alpha = .93$.

Participants in different conditions were equal concerning their prior motivation, prior knowledge, WMC and SR skills. All analyses were done with following variables in the model: prior knowledge score, WMC score, SR skills and condition (no control, LC, LC with instruction).

Mental effort ratings. SR skills show significant effects on mental effort ratings ($F(1,144) = 13.39$, $p = .001$, $\eta^2 = .09$). The lower the SR skills, the higher the invested mental effort reported ($b = -.05$). There were no significant effects of condition ($F(2,144) = .25$, $p > .05$) and prior knowledge ($F(1,144) = 2.54$, $p > .05$). Also, working memory capacity ($F(1,144) = 1.35$, $p > .05$) did not show any significant effects.

Post-experimental motivation. Both prior knowledge ($F(1,136) = 4.74$, $p = .03$, $\eta^2 = .03$) and SR skills ($F(1,136) = 7.89$, $p = .006$, $\eta^2 = .06$) significantly affected motivation, although this effect was not related to the condition ($F(2,136) = 1.76$, $p > .05$) and WMC ($F(1,136) = 0.61$, $p > .05$). The higher the prior knowledge ($b = 1.67$) and the higher the self-regulated learning skills ($b = 0.54$), the higher the post-experimental motivation.

Learning outcomes. Prior knowledge (Wilk's Λ , $F(2,141) = 3.05$, $p = .05$, $\eta^2 = .04$) and self-regulated learning skills (Wilk's Λ , $F(2,141) = 6.10$, $p = .003$, $\eta^2 = .08$) significantly affected learning outcomes (as defined by course score and posttest score). The higher the self-regulated learning skills and prior knowledge, the higher the course and posttest score.

Discussion and Conclusion

Research on LC should not focus on whether to include LC, but rather on how to include LC, how to support learners in using LC (Merrill, 1984) and under which conditions LC gains the effectiveness of learning. In this study, we emphasized the importance of perception of LC and its effects on motivation, learning outcomes and mental effort.

We did not find any effect of instruction of LC on the dependent variables, nor did we find interaction effects between WMC, SR skills and instruction. This might be due to the lack of available support or advisement for the learners. Hannafin (1984) stated that learner control, compared to program control, is likely to be most effective in conditions where learner control is accompanied by advisement to assist learners in making appropriate decisions. Clarebout and Elen (2006) also stressed the importance of advisement and support in their research on tool use. Simply giving control to the learners is not enough. Simply instructing learners that they have control is also not sufficient. A follow-up study will be administered to see whether the combination of instruction and advisement on LC shows better results than simple instruction of LC.

PAPER PRESENTATION

Using process data to re-examine the hypothesized impact of relevance instructions on text-based learning

Lai Jiang, Institute Tropical Medicine/Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium

The instructional effectiveness of relevance instructions (learning goals and postquestions) on factual learning and problem solving in a prose learning environment were examined. The difference with previous studies is that this study not only examined the learning outcomes, but more importantly, the learning process. This was done by investigating how students perceived and used the learning goals or postquestions and how they were engaged in learning processes with these instructional supports. The investigation of the process included examining students' interpretations of the learning goals, information selection and integration processes and monitoring behaviour. A

total of 110 university students studied a scientific text on the relation between obesity and impulsivity. They were assigned to a control group, a learning goal group or a postquestion group. Analysis of students' reading behaviour and cognitive processes suggests that the absence of significant performance differences between the conditions can be explained by referring to students' actual use of learning goals or postquestions.

Relevance instructions intend to help students in generating learning goals, allocate resources in a more systematic way and hence facilitate students to learn more efficiently from texts (McCrudden & Schraw, 2010). Relevance instructions can be learning objectives/learning goals, advance organizers or inserted questions. Although relevance instructions are intended to support learning, they do not always lead to better learning (e.g., Duchastel & Merrill, 1973; Reynolds, Trathen, Sawyer, & Shepard, 1993). The reported inconsistent effects of relevance instructions may be due to the ignorance of the variance in processes (i.e., learners' different use of relevance instructions)(Winne, 1982).

The increasing integration of education and technology provides opportunities to record multiple sources of data and to directly observe students' learning behaviour and cognitive processes (Hadwin & Winne, 2001). The current study investigated how relevance instructions were actually used in a prose learning environment. Log-file data that directly described students' cognitive processes and cognitive products was used to test the hypothesized links between two types of relevance instructions (i.e., learning goals and massed postquestions), cognitive processes and learning outcomes (e.g., Andre, 1979; Mayer, 1987; McCrudden & Schraw, 2010; Pressley, 2002).

Theoretical Hypotheses on the Facilitating Effects of Learning Goals and Postquestions

The intention of providing explicit learning goals (objectives) and postquestions to students is to cue and/or encourage them to cognitively operate on relevant information in a particular way (e.g., Salmeron, Kintsch, & Kintsch, 2010). The following theoretical hypotheses on the facilitating effect of learning goals and postquestions were tested in this study:

Hypothesis 1: Learning goals may help students to understand task demands and to set goals for studying (e.g., McCrudden & Schraw, 2007).

Hypothesis 2: Learning goals may help students to select relevant information (e.g., Lorch, Lorch, & Mogan, 1987) and

Hypothesis 3: Learning goals may help students to monitor their learning in a more systematic way (e.g., Duchastel & Merrill, 1973).

Hypothesis 4: postquestions may direct students reading attention (i.e., specific backward review and general backward review: Rickards, 1979).

Hypothesis 5: postquestions may stimulate students to monitor their reading comprehension (Garner & Reis, 1981) and improve the accuracy of students' self-monitoring during reading (Pressley, Snyder, Levin, Murray, & Ghatala, 1987).

Method

Materials

A program, called OBESITAS, provided a computer-based prose environment in which participants were asked to study a scientific text on the relation between overweight and impulsivity. The text comprises 2,178 words (17 paragraphs). Each paragraph was displayed on a separate screen.

Participants and procedure

One hundred and ten university students were pre-tested one week before the experiment. The results of the pretest were used to equally assign higher/lower prior knowledge students into three conditions: with learning goals (n = 37); with postquestions (n = 37) and a control group (n = 35). Students in the learning goal condition were asked to interpret the assigned learning goals and specify their learning objectives based on the assigned goals before reading the text. In the question condition, when students had read all the paragraphs at least once, postquestions appeared which had to be answered. Students' interpretations/answers were allowed to be modified at any time. A note space was provided in the three conditions. Students' notes were recorded and used to find out whether they carried out the intended cognitive processes. During the learning session, all learning behaviours and inputs of each participant were recorded in individual logfiles. Finally, a post-test was conducted to measure participants' factual knowledge, understanding of the relations between causal factors for obesity and the ability to solve problems.

Measure of cognitive processes and cognitive products

The following variables were recorded in logfiles and used to assess students' cognitive processes and cognitive products: students' responses to learning goals (to test hypothesis 1), notes in learning goal condition (to test hypothesis 2), answers to the postquestions (to test hypothesis 4) and studying sequence (to test hypothesis 3 & 5).

The analyses of students' studying sequence intended to find out whether students used learning goals/postquestions to monitor their cognitive actions and to adjust their studying processes when necessary.

Results

Students' actual use of learning goals and postquestions related to their theoretical hypotheses

H1: Not all students understood task demands and set specific goals in line with the assigned learning goals. For instance, for each learning goal, about 10 students failed to specify what they needed to do in order to achieve their own goals.

H2: Learning goals helped students to select relevant information. The analysis of the notes made by students in the learning goals condition were more strongly correlated to performance than the notes in the control condition.

H3, H4 & H5: Most students did not use learning goals or postquestions to monitor their learning in a more systematic way. Logfiles revealed that 64.9% of the students never reviewed goals after constructing their responses to them and only 6 out of 37 students realized that the information in their notes and their memory was not adequate and selectively reviewed the text.

Students' use of relevance instructions and performance

When comparing performance between three conditions, no significant difference was found. However, when looking at the relation between students' study behaviour and performance, strong relations were found. Students in the learning goal condition who understood the assigned learning goals correctly and described the goals in great detail achieved higher posttest scores. Furthermore, the higher the quality of notes (the better they implemented these assigned goals), the better they performed in the posttest. In addition, students who answered postquestions with backward review achieved better.

Conclusions

This study examined the hypothesized effects of learning goals and postquestions on students' learning processes and learning outcomes. A detailed analysis of students' behaviour and cognitive processes showed that students did not successfully carry out most desired cognitive processes. This could be the main reason for the lack of effects of learning goals and postquestions on intentional learning.

The results of the analysis of students' use of learning goals and postquestions at a behavioural and cognitive level provide evidence that the way in which instructions are used accounts for their instructional effectiveness. The detailed descriptions of students' interaction with learning goals/postquestions provide a sense of how commonly implemented instructions are actually perceived and used by students for knowledge acquisition. By looking deeply into the students' cognitive operations, this study identified specific suboptimal usage behaviour and therefore provides a better view for instructional designers on what needs to be done to tackle suboptimal use.

PAPER PRESENTATION

Does Animation Facilitate Comprehension of Public Information Graphics? Evidence from Eye Tracking

Jean-Michel Boucheix, University of Dijon, LEAD-CNRS, France; Jonathan Groff, INRETS & LEAD-CNRS, France; Richard Lowe, School of Education, Curtin University, Australia; Laurence Paire-Ficout, INRETS, Lyon-Bron, France; Stephane Argon, LEAD-CNRS, France; Laurent Saby, CERTU, France; Aline Alauzet, INRETS, Lyon-Bron, France

Graphic information displays have the potential to communicate public information in situations where normal announcement types are ineffective. This study used eye tracking techniques to analyze comprehension mechanism of event-related information on railway traffic disruptions presented via different graphic formats. One hundred thirteen participants were asked to understand and compare series of traffic disruption messages delivered via three purely visual formats. Animated displays were the most effective presentation type. Eye tracking data showed why an animation facilitates comprehension: it enhances processing strategies which provide the best condition for segmenting the causal chain of the events provided in the message.

Most previous research on the comprehension of animated graphics has concerned formal learning in scientific and technical domains (Bernay & Béêttrancourt, 2009; Hßffler & Leutner, 2007; Scheiter & al., 2010). This paper focuses on a rather different application of animations - providing public information messages about train traffic disruptions for people who cannot hear or understand normal spoken announcements. The target audience includes not only the

elderly, people with hearing impairments, and travelers from other countries, but also anyone else to whom loudspeaker announcements are 'unavailable' because of noise in the station or their distance from loudspeakers. Station loudspeaker announcements typically follow a standard event-based format such as: "Your attention please, contrary to the information that has been displayed, the TGV number 1259 for Paris, will not start from platform A but will start from platform B". Because travel disruptions can be a part of the everyday context for people taking trains, visual alternatives to spoken announcements (e.g. Figure 1) are one possibility for improving information availability. The approach taken in the present research study recruits theoretical ideas about visual comprehension from the Animation Processing Model (Lowe & Boucheix, 2008). It explores the potential of dynamic visual displays to quickly and effectively trigger a task-appropriate script of the relevant events. A key issue in using visualizations for this purpose is the extent to which bottom-up features of the external depiction map to top-down aspects of existing internal representations. Pilot investigations (Boucheix et al., 2010) with small samples of hearing impaired and elderly people suggested that comprehension could be higher with animated rather than static graphics.

The 113 undergraduate student's participants were randomly assigned to six groups, one for each version. Participants were presented with the disruption messages in their assigned format then asked to give verbal explanations of the message's meaning (i.e., what does it say, and what would you have to do in this situation). Eye movement (Tobii 120 hertz) and verbalizations were recorded and synchronized. Explanations were scored with a comprehension grid (interrater agreement, chance corrected Cohen's kappa, was 0.95), and the frequency of train travel recorded. Four Areas Of Interest (AOI) for the eye-tracking measures were based the area of on each picture (figure 2) and used to investigate processing behaviour (analysis included time to first fixation in each AOI, fixation duration, scan path and transition between AOIs).

Figures 3 shows comprehension scores (% for all messages). A repeated measure ANOVA (format x linearity x messages) showed a main effect of format $F(2, 107) = 5.81, p$ Figure 4 shows comprehension scores as a function of the frequency of train travel. A repeated measure ANOVA (frequency x message) showed a main effect of the frequency of use of trains on comprehension scores, $F(1, 111) = 32.51, p$ Eye tracking measures Due to space limitations in this summary, we include results here for only the first measure (time to first fixation on each AOI), Figure 5. A repeated measure ANOVA (Format x AOI) for all messages showed a main effect of the format $F(2, 654) = 46.14, p$

Findings from the present study indicate that animated graphics have the potential not only to facilitate public information comprehension but also to elicit more efficient information processing strategies. The animation format, seems to provide the best condition for segmenting the causal chain of the events provided in the message to facilitate comprehension.

- Bernay, S., & B    rancourt, M. (2009). When and Why does animation enhance learning: a review. Proceedings of the EARLI Biennial Conference, (p 227), Amsterdam, August 25-29, 2009.
- Boucheix, J-M., Lowe, R.K., Paire-Ficou, L., Saby, L., Alauzet, A., Conte, F., Groff,F., & Argon, S.(2010). Comprehension of animated public information graphic. A pilot study. EARLI-SIG Comprehension of Text and Graphics meeting. T  bingen, KMRC, 28-30 August 2010
- H     ler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis. Learning and Instruction, 17, 722-738.
- Lowe, R. K., & Boucheix, J.-M. (2008). Learning from animated diagrams: How are mental models built? In G. Stapleton, J. Howse, & J. Lee (Eds.), Theory and applications of diagrams (pp. 266-281). Berlin: Springer

Scheiter, K., Gerjets, P., & Schuh, J. (in press). The acquisition of problem-solving skills in mathematics: How animations can aid understanding of structural problem features and solution procedures. *Instructional Science*

PAPER PRESENTATION

Increase effectiveness of simulation-based learning through scripted collaboration

Florian Pilz, Ludwig-Maximilians-University Munich, Germany; Karsten Stegmann, University of Landau, Germany; Matthias Siebeck, University of Munich, Germany; Frank Fischer, Universität München, Germany

Simulations with standardized patients can foster knowledge acquisition in medical education. Often only one student can perform such simulations at a time. Offering students to observe the simulation and perform peer-feedback might enhance the effectiveness of the simulation. Because groups often work ineffectively collaboration scripts were used as instructional approach to support the learners. In a study with 235 medical students we varied an observation script (with vs. without), a feedback script (with vs. without) and the role during the simulation (examiner vs. observer). We examined the effects on the knowledge acquisition regarding the rectal exam. The observation script specified a list of important features the observer should focus on. The feedback script provided guidelines how to provide helpful feedback. The learning phase was segmented into three phases: First, the student in the examiner role performed the rectal exam while being observed by the observer. Second, while the examiner receives feedback from the standardised patient, the observer prepared feedback for the examiner. Finally, the examiner received feedback from the observer. Results show that the observation script (but not the feedback script) had a positive effect on knowledge acquisition for both roles whereas the observer benefitted significantly more. This study shows that the scripted observation of simulations can enhance the knowledge acquisition of learners.

Simulations with standardised patients can be an effective means to foster knowledge acquisition in medical education (cf. Schwald et al., 2009). However, usually only one student at a time can perform such simulation as examiner. By allowing other students to observe a simulation, the effectiveness of simulations may increase (cf. Zottmann et al., 2006). Not only the observer may learn from the social modelling and may reflect and modify their own knowledge by comparing themselves with the model (cf. King, 2007). In addition, the examiner may benefit from the observer's feedback. Feedback has been broadly found to be an effective means on knowledge acquisition (cf. Hattie, & Timperley, 2007). The most effective feedback is correct and provided in an informative and elaborated way (Hattie, 2009). However, peer-feedback often lacks certain qualities and needs to be supported (Hattie, 2009). Collaboration scripts can be regarded as an effective means to support specific collaborative learning activities (cf. Kollar et al., 2006). Collaboration scripts provide structures with respect to content (guidance through important steps) and with respect to interaction (support how to work together on a task) (cf. Weinberger et al., 2005).

Against this background our research question was, to what extent a content-related observation script, an interaction-related feedback script the role during the simulation and the interactions thereof affect the knowledge acquisition while learning with simulations in medical education.

Method

In a 2x2x2 pre-post design we varied an observation script (without vs. with), a feedback script (without vs. with) and the role (examiner vs. observer) during the simulation of a rectal examination. 235 medical students at the LMU Munich were randomly assigned to one of the 6 conditions. Learners participated in the learning session in dyads and took over either of the two roles. The learning session (about 45 minutes) was segmented into 3 phases: First, the student in the examiner role performed the rectal exam (about 20 minutes) observed by the second student. Second, while the examiner received feedback from the standardised patient (about 10 minutes), the observer prepared feedback for the examiner. Finally, the examiner received feedback from the observer (about 15 minutes).

The observation script specified a list of important steps the observer should focus on and asked the observer to check whether the examiner performed these steps. Without the observation script, observers were only asked to observe the examination and to provide feedback to the examiner afterwards. The feedback script asked the observer to pre-structure the feedback, to provide elaborated feedback including suggestions how to perform better and to ask the examiner to reflect on his/ her own performance. Without script, observers were only asked to prepare and provide feedback based on their observation.

The knowledge regarding how to perform a digital rectal exam was measured before and after the learning session. An expert solution differentiated 55 different relevant features of the rectal exam including communication aspects

(e.g., call the patient by name, announce the next steps) as well as medical content knowledge (e.g., inspection of the anal region, medication history). Two trained coders (Cohen's Kappa = .93) analysed the knowledge test regarding these features. The number of different relevant features in the description was used as measure of knowledge regarding the rectal exam.

Results

The observation script had a significant effect on the acquisition of knowledge. Dyads supported by the observation script showed higher knowledge gains than groups without script. Additionally there is a differential effect of the two roles. Both roles benefitted significantly from the observation script, however, the observer had significantly higher knowledge gains. The feedback script had no significant influence on the students' knowledge.

Conclusions

In line with the findings of Zottmann and colleagues (2006), our results show that observing a simulation can facilitate the acquisition of knowledge, but only if supported by an observation script. Furthermore, our results show that both roles benefitted from the observation script although the examiner had not worked directly with it. The examiner might benefit indirectly through enhanced feedback. Thereby, the effectiveness of the simulation was not only increased by the means of more participants per simulation, but also by the means of increased knowledge acquisition compared to individual learners. An important limitation of the study is that it was not measured how the students really perform a rectal exam. A performance-oriented post-test might show a better performance by the examiner than by the observer.

References

- Hattie, J. (2009). *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*. Routledge: London.
- Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81-122
- King, A (2007). Scripting collaborative learning processes: A cognitive perspective. In F. Fischer, I. Kollar, H. Mandl & J. M. Haake (Hrsg.), *Scripting computer-supported collaborative learning: Cognitive, computational, and educational perspectives* (pp.13-37). New York: Springer.
- Kollar, I., Fischer, F., & Hesse, F. W. (2006). Collaboration scripts - a conceptual analysis. *Educational psychology review*. 18(2), 159-185.
- O'Donnell, A. M. (1999). Structuring dyadic interaction through scripted cooperation. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 179-196). Mahwah, NJ: Erlbaum.
- Schwald, B., Siebeck, M., Frey, C., Stegmann, K. & Fischer, F. (2009, August). Different types of simulation in the training of the digital rectal examination: Reducing inhibition and facilitating complex skills. Paper presented at the 13th Biennial Conference of the European Association for Research on Learning and Instruction (EARLI), Amsterdam, 25. bis 29. August 2009.
- Weinberger, A., Ertl, B., Fischer, F., & Mandl, H. (2005). Epistemic and social scripts in computer-supported collaborative learning. *Instructional science*, 33(1), 1-30.
- Zottmann, J., Dieckmann, P., Rall, M., Fischer, F. & Taraszow, T. (2006). Fostering simulation-based learning in medical education with collaboration scripts. *Simulation in Healthcare*, 1(3), 193.

PAPER PRESENTATION

Boundary as bridge: A systematic conceptual review of the educational neuroscience literature

Catherine Beauchamp, Bishop's University, Canada; Miriam Beauchamp, University of Montreal, Canada

Recognizing the need to establish a connection between the findings of neuroscience research and teaching and learning contexts, this paper reports on a systematic conceptual review of 87 articles in the educational neuroscience literature focused on the link between education and neuroscience. This review, conducted by a neuroscientist and an educator, considers the problems of integrating two complex fields in the context of disciplinary boundaries and focuses on the following question: According to relevant literature, does educational neuroscience represent a bridge or a boundary for the merging of the two disciplines? The review resulted in an identification of themes related not only to tensions at the disciplinary boundary between the two fields but also to potential paths for resolving these tensions. It suggests that using the lens of disciplinary boundaries has potential for enhancing an understanding of the emergent field of educational neuroscience.

Aims:

The need to establish a connection between the findings of neuroscience research and teaching and learning contexts is documented in both neuroscience and education literature (e.g., Ansari, 2008; Goswami, 2004). The emergent discipline of educational neuroscience aims at “the integration of the diverse disciplines that investigate human learning and development ... to form the new field of mind, brain and education” (Fischer et al., 2007, p.1). However, concerns exist that the impact of neuroscience research on education has been less effective than hoped and further efforts are required to strengthen the connections between the two disciplines (Willingham, 2009). Bruer (1997) suggests that the linking of the two disciplines may be “a bridge too far”; others comment on the notion of a bridging of the two in both positive and negative ways (Willis, 2008). In seeking a way forward, it may be useful to consider the problems of integrating two complex fields in the context of disciplinary boundaries (Akkerman & Bakker, 2009). Evidence indicates that different disciplines remain entrenched in their traditional cultures, hindering a smooth crossing from one to another or a blending of two or more (Becher, 1989). Yet Dillon (2008) has noted that the idea of boundary crossing has potential for examining transactions that take place at the boundary between disciplines. While the notion of boundaries has been prevalent in the transfer from one social context to another (e.g. from an academic to a workplace setting) (Tuomi-Grohn & Engestrom, 2003), it may also help take into account the tensions generated by the integration of multiple disciplines (Dillon, 2008). As a neuroscientist and an educator, our aim was to understand the potential links between neuroscience and education by using boundaries as a lens for a systematic review of educational neuroscience literature and to extract common tensions and promising insights. We focused on the following question: According to the relevant literature, does educational neuroscience represent a bridge or a boundary for the merging of the disciplines of education and neuroscience?

Methodology:

We systematically reviewed literature in PsycInfo, ERIC, Medline and Current Contents (1970-2010) for empirical articles, conceptual papers, and commentaries in the field of educational neuroscience using these keywords: education, teaching, classroom(s), and pedagogy combined with neuroscience, brain, neuromyth(s), as well as the overlapping terms ‘educational neuroscience’, ‘mind, brain and education’, and ‘neuroeducation’. 467 references were categorized into four areas, one representing 87 articles whose central focus was the linking of education and neuroscience. We categorized the contents of these articles according to themes of boundary language, inter-disciplinary tensions, needs at the boundary, and potential aids to resolving tensions.

Findings:

Although none of the reviewed works referred directly to boundary theory, recurring vocabulary suggests indirect use of boundary principles, including the idea of connections and bridges between disciplines, inter- and trans-disciplinarity, foundations for transferable knowledge, bidirectional exchanges, and a common language. Frustrations and issues evoked were reminiscent of the tensions related to negotiating boundary crossings in the generation of a new discipline. Most cited were problems with misinterpretations in the application of neuroscientific findings to educational practice (neuromyths). A related theme indicates that direct extrapolation from one discipline to the other is inappropriate and that knowledge transferred across the boundary should be descriptive rather than prescriptive (e.g. Christodoulou & Gaab, 2009). More positively, potentials for progress were highlighted: the need for more concerted collaboration, a more skeptical approach in interpreting neuroscientific findings and their limitations in educational practice. Some literature suggests tools (boundary objects) for uniting the two disciplines: an accessible, common language and mode of communication across the boundary, ‘bridges’ through existing disciplines such as cognitive psychology, and creating research schools or shared databases on learning (e.g., Fischer, 2009). The concept of brokerage (Wenger, 1998) appears, recommending people at the boundary to facilitate the evolution of educational neuroscience, including scientists knowledgeable about educational research capable of communicating across the boundary (‘translators’) (Fischer, 2009; Christodoulou & Gaab, 2009) or existing specialists such as educational psychologists (Mason, 2009). Analyzing the educational neuroscience literature through the lens of boundary principles indicates the boundary between the two disciplines may itself be a bridging mechanism useful for the creation of a new discipline. Boundary crossings between disciplines must not be seen as obstacles, but as positive transformations that combine “different modes of thinking in the generation of new outcomes” (Dillon, 2008, p.261).

Theoretical significance:

Understanding the nature of the boundaries and resulting tensions produced by the merging of disciplines could enhance discussion about the significance of neuroscientific research as it applies to education. Continued attention to the tensions produced by this union of disciplines is a first step in clarifying the challenges of applying research findings; a second step could involve attempts to resolve these tensions. This resolution might, for example, involve the dispelling of neuromyths, the increased potential for both neuroscientists and educators to understand their own and the opposite academic culture, and the development of a common language for naming and working within the concepts important to both fields.

Selected References

- Akkerman, S., & Bakker, A. 2009. Meaning in motion: a literature review of boundary phenomena. Presentation at the Biennial Conference for Research on Learning and Instruction, EARLI, Amsterdam, August 25-29.
- Ansari D. (2008). The brain goes to school: Strengthening the education-neuroscience connection. *Education Canada*, 48(4), 6-10.
- Becher, T. (1989). *Academic tribes and territories*. Milton Keynes, UK: Open University Press.
- Bruer, J. (1997). Education and the Brain: A Bridge Too Far. *Educational Researcher*, 26(8), 4-16.
- Dillon, P. (2008). A pedagogy of connection and boundary crossings. *Innovations in Education and Teaching International*, 45 (3), 255–262
- Fischer, K., et al. (2007). Why mind, brain, and education? Why now? *Mind, Brain, and Education*, 1(1), 1-2.
- Goswami U. (2004). Neuroscience and education. *British Journal of Educational Psychology*. 74(1), 1-14.
- Mason L. (2009). Bridging neuroscience and education: a two-way path is possible. *Cortex*, 45(4), 548-549.

PAPER PRESENTATION

Involvement of inhibitory control mechanisms in overcoming intuitive interference

Ruth Stavvy, Tel Aviv University, Israel; Reuven Babai, Tel Aviv University, Israel; Stefan Elmer, University of Zurich, Switzerland; Nahed Younis, Tel Aviv University, Israel; Lutz Jancke, University of Zurich, Swaziland

Many students encounter difficulties when solving problems in science and mathematics. Research indicates that these difficulties may stem from intuitive interference with analytic reasoning. Our research aims at deepening the understanding of these difficulties and their underlying reasoning mechanisms in order to help students overcome them.

Interference or conflict between intuitive and analytic reasoning results in increment in error rate. In a previous fMRI study participants compared the perimeters of two geometrical shapes in two conditions: 1) congruent, in which correct response is in line with the intuitive reasoning (larger area–larger perimeter) and 2) incongruent, in which the correct response is counterintuitive (larger area–equal perimeter). Success rate was lower in the incongruent condition and correctly answering it specifically activated bilateral prefrontal areas known for their executive control over other brain regions. Moreover, reasoning associated with overcoming the intuitive interference was reciprocally correlated with the level of brain activation in the prefrontal region. Here we further studied the involvement of inhibitory-control-mechanisms in overcoming intuitive interference. Our findings indicate that students with strong and efficient inhibitory-control-mechanisms outperform students with non-efficient ones. In addition, a preliminary tDCS experiment suggests that stimulation of the right prefrontal cortex increases accuracy of responses in the incongruent condition. These findings further point to the importance of control mechanisms in overcoming intuitive interference. We will discuss the educational relevance of these findings.

Background and Aims

Students' difficulties in science and mathematics may stem from intuitive interference with analytic reasoning. Our research aims at deepening the understanding of these difficulties and their underlying reasoning mechanisms in order to help students overcome them. Here we focus on the comparison-of-perimeter task known to elicit intuitive incorrect responses.

In a previous fMRI study (Stavvy & Babai, 2010) participants compared the perimeters of two geometrical shapes in two conditions: 1) congruent, in which correct response is in line with the intuitive reasoning (larger area–larger perimeter) and 2) incongruent, in which the correct response is counterintuitive (larger area–equal perimeter). Success rate was lower in the incongruent condition and correctly answering it specifically activated bilateral prefrontal areas known for their executive control over other brain regions. Moreover, reasoning associated with overcoming the intuitive interference was reciprocally correlated with the level of brain activation in the prefrontal region.

We describe two studies aimed at understanding the involvement of inhibitory-control-mechanisms in overcoming the intuitive interference in the comparison-of-perimeter task.

Study 1 - Accuracy of responses of students with strong or weak inhibitory-control-mechanisms

Our aim in this study was to find out whether participants that exhibit strong inhibitory-control-mechanisms will succeed better in overcoming intuitive interference than those that exhibit weak inhibitory-control-mechanisms.

Methodology

Eighty-five ninth graders participated in the study. The strength (strong/weak) of inhibitory-control-mechanisms of each student was assessed using the digit cancellation test according to Israeli norms (Vakil et al., 2009). In this test participants were shown a pattern of digits and were required to first cross out target digit "8" and then the target digits "3" and "5". Time to completion and number of errors were measured.

We used a revised version of the computerized comparison-of-perimeter test (Babai et al., 2006). The test included 16 congruent and 16 incongruent trials. Each condition had 8 simple and 8 complex (more difficult) trials (Figure 1). In each trial two polygons were presented on a computer screen, until the participant gave a response (right is larger; left is larger; both are equal) by pressing an appropriate key.

Findings
Results are depicted in Table 1.

A 2x2x2 repeated measure ANOVA was conducted. As expected significant main effects of congruity (ppp
Significant interaction congruity x group (pp=0.002) probably due to the failure of Group2 in incongruent trials.

These findings indicate that inhibitory-control-mechanisms play an important role in overcoming intuitive interference.

Study 2 - Effect of tDCS on overcoming intuitive interference (an on going project – more data are expected by the conference time)

Neurons are known to respond to Direct Current electrical fields by altering their firing rates. Generally speaking, when the anode is located near the neurons it stimulates their activity by slightly changing the membrane potentials. In this preliminary study we explored how accuracy in the comparison-of-perimeter task is affected by tDCS (transcranial Direct Current Stimulation) to the prefrontal cortex. Will such stimulation improve participants' ability to overcome intuitive interference?

Methodology

Participants were twenty-seven (17 experimental, 10 control) right handed young adult males. All performed twice a longer version of the comparison-of-perimeter test (160 stimuli divided equally to: congruent-simple, congruent-complex, incongruent-simple, incongruent-complex). At the beginning of the testing session both groups received a 9 minute Sham treatment (1 mA applied for the first 30 seconds). Participants then responded to the test (Test1). After a pause of 30 minutes the experimental group received anodic stimulation (1 mA for 9 minutes) and the control group a Sham treatment (as before). Both groups then completed the test (Test2). Stimulation was applied in the right prefrontal region and the reference was set behind the ear. Neuropsychological test battery showed that the groups were similar in their short-term memory and visuospatial abilities.

Findings

Results are depicted in Table 2.

In the experimental group a significant improvement in accuracy from Test1 to Test2 was found in the incongruent complex condition (64% to 79%, $p=0.042$) while in the control group similar success rates were observed for this condition from Test1 to Test2 (54% to 56%). In addition, in the experimental group the mean accuracy in the incongruent condition increased from Test1 to Test2 (73% to 86%, $p=0.073$), while in the control group similar success rates were observed for this condition from Test1 to Test2 (60% to 62%).

These preliminary findings suggest that stimulating the prefrontal cortex improves participants' ability to overcome intuitive interference, possibly due to activation of inhibitory-control-mechanisms and/or other relevant cognitive functions.

Educational significance

The findings presented above point to the importance of inhibitory-control-mechanisms in students' ability to overcome intuitive interference and hence their difficulties in science and mathematics. Accordingly, our findings suggest putting more emphasis on enhancing students' executive control mechanisms in addition to supporting relevant content knowledge, as is traditionally done in schools. It should be noted that successful attempts to specifically improve executive functions have been carried out so far mainly with preschoolers (for example, Diamond et al., 2007; Rueda et al., 2005). It seems worthwhile, therefore, to attempt it with school children.

PAPER PRESENTATION

Detecting Cognitive Load Levels by Means of Brain-Computer-Interface Methodology

Gabriele Cierniak, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany; Carina Walter, University Tuebingen, Germany; Martin Bogdan, University Tuebingen, Germany; Wolfgang Rosenstiel, University Tuebingen, Germany

According to Cognitive Load Theory (CLT) the type and amount of cognitive load during learning is crucial for successful learning. CLT recommends that cognitive load should not exceed working memory capacity at any time during learning. A continuous online measure of CL during learning is necessary to investigate whether learning environments meet this criterion. Antonenko et al. (2010) suggest that continuous EEG data might be used to measure instantaneous CL. In the current study we applied a Brain-Computer-Interface (BCI) methodology to test whether continuous EEG data can be used offline to classify students' CL levels during learning. The EEGs of 8 students were recorded during learning angle theorems (higher CL) and watching comic-strips (lower CL). First, it was shown that the classifiers used for BCIs and trained on the EEG data during learning theorems and watching comic-strips classified both phases on average as 73% correct. For individual students the percentage of correct classification reached 82%. Second, it was shown that binary classifiers trained on the EEG data only during learning the theorems presented in three formats (lower, medium, and higher CL), classified on average 65% between lower and medium, lower and higher, as well as medium and higher CL format. The results of this study indicate that continuous EEG data in combination with BCI methodology is a promising approach to measure learners' CL online.

Introduction

Cognitive Load Theory (CLT) proposes that the limited capacity of working memory is a crucial factor in learning. Thus, one important aspect in designing learning environments is to keep the cognitive load within the limit of learners' working memory capacity. CLT distinguishes between three CL types: intrinsic CL is caused by the content complexity, extraneous CL is caused by the design and hampers learning, whereas germane CL subsumes learners' elaboration processes that support learning. The three load types are additive and their sum should not exceed learners' working memory capacity, because learning is hampered by cognitive overload.

According to CLT it would be useful to measure instantaneous CL during learning to investigate how much CL is put on learners' working memory. Antonenko et al. (2010) suggest that instantaneous CL can be measured by continuous EEG data. Neuropsychological studies suggest that an increase in cognitive load is associated with an increase in theta band activity and a decrease in alpha band activity. We conducted the following experiment in order to test whether different levels of learners' CL can be distinguished offline by BCI methodology relying on continuous EEG data. The overall aim was to find optimal classifiers for each individual.

Experiment

Participants and Design

8 students (12-15 years old) participated in the experiment. We manipulated CL on a coarse-grained and a fine-grained level. On the coarse-grained level, students were asked to study five angle theorems (higher CL) and to watch 15 comic-strips (lower CL). On the fine-grained level, each of the five angle theorems was presented in three complexity formats (lower, medium, and higher CL). All participants studied 15 (5x3) angle theorems and 15 comic-strips to allow for within-subjects comparisons.

Procedure and Materials

The experiment consisted of four phases. In phase 1, students were asked to solve angle problems to measure students' prior knowledge (pre-test). Phase 2 consisted of three learning cycles (lower, medium, and higher CL; see Figure 1). In each cycle participants were asked to study five angle theorems and to watch five comic-strips. Each comic-strip and theorem was presented for 45 sec. After one comic-strip an angle theorem was presented. In phase 3, students applied the theorems with a German version of the Carnegie Learning's Cognitive Tutor provided by Schwonke et al. (2007). Finally, participants had to solve the first angle problems again (post-test).

FIGURE 1

Apparatus

Participants' EEG data were collected during the experiment by 16 electrodes which were placed according to the Modified Combinatorial Nomenclature expanded 10-20 system. EEG data were collected at a sampling rate of 256 Hz. EEG Data Analysis

Support-Vector-Machines (SVMs) were used for classifying the filtered EEG data. EEG spectral power analyses were run to check whether a theta band increase and/or alpha band decrease between assumed CL manipulations took place.

Results

Learning Outcomes. A RM-ANOVA indicated that all participants solved significantly more angle problems in the post-test ($M = 95\%$) than in the pre-test ($M = 40\%$; $F(1,9) = 354.77$; p

Classification 1. On the coarse-grained level, it was tested how well binary SVMs distinguished between learning angle theorems and watching comic-strips. The percentage of correct classifications reached on average about 73% with a minimum of 66% and a maximum of 82%.

EEG spectral power 1. A dependent t-test on the participants' spectral power (see Figure 2) showed a trend in that most participants' theta band increased and occipitoparietal alpha band decreased from watching comic-strips to learning angle-theorems ($p = .10$), especially over the right hemisphere.

FIGURE 2

Classification 2. On the fine-grained level, it was first tested how well 3-classes SVMs distinguished between learning angle theorems presented in lower, medium, and higher CL format. The percentage of correct classification reached on average about 42%. Binary SVMs between lower and medium CL reached on average 62% (max. 71%), between lower and higher CL about 68% (max. 80%), and between medium and higher CL about 64% (max. 74%) correct classifications.

EEG spectral power 2. Individual dependent t-tests showed that most participants' upper theta band (6Hz–8Hz) power significantly increased from learning theorems presented in lower compared to medium or higher CL format.

Discussion

The study investigated whether continuous EEG data and BCI methodology can be used to distinguish between different CL levels during learning. First, the results showed that SVMs had a good percentage rate of correct offline classifications (73%) between learning (angle theorems) and non-learning (comic-strip) phases. The percentage rates of correct offline classifications between more subtle differences in CL levels (lower, medium, and higher theorem format complexity) were lower but nevertheless reached about 65% on average. Second, the results showed that theta and alpha bands were the critical EEG frequencies indicating spectral differences between the coarse-grained CL manipulations. This result is in line with neuropsychological evidence about mental workload (Klimesch, 1999) and suggests that the SVMs probably relied on cognitive load differences rather than on surface differences in stimuli characteristics. The result that the EEG band differences appeared especially over the posterior right hemisphere probably reflects the spatial demands of processing angle theorems (Gevins et al., 1997). The study suggests that the combination of continuous EEG data and BCI methodology is a promising approach to distinguish between learners' CL levels online. This methodology might be used for adaptive learning environments.

References

- Antonenko, P. D., Paas, F., Grabner, R. H., & Van Gog, T. (2010). Using electroencephalography to measure cognitive load. *Educational Psychology Review*.
- Gevins, A., Smith, M. E., McEvoy, L., & Yu, D. (1997). High-resolution EEG mapping of cortical activation related to working memory: Effects of task difficulty, type of processing, and practice. *Cerebral Cortex*, 7(37), 374-385.
- Klimesch, W. (1999). EEG alpha and theta oscillations reflect cognitive and memory performance: a review and analysis. *Brain Research Reviews*, 29, 169-195.
- Schwonke, R., Wittwer, J., Alevy, V., Salden, R., Krieg, C., & Renkl, A. (2007). Can tutored problem solving benefit from faded worked-out examples? In S. Vosniadou, D. Kayser, & A. Protopapas (Eds.), *Proceedings of the 2nd European Cognitive Science Conference* (pp. 59-64). New York, NJ: Erlbaum.

PAPER PRESENTATION

Early number competence and working memory are key for later mathematics achievement

Caroline Hornung, University of Luxembourg, Luxembourg; Martin Brunner, University of Luxembourg, Luxembourg; Christine Schiltz, University of Luxembourg, Luxembourg; Romain Martin, University of Luxembourg, Luxembourg

Early number competence is essential for children's later mathematics achievement. Previous studies have indicated that early number competence is grounded in more basic cognitive mechanisms, such as working memory and nonverbal number sense. This longitudinal study had two main objectives. First, we examined how early number competence in kindergarteners predicted mathematics achievement one year later in first grade. Second, we examined the specific role of working memory in early number competence and mathematics achievement. Latent regression models revealed that early number competence strongly predicted later mathematics achievement. Further analyses indicated that working memory explained unique variance in early number competence when nonverbal number sense, verbal comprehension, and fluid intelligence were controlled. These findings emphasize (a) the importance of early number competence for later mathematics achievement, (b) the key role of working memory

processes in basic number and mathematical processing in young children. Early screening programs designed to identify children at risk of developing later mathematical difficulties should therefore include working memory measures. Targeted early intervention programs offer the opportunity to foster these children's cognitive and early number development and thus to promote their later mathematics achievement.

Research objectives of the present study

Previous studies acknowledged that a broad range of variables may be useful to identify the cognitive underpinnings of mathematical competence and mathematical learning difficulties (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; De Smedt et al., 2009; Koponen, Aunola, Ahonen, & Nurmi, 2007; Kroesbergen, Van Luit, Van Lieshout, Van Loosbroek, & Van de Rijt, 2009). The aim of the present study was therefore to investigate a range of cognitive variables at the end of kindergarten prone to influence mathematics achievement one year later at the end of first grade. Earlier studies reported that mathematical competence grounds either in early number skills, e.g., counting skills (Jordan, Glutting, & Ramineni, 2010; Jordan, Kaplan, Locuniak, & Ramineni, 2007; Jordan, Kaplan, Oláh, & Locuniak, 2006; Jordan, Kaplan, Ramineni, & Locuniak, 2009), in more basic number-specific processes, i.e. nonverbal number sense (Butterworth, 1999, 2005; Landerl, Bevan, & Butterworth, 2004; Landerl & Kölle, 2009), or in domain-general processes, i.e. working memory (Raghubar et al., 2009, for a review). The contribution of these different underlying processes has been studied either separately or concurrently and consequently yielded inconsistent results. For example, Jordan et al. (2009) found that early number competence was a better predictor for later mathematics achievement than working memory. Likewise, Halberda and Feigenson (2008) found that nonverbal number sense related significantly to later mathematics achievement after accounting for domain-general capacities (also see Fuchs et al., 2010). And Kroesbergen et al. (2009) found that working memory (domain-general processes) and nonverbal number sense (domain-specific processes) predicted both incremental parts of variance in early number competence.

We therefore examined the contribution of domain-general and domain-specific processes to developing early number competence and to later mathematics achievement. In line with Kroesbergen et al. (2009; No&il, 2009) we defined early number competence as a cultural acquisition (cf. biological secondary abilities, Geary, 1994, 2000) dependent on education and numerous cognitive processes that may be partly domain-general and partly domain-specific (verbal, numerical and visuo-spatial). For example, early number competence includes verbal counting skill, which requires children to recite the number word sequence in the correct order. This root counting skill implicates multiple processes: aspects of language production, knowledge of the sequence of number words and working memory to keep track of the counting process (stay on task and remember which number word comes next). From this rationale, basic cognitive abilities such as working memory, nonverbal number sense and verbal ability are likely to underlie early number competence (cf. Kroesbergen et al., 2009). Thus, in this study, early number competence, nonverbal number sense, working memory and verbal ability were conceived from a hierarchical perspective. While working memory, nonverbal number sense and verbal ability refer to more basic cognitive abilities; early number competence refers to a complex cognitive ability that grounds in basic cognitive abilities. Rather than simultaneously studying the prediction of early number competence, working memory, nonverbal number sense and verbal ability on mathematics achievement, the study is divided into two sections. The first section investigated the role of kindergarteners' early number competence on mathematics achievement. In line with Jordan and colleagues, early number competence may be determinant for later mathematics achievement (Aunola et al., 2004; Jordan et al., 2006; Jordan et al., 2009; Krajewski & Schneider, 2009). The second section investigated the cognitive underpinnings of kindergarteners' early number competence. To this end latent variable analyses examined how working memory, nonverbal number sense, verbal ability and additionally fluid intelligence (as control variable) accounted for early number competence in kindergarten.

Method

Our longitudinal study involved two measurement points: the first when participants were in the third and final year of preprimary education (i.e., kindergarten) and the second 11 months later, when they were in first grade. All participating children were taught the same first grade mathematics curriculum for 8 months. Our analyses are based on data of all 165 children who provided data for the measures at the end of kindergarten. Written parental consent was obtained for all participating children. The assessments were all conducted in kindergartens and primary schools in Luxembourg.

In kindergarten, we administered verbal counting, dot counting, and Arabic number comparison tasks to measure early number competence. WM was assessed by four verbal (e.g., digit span, backward color span) and two visuo-spatial span tasks, each beginning at a list length of two stimuli. Nonverbal number sense was assessed by two numerosity comparison tasks: a dot comparison task and a stick comparison task. In both tasks, children pressed either a pink (left) or a blue (right) button to identify the side of the screen with the larger numerosity. The first 10 test sets of the verbal comprehension test of the British Picture Vocabulary Scale (Dunn, Dunn, Whetton, & Burley,

1997) were translated into Luxembourgish and administered to evaluate children's receptive vocabulary. We measured fluid intelligence using a widely applied abstract reasoning ability task, Raven's Coloured Progressive Matrices (Raven, Raven, & Court, 1998). In first grade, we assessed three core aspects of children's mathematics achievement: arithmetic, visuo-spatial mathematical abilities, and number line estimation. For statistical analysis we conducted structural equation modeling with Mplus 5.2 (Muthén & Muthén, 1998–2007). The full information maximum likelihood (fiml) method was used to handle missing data in all analyses (cf. Schafer & Graham, 2002) due to longitudinal data.

Results and practical implications

Overall, the study highlights 2 key findings. First, early number competence is a crucial predictor for mathematics achievement as assessed at the end of first grade. Second, working memory representing domain-general abilities explains incremental variance in early number competence after controlling for basic number-specific and language abilities. Thus, kindergarteners' working memory abilities partly explain the strong relationship between kindergarteners' early number competence and their first-grade mathematics skills. This finding emphasizes the role of working memory in learning mathematics at an early stage in development and aligns with previous research underscoring the role of working memory in children's cognitive and academic development (Cowan & Alloway, 2009, Raghubar et al., 2009). These results have practical implications for early screening and intervention programs. In particular, identifying whether early number competence is grounded in domain-general processes (i.e., WM) or in domain-specific processes (i.e., nonverbal number sense) would improve the comprehension of the underpinnings' of early number development and eventual early number difficulties. This may consequently advance early screening and intervention practices in mathematics.

PAPER PRESENTATION

Doctoral examining for sustainable research capacity building – examiner threshold crossing.

Assessment methods, Higher education, Research based learning

Gina Wisker, University of Brighton, United Kingdom

In discussions of what makes a 'Good enough PhD' (Wisker 2010), a major area to be explored further is that of the practices of and standards sought by doctoral examiners. Internationally, increasing numbers of students seek doctoral qualifications (EdD, DBA, Prof Doc, PhD) in a wide variety of disciplines, or interdisciplines. Examiners consider work produced for doctorates in varied contexts whether dealing with the text alone (Australia) or the text and the viva (Europe, UK, America). It is timely to revisit early work (Kiley and Mullins 2002), build new work on doctoral examining and to ask some further hard questions about processes, behaviours, standards and quality. Current research reported here uses conceptual threshold crossing theory (Wisker, Kiley, Robinson, Aiston 2006) to consider in what ways and where examiners' examining processes engage with, identify and discover in practice indicators of the achievement of qualities expected in a marginal and in a successful doctorate. Interviews of doctoral examiners in a variety of international contexts reveal their examining processes, awareness of evidence of conceptual threshold crossing and evidence which they recognise constitutes sufficient quality to merit a doctorate.

Aims and background

In discussions of what makes a 'Good enough PhD' (Wisker 2010), a major area to be explored further is that of the practices of and standards sought by doctoral examiners. Internationally, increasing numbers of students seek doctoral qualifications (EdD, DBA, Prof Doc, PhD) in a wide variety of disciplines, or interdisciplines. Examiners consider work produced for doctorates in varied contexts whether dealing with the text alone (Australia) or the text and the viva (Europe, UK, America). It is timely to revisit early work, build new work on doctoral examining and to ask some further hard questions about processes, behaviours, standards and quality.

Methodology and methods

Current research reported here uses conceptual threshold crossing theory (Wisker, Kiley, Robinson, Aiston 2006) to consider in what ways and where examiners' examining processes engage with, identify and discover in practice indicators of the achievement of qualities expected in a successful doctorate. Our work in this area arises from two recent and ongoing projects, one UK based, one international. The UK, NTFS (National Teaching fellowship) project 'Doctoral learning journeys' (DLJ) 2007-2010, builds on and accompanies 13 years of the 'parallel project' itself partly funded by an individual NTFS. The most recent focus of both projects is a scrutiny of examiners' processes, definitions and recognition of achieved outcomes and standards in the doctorate which are indicators of success and which lead examiners to recommend a pass, or a pass with modifications. The DLJ began in 2007 with a large scale survey of UK PhD students (350), tracks learning journeys of 20 doctoral students, 20 supervisors and latterly

examiners (11), using narrative inquiry and interviews. The parallel project 1998- 2010- uses inventory data on doctoral students' learning outcomes and behaviours (@300 students) interviews with students and supervisors, and latterly interviews with examiners. Previous work on doctoral examining (Kiley, 2009; Kiley & Mullins, 2004; Mullins & Kiley, 2002, Holbrook et al 2004, c b) indicates that examiners identify a passable thesis and work which makes a recognisable contribution in terms of certain characteristics, early on in their examining processes. (Kiley M., Wisker, G., 2009, Kiley M., Wisker G., 2010) indicate that doctoral students and their supervisors are aware of moments of conceptual threshold crossing involving transformed ways of understanding, interpreting, viewing and articulating 'something'. Without such awareness it is argued, students seem unable to make a contribution to knowledge sufficient to progress at the level required for research and doctoral achievement. Mullins & Kiley, (2002) reported that a 'good' thesis demonstrates:

Critical analysis & argument	Confidence & a rigorous, self-critical approach
A contribution to knowledge	Originality, creativity & a degree of risk taking
Comprehensiveness & scholarly approach	Sound presentation & structure
	Sound methodology

In our recent interviews we asked the following questions of thesis examiners:

How do examiners recognise and comment on doctoral level achievement?	How do they discuss theses considered marginal?	What are the characteristics of marginal theses at examination?
		What are the characteristics of doctoral level achievement and conceptual threshold crossing at examination?

Findings

Our recent work reveals in practice the notion of 'examiner thresholds', threshold crossing moments for examiners triggered by the quality of the thesis when they recognise achievement and expression worthy of a doctorate. We have also identified examiners' perceptions of the characteristics of the marginal or the 'good enough' doctorate, and characteristics of the doctorate which indicates work of a higher than marginal, sometimes stunning quality. Examiners reported that they considered a 'good' thesis to have:

Sound design, methodology in action	Good qualities and cohesion throughout plus that extra 'newness' and 'flourish' which goes beyond the thesis
Engagement with the literature in dialogue	Real sense of mastery and adding something new
'The magic ingredient' 'I'm looking for somebody who really, really knows this subject so well that they're able to step beyond the subject and go somewhere new with it.they get to the margins of the theory and they're challenging' While a marginal thesis was described as:	
Too complex without order or focus	'too many beads'
Too mechanistic	'It's not illuminating, I want to see lights come on something that's moving on from that, the exception is where I see illuminated thinking coming through in the sections.'

Educational significance

Our work with doctoral examiners reveals their examining processes, awareness of evidence of conceptual threshold crossing and evidence which they recognise constitutes sufficient quality to merit a doctorate.

References

- Holbrook, A., Bourke, S., Lovat, T. & Dally, K. (2004b). PhD theses at the margin: Examiner comment on re-examined theses. *Melbourne Studies in Education*, 45, (1) May, pp.89-115.
- Holbrook, A., Bourke, S., Lovat, T. & Dally, K. (2004c). Qualities and characteristics in the written reports on doctoral thesis examiners. *Australian Journal of Educational and Developmental Psychology*, 4, pp.110-129.
- Kiley, M. (2009). You don't want a smart Alec: Selecting examiners of doctoral dissertations *Studies in Higher Education*, 34(8), 889-903.
- Kiley, M. (2009b). Identifying threshold concepts and proposing strategies to support doctoral candidates. *Innovations in Education and Teaching International*, 46(3), 293-304.
- Kiley, M., & Mullins, G. (2004). Examining the examiners: How inexperienced examiners approach the assessment of research theses. *International Journal of Educational Research*, 41(2), 121-135.
- Kiley, M., & Wisker, G. (2009). Threshold concepts in research education and evidence of threshold crossing. *Higher Education Research and Development*, 28(4), 431-441.
- Mullins, G., & Kiley, M. (2002). 'It's a PhD, not a Nobel Prize': How experienced examiners assess research theses. *Studies in Higher Education*, 27(4), 369-386.
- Wisker, G., Kiley, M., Robinson, G., & Aiston, S. (2006). Making the learning leap: Research students crossing conceptual thresholds. In M. Kiley & G. Mullins (Eds.), *Quality in Postgraduate Research: Knowledge creation in testing times* (pp. 195-201). Canberra: CEDAM, The Australian National University.
- Wisker, G. (2010). 'The Good Enough PhD: Crossing thresholds and building communities'. *Acta Academica*
- Wisker, G., Morris, C., Cheng, M., Masika, R., Warnes, M., Lilly, J., Trafford, V., Robinson, G. (2010) *Doctoral Learning Journeys – final report of the NTFS funded project*.

PAPER PRESENTATION

LINKING STUDENTS' PHD EXPERIENCE TO THEIR UNDERSTANDING OF THE THESIS

Maria Cerrato Lara, Ramon Llull University (Barcelona), Spain; Montserrat Castello, Universitat Ramon Llull, Spain

All PhD students have to face the writing of the thesis. The literature remarks it as a complex self-regulated learning task, but what do the protagonists think about it? Research on students' attitude to writing a thesis shows that action-control belief variables (academic ability, belief in luck, and knowledge orientation) are seen as having both direct and indirect effects on students' attitude to writing a thesis. We also think that students' subjective well-being in relation to their process, their learning context and of course outside the PhD can also play an important role on how students experience the writing of the thesis. With this purpose, a sample of 631 PhD students from Spain completed the PhD experience questionnaire that includes items from the MED NORD questionnaire (Lonka et al., 2008) that were modified to fit the PhD context in Pyhälä, Stubb & Lonka (2009) and items from The Writing Process Questionnaire (Lonka, 1996, 2003, 2007). After an analysis of factors and reliability of the instrument, a correlation analysis of factors and 2nd order factors was made with interesting results and also in relation to gender, age and discipline. A qualitative analysis was also made with 300 of the participants to complement the results by analyzing seven of the open-ended questions of the questionnaire that we considered could give us relevant information for our purpose.

Students' representations of academic tasks are crucial to understand how they develop them (Pozo, Scheuer, Mateos & Péerez Echeverría, 2006). We guess this is not an exception for PhD students with their thesis and this is why in this research we are interested in investigating how students understand the thesis. The literature reviewed concerned about the doctoral experience, that is, how students perceive this process, focuses on well-being aspects, learning environment aspects and writing aspects. In relation to the first group, Beauchamp, Jazvac-Martek & McAlpine (2009), for example, study the tensions inherent in the doctoral experience. In relation to the second group, we found a study of Rachel (2009), for example, that focuses on PhD students' perceptions of the community learning experience. In relation to the third group, Sachs (2002), for example, makes research on students' attitude to writing a thesis. As a fact it has to be highlighted that literature in the field of Doctoral studies is not very extensive.

We take into consideration these three variables –well-being, learning environment and writing perceptions- with the hypothesis they contribute in the understanding PhD students have of the thesis. In order to test it, 206 PhD students developing their doctoral studies in Spain were asked to answer, respecting their anonymity, the PhD experience questionnaire (Lonka, 1996; Lonka, 2010 in press) that combines 8 open-ended questions, 49 Likert type statements and 18 background questions. Before passing the instrument we proceeded to its validation in the Spanish population with a sample of 67 PhD students and now this work has been sent to be published (the authors and Martínez-Fernández, sent).

For this study we analyzed one of the eight open-ended questions (the one related to students' understanding of the thesis) and 39 of the 49 Likert type statements (8 related to well-being variables –anxiety, exhaustion and lack of interest specifically-, 15 related to learning environment variables –atmosphere, feedback and workload specifically- and 16 related to writing variables –perfectionism, knowledge creation, productivity and general negative self-perceptions as writers specifically).

In relation to students' understanding of the thesis (the open ended question), we applied a qualitative methodology analysis using the Atlas-ti software and afterwards we calculated the percentages. Results in this part of the research show us that the thesis is perceived as an opportunity to deep on a topic of interest (29%), a contribution to the society (13%), an emotional experience (14%), an opportunity to learn (12%), a way to transfer knowledge to the practice (12%), a personal challenge (8%), a way to get part in the academic community (7%) and others (5%).

Regarding the Likert type statements, the SPSS software was used for the data analysis and some correlation analysis were applied. Regarding to this, we have some results that the literature corroborates: anxiety is significant and negatively correlated with production ($r = -.594$; pBoice & Johnson (1984) in their research observed that productive writers experience little anxiety and Onwuegbuzie (1999) in his research concluded that students with the lowest perceived scholastic competence and perceived creativity tended to have the highest anxiety about writing.

Linking students' PhD experience to their understanding of the thesis, an interesting result to remark is that students with perceptions of the thesis in which the learning aspect is especially highlighted (41%) perceive less workload in their doctoral studies in comparison the rest of the sample. In the conference we will show you results in detail.

We think this investigation can contribute to rethink and reflect on the quality of doctoral programs. We guess students' voice is a powerful tool that can give us clues for this and very often we don't pay attention to it. From the point of view of the supervision, if tutors have information about how their students experience PhD studies, they

may be able to understand better how their students carry out their thesis and can then offer a more adjusted help in this process taking into account that writing a thesis can be characterized as the ultimate self-regulated learning task (Sachs, 2002) and it is then important students are to be guided successfully through this process.

PAPER PRESENTATION

The many faces of deep approach – what are we really measuring?

Juha Nieminen, University of Helsinki, Finland; Annamari Heikkilä, University of Helsinki, Finland; Kirsti Lonka, University of Helsinki, Finland

Investigating deep and surface approaches to learning by self-report instruments entails difficult choices regarding the context the respondents are expected to keep in mind while rating questionnaire items. It may be useful to try to distinguish between what students believe to be important and what they try to do when studying in a particular context. Finnish and Swedish students (N=1839) rated statements on a number of study practices typically associated with either a deep or a surface approach to learning. Three scales reflecting students' views on the importance of certain study practices, and three matching scales measuring their application, were created. For deep approach, application scales showed lower means and larger standard deviations than importance scales. Critical evaluation of knowledge and aiming to understand content appeared as two differing, related aspects of deep approach. Aiming to understand was consistently linked with study success. Medical students reported lower levels of critical evaluation than students from other domains. Measuring simultaneously the importance and application of approaches appears a promising strategy for investigating student learning.

Theoretical background

An extensive literature on student approaches to learning (J. B. Biggs, 1993; N. J. Entwistle & McCune, 2004; Richardson, 2000; Watkins, 2001) shows that university students vary in what they see as important in learning and in how they perform learning tasks. The distinction between deep and surface approaches to learning has proven to be a fruitful conceptualization of student learning, inspiring an extensive tradition of empirical research.

The multilayered nature of the phenomena poses a challenge to a researcher trying to decide which aspects should be measured and which distinctions can be empirically studied. When measuring approaches to learning by self-report instruments, it is often difficult to know to what extent students answered based on what they believe to be beneficial in learning and to what extent based on their context-specific approaches.

Aims

We set out to measure simultaneously a) what kinds of learning processes students believed to be useful in studying and b) to what extent they would report adopting those strategies while preparing for an examination. We were interested in whether the measurement of approaches to learning might be improved by specifying a context of application to keep in mind when rating questionnaire items.

Methods

Three groups of students participated in this study. The first group consisted of 865 Finnish students from faculties of arts (n=360) agriculture (n=302), and law (n=203). The second group consisted of 626 medical students from three Finnish medical schools, and the third group of 348 Swedish medical students.

Based on previous inventories such as the Approaches to Study Inventory ASI and the Inventory of Learning Styles ILS, we formulated statements describing a variety of study practices. The items were expected to reflect two types of approaches to studying, a deep approach (e.g., "It is important to try to relate details to a bigger whole"), and a surface approach (e.g., "It is important to memorize new definitions and scientific concepts as literally as possible"). After each statement, students were to answer to the statement "I do this when studying for an examination". All statements were rated using a Likert-scale ranging from 1 (totally disagree) to 6 (totally agree). Study success was measured as self-reported grades and, for the Finnish multi-faculty students also as actual GPA's obtained from university archives.

Results

To investigate the structure of the scales, maximum-likelihood factor analyses with Varimax rotation were performed. Confirmatory factor analyses are currently underway and preliminary results support the factor structure obtained by maximum likelihood factor analyses. Based on the results of the factor analyses, three composite scales were created to measure experienced importance: Importance of Critical Evaluation, Importance of Understanding, and Importance

of Surface Approach. Further, for each of the three importance-focused scales, a corresponding application-focused scale was constructed using the follow-up items ("I do so when reading for an examination"). Altogether, we created three pairs of scales: Importance of Critical Evaluation and Application of Critical Evaluation; Importance of Understanding and Application of Understanding; Importance of Surface Approach and Application of Surface Approach. Reliabilities ranged from acceptable to good for most of the scales. Reliabilities were slightly higher for the scales measuring application than for the scales measuring importance, except for the Critical Evaluation scales in the Swedish medical data.

*The means of Importance of Understanding were extremely high, over 5.0 in all student groups, indicating that all students valued understanding highly. This was also the case for Importance of Critical Evaluation in the multi-faculty group. In the medical student groups the means of Importance of Critical Evaluation were also high, yet significantly lower than they were in the multi-faculty group. The means of the surface approach scales were slightly above the mid-point of the rating scale. The means of importance scales and application scales differed significantly from each other in all student groups.

In the Finnish multi-faculty sample the pattern of associations between approaches to learning and study success was very clear, confirming earlier results: all the scales measuring aspects of deep approach were positively linked with grades. This was true also for grades received for the four-year period after students had filled in the questionnaire and even for grades received on Master's theses. In the medical data, both the understanding aspect of deep approach and surface approach showed a small significant correlation with grades. Results regarding the link between surface approach and grades were rather weak.

Conclusions

The results indicate that university students may respond extremely positively to items measuring the importance of practices related to deep approach, but give considerably lower ratings to scales measuring their application in specific contexts of studying. The results further indicate that inquiring about students' practices in a specified context of studying may improve the reliability of scales. In addition, applied scales may capture more variance than scales of more general nature.

The present study indicates that what students' believe to be important in university studies and what they do when preparing for examinations differ from each other at least when measured simultaneously, and that it is possible to empirically distinguish these aspects of approaches to learning. Furthermore, critical evaluation of knowledge and aiming for understanding appear to be adopted to varying degrees in differing academic domains. Seeking to understand while studying for an examination seems to be the variable most consistently related to study success, even for grades received on Master's theses.

PAPER PRESENTATION

Development Of Teacher Candidates' Professional Competencies During a Practical Internship

Alexander Groeschner, Technische University Munchen, Germany; Tina Seidel, Technische Universität München, Germany; Cordula Schmitt, Institute of Psychology, University of Jena, Germany

Opportunities of learning to teach (such as internships) are considered as valuable for developing professional competencies in pre-service teacher education (Zanting, Verloop, & Vermunt, 2001). However, research mainly concentrates on interventions such as student mentoring. So far, knowledge about teacher candidates' development of professional competencies during such teaching practice is limited. The study presents findings from a research project monitoring the development of professional competencies in a semester of practical internship. Teacher competencies were assessed by means of a newly developed instrument, including four scales of teaching skills (Cronbach's Alpha .87), evaluation (.83), classroom management (.86), self-regulation (.76). In a pre- and post-test 239 teacher candidates were investigated. Furthermore, learning experiences during the practical internship were assessed by means of the quality of mentoring at school (.86) and quality of mentoring at university (.89). In addition, both aspects were investigated by means of teacher candidates' perceptions of effective methods (7 items) and instruction (3 items) in class. Findings show a significant development of teacher candidates' professional competencies during the internship in all areas (Cohen's $d = .31$ to $d = 1.05$). Furthermore, the scientific guidance through an accompanying university course is systematically related to the development of teacher candidates during their teaching practice ($F(3;134) = 1.85$, $pF(3;134) = 1.06$, n.s.). Although, observed mentors' teaching is related to teacher candidates' own teaching ($r = .31$ to $.55$). The study contributes to identifying factors that can help to explain effective internship-terms in teacher education.

Theoretical background and research question

The evaluation of development and outcomes of initial teacher education has been increasingly becoming important for the improvement of teacher education (Darling-Hammond, 2006). With regard to developing practical competencies of teacher candidates internships are considered as being valuable learning opportunities in both students' and teachers' perspective (Zanting, Verloop, & Vermunt, 2001; Orland, 2001). Especially long-term internships are considered as fruitful places of learning because they also provide sustainable experiences of mentoring (Hobson et al., 2009). According to the definition of competence as conglomerate including skills, knowledge, and beliefs (Weinert, 2001), internships have the potential to support the transition process from student to teacher as well as to developing professional competencies (Velez-Rendon, 2006). Educational research on the acquisition of competencies in teacher education still lacks instruments and studies taking into account the sophisticated role teaching practice has for teacher candidates (Graham, 2005).

Therefore, the study presented here concentrates on three research aspects: (1) developing an instrument (based on self-reports) adequate for measuring practical experiences in internship-terms in pre-service teacher education, (2) investigating the development of teacher candidates' professional competencies during a practical internship-term, and (3) investigating the quality of mentoring at the school and university during the internship. The four-month internship term combines elements of practical experiences at schools and course work at university. The university courses concentrate on planning and performing a lesson as well as on reflecting upon the educational content of effective instruction.

Methodology

We initiated a research project focusing on the development of professional competencies in a long-term internship. At two measuring points (before the internship-term, after the internship-term) 239 pre-service teachers have been investigated at a German university. The sample consists of 56.1 % female and 43.9% male pre-service teachers. Overall, the mean age of the participants was 21.55 (SD=1.46) and in average they were attending their 5th semester of study program (SD=.45). To assess the competencies an instrument was developed with four seven-point Likert-type scales (ranging from 1= "not at all competent" to 7="full competent") in the areas teaching skills (11 items, (Cronbach's Alpha .87), evaluation (7 items, .83), classroom management (9 items, .86) and self-regulation (6 items, .76) (Grßschner, 2009). Furthermore, learning experiences during the practical internship were assessed by means of the quality of mentoring at school (12 items, .86) and the quality of mentoring at university (7 items, .89). Both mentoring aspects were additionally investigated by means of teacher candidates' perceptions of teaching methods used by mentors and in own lessons (7 single items, e.g. group-work) as well as effective instruction taught in university courses and observed in mentors' lessons and realized in own lessons (3 single items, e.g. goal clarity).

Findings

Pre-service teachers' professional development increased significantly ($p = 1.05$), followed by self-regulation (Cohen's $d = .57$), evaluation (Cohen's $d = .37$) and classroom management (Cohen's $d = .31$). Multivariate analyses show that the scientific guidance through an accompanying university course – with regard to pedagogical content knowledge (PCK) – is systematically related to the development of teacher candidates during their teaching practice ($F(3;134) = 1.85$, $pF(3;134) = 1.06$, n.s.). With regard to the perceptions of teaching methods and effective instruction we found positive interrelations between what teacher candidates observed in mentors' classes and what they tried to realize in their own teaching attempts (from $r = .31$ to $r = .55$; $pM = 3.65$, $SD = .88$; range from 1='not performed' to 5= 'performed') and student discussions ($M = 3.03$; $SD = 1.01$). With regard to aspects of effective instruction they particularly referred to goal clarity ($M = 4.30$, $SD = .65$) during their practical internship.

Discussion

The findings of the presented study show that internship-terms are valuable teaching-learning environments for developing teacher candidates' professional competencies. With regard to mentoring accompanying university courses seem to have the potential to scaffolding practical experiences during the internship-term. The fact, that there was no significant effect of mentoring at schools on the development of professional competencies could be traced back to the overall highly positive values pre-service teachers reported for the quality of mentors' guidance. Taking teacher candidates' perceptions into account our findings emphasize on the importance of the qualitative aspects of mentors' teaching practice (e.g. using different teaching methods) for the development of pre-service teachers' professional competencies. Scientific and educational relevanceThe study contributes to teacher research with regard to identifying factors that can help to explain effective internship-terms and the organization of practical experiences. It highlights the importance of institutional mentoring in school and university.

References

- Darling-Hammond, L. (2006). Assessing teacher education. The usefulness of multiple measures for assessing program outcomes. *Journal of Teacher Education*, 57(2), 120–138.
- Graham, P. (2005). Classroom-based assessment: Changing knowledge and practice through preservice teacher education. *Teaching and Teacher Education*, 21, 607–621.
- Grßschner, A. (2009). Erfassung von professionellen Kompetenzen in der Lehrerbildung [Measuring Teacher Candidates' Professional Competencies]. Jena: University of Jena.
- Hobson, A.J., Ashby, P., Malderez, A., & Tomlinson, P.D. (2009). Mentoring beginning teachers: What we know and what we don't. *Teaching and Teacher Education*, 25, 207–216.
- Orland, L. (2001). Reading a mentoring situation: One aspect of learning to mentor. *Teaching and Teacher Education*, 17, 75–88.
- Velez-Rendon, G. (2006). From Student to teacher: A successful transition. *Foreign Language Annals*, 2, 320–333.
- Weinert, F. (2001). Vergleichende Leistungsmessung in Schulen – eine umstrittene Selbstverständlichkeit [Comparative performance assessment in schools – A controversial implicitness]. In F. E. Weinert (Ed.), *Leistungsmessungen in Schulen* [Performance assessment in schools] (pp. 17–31). Weinheim/Basel:
- Beltz.Zanting, A., Verloop, N. & Vermunt, J. D. (2001). Student teachers' beliefs about mentoring and learning to teach during teaching practice. *British Journal of Educational Psychology*, 71, 57–80.

PAPER PRESENTATION

Cooperative and competitive learning in biology education

Sarah Sennebogen, Ludwig-Maximilians-University, Germany; Birgit Neuhaus, Ludwig-Maximilians-University, Munich, Germany

Cooperative learning is used in schools by many practitioners and has been evaluated in the past decades by many researchers comparing cooperative learning with competitive learning. National Education Standards claiming to enhance not only the students' competences, e.g. in inquiry acquisition became effective in Germany in 2005. Therefore, new teaching methods, like the Egg-Race, are necessary. Egg-Races combine cooperative and competitive learning environments because students work in cooperative small groups which are competing against other groups. The presented study evaluates the small group competitions' influence on achievement, expert interest, situational interest and perceived interaction within the group in the teaching unit 'forest' in a pre-post-test-design. 111 6th graders from secondary modern school took part in the study. Results show that the cooperative competition can enhance the achievement, expert interest and situational interest. But it also reveals a negative influence on perceived interaction within the group. Nevertheless, subsequent studies should examine the validity of the results for other learning contents and the influence of small group competition on social-psychological variables.

Discussion and Forecast

The results demonstrate that cooperative competition can enhance achievement, compared to pure cooperative learning environments. Therefore, the results of Julian and Perry (1967), who evaluated psychology students, can be verified for biology education. The present study also proved that cooperative competition has a positive influence on expert interest in biology education. Due to the possibility of winning a prize, the students in the competitive treatment also showed higher situational interest. Moreover, the study proved that students in the non-competitive treatment were more satisfied with the perceived interaction within the group. This again supports the results of Julian and Perry (1967), who argue that the tone in pure cooperative learning environments is warmer. Connected with a context-oriented and problem-oriented approach, Egg Races are able to complement biology education in a reasonable way. Future studies should survey if the results are valid for other learning contents and older students. The focus should be on the perceived interaction in the small group. Results of these studies and further Egg Races with biological content will be presented at the EARLI 2011.

References

- Bosworth W.A. & Wilkinson, J. (2004). The Egg Joust. *The Physics Teacher*, 46, 344 – 346
- Bouffard, K. (2000). Mousetrap Racing Car. *The Physics Teacher*, 38, 158.
- Creative Chemistry, Nigel Saunders (2010). Egg Races Index. Available under http://www.creative-chemistry.org.uk/activities/egg-races_main.htm [08-09-2010]
- Gärtner, H.-J. & Scharf, V.(2001). Chemische „Egg Races" in Theorie und Praxis. Available under: <http://ekaestr.bildung.de/staff/gae/methode/egg-race/chem-race.pdf> [11-26-2009]
- Hammond, L.K. & Goldman, M. (1961). Competition and Non-Competition and its Relationship to Individual and Group Productivity. *Sociometry*, 24(1), 46 – 60

- Johnson, D.W. & Johnson, R.T. (1989). *Cooperation and Competition: Theory and Research*, Minnesota: Interaction Book Company.
- Johnson, D.W.; Maruyama, G.; Johnson, R.T.; Nelson, D. & Skon, L. (1981). Effects of Cooperative, Competitive, and Individualistic Goal Structures on Achievement: A Meta-Analysis. *Psychological Bulletin*, 89(1), 47 – 62.
- Julian, J.W. & Perry, F.A. (1967). Cooperation contrasted with Intra-group and inter-group competition. *Sociometry*, 30(1), 79 – 90.
- Schrammen, S. & Bickel, H. (2006). Samen keimen um die Wette. *Unterricht Biologie*, 317, 20–23.
- Slavin, R.E. (1991). Synthesis of Research on Cooperative Learning. *Educational Leadership*, 48(5), 71 – 82.

PAPER PRESENTATION

Development and validation of a self-report instrument for exploring team work in schools

Taiga Brahm, University of St. Gallen, Switzerland; Annette Bauer-Klebl, HSG, Switzerland; Saskia Raatz, University of St. Gallen, Switzerland

Cooperative learning is a popular method for classroom teaching since it makes it possible to accommodate for individual differences as well as to achieve various educational goals (academic as well as social). Additionally, it aligns with the socio-constructivist notion of learning (Antil et al., 1998). However, when looking at everyday practice in classrooms, cooperative learning seems to not always be able to hold its promises. One reason for this might be that certain framing conditions are neglected in classroom practice which would be necessary for the effectiveness of cooperative learning (Abrami & Chambers, 1996). Due to the complexity of teamwork, it is a challenge for teachers to identify the reasons why teamwork in the classroom does not lead to the results expected. This study aims at developing and validating a self-report instrument for assessing team work at schools and for providing teachers with hints on how to improve teamwork in their classrooms. The instrument will be validated with about 400 students of at least 4 different schools. The scales are theoretically founded and cover relevant aspects of teamwork at school. All instruments were either originally developed for usage in schools or adapted to the school context. Even though further validation is necessary, the first results are already quite promising. In sum, this study provides a valuable instrument for both practitioners and researchers.

Cooperative learning is a popular method for classroom teaching since it allows for the accommodation of individual differences as well as for achieving various educational goals (both academic and social), and it is in tune with the socio-constructivist notion of learning (Antil et al., 1998). There is a vast amount of research on cooperative learning and it has been called "one of the greatest success stories in the history of educational research" (Slavin, 1996, 43). The effects of cooperative learning on student achievement were studied in many different settings, in both laboratory and field studies. However, looking at the common practices in classrooms, cooperative learning seems to not always be able to come up to the often high expectations. One reason for this might be that some of the framing conditions determining the effectiveness of cooperative learning are not taken into account in classroom practice. For instance, it is frequently neglected that the learning task needs to be suitable for cooperative learning (Abrami & Chambers, 1996). Since teamwork is very complex, it is a challenge for teachers to identify the reasons why teamwork in the classroom does not lead to the expected results. Theoretical and empirical contributions to teamwork show that there are various determinants of good collaboration. These determinants can be systematized according to so-called input-process-output models (e.g. Ilgen et al., 2005; Van den Bossche et al., 2006). Such models take into account that various input factors, i.e. personal prerequisites (motivation, team competence, self-efficacy) and task characteristics (complexity of the task, team size), influence the processes of team work. These processes include task-related as well as social aspects, such as communication among team members, reflection processes, trust and cohesion. These processes mediate the influence of the input factors on the results of team work. Yet, according to the authors' knowledge, there is no comprehensive instrument to evaluate teamwork in the classroom. Most instruments available are only validated for work contexts but not for learning contexts, especially not at schools. Instruments suitable for schools usually only cover some few aspects of teamwork.

The aim of this proposal is to report on the development and validation of a self-report instrument for assessing team work at schools and for providing teachers with hints on how to improve teamwork in their classrooms. Since the instrument is empirically validated, it can also be used for research purposes.

The methodology of the study is based on a quantitative approach. In a first step, a number of already existing instruments was selected. The selection criteria for these instruments were a) that they had already been empirically validated in other studies and b) that they were suitable for the school context, especially for the target group of 15-18 year old learners. The instruments were then recombined resulting in three questionnaires (one for the input, one

for the process, and one for the output of the teamwork). Up to now, the questionnaires have been employed at 4 different schools with 10 classes. Up to now, about 100 pupils took part in the study leading to an initial validation. Over the next 6 months, the questionnaires will be used with about 400 learners so that the results of this comprehensive validation can be reported at the conference. The data is gathered in real group work settings at different schools such as grammar schools, high schools and colleges for vocational education. The learners are between 15 and 18 years old so that complex group task are possible. To analyze the data, reliability analyses, factor analyses, and structural equation modeling were used.

The findings of the study include a general confirmation of the proposed instrument including input, process, and output constructs. Input factors are assessed by learning and performance motivation (SELLMO, Spinath et al., 2002), self-efficacy (Jerusalem & Satow, 1999), and the attitude towards teamwork (Freeman, 1996). Cronbach's Alpha of these scales ranges between .648 and .879. To evaluate the collaboration process, task cohesion (Sargent & Sue-Chan, 2001), group potency (Rohn, 2006; Campion et al., 1993) trust (Jarvenpaa & Leidner, 1999), team reflexivity (Schippers et al., 2007), task interdependence (Van der Vegt et al., 1999), participation (in analogy to Rohn, 2006; Campion, Medsker & Higgs, 1993), task and relationship conflicts (Jehn, 2005; Saavedra, 1993; Jehn & Mannix, 2001) were assessed, providing reliabilities between .740 and .852. The outcome of the team process is surveyed by task effectiveness (Saavedra, 1993; Rohn, 2006) and by satisfaction with the results (Nelson & Coopridge, 1996; Earley & Mosakowski, 2000) with Cronbach's Alpha between .644 and .907. In order to receive objective performance data and thus, to avoid common-method bias, the performance of the teams is also assessed with a grade. Both, factor analyses as well as structural equation modeling yield a confirmation of the factor structure.

All in all, this study provides a useful instrument for both practitioners and researchers to comprehensively evaluate teamwork at schools. The scales are theoretically founded in the input-process-output model covering relevant aspects of teamwork at school. All instruments were either originally developed for usage in schools or have been adapted to the school context. While the instruments will be further validated with more students within the next six month, the first results are already quite promising. They show that the basic structure of the questionnaires is valid and that the instruments are reliable.

In addition to providing instruments for research and practice, the study also contributes to theory building by taking the research on teams from other organizational contexts into account and relating it to teaching and learning in schools. This combination of two research strands leads to a comprehensive understanding of teamwork in schools and can further enhance our understanding of cooperative learning.

PAPER PRESENTATION

Motivation regulation in groups: Theoretical considerations about the learning partner's motivation

Cornelia Schoor, TU Dresden, Germany; Susanne Narciss, Technische Universität Dresden, Germany; Hermann Koerndle, TU Dresden, Germany

Regulating learning in groups is an emergent topic in educational research. Like individuals in self-regulated learning, groups have to handle cognitive, metacognitive, and motivational tasks during their learning process. Therefore, motivation regulation is one aspect of shared regulation in groups. In this paper, we focus on one particular aspect of motivation regulation in groups, namely on the role the motivation of the learning partner plays. First evidence stem from research on providing a collaborative learning group with feedback about their members' motivation. Feeding back motivational parameters of the group members seems to have a positive effect on motivation. On the other hand, research on motivation gains and losses in groups shows positive and negative effects the motivation of the learning partner has for one's own effort. As so far a theoretical model integrating these results is missing, we suggest applying a regulation model stemming from system theory and feedback research to the role the learning partner plays in group motivation regulation. The interactive two-feedback-loop (ITFL) model for instructional feedback by Narciss (2008) assumes an internal feedback loop of the learner and an additional external feedback loop of a teacher or instructional medium. We translate this model into group motivation regulation by assuming the external feedback loop to be the motivational feedback from the learning partner. This model is not only able to explain the mentioned results but also constitutes a suitable basis for specific research questions and for a more elaborated model on shared group regulation.

Regulating learning in groups is an emergent topic in educational research (c.f. Järvelä, Järvenoja, & Veermans, 2008; Vauras, Liskala, Kajamies, Kinnunen, & Lehtinen, 2003). Like individuals in self-regulated learning, groups have to

handle cognitive, metacognitive, and motivational tasks during their learning process. Therefore, motivation regulation is one aspect of shared regulation in groups.

In this paper, we focus on one particular aspect of motivation regulation in groups, namely on the role the motivation of the learning partner plays. So far, there are some empirical results, which we briefly review, but no theoretical framework. Therefore, we suggest applying a regulation model from feedback research to this topic. In collaborative learning, the learning partner's motivation can either be explicitly stated or it can be deduced from the partner's behavior.

First evidence on the role the learning partners plays in group motivation regulation stem from research on providing a collaborative learning group explicitly with feedback about their members' motivation (e.g. Martens, 2009; Zumbach, Reimann, & Koch, 2006). Martens (2009) used the „Quality of Working in Groups Instrument" (QWIGI) by Boekaerts and Minnaert (2003) to support students in statistics courses. Half of the participants filled in the QWIGI (covering autonomy, competence, and social relatedness) after every course session while a control group filled in a questionnaire about the course design. Both groups were fed back their own ratings as well as the mean ratings of their small group, and were encouraged to discuss this. After ten weeks, the QWIGI group showed significantly more intrinsic motivation than the control group. Zumbach et al. (2006) compared collaborative groups who either received or did not receive feedback of parameters of participation, motivation and emotion. They found positive motivational effects of feeding back these parameters.

Another line of research on the role of the partner's motivation is research on motivation gains and losses in groups where the partner's behaviour provides implicit feedback on her motivation. Kerr (1983), for example, showed that low effort of a capable partner reduced own effort in an air pumping task. On the other hand, there are results showing that participants were even more motivated (in terms of effort) when their partners exerted less effort (e.g. Liden, Wayne, Jaworski, & Bennett, 2004). So far, there has been no attempt to integrate these results into a coherent model. Therefore, we suggest applying a regulation model stemming from system theory and feedback research to the role the learning partner plays in group motivation regulation. The interactive two-feedback-loop (ITFL) model for instructional feedback by Narciss (2008, c.f. figure 1) assumes an internal feedback loop of the learner and an additional external feedback loop of a teacher or instructional medium. After, for example, having solved a task, the learner generates internal feedback which is compared to her internal reference value (e.g. her goal of task performance). Additionally, there is an external sensor which provides the external controller (e.g. the teacher or the instructional medium) with an actual value (e.g. perceived task performance) that is compared with an external reference value (e.g. the goal the teacher set). The resulting external control action (e.g. the feedback of the teacher to the learner) is fed back to the learner as additional input to the internal controller. The internal controller now compares internal feedback, internal reference value and external feedback, before she generates an internal control action (e.g. more effort on the next task)

We translate this model into group motivation regulation by assuming the external feedback loop to be the motivational feedback from the group. For example, feeding back motivation of the group (Martens, 2009; Zumbach et al., 2006) is collecting motivation data by means of an external sensor, processing it in the external controller by comparing it to the other group members' motivation data (external reference value), and feeding it back to the learner in terms of a group mean value and her own value (external feedback). Also, findings on motivation gains and losses subject to the partner's motivation fit well into this model. Diverging results can be attributed to different handling of feedback by the internal controller (c.f. Butler & Winne, 1995): Under some circumstances, a lower motivation of the partner seems to increase the internal reference value, while in other cases, the internal reference value is decreased. This model provides us with concrete hypotheses and research questions for future research (e.g. the effect of motivation feedback depends on a reference value being available, learners dispose of different alternatives how to treat external motivation feedback) as well as with a suitable basis for a more elaborated model on shared group regulation.

References

- Boekaerts, M., & Minnaert, A. (2003). Assessment of students' feelings of autonomy, competence, and social relatedness: A new approach to measuring the quality of the learning process through self- and peer assessment. In M. Segers, F. Dochy & E. Cascallar (Eds.), *Optimising new modes of assessment: In search of qualities and standards* (pp. 225-246). Dordrecht, The Netherlands: Kluwer.
- Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

Järvelä, S., Järvenoja, H., & Veermans, M. (2008). Understanding the dynamics of motivation in socially shared learning. *International Journal of Educational Research*, 47(2), 122-135.

Kerr, N. L. (1983). Motivation losses in small groups: A social dilemma analysis. *Journal of Personality and Social Psychology*, 45(4), 819-828.

Liden, R. C., Wayne, S. J., Jaworski, R. A., & Bennett, N. (2004). Social Loafing: A Field Investigation. *Journal of Management*, 30(2), 285-304.

Martens, T. (2009). Unterstützung der intrinsischen Motivation beim Lernen von Methodenlehre in Gruppen mit Hilfe von Online-Monitoring [Support of intrinsic motivation during the learning of methods in groups via online monitoring]. In M. Kraemer, S. Preiser & K. Brusdeylins (Eds.), *Psychologiedidaktik und Evaluation VII* (pp. 265-276). Aachen: Shaker.

Narciss, S. (2008). Feedback strategies for interactive learning tasks. In J. Spector, M. Merrill, J. Van Merriënboer & M. Driscoll (Eds.), *Handbook of research on educational communications and technology* (pp. 125-144). Mahwah, NJ: Lawrence Erlbaum Associates

Vauras, M., Iiskala, T., Kajamies, A., Kinnunen, R., & Lehtinen, E. (2003). Shared-regulation and motivation of collaborating peers: A case analysis. *Psychologia: An International Journal of Psychology in the Orient*, 46(1), 19-37.

Zumbach, J., Reimann, P., & Koch, S. (2006). Monitoring students' collaboration in computer-mediated collaborative problem-solving: Applied feedback approaches. *Journal of Educational Computing Research*, 35(4), 399-424.

PAPER PRESENTATION

Enhancing students' socioscientific decision making: the influence of cooperative trainings

Sabina Eggert, Georg-August-University, Germany; Rainer Watermann, Georg-August-University Goettingen, Germany; Marcus Hasselhorn, DIPF, Germany; Susanne Boegeholz, Georg-August-University Goettingen, Germany

The implementation of socioscientific issues within the science classroom has been identified among science educators and curriculum developers as one core element in order to support students becoming informed citizens. Socioscientific reasoning and decision making comprises several elements such as the ability to search and evaluate relevant information, the ability to argue and reason about possible solutions strategies or the ability to reflect on decisions processes, including inherent values and norms. Thus, evaluation and monitoring processes play an important role. In the presented study, we examined the effect of two cooperative learning settings on students' socioscientific reasoning and decision making. Group one worked in a cooperative learning environment (COOP), while group two worked in a cooperative learning environment with an additional metacognitive training (COOP META). We used a quasi-experimental pre-posttest design. Data analysis was conducted using probabilistic as well as classical test theory. Data analysis addressed two main questions: the aspect of measuring invariance as well as the differential effects of both treatment groups. Results showed that partial invariance was ensured. A repeated measures ANOVA showed main results for measurement point in time as well as treatment. However, no interaction effect could be found. Implications concerning the measurement procedure as well as optimization of both treatment group designs are discussed.

The implementation of socioscientific issues within the science classroom has been identified among science educators and curriculum developers as one core element in order to support students becoming informed citizens (cf. American Association for the Advancement of Science, 1991; KMK, 2004; National Committee on Science Standards and Assessment, 1996). Socioscientific issues represent real-world scenarios of modern science. They are usually complex in nature and do not have a clear cut solution. Instead, several possible options have to be considered in a multi-perspective way, including scientific as well as economic and social aspects (cf. Sadler, Barab & Scott, 2007; Ratcliffe & Grace, 2003; Zeidler et al., 2003). Socioscientific reasoning and decision making comprises several elements such as the ability to search and evaluate relevant information, the ability to argue and reason about possible solution strategies or the ability to reflect on decisions processes, including inherent values and norms (Eggert & Bögeholz, 2010; Gausmann et al., in press; Jimenez-Aleixandre, 2002; Kolsto, 2006; Sadler et al., 2007; Zohar & Nemet, 2002). Thus, evaluation and monitoring processes play an important role.

The aim of our study was to examine the effect of a metacognitive cooperative training on students' socioscientific reasoning and decision making competencies. On the basis of Mevarech & Kramarski's work on the effect of different metacognitive trainings on mathematical problem solving (cf. Mevarech, 1999, Kramarski, Mevarech & Arami et al., 2002, we designed to training groups.

In group one (COOP), students worked in a cooperative learning setting that was characterized by the five principles of cooperative learning (cf. Slavin, 1982). In group two, students worked in the same cooperative learning setting, but got an additional metacognitive training (COOP META). The metacognitive training was developed on the basis of four metacognitive question types proposed by Mevarech & Kramarski. We used a quasi-experimental pre-posttest design

to analyse the influence of these two cooperative learning settings on students' socioscientific reasoning and decision making. Specifically, we focused on students' abilities to compare different solutions strategies with respect to socioscientific issues and to reach an informed decision.

The participants in this study were 258 seventh grade students from German grammar schools. Their mean age was 12.84 years; 128 female). The two treatments were implemented within the usual science course of the seventh graders. The topic of both treatments was the sustainable development of rivers and riverbanks. Both treatments were designed together with experienced science teachers, who were also experienced in teaching socioscientific reasoning and decision making. Teachers were randomly assigned to the two treatment groups. In total, 118 students took part in the COOP training and 140 students took part in the COOP-META training. Both treatments were equal with respect to time, science topics and socioscientific issues covered. While students in the COOP-META group answered the metacognitive questions, students in the COOP group worked on the science topics in more detail. Students' abilities with respect to socioscientific reasoning and decision making were measured using a pre- and posttest.

The questionnaire used was developed in several studies prior to this intervention study (cf. Eggert & Bßgeholz, 2010). The questionnaire presented three different socioscientific issues. For all three issues students had to answer open-ended questions. In total, 13 polytomous items were used to score student's answers. With respect to the pretest, WLE person separation reliability was 0.98; Cronbach's $\alpha = 0.73$. With respect to the posttest, WLE person separation reliability was 0.99; Cronbach's $\alpha = 0.86$.

Data analysis was conducted using probabilistic as well as classical test theory. Our analysis was concerned with two main questions. First, we analysed whether the questionnaire that was used in the pre- as well as in the posttest really measured the same latent construct. Second, we compared both treatment groups with respect to their performance on the socioscientific decision making questionnaire using a repeated measures ANOVA. With respect to the first question, we modeled students' performances on the pre- as well as on the posttest using the Rasch Partial Credit Model (Masters, 1982). We estimated person ability using Warm's Likelihood Estimates (WLE). To analyse the prerequisite of measurement invariance, we compared WLE estimates for the pre- and posttest using a graphical model test as well as comparing logit differences (cf. Wilson, 2005).

Results showed that some items or some itemsteps respectively exhibited differential item functioning (dif). In order to compare person abilities between the first and the second measurement time, we used item difficulties estimated at T1 to estimate item difficulties at T2. Those items that exhibited differential item functioning were estimated without parameter fixation. Thus, partial invariance of item parameters was ensured. Secondly, we used person ability estimates to conduct a repeated measures ANOVA. Results showed that both groups performed significantly better on the posttest. We found main effects for time ($F(1,256) = 17.240$, $p(1,256) = 6.136$, $p(1,256) = 1.751$, $p > .05$).

These findings have several implications. Firstly, the analysis of measurement invariance showed that some items or itemsteps respectively were disproportional easy at the second measurement point in time. One reason for this could be that teachers of both treatment groups focused on these aspects in their science classrooms to a great extent. On the contrary, items that were concerned with the evaluation of decision making processes were disproportional difficult at the second measurement in time. Consequently, one can deduce that teachers in both treatment groups did not foster these elements. Thus, one future aim is to optimize the design of the COOP-META group especially with respect to the aspect of evaluating and reflecting on decision making processes.

PAPER PRESENTATION

Self-regulation in learning: the process of information

DAVID MARTIN SANTOS MELGOZA, Universidad Autonoma Chapingo, United Kingdom

This work presents an ontological perspective on the study of academic learning. As there is a growing body of work concerned with personal epistemology, we will make two considerations regarding the process of academic learning: 1) concerning with what Richter and Schmid (2010) define as epistemic strategies, that we identify as the action of assigning epistemological status to information, and 2) the process of building knowledge, seen as a process of becoming aware of the objective quality of academic information. It is assumed that knowledge is systematized information ordered by a function of logical criteria of validity. It is sustained in formal or empirical evidence and is maintained as valid as long as no contradictory evidence is presented. If the organization, coherence and unity of the scientific knowledge taught is different from that existing in the subject's mind, what interactions should take place

between the subjective information schema and knowledge? We may tackle this inquiry assuming the relation object-of-knowledge-subject-of-knowledge where knowledge is an entity, but we may assume that the metacognitive focus could be directed to the knowledge as a process of "knowing", where, ontologically the difference emerges from the fact that knowledge taken as an entity (a noun) is taken as a finished object, but any knowledge is the same in the page of a book as in the experience of the student

This work presents an ontological perspective on the study of academic learning. As there is a growing body of work concerned with personal epistemology, we will make two considerations regarding the process of academic learning: 1) the first, associated with what Richter and Schmid (2010) define as epistemic strategies, that we identify as the action of assigning epistemological status to information, and 2) the process of building knowledge, seen as a process of becoming aware of the objective quality of academic information.

Perhaps an easy way to illustrate these considerations is with a specific teaching-learning situation I was involved in Mexico, where a task had been given to Robin, a young man who has some autistic characteristics, in order to prepare him for "normal life". Due to his echolalia (repeating back what is said to him), we were never sure of what he had taken from what we were trying to teach him. In the task, Robin had to choose the right nut for a specific bolt from a basket of mixed-up nuts of various sizes. In order to motivate him, every time he chose the correct nut for a bolt I shouted and jumped with joy, so he tried to do it well in order to make me happy. After several tries at this task, he always chose the right nut, so I called a colleague to have a go, but Robin could no longer choose the correct nut for him. After repeating the training, I realized that what Robin had learnt was to identify the answer in my face; every time he chose a nut he looked at me and saw my expression. So what he learnt, in giving the expected answer, was related to different elements of the context. The aim for Robin was not the same as the aim for me.

Now, in a school learning situation the student may not be aware of (or know) what and how to learn or why to act or what for. For a student to be able to direct behavior toward learning, it is necessary for the learner to make skills an object of knowledge, to both identify available information and understand it as an analyzable object, thus gradually becoming aware of what is required to be successful in dealing with information. Knowledge of their own skills can direct learners more precisely and clearly in constructing their own informational schemata that acquire, for them, the category of knowledge (Weinstein, et al., 1998). Even when the student is committed cognitively to a task, for example, the solution to a mathematical problem can represent, in adaptive terms, a means of reaching multiple ends (Manasero y Vazquez, 1995; Entwistle, et al., 1989; Wigfield & Eccles, 1992; Weiner, B., 1979).

In self-regulating the process of solving mathematical problems, ideas come into play impacting both motivation and the type of cognitive commitment the student assumes when facing a task. Research has demonstrated how goals take control over processes of attention, memory, and motivation, and thus the results of learning can be quite diverse (Helmke, 1989). Each individual assumes a different position relative to the information to be dealt with. Depending on this assumed position and on the particular situation, individuals will understand to different degrees what function a knowledge schema has in explaining reality. It is evident that acquisition of informational schemata in a school situation does not mean acquiring knowledge.

During the learning episode (Boaekarts, 1996), epistemological beliefs concerning what a student knows about their goals and the possibilities of reaching them takes place. Attention is focused on knowledge structures and on the process of objectivization by which the structures are constructed. A focus of interest is the subject's process of elaborating explanations of their current condition as a student in terms of how they attack the academic task and of the way they justify explanations. It is during this process that the subject assigns an epistemological status to the incoming information during the learning episode.

We can also observe that individuals differ in terms of the degree of awareness they have regarding the nature of knowledge, as has been demonstrated by research into epistemological beliefs (Hoffer and Pintrich, 1997). So, it is assumed that knowledge is systematized information ordered by a function of logical criteria of validity (Kuhn, 2000). It is sustained in formal or empirical evidence and is maintained as valid as long as no contradictory evidence is presented (Miller, 1995). If the organization, coherence and unity of the scientific knowledge taught is different from that existing in the subject's mind, what interactions should take place between the subjective information schema and knowledge?

We may tackle this inquiry assuming the relation object-of-knowledge-subject-of-knowledge where knowledge is an entity, but we may assume that the metacognitive focus could be directed to the knowledge as a process of "knowing", where, ontologically the difference emerges from the fact that knowledge taken as an entity (noun) is taken as a finished object, but any knowledge is the same in the page of a book as in the experience of the student.

References

- Boekaerts, M. (1996). Personality-and-the-psychology-of-learning. *European Journal of Personality*, 10, 377-404.
- Entwistle, N., Kozeki, B. and Tait, H. (1989) Pupils'-Perceptions-of-School-and-Teachers-II-Relationships-with-motivation-an-approaches-to-learning. *J. Educ. Psychol.* 59, 340-350.
- Helmke, A., (1989). The-impact-of-student-self-concept-of-ability-and-task-motivation-on-different-indicators-of-effort-at-school. *International Journal of Educational Research*, 13 (8), 281-295.
- Hofer, B. K., and R. P. Pintrich (1997). The-development-of-epistemological-theories:-Beliefs-about-knowledge-and-knowing-and-their-relation-to-learning. *Review of Educational Research*, 67 (1) 88-140.
- Kuhn, D. (2000). The-development-of-epistemological-understanding. *Cognitive Development*, 15 (3), 309-328.
- Manassero, M. A. and Vázquez, A. (1995). Atribuciones-causales-de-alumnado-y-profesorado-sobre-el-rendimiento-escolar: Consecuencias para la práctica educativa. *Rvta. Interuniversitaria de Formación del Profesorado*, 24, sep-dic. 125-141.
- Miller, D. (compilador) (1995) *Popper Escritos Selectos*. Fondo de Cultura Económica. Mééxico, D.F.
- Richter, T. & Schmid, S. (2010) Epistemological-beliefs-and-epistemic-strategies-in-self-regulated-learning. *Metacognition Learning*, 5:47-65
- Weiner, B. (1979). A-theory-of-motivation-for-some-classroom-experiences. *Journal of Educational Psychology*, 71, 3-25.
- Weinstein, C. E., Powdrill, L., Husman, J., Roska, L. A. and Dierking, D. R. (1998) Aprendizaje estratéégico: un modelo conceptual, instruccional y de evaluaciôn. In S. Castaôeda (Ed.). *Evaluaciôn y fomento del desarrollo intelectual en la enseôanza de ciencias, artes y téécnicas. Perspectiva internacional en el umbral del siglo XXI*. (pp. 197-228), Mééxico D. F. : CONACYT, UNAM y Miguel Angel Porrúa.
- Wigfield and Eccles (1992) The-development-of-achievement-task-values: A theoretical analysis. *Developmental Review*, 12, 265-310.

PAPER PRESENTATION

Different grades for girls vs. boys? The impact of teachers' perception of students' self-regulation

Poldi Kuhl, Freie Universitat Berlin, Germany; Bettina Hannover, Freie Universitat Berlin, Germany

In this study, we investigated whether boys' lower ability for self-regulated and responsible learning in school might contribute to explaining the well-documented gender differences in grading. A total of $n = 756$ girls and $n = 777$ boys in fourth grade from 78 German primary schools performed standardized tests in German reading comprehension and mathematics. Moreover, teachers provided students' mid-term grades in German and mathematics. Teachers also rated each student's ability for self-regulated learning. Results of multilevel-mediation analyses showed that after controlling for test scores, girls were graded more favorably in German than boys were. This even held true when we additionally controlled for students' ability to self-regulate their learning processes. In mathematics, we did not observe any gender differences in grading or test scores. However, when controlling for students' ability for self-regulated learning, boys featured better grading than girls. These results suggest that teachers' perceptions of students' ability for self-regulated learning partially explain the gender difference in grading in German. In mathematics, however, teachers presumably overestimate and overcorrect the influence of boys' lower ability for self-regulated learning. The results will be discussed with regard to their theoretical implications and their relevance for educational practice.

Different grades for girls and boys?

Examining the role of students' ability for self-regulated learning as perceived by their teachers

Aim:

Numerous studies have documented gender-differences in grading, with girls typically earning better school grades than boys (e.g. PISA 2000, PIRLS 2006, TIMSS 2007). Although this finding has been replicated many times, girls usually do not perform any better in standardized achievement tests or cognitive ability measures than boys do. Hence, boys perform better in standardized tests than would be predicted from their grades.

In order to explain this discrepancy, some authors have argued that standardized tests and their formats favor boys. In contrast, in the present research we investigated the assumption that grades do not only reflect the teacher's perception of a student's performance level and cognitive abilities, but also the teacher's perception of the extent to which a student is a competent self-organized learner. We predicted that as compared to boys, teachers would consider girls to more likely engage in self-regulated learning, i.e. to self-organize, be independent, and manage their

learning processes. As a result, they should grade girls better than boys, after controlling for the impact of competence level.

Methodology:

Study design: Data were taken from the fourth-grade assessment of a longitudinal study on competence development in primary school in Germany. In grade four, we collected data using standardized tests as well as self-report questionnaires for students and teachers in sample schools.

Sample: The sample comprised of $N = 1.533$ fourth graders from 78 German primary schools. About half of the sampled students were girls (49.3%). Students were on average 10.4 years old, with a range between 8 and 12 years.

Instruments: Students performed standardized tests in German reading comprehension and mathematics. Moreover, teachers provided each student's mid-term grades in German and mathematics. Teachers also rated each student's ability for self-regulated learning and self-organized school-related behaviors.

Findings:

Descriptives: Girls earned significantly better grades and test scores in reading comprehension. No gender differences, however, were found with respect to test scores and grades in mathematics. With respect to the ability to regulate and organize learning, teachers rated girls to be more competent than boys.

Multilevel-mediation analyses: Analyses were performed separately for German reading comprehension and mathematics. Even after controlling for their test scores and self-regulated learning ability, girls received better grades in German than boys. As expected, however, the relationship between gender and grading decreased significantly when controlling for self-regulated learning. This suggests that the difference in teachers' perceptions of boys' and girls' competence for self-regulated learning contributes to the gender difference in grades in German.

With respect to mathematics, another pattern of results emerged. In the initial model, no gender differences in grades or test scores emerged. However, there was a significant gender difference after controlling for self-regulated learning competence. That is, given the same competence level and ability for self-regulated learning, teachers graded boys better than girls.

Theoretical and educational significance of the research:

Taken together, students' ability to regulate their learning processes can contribute to explaining the gender differences in grading in schools. Controlling for students' competence for self-regulated learning significantly decreased the gender difference in grades in German. That is, when grading their students, teachers apparently do not only consider students' achievement in terms of performance scores, but also acknowledge girls' stronger self-regulatory and responsible behaviors. In mathematics, gender differences in grades only became apparent when we controlled for test score and ability for self-regulated learning.

From this research we cannot conclude whether girls are in fact better in organizing their own learning than boys. Teachers' ratings could as well reflect gender-stereotypical evaluations or expectations. In future analyses and follow-up studies, we therefore plan to explicitly address teachers' gender-role stereotypes and gender-specific competency expectations, as those might impact their perception of boys' and girls' behaviors. In addition, by additionally considering the self-report data in the student' questionnaires, we aim at exploring the congruency between teacher perceptions and students' self-ratings of self-regulated learning abilities and how they relate not only to grading but also to the development of students' competences and self-concepts.

PAPER PRESENTATION

Fostering students' autonomy and self-regulation: video-analysis of interactional episodes

Valeska Grau, Pontificia Universidad Catolica de Chile, Chile; Sandy Farias, Pontificia Universidad Catolica de Chile, Chile; Barbara Hayes, Pontificia Universidad Catolica de Chile, Chile

The present paper presents the findings of a descriptive study focused on teachers and students interactions within primary classrooms in relation to the promotion of cognitive autonomy and SRL. The data was obtained from analyzing videos filmed for a teaching assessment system implemented by the Chilean Government. 60 videos were randomly selected, considering different levels of performance, content-domain (math or language) and different grades of primary school (1st to 4th grade). A coding scheme was created considering the interaction as a unit of analysis. The codes attempted to describe the ways in which the teachers scaffold the development of cognitive autonomy and

self-regulation. Preliminary findings suggest that teachers do not tend to actively promote these aspects of development in Chilean primary schools. Interactions of low level of cognitive engagement and challenge are predominant. Subsequent analyses are hypothesised to show the relationships between autonomy and self-regulation support and students' developmental stages.

Introduction and aims

The development of autonomy and self-regulated learning (SRL) has been described as essential to children's development, especially in the global networked society. Hence, it is considered a desirable outcome of any educational system. The concept of SRL comes from a sociocognitive perspective, within literature attempting to explain academic achievement in classrooms. It is defined as the capacity to engage actively and constructively in our own learning processes, regulating cognitions, motivations, behaviours and environment (Boeakerts & Corno, 2005). Although SRL have been originally conceptualised as strongly related to metacognition and cognitive regulation, current developments have included motivational aspects, such as agency, autonomy, goal orientation, among others. Increasingly, the models of SRL have been including guidelines to promote this ability in the classroom through the provision of challenge, encouragement of group-work, capacity of self-evaluation and promotion of mastery orientation through adequate feedback (Meyer & Turner, 2002; Pintrich, 2000; Whitebread et al, 2005)

On the other hand, the concept of autonomy support comes mainly from the self-determination theory of motivation. This research has had an important focus on the contexts that foster the development of autonomy, including in educational systems. These studies have mainly focused on observation of classrooms looking at how the autonomy support could be observed in specific teachers' behaviours (e.g. Reeve, 2009; Reeve & Jang, 2006; Reeve et al, 2008; Stefanou et al., 2004). These behaviours, interestingly, overlap to some extent with the advice from the SRL perspective. Bridging the two perspectives together, It has been suggested that classrooms which are autonomy supportive foster and promote students through helping students to set their own goals, seek challenges, direct their behaviours, being more active and flexible, being persistent, and experiencing more positive feelings about their learning (Reeve, 2002). Empirically, there is evidence showing that when teachers and parents are high in autonomy support, students become more intrinsically motivated and more effective in self-regulating their performance (Grolnick & Ryan, 1989)

Looking at the theoretical roots, we have found that both perspectives seem to converge more closely in the concept of cognitive autonomy support, proposed by Stefanout et al (2004). Cognitive autonomy support (in contrast to organisational or procedural autonomy support) refers to the encouragement of students' ownership of their own learning processes and It is related to teachers' behaviours such as asking students to explain their way of thinking or problem solving paths. Despite the efforts to create adequate ways to observe and analyse autonomy and SRL support, up to now the focus has rather relied on the isolated behaviour of teachers (e.g. "the teacher provide feedback to their students", "the teachers listen to their students"), without necessarily looking at the interaction as a unit of analysis. We think that this kind of interactional approach could be very beneficial to looking at the ways in which teachers really engage students in their learning and the ways in which they adapt to students' needs in terms of content knowledge, strategies and motivation.

The main questions guiding the study are the following: Do Chilean primary teachers foster the autonomy and self-regulation development during instructional activities? Assuming that they do, which are the main instructional strategies they use to accomplish it? How do they engage their students in processes of cognitive autonomy and self-regulation? Also, we are interested in the ways in which teachers might adapt their strategies according to students' developmental stages.

Methodology and preliminary results

Design.

This is an exploratory study aiming to describe teachers' strategies and classroom interactions that support the development of autonomy and self-regulation in primary school.

Sample.

60 videos were randomly selected from the videos of the teachers' national evaluation (Docente Mas, hereafter DM). DM is a nationwide system for the assessment of teaching, and includes 4 instruments: a self-assessment, an interview made by a peer, report by third parties and a portfolio, which in turn includes a video-survey of a class (Manzi et al., 2008). In this context 30 language classes and 30 math classes were selected, with different levels of outcome in the whole process of the national evaluation. The videos were from all over the country.

Procedure.

Expert cameramen filmed each teacher. Filming times were agreed in advance and students' attendance was highly encouraged. The cameramen knew in advance the kind of activities the teachers was going conduct, in order to carry

out an adequate record of the lesson. Teachers were asked to conduct the classes as usual, but with an explicit emphasis on addressing students and interacting with them.

Analysis.

Based on the previous work of Reeve et al (2006, 2008), Stefanou et al (2004) in autonomy support and the model of Pintrich (2000) of SRL in educational contexts, a coding system was developed to identify interactional episodes in which teachers are scaffolding the autonomy and self-regulation in their students. Findings.

Preliminary results are showing that there are not many teachers who systematically scaffold autonomy and self-regulation during their classes. Most of them tend to interact with students and give them space to talk, but the interactions are characterised by having a low cognitive level (students have to complete phrases or respond to closed question) with high control from the teachers. These results are probably closely related with the current problems of Chilean education (low results in international evaluations such as TIMSS and PISA and poor results also according to national standards) and is coherent with findings of other studies suggesting that Chilean teachers' instructional patterns are based mainly on transmission of knowledge and practice of basic skills more than the development of metacognition and thinking processes (Preiss, 2009). Conclusions.

The present research contributes to the study of autonomy and self-regulation support through interactions in classrooms. Also, the results are providing some clues about how to foster autonomy and SRL development during the early years of schooling and posit interesting indications for pre-service and in-service teacher training. Further, it opens a discussion regarding the kind of pedagogy that is valued in our culture.

Some References

- Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review*, 54(2), 199-231.
- Pintrich, P. R. (2000). The role of goal Orientation in self-regulated learning. In M. Boekaerts, P. Pintrich & M. Zeidner (Eds.), *Handbook of Self-Regulation* (pp. 451–502). San Diego, CA: Academic Press.
- Reeve, J., Ryan, R., Deci, E. L., & Jang, H. (2008). Understanding and promoting autonomous self-regulation: A self-determination theory perspective. In D. Schunk & B. Zimmerman (Eds.), *Motivation and Self-Regulated Learning. Theory, Research, and Applications* (pp. 223-244). New York: Lawrence Erlbaum Associates.
- Stefanou, C., Perencevich, K., DiCintio, M. & Turner, J. (2004). Supporting autonomy in the classroom: ways teachers encourage student decision making and ownership. *Educational Psychologist*, 39 (2), 97-110.

PAPER PRESENTATION

The Impact of Study Programmes on the Dynamic Forces of Self-Direction in Academic Learning

Dirk Bissbort, University of Oulu, Faculty of Education, Finland

As a consequence of the implementation of the Bologna process, the design of study programmes is widely discussed also in the light of goals for academic learning, e.g. advancing students as autonomous learners. This empirical study aims at investigating the impact of study programmes on students' ability of self-directed learning: the influence of 1. study experience of students (number of terms) and 2. level of structuring of the study programmes on the mode of interaction of the dynamic forces on self-direction in learning. For this purpose, the concept 'Dynamic Forces on Self-Directed Learning' was introduced. In questionnaire-based studies (n=879), the modes of interaction of forces within self-directed learning were examined in path analyses for both traditional study programmes and study programmes developed during the Bologna process. The results show that students enrolled in the new BA study programme have a very different motivational and emotional approach to self-direction in their academic learning compared to students in other study programmes. The theoretical significance of this research lies in the development of a new conception of self-directed learning and its dynamic forces that allows a more differential understanding and a more systematic insight in the reciprocity of interrelations of the particular dynamic forces. Regarding the educational significance, the outcomes point to how far changes on the macro level, the design of study programmes, influence students' academic self-directed learning and can therefore serve for developers of study programmes to reflect on the goals and the quality of academic learning when developing programmes.

Aims

As a consequence of the implementation of the Bologna process, the design of study programmes is widely discussed in the light of goals for academic learning, e.g. advancing students as autonomous learners. This empirical study aims at investigating the impact of study programmes on students' ability of self-directed learning: the influence of

1. study experience of students (number of terms) and
2. the level of structuring of the study programmes, on the mode of interaction of the 'dynamic forces' on self-direction in learning. For this purpose, the concept 'Dynamic Forces on Self-Directed Learning', was introduced. It was built from theories and models of self-directed learning (Knowles, 1975; Nenniger, 1999) and its self-regulatory processes (Boeckeaerts, 1997; Efklides, 2004; Kuhl & Heckhausen, 1996; Nenniger, van den Brink & Bissbort, 2009; Schiefele & Pekrun, 1996; Pekrun, Elliot & Maier, 2006; Zimmerman, 1989, 2000), and from concepts of "Approaches to Learning" (as e.g. in Biggs, 1987; Entwistle 2000; Entwistle & Ramsden, 1983; Marton & Säljö, 1976).

The concept focuses on the modes of interaction of the dynamic forces of self-direction in learning and allows outlining the sensitivity of particular forces from changes of other forces like study programme and the effect on students' self-direction in their learning.

Methodology

In questionnaire-based studies (n=879) in Germany, the concept 'Dynamic Forces on Self-Direction in Learning' was validated on basis of samples (n1=146, n2=82, n3=879) of university students of educational science and teacher education. The respective instrument was developed on the basis of scales from current instruments (MLSQ, LIST, BEMSELHIS, SSI, AEQ, ASSIST, ETLQ, IPA-u and LSQ). Next, the modes of interaction of forces within self-directed learning were examined: Scores of the constructs related to the concept 'Dynamic Forces on Self-Direction in Learning' were entered into path analyses. Among the different path models, the following causal structure remained as the most suitable solution (typically RMSEA= .05, CHI=1.46, p=.23, GFI=.99, CFI=.99) to explain the dynamic forces of self-direction in learning (cf. figure 1):

Figure 1: Causal structure of the path model (see appendix)

Dependent factor: Regulation related learning characteristics

Independent factors: Person related learning characteristics.

Perceived learning environment. Continuity oriented learning characteristics. Emotion related learning characteristics

Findings

The major findings from the path analyses carried out for both, traditional study programmes and study programmes developed during the Bologna process, can be shortly described as follows: The influence of dynamic forces on self-direction in learning is characterised by a unique pattern appearing across all path models: differences in the causal structure of dynamic forces influencing self-direction in learning exclusively address the amount of interrelationships between the dynamic forces and their strength of influence on self-direction in learning. In sum, the results show that students enrolled in the new BA study programme have a very different motivational and emotional approach to self-direction in their academic learning, for example, they are less emotionally involved in their mode of self-direction in learning.

Theoretical and educational significance of the research

As advancing active self-directed learning is linked with both, a certain structured study programme and with the study experience acquired therein, these two aspects have to be examined in an integrative rather than in a separate view. The theoretical significance of this research lies in the development of a new conception of self-directed learning and its dynamic forces that opens the view towards a more differential view and innovative understanding in so far as it allows a more systematic insight in the reciprocity of interrelations of the particular dynamic forces. Regarding the educational significance, the outcomes point to how far changes on the macro level, the design of study programmes, influence students' academic self-directed learning and can therefore serve for developers of study programmes to reflect on the goals and the quality of academic learning when developing programmes.

References

- Biggs, J. B. (1987). Student approaches to learning and studying. Hawthorn: Australian Council for Educational Research.
- Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning & Instruction*, 7, 161-186.
- Efklides, A. (2004). The multiple role of metacognitive experiences in the learning process. In M. Wosnitza, A. Frey & R. S. Jaeger (Eds.), *Lernprozess, Lernumgebung und Lerndiagnostik. Wissenschaftliche Beiträge zum Lernen im 21. Jahrhundert* (pp. 256-266). Landau, Germany: Verlag Empirische Paedagogik.
- Entwistle, N. J. (2000). Approaches to studying and levels of understanding: The influence of teaching and assessment. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XV, pp.156-218). New York: Agathon.
- Entwistle, N.J. & Ramsden, P. (1983). *Understanding student learning*. London: Croom-Helm.
- Knowles, M. S. (1975). *Self-directed learning*. Chicago: Follett.
- Kuhl, J. & Heckhausen, H. (1996). *Motivation, Volition und Handlung*. Goettingen: Hogrefe.
- Marton, F. & Säljö, R. (1976). On qualitative differences in learning: I - Outcome and process. *British Journal of Educational Psychology*, 46, 4-11.

- Nenniger, P. (1999). On the role of motivation in self-directed learning. The 'Two-Shells-Model of motivated self-directed learning' as a structural explanatory concept. *European Journal of Psychology of Education*, 14, 71-86.
- Nenniger, P., van den Brink, K. & Bissbort, D. (2009). On a Differential Explanation of Self-Direction in Motivating Learning Environments. In M. Wosnitza, S. A. Karabenick, A. Efklides & P. Nenniger (Eds.), *Contemporary motivation research: From global to local perspectives*. pp. 147-166. Göttingen and New York: Hogrefe & Huber.
- Pekrun, R., Elliot, A. J., & Maier, M. A. (2006). Achievement goals and discrete achievement emotions: A theoretical model and prospective test. *Journal of Educational Psychology*, 98, 583-597.
- Schiefele, U., & Pekrun, R. (1996). Psychologische Modelle des fremdgesteuerten und selbstgesteuerten Lernens [Psychological models of other-directed and self-directed learning]. In F. E. Weinert (Eds.), *Enzyklopädie der Psychologie. Pädagogische Psychologie: Bd 2. Psychologie des Lernens und der Instruktion* (pp. 249-278). Göttingen: Hogrefe.
- Zimmerman, J. B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, 81, 329-333.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego: Academic Press.

PAPER PRESENTATION

Parental engagement and home support for reading literacy in 14 educational systems in PISA 2009

Pou Seong SIT, University of Macau, Macau; Kwok Cheung CHEUNG, University of Macau, Macau; Soi Kei MAK, University of Macau, Macau

Sixty five educational systems participated in PISA 2009 reading literacy study, which sought to examine factors affecting quality and equity of reading acquisition of 15-year-old secondary students. Amongst the many important factors one pertains to the parents of the sampled students. A total of fourteen educational systems have collected data from the parents of the sampled students, allowing the present study to examine the differential effects of parental engagement and home support on reading literacy performance. Based on a conceptual model depicting how parents' engagement and support of child's reading literacy mediates its effect via provision of home reading resources on the enhancement of reading literacy performance, variables are conceptualized and analyzed using hierarchical linear modeling (HLM). The first finding is that across the fourteen educational systems, the proportion of the between-student within-school reading literacy variance explained by the joint effect of parents' engagement and support of child's reading literacy varies from 0.7% to 3.7% across educational systems. Additional variance attributed to the mediating effect of the provision of home reading resources varies from 0.2% to 2.0% across educational systems. Apart from two educational systems, the mediating effects of the provision of home reading resources are all statistically significant. Preliminary analyses of the parental engagement and home support variables suggest that it is illuminative to analyze the interrelationship of variables in the three high-performing systems using structural equation modeling (SEM). Differential patterns of parental engagement and home support for reading literacy development are revealed, and implications are discussed against literature.

Reading literacy acquisition is an important educational goal in all basic education systems around the world, and parents play a prominent role for its early and continued development both at home and in schools (Clay, 1967; Anderson, Hiebert, Scott, & Wilkinson, 1985). Several decades of educational research into reading literacy development shows that parental engagement and home support are important factors influencing adolescents' reading literacy development (Finn, 1998; Pressley, Billman & Perry, 2007). Amongst the many parental engagement and home support factors under examination by the educational researchers, parents' positive attitudes towards reading-related activities and home provision of appropriate reading resources are construed to be instrumental to the emergent and onward development of reading literacy of young children entering adulthood (Baker, Scher, & Mackler, 1997; Klaua, 2009).

The PISA 2009 Study, an OECD-organized international sample survey of reading literacy in sixty-five countries, renders researchers to examine the effects of parental engagement and home support for reading literacy development from a comparative education perspective. The fourteen educational systems which have parent data included in the present study are: Chile, Croatia, Denmark, Germany, Hungary, Korea, Hong Kong, Italy, Lithuania, Macao, New Zealand, Panama, Portugal and Qatar. The data represents some 2,207,171 parents of 15-year-old students in the fourteen educational systems. In the parent questionnaire there are questions pertaining to parental engagement and support in home and reading activities, namely: (1) highest educational level of parents; (2) number of siblings in household; (3) parents' time spent at home for their own enjoyment; (4) provision of home reading sources for child's use; (5) motivational attributes of parents' own reading engagement; (6) parents' reading activities

when their child attended the first year of primary school; (7) parents' current home and reading activities with children. In addition, students' report of number of books at home is also included.

Scaling of these responses using factor analyses and item response theory (IRT) results in the composition of the four conceptually and empirically clear constructs to interrelate with reading literacy performance: (1) parents' support of child's reading literacy at beginning of primary education (PRESUPP: 9 items); (2) motivational attributes of parents' own reading engagement (MOTREAD: 4 items); (3) parents' current support of child's reading literacy (CURSUPP: 6 items); (4) provision of reading resources at home for child's use (READRES: 6 items).

A conceptual model structuring the temporal order of constructs is then postulated, within this parents' engagement and support of child's reading literacy is manifested in terms of PRESUPP, MOTREAD, and CURSUPP. This model highlights the direct effect, as well as the mediating effect of READRES on reading literacy performance.

Utilizing these constructs, the following four research questions may be answered:

1. Across the various educational systems, what is the frequency distribution of number of books at home, parents' support of child's reading literacy at beginning of primary education, as well as parents' current support of child's reading literacy at home?
2. Across the various educational systems, what are the breakdown statistics of reading literacy performance on: (1) highest educational level of parents, (2) parents' time spent on reading at home for one's own enjoyment, (3) provision of home reading resources for child's use, (4) motivational attributes of parents' own reading engagement, (5) parents' support of child's reading literacy at beginning of primary education, and (6) parents' current support of child's reading literacy?
3. Across the educational systems, what proportion of reading literacy variance can be explained by the joint effects of parents' engagement and support of child's reading literacy, and what additional proportion of reading literacy variance may be attributed to the mediating effects of the provision of home reading resources for child's use, after accounting the prior effects of the economic, social and cultural status of the home and gender of students?
4. For the three high-performing educational systems in reading literacy with parent data, to what extent the effect of parents' engagement and support of child's reading literacy on reading literacy performance is direct and/or mediated by provision of home reading resources for child's use, after accounting for the effects of economic, social and cultural status of the home and gender of student? How to explain the findings in terms of reading acquisition in culturally diverse school settings? For research question 1 and 2, frequency distribution and breakdown of responses to questionnaire questions and on test scores are conducted. For research question 3, Hierarchical Linear Modeling (HLM) is applied to examine the independent mediating effect of provision of home reading resources on reading literacy performance, after accounting for the effect of parents' engagement and support of child's reading literacy, economic, social and cultural status of the home and gender of student. For research question 4, Pearson correlations of the constructs delineated are calculated. Structural Equation Modeling (SEM) is applied to assess the direct effect of parental engagement and home support, as well as the mediating effect of provision of home reading resources which channels the joint effects of parents' engagement and support of child's reading literacy on reading literacy performance.

The first important finding is that across the educational systems, less than 3.7% of the proportion of the between-student within-school reading literacy variance can be explained by the joint effects of parents' engagement and support of child's reading literacy. In addition, less than 2.0% of the variance may be attributed to the mediating effect of the provision of home reading resources for child's use. Apart from two systems, the mediating effect of the provision of home reading resources are all statistically significant ($\alpha=0.05$). The second important finding is that the three high-performing systems with parent data exhibit differential patterns of parental engagement and home support relationships with reading literacy performance. Review of literature against these findings leads the authors to recommend evidence-based practices to revitalize parental engagement and home support for the betterment of reading literacy acquisition in the 21st century.

PAPER PRESENTATION

Does empathy has an effect on literary reading comprehension?

Sofie Henschel, Freie University of Berlin, Germany; Thorsten Roick, Freie University of Berlin, Germany

In the last years, the main predictors for non-fictional (general) reading comprehension have been well investigated (e.g. Guthrie et al., 1999; McElvany et al., 2008). So far, it is not clear which cognitive, motivational and affective aspects effect literary (fictional) reading comprehension. Particularly in the literature (e.g. Oatley, 1994) affective and

emotional components, such as empathy, are pointed out as specific to understand literary and fictional texts, which was not proved empirically yet. Thus, the present study investigates the role of empathy in literary and non-fictional reading comprehension considering the amount of reading literary and fictional texts. About 1.300 ninth graders from German school classes participated in the study. Students completed a test of literary reading comprehension and a test of non-fictional reading comprehension and filled out a questionnaire assessing the individual reading amount and empathy. The analyses show that especially one sub-dimension of empathy, "fantasy", has a stronger effect on literary reading comprehension than on non-fictional reading comprehension, but only for girls. Results reveal no similar differential pattern for boys. The differential effect for girls did not remain stable after controlling for the reading amount of literary and fictional texts. Implications for further research in the field of literary reading comprehension are discussed.

Theoretical Background:

In comparison to the extensive results in non-fictional (general) reading research, there is a lack of studies taking into account the cognitive, affective and motivational determinants in explaining literary (fictional) reading comprehension. While psychological models of text comprehension predominantly focus on cognitive and motivational aspects (Kintsch, 1998), literary didactics emphasize the role of affective components, such as involvement or empathy (Oatley, 1994). So far, there is no empirical evidence underlying the assumption that affective aspects are more important to understand a literary or fictional text than a non-fictional text. Thus, the present study investigates the role of empathy in literary reading comprehension in contrast to non-fictional reading comprehension considering the amount of reading fictional texts.

Empathy, literary reading comprehension and reading amount:

There is evidence that non-fictional reading comprehension and literary reading comprehension are separable and represent partly distinct competencies (Roick et al., in press). It is currently not clear what role empathy plays in literary reading comprehension compared to non-fictional reading comprehension.

Empathy is defined as a motivated competence that "involves the inner experience of sharing in and comprehending the momentary psychological state of another person" (Schafer, 1959, p. 342). The whole construct consists of four cognitive or affective sub-dimensions (empathic concern, distress, fantasy and perspective taking). Recent studies have shown that girls score higher on all sub-dimensions of empathy (Davis, 1983). Despite the central role of empathy suggested by educationalists in theoretical models, researchers have devoted little attention to examining the role of empathy in literary reading comprehension empirically.

Moreover, we know from recent studies that frequently reading literary and fictional texts has a positive effect on empathy (Mar et al., 2006), especially on fantasy empathy (Mar, et al., 2009). Empathy, on the other hand, effects non-fictional reading comprehension positively, but only for girls (Feshbach & Feshbach, 1987). Similar findings are well known for non-fictional reading comprehension and reading amount (Guthrie et al., 1999). Based on recent findings in the field of reading research, we explored three questions:

1. Does empathy has a stronger effect on literary reading comprehension than on non-fictional reading comprehension?
2. Is a differential effect of empathy valid for boys and girls?
3. Is the differential effect stable after controlling for reading amount literary texts?

Method:

About 1300 ninth graders taken from 52 German school classes participated in the study. A cross-sectional design was used. Students' literary reading comprehension (LRC) was measured with nine literary and fictional texts and a total of 62 items ($\alpha=.86$). We used a multi-matrix design with nine booklets, i.e. each student only answered a subset of the test items. Students also completed a test of non-fictional reading comprehension (NRC) which consisted of four expository texts with a total of 18 items ($\alpha=.74$) filled out a questionnaire assessing two sub-dimensions of empathy (fantasy: 10 items, $\alpha=.86$; empathic concern: 10 items, $\alpha=.84$) (Leibetseder et al., 2001) and their amount of reading literary and fictional texts (poems, comics, novels, etc.) for enjoyment (10 items, $\alpha=.81$). Given the nested structure of the data, structural equation analyses were carried out.

Results:

Latent models were used for estimating empathy, LRC, and NRC. Results show that particularly fantasy has a differential effect on reading comprehension ($\beta_{LRC}=.45$, $\beta_{NRC}=.36$, $p<.01$; Wald- $\chi^2(1)=7.43$, $p<.01$) which was not confirmed for empathic concern ($\beta_{LRC}=.11$, $p=.03$, $\beta_{NRC}=.09$, $p=.16$; Wald- $\chi^2(1)=0.15$, $p=.70$). Hence, empathic concern was excluded for further analyses. While we found a differential correlation pattern for girls (Wald- $\chi^2(1)=4.21$,

$p=.04$) we could not confirm it for boys ($\chi^2(1)=0.50$, $p=.48$). After controlling for reading amount literary and fictional texts we did not find support for a differential effect of fantasy on reading comprehension for girls or boys. Moreover the findings reveal that fantasy has no significant effect on literary reading comprehension for boys ($\beta_{LRC}=.17$, $p=.08$) but reading amount has ($\beta_{LRC}=.27$, $p<.01$). On the other hand we found a significant effect of fantasy ($\beta_{LRC}=.22$, $p<.01$) and reading amount ($\beta_{LRC}=.25$, $p<.01$) on literary reading comprehension for girls.

Therefore, we can conclude that fantasy empathy represents no specific factor to understand literary and fictional texts as assumed in literary studies (Oatley, 1994). Although, the results show that fantasy is more important for girls than for boys to understand a literary text. Moreover it is not clear how other sub-dimensions of empathy (i.e. perspective taking, distress) might effect reading comprehension. Thus, further research is needed to explain literary reading comprehension more precisely.

Literature:

- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113-126.
- Feshbach, N. D. & Feshbach, S. (1987). Affective processes and academic achievement. *Child Development*, 58(5), 1335-1347.
- Guthrie, J. T., Wigfield, A., Metsala, J. L. & Cox, K. E. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific studies of Reading*, 3(3), 231-256.
- Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge, UK: Cambridge University Press.
- Leibetseder, M., Laireiter, A.-R., Riepler, A. & Koller, T. (2001). E-Skala: Fragebogen zur Erfassung von Empathie - Beschreibung und psychometrische Eigenschaften. *Zeitschrift für Differentielle und Diagnostische Psychologie* 22(1), 70-85.
- Mar, R. A., Oatley, K., Hirsh, J., dela Paz, J. & Peterson, J. B. (2006). Bookworms versus nerds: Exposure to fiction versus non-fiction, divergent associations with social ability, and the simulation of fictional social worlds. *Journal of Research in Personality*, 40(5), 694-712.
- Mar, R. A., Oatley, K. & Peterson, J. B. (2009). Exploring the link between reading fiction and empathy: Ruling out individual differences and examining outcomes. *Communications: The European Journal of Communication Research*, 34, 407-428.
- McElvany, N., Kortenbruck, M. & Becker, M. (2008). Lesekompetenz und Lesemotivation: Entwicklung und Mediation des Zusammenhangs durch Leseverhalten. *Zeitschrift für Pädagogische Psychologie*, 22(3), 207-219.
- Oatley, K. (1994). A taxonomy of the emotions of literary response and a theory of identification in fictional narrative. *Poetics*, 23(53-74).
- Roick, T., Stanat, P., Dickhauser, O., Frederking, V., Meier, C. & Steinhauer, L. (in press). Strukturelle und kriteriale Validität der literarästhetischen Urteilskompetenz. In E. Klieme, D. Leutner & M. Kenk (Eds.), *Kompetenzmodellierung. Zwischenbilanz des DFG-Schwerpunktprogramms und Perspektiven des Forschungsansatzes*. 56. Beiheft der Zeitschrift für Pädagogik. Weinheim: Beltz.
- Schafer, R. (1959). Generative empathy in the treatment situation. *The Psychoanalytic Quarterly*, 28, 342-373.

PAPER PRESENTATION

Theoretically Framing Research on Classroom Discourse as it Affects Reading Comprehension

Ian A.G. Wilkinson, The Ohio State University, United States; Hsiao-Feng Tsai, The Ohio State University, United States

The purpose of this study was to examine the theoretical frameworks used by researchers to argue for the benefits of discourse in discussion for promoting reading comprehension. We sought to identify the theoretical constructs invoked by authors of studies of nine prominent approaches to text-based discussions and to examine how they vary by dominant stance toward the text. We developed a taxonomy of theoretical frameworks cited by authors as a rationale for why their approach to discussion should contribute to students' comprehension. We then coded 157 empirical studies of nine prominent approaches to conducting classroom discussion about text using the taxonomy. We found that most researchers invoked a hybrid of theoretical constructs to argue for the benefits of discourse in discussion though Vygotskian theoretical constructs were most commonly used. We also found that theoretical explanations for the effects of discussion varied by dominant stance toward the text (efferent, aesthetic/expressive, critical-analytic). Almost all scholars invoked theories as a 'foundational platform' for their study. Rarely did they explicitly test the theoretical mechanisms they propose as responsible for effects. We conclude with a call for research to test the validity of claims made regarding the mechanisms by which discussion fosters growth in students' reading comprehension.

Aims

The purpose of this study is to examine the theoretical frameworks used by researchers to argue for the benefits of discourse in discussion for promoting reading comprehension. We identify the theoretical constructs invoked by authors of studies of nine prominent approaches to text-based discussions and examine how they vary by dominant stance toward the text. Our goals are to 1) determine the theoretical explanations for the effects of discussions on reading comprehension and their relationship to the goals of discussion as espoused by authors; and 2) examine how theory is being used in research on text-based discussions.

Conceptual Rationale

Recent research supports claims that classroom discourse in small-group and whole-class discussions about text promotes students' reading comprehension. Nystrand (1997) and colleagues showed that features of whole-class discussion were positively related to students' reading comprehension and literary response. These results were largely replicated by Applebee, Langer, Nystrand, and Gamoran (2003) and similar relationships between discussion and students' performance in literacy have been reported in other correlational studies (e.g., Taylor, Pearson, Clark, & Walpole, 2000). In a recent meta-analysis of 42 studies of the effects of various approaches to text-based discussions, Murphy, Wilkinson, Soter, Hennessey and Alexander (2009) showed that many of the approaches were effective at promoting students' literal and inferential comprehension, and some were effective at promoting students' critical-thinking, reasoning, and argumentation about text.

Researchers use various theories to justify their use of discussions to promote reading comprehension and to explain their results. From a cognitive perspective, they argue that discussion promotes active engagement in making meaning from text (e.g., McKeown, Beck, & Blake, 2009). From a Piagetian sociocognitive perspective, they argue that discussion enables students to make public their perspectives on issues arising from the text, to consider alternative perspectives, and to reconcile conflicts among the opposing points of view (e.g., Almasi, 1995). From a Vygotskian sociocultural perspective, they argue that discussion enables students to co-construct knowledge and understandings and to internalize ways of thinking to engage more effectively with new text (e.g., Wells, 2007). From a Bakhtinian dialogic perspective, they argue that the tension and conflict among relative perspectives helps shape discourse and students' comprehension (e.g., Nystrand, 2006).

In this study, we systematically analyze the theoretical arguments made by scholars who conduct research on text-based discussions. We sought to determine the major theoretical explanations for the effects of discussions on reading comprehension and whether the theories varied by the espoused goals of discussion. We also sought to examine how theory is used in the research. According to Dressman (2007), theories can play various roles in the conduct of empirical studies: as a foundational platform to warrant the study, as a frame, as a discursive scaffold, or as the subject of an empirical examination.

Research Methods

Data Source.

Our data source comprised 157 empirical studies of nine different approaches to conducting text-based discussions. We identified these studies by carrying out systematic searches of five major databases. We categorized the approaches according to their dominant stance toward the text (i.e., the goal of discussion): to acquire information on an efferent level (Instructional Conversations, Junior Great Books, Questioning the Author); to respond to literature on an aesthetic or expressive level (Book Club, Grand Conversations, Literature Circles); or to critically analyze the text (Collaborative Reasoning, Paideia Seminars, Philosophy for Children).

Coding.

We developed a 50-item taxonomy of theoretical frameworks cited by authors as a rationale for why their approach to discussion should contribute to students' comprehension. Each item comprised a three-part categorization of 'label-person-construct.' For example, an item under cognitive theory was 'cognitive-Chi-self explanation.' We coded only empirical studies, rather than conceptual descriptions, on the grounds that they would provide a clearer indication of the theoretical warrants for claims made. A single study could be coded in terms of multiple perspectives. Two coders independently coded 17 randomly selected reports, achieving full agreement on 77% and partial agreement on 88%. Thereafter, one coder coded all remaining studies while monitoring agreement with the other coder on a random 10% of studies.

Findings

Results showed that most researchers invoked a hybrid of theoretical constructs to argue for the benefits of discourse in discussion. Across all approaches, Vygotskian theory and its variants were most frequently invoked, with authors citing constructs such 'language as a tool for thought,' 'scaffolding,' and 'internalization' to explain how discussion affords students ways of thinking that they apply to new texts or novel comprehension tasks.

Results also showed that theoretical explanations for the effects of discussion varied by dominant stance toward the text. Studies of approaches that foregrounded an efferent stance were often predicated on a cognitive framework involving some variant of schema theory. Studies of approaches that foregrounded an aesthetic or expressive stance were largely predicated on reader-response theory (e.g., Rosenblatt) and Vygotskian sociocultural theory. Studies of approaches that foregrounded a critical-analytic stance were more eclectic. Researchers frequently cited Adler, Dewey, and Socrates and the importance of engaging with big ideas and educating for critical thinking. These researchers also invoked constructs from schema theory and Vygotskian sociocultural theory.

Theoretical and Educational Significance

Importantly, we found that almost all scholars invoked theories solely as a "foundational platform" (cf. Dressman, 2007) to provide a rationale for their discussion approach and their study. Rarely did they explicitly test the theoretical mechanisms they propose as responsible for effects (a possible exception in this regard is research by Richard C. Anderson and colleagues of Collaborative Reasoning discussions). Studies are therefore needed, preferably microgenetic studies, to test the validity of claims made regarding the mechanisms by which discussion fosters growth in students' reading comprehension.

PAPER PRESENTATION

Development of elementary school teachers' inferential skills and reading comprehension in Chile

Airi Rovio-Johansson, University of Gothenburg, Sweden; Beatriz Figueroa Sandoval, University of Concepcion, Chile; Mariana Aillon Neumann, University of Concepción, Chile

Previous research has found that inferential skills are important in the development of among classroom teachers. According to results of national and international standard tests the reading ability is deficient among adult population in Chile. The purpose of the study is to study and explore the development of elementary language teachers' reading comprehension and competences to use inferential questions (fourth year level) after a training course at a Chilean elementary school. The paper draws on the phenomenography and the variation theory as well as the learning study model in offering 45 elementary language teachers a training course (24 hours and 6 meetings) in reading comprehension and in development of skills in formulating inferential questions. The findings suggest that the Learning study model used to train language teachers reading skills and their ability to formulate inferential questions resulted in improved knowledge and skills among the teachers. On average 60% achieved the highest comprehension level on test 1, and 40% on test 2 and test 3. These results indicate a substantial development of teachers' reading comprehension and skills in formulation of inferential questions and course and effect questions, since elementary teachers have had few chances to improve their reading skills and a systematic and reflexive development of it. Besides, they have lacked didactic practices to be better prepared to generate improved reading comprehension among their students.

Purpose

The purpose of the study is to explore the development of 45 elementary language teachers' reading comprehension and competences to use inferential questions (fourth year level) after a training course by means of the Learning study at a Chilean elementary school. Previous research (Parodi, 1989) has found that inferential skills are important in the development of reading comprehension among classroom teachers. According to results of national and international standard tests the reading ability is deficient among adult population in Chile (OECD, 2000).

Theoretical frame

The study is based on the variation theory: a learning theory originated from phenomenographic research. The phenomenographic research approach is aiming at describing the various ways people understand different phenomena in the world (Marton, 1981). The rational of the learning study is the variation theory, a learning theory developed from the phenomenographic research approach, focuses on learning outcomes and the students' quality learning generated at micro-level of a lesson in the classroom.

Pedagogical teaching and learning models such as the Chinese and Japanese lesson study (Stigler and Hiebert, 1999; Yoshida, 1999; Lewis, et al., 2005) is applied in elementary schools on all levels in many Asian countries. The learning

study (Marton and Tsui, 2004) is a hybrid of the lesson study model according to Marton and Tsui (2004). These models are similar in several aspects: both are based on the idea that a team of teachers should be involved in a continuous working process developing their teaching and lessons, which implies the planning of the lesson, its execution, evaluation and revision. After these steps the teachers start planning a revised lesson to further improve the lesson. The cycle is repeated two to four times, until the group of teachers are satisfied with the results. This means that teachers do not attend classes at the university to improve their skills. Instead the researchers go to the classroom and they teachers and researcher form jointly a "research circle".

The difference between these models is that the lesson study is based on teachers' knowledge from practice, and the learning study, is based on a theory of learning, the variation theory (Marton and Tsui, 2004). The research unit of the variation theory is the student's ways of experiencing and understanding a phenomenon (individual level). The research object is the teachers' qualitatively variation of ways in experiencing, perceiving, and understanding the learning object (collective level). They focus on teaching a subject matter and develop disciplinary/didactic knowledge in preparing the "lesson", based on the learning theory (variation theory) are means to develop teachers' reading comprehension. The group of teachers and researchers share the learning opportunity and the knowledge generated during classroom interaction.

Methodology

The study applies the Learning study model in a training course for 45 language teachers at fourth grade in an elementary school in Chile. Working elementary teachers have had few chances to improve their reading skills and a systematic and reflexive development of it. Besides, they have lacked didactic practices to be better prepared to generate improved reading comprehension among their students.

The training course (6 meetings /4 hours/meeting), including 45 teachers and four researchers, focused on the theoretical comprehension of the concept of inference in general, then on the particular specificity of the cause and effect inferences, then on the application of this knowledge in the asking of inferential cause and effect questions or on the selected texts chosen with the purpose of practicing them. Study material in the training course for the teachers consisted of three textbooks, and texts extracted from science books and history books belonging to a fourth year of elementary school level.

The teachers were split in 10 sub-groups and their knowledge was tested by written tests. Qualitative analysis was used to establish their knowledge to formulate inferential questions. Four tests and three criteria were used to find out teachers' improved knowledge.

Findings

The findings suggest that the Learning study model used to train language teachers reading skills and their ability to formulate inferential questions resulted in improved knowledge and skills among the teachers. On average 60% achieved the highest comprehension level on test 1, and 40% on test 2 and test 3. However, in test 4 only 30% has reached the comprehension highest level. On test 1 "accepted knowledge level" was achieved by 40%, on test 2 and three 50% and on test 4 40%. These results mean a substantial development of teachers' reading comprehension and skills in formulation of inferential questions and cause and effect questions.

Limitations and implications of the results for teacher training program and the procedure of the assessment of teachers' improved knowledge will be further elaborated in the paper.

Main references

- Lewis, C., Perry, R. and Murata, A. (2006). How should research contribute to instructional improvement? The Case of Lesson Study. *Educational Researcher*, Vol. 35, no. 3, 3-14.
- Marton, F. (1981). Phenomenography – Describing conceptions of the world around us. *Instructional Science*, 10, 177-200.
- Marton, F., Tsui, A. B. M. (and Chik, P. P. M., Ko, P. Y., Lo, M. L., Mok, I. A. C., Ng, F. P., Pang, M. F., et al.) (2004). Classroom discourse and space of learning. Mahwah, NJ.: Lawrence Erlbaum Associates, Inc.
- OECD (2000) Literacy in the information age. Organization for Economic Cooperation and Development: Paris.
- Parodi, G. (1989) "Inferencias: concepto y clasificaci3n". En: Informe Proyecto Fondecyt N° 7188. Fondecyt Foundation: Santiago, Chile.
- Stigler, J., & Hiebert, J. (1999). The teaching gap: Best ideas from the world's teachers for improving education in the classroom. Free Press. New York.
- Yoshida, M. (1999). Lesson Study: A Case Study of a Japanese Approach to Improving Instruction Through School-Based Teacher Development. Unpublished doctoral dissertation, The University of Chicago.

PAPER PRESENTATION

Changing teaching profession through co-teaching

Anna Rytivaara, University of Jyväskylä, Finland; Jonna Pulkkinen, University of Jyväskylä, Finland

Issues of teacher collaboration and co-teaching are currently being discussed in relation to both policy and practice. Teaching is a changing profession with different phases; nevertheless, it has traditionally been a profession of solitary individuals. This study focused on how co-teaching modifies teaching profession and what factors facilitate or complicate co-teaching. The main data of this paper were the diaries of 30 teachers. The data was analysed with qualitative content analysis. The results of this study indicated that co-teaching lightens teachers' workload due to sharing. Teachers' collaboration seemed to have many positive effects on teaching as well. The study suggests that co-teaching demands reflection, flexibility and common way of thinking about teaching and learning. Co-teaching seems to change both direct and indirect work of teachers. Furthermore, it looks like co-teaching has influence on several dimensions of teachers' professionalism. A critical point of collaboration and co-teaching, however, is common planning time. Implications for teacher education are discussed.

Introduction.

Issues of teacher collaboration and co-teaching are currently being discussed in relation to both policy and practice. Teaching is a changing profession with different phases; nevertheless, it has traditionally been a profession of solitary individuals (Hargreaves, 2000). New era might be emerging, however, since teacher collaboration and co-teaching are mentioned in official documents, such as in the Finnish special education strategy proposal (Finnish Ministry of Education, 2007). The situation in many other countries is probably very similar to Finland, where special education teachers use only 7% of their teaching time in general education classroom together with another teacher (Takala, Pirttimaa, & Törmänen, 2009). The main idea of this inclusive act is to provide pupils with flexible support, contrary to present, rather heavy special education system. However, there is very little evidence of how co-teaching actually affects on teaching profession. Professionalism can be divided into three dimensions: technical culture, service ethic and professional commitment. The last one of these includes commitment to teaching, the subject matter and continual personal growth (Day, 2002). Furthermore, teachers' work can be divided into direct work, related to teaching, and into indirect work, which is related to work teachers do outside lessons (Takala et al., 2009). In co-teaching, unlike in the traditional working model, teachers share both of these, wholly or partly. It is, therefore, important to focus in more detail on teachers' views on collaboration and co-teaching. The aim of this paper is to examine how co-teaching modifies teachers' work, and what factors facilitate or complicate co-teaching.

Methods.

This research is part of a larger project which aims at developing new forms of support at schools. The project is funded by the Finnish Board of Education. The subproject from which the data was collected for this paper, focuses on teacher collaboration and co-teaching. It includes eight participating municipalities in Central Finland with total of 850 elementary school teachers. In the first phase of the study, all the teachers were sent a questionnaire. The focus of this paper is on the second phase of the study, in which we got 22 applications from teacher teams who were willing to volunteer to experiment intensive co-teaching for nine weeks. 11 teams, 30 teachers, were selected for the experiment on the basis of the aims the teams had set for co-teaching. The project funding made it possible to pay the teachers 4 hours of work a week for their co-planning and reporting, which was in addition to their regular working hours (~24 lessons plus 3 hours for indirect work a week). All the teachers were informed about the research at the project announcement. Furthermore, all the teachers selected to the project signed an informed consent for us to use the data (diaries, interviews) for research purposes. In addition to actual working together, the teachers were committed to fill in a short daily questionnaire, and to keep a weekly diary. In addition, the researchers visited each of the schools to make tentative interviews and to get acquainted with the teachers. Teachers' diaries are the main data of this paper. The data was analysed with qualitative content analysis (Mayring, 2000). Further analysis of the data is under process.

Results.

All the teachers had rather similar experiences regarding the effects of co-teaching. Teachers talked about self-reflection; how it is possible to observe another teacher at work and to learn from it, as well as to ponder one's own teaching. Co-teaching also gave teachers more time to observe the pupils and their learning more closely while the other teacher took responsibility for actual teaching. Co-teaching also encouraged teachers to use instructional strategies which they could not use when working alone. Most of the teachers seemed to enjoy co-teaching. Some teachers, however, were more willing than others to share their work with their colleague, whereas some kept rather

fixed roles during the common lessons. A remarkable challenge for the teachers was to find a common planning time with their co-teachers. For the more flexible teachers, however, even the common planning time was kind of an extended and enjoyable part of co-teaching. Based on the differences in teachers' interviews, it seemed that success in co-teaching was based on common trust and teachers' open attitudes towards new ways of working. These teachers also expressed common way of thinking about teaching and learning. They emphasized flexibility at work as well.

Conclusions.

The results of this study indicate that co-teaching lightens teachers' workload due to sharing. Teachers' collaboration seems to have many positive effects on teaching. The results are consistent with current research (Pfeifer & Holtappels, 2008), but our study adds new knowledge about the co-teaching. The study suggests that co-teaching demands reflection, flexibility and common approaches to teaching. Co-teaching seems to change both direct and indirect work of teachers. Furthermore, it looks like co-teaching has influence on several dimensions of teachers' professionalism. A critical point of collaboration and co-teaching, however, is common planning time. This finding corresponds to the findings of Carter, Prater, Jackson, and Marchant (2009). All-day working model could be a suitable solution for this problem. The implication for teacher education is how to support this kind of new professionalism. The other issue is to consider such criteria for the admittance to the teacher education that would result in student teachers and professional teachers, who are willing to share their classroom with another professional.

References

- Carter, N., Prater, M. A., Jackson, A., & Marchant, M. (2009). Educators' perceptions of collaborative planning processes for students with disabilities. *Preventing School Failure: Alternative Education for Children and Youth*, 54(1), 60-70.
- Day, C. (2002). School reform and transitions in teacher professionalism and identity. *International Journal of Educational Research*, 37(8), 677-692.
- Finnish Ministry of Education. (2007). *Erytyisopetuksen strategia* [The special education strategy] Publications No. 47. Opetusministeriö.
- Hargreaves, A. (2000). Four ages of professionalism and professional learning. *Teachers and Teaching*, 6(2), 151-182.
- Mayring, P. (2000). Qualitative content analysis.1(2), 2-11.
- Pfeifer, M., & Holtappels, H. G. (2008). Improving learning in all-day schools: Results of a new teaching time model. *European Educational Research Journal*, 7(2), 232-242.
- Takala, M., Pirttimaa, R., & Törmänen, M. (2009). Inclusive special education: The role of special education teachers in Finland. *British Journal of Special Education*, 36(3), 162-173.

PAPER PRESENTATION

How cognitive activating are novice teachers' lessons compared to those of experienced teachers?

Corinne Wyss, University of Education Zurich, Switzerland; Titus Guldemann, University of St Gallen, Switzerland;
Mirjam Kocher, University of Education Zurich, Switzerland; Anneliese Elmer, University of St Gallen, Switzerland
Matthias Baer, University of Education Zurich / University of Zurich, Switzerland

As a result of the unsatisfactory effectiveness of Swiss teacher training (Oser & Oelkers, 2001; Oelkers & Oser, 2000), for the first time in the history of Swiss teacher training, standards were formulated which attempt to conceive the competences of teachers in a concise manner based on defined ideals. Embedded in this context and supported by the Internationale Bodensee Hochschule (IBH) and the Swiss National Science Foundation (SNF), our research project examined training and job experience oriented towards professional practice. Additionally, the impact of the first year in profession on novice teachers' competences was investigated. For the three years of teacher education, the results show an overall increase in teaching competences for each year. However, for the first year in profession almost no further progress in novice teachers' teaching competences was found and the level of students' cognitive activation in the 82 videotaped lessons taught by them at the beginning and at the end of their first year after graduation rather seems to be low. Due to these observations, tracing the quality of novice teachers' competence to cognitively challenge their students in a lesson became the specific focus in continuing the research project. On the basis of Klieme, Pauli & Reusser (2003), Blömeke et al. (2006) and Danielson (2009), we developed and applied procedures for analyzing the 82 lessons. Accordingly, the videotaped lessons of experienced teachers with ten and more years of successful teaching as a reference group were analyzed. Results of these analyses will be presented.

As a result of the examination of the effectiveness of Swiss teacher training in the 1990s by Oser & Oelkers (2001; Oelkers & Oser, 2000), it became evident that the training of teachers in Switzerland was not as good as previously

imagined. Oser's (2001, p. 310) conclusion that "what develops in the heads of candidates for the teaching profession is not professional ability and mastery, but merely isolated pieces of knowledge" (see also Wideen, Mayer-Smith & Bloom, 1998) was disconcerting. A great deal has changed since then. Fuelled by the unsatisfactory effectiveness of Swiss teacher training, the turn of the millennium saw the emergence of "Pädagogische Hochschulen" (educational universities) in Switzerland. Whereas teachers had been trained in so-called Lehrer/innenseminaren - pre-service training at higher secondary level - training of teachers occurs now, after the reform, at the tertiary level. Moreover, influenced by initiatives of teachers' associations and state educational institutions in America and Australia (cf. for example Wilbers, 2005, 135 ff; Keller, 2002; Dalla Piazza, Keller & Lienhard, 2002), for the first time in the history of Swiss teacher training, standards were formulated which attempted to conceive the competences of teachers in a concise manner based on defined ideals. Teacher training should no longer take place according to the principle of "anything goes", as Oelkers stated, but should rather be oriented towards a total of ten professional standards. The new educational universities adopted these standards as the maxim of their training (PHZH, 2002; Jurt, 2005; Baer et al., 2008). Referring to these standards new curricula and examination regulations were developed, the Bologna declarations were implemented in a step-by-step fashion, the Swiss educational universities learned to devise and pursue longer-term development strategies, and the question of effectiveness and quality, of achieved standards and acquired competences, became a focal point of interest. Reforms of the degree courses, which were designed only a few years ago, are meanwhile already underway (Keller, 2006).

Embedded in this context and supported by the Internationale Bodensee Hochschule (IBH) and the Swiss National Science Foundation (SNF), our research project examined a key area of the teacher training degree course, namely training and job experience oriented towards professional practice. Additionally, the impact of the first year in profession on novice teachers' competences was investigated. Both perspectives aimed to provide information about the acquisition and quality of teaching competences of prospective and novice teachers at the primary school level (grade 1 to 6 in Switzerland). A group of expert teachers with many years of successful teaching experience constituted the reference group.

The results of the research project give rise to optimism: For the three years of teacher education, the results show an overall increase in teaching competences for each year (Baer et al. 2007, 2009, in prep.; Larcher et al., 2010; Kocher, Wyss, Baer & Edelmann, 2010), also with regard to the dimension "cognitive activation". However, there are two "but": (1) For the first year in profession almost no further progress in novice teachers' teaching competences could be found. (2) Although student teachers' competence to cognitively activate the students in their videotaped lessons significantly improved throughout teacher education, questions and problems novice teachers' – in their first year after graduation – let the students work on do not seem to be challenging enough due to rather low cognitive activation levels. These observations drew our attention in continuing the research project.

Tracing the quality of novice teachers' competence to cognitively challenge the students in their lessons became the specific research focus. Students' cognitive activation is central for teaching quality. According to Stein et al. (2003) and Hiebert and Grows (2007), adequate cognitive challenge is – besides time on task – a very important factor for students' success in learning. Together, the two factors lead to deeper understanding and more sustained learning due to more profound information processing and problem solving activities by the learner. Therefore, it is imperative that teachers are able to pose adequate questions and problems to challenge students' cognitive activities.

In pursuing the research question whether novice teachers are competent enough to challenge students cognitively, we analysed 82 videotaped lessons which novice teachers taught at the beginning, respectively the end of their first year in profession. Our research questions are: How do novice teachers arrange the important start phase of a lesson (first 10 minutes)? Of what quality are the questions and/or problems novice teachers pose their students (at the beginning of a lesson)? In which ways do students participate in the learning activities of the videotaped lesson? How cognitively challenged are they? How are the learning interactions arranged between teacher and students and among students? Of what quality for students' learning processes are they? How do novice teachers support the learning processes of their students? Is their support cognitively beneficial enough for the students?

On the basis of Klieme, Pauli & Reusser (2003), Blömeke et al. (2006) and Danielson (2009), we developed and applied procedures for analyzing the videotaped lessons, respectively for transforming qualitative data into quantitative data. The videotaped lessons of experienced teachers with ten and more years of successful teaching as a reference group were analyzed accordingly. First results show that the cognitive activation level is astonishingly low. Furthermore, novice teachers predominately pose many small and close questions in a lesson which are answerable by the students with few cue words only. More detailed results, especially those from comparing novice and experienced teachers and from comparing data from the first and the second measurement point will be available by the time of the conference.

PAPER PRESENTATION

Teachers' motivations for teaching in higher education

Gerda Visser-Wijnveen, Leiden University, Netherlands; Ann Stes, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium

Motivation is a powerful, but rather neglected force in teaching at higher education institutes. In the strive for excellence in teaching a better understanding of academics' motivations for teaching is necessary. In this mixed-method study a questionnaire was presented to 283 academics and semi-structured interviews were conducted with 18 of them. Six different clusters of teachers were identified with regard to motivation: expert teacher, moderate teacher, subject specialist, passionate teacher, low commitment teacher, and weak teacher. The teachers in the various clusters differ on their perceived personal effectiveness, interest, and effort for teaching. Interview data revealed the competitive function of research and the importance of the subject they have to teach.

Aims

One of the major issues in higher education is the quality of teaching. As staff/student ratios increased over the decades, while at the same time international attention to teaching and student learning expands, enormous efforts have to be made to find ways to help academics develop their teaching quality (Schimank & Winnes, 2000). Next to someone's capacities his or her motivation greatly influences the actual performance (Ambrose & Kulik, 1999). If we want the teaching body of universities world wide to improve we need to address this issue and see what different motivations academics hold for teaching and how we can use this for the benefit of universities, academics, and students. In the concept of motivation we include aspects of self-efficacy, interest, and effort. We aim to distinguish between various forms of motivation for teaching by means of clustering.

Methodology

On a voluntary basis 283 academics from various higher education institutes returned a questionnaire on motivation for teaching. Interviews were conducted with a small sample that participated in a one-year instructional development programme for novice teachers aimed to raise professional standards with regard to classroom practice. For 18 academics both questionnaire and interview data were available. The questionnaire on motivation was developed on the basis of three previous questionnaires: a self-efficacy/motivation questionnaire by Trigwell, Aschwin, Lindblom-Ylänne, and Nevgi (2004), the Intrinsic Motivation Inventory (Deci & Ryan, n.d.) and the Teacher Efficacy-questionnaire by Soodak and Podell (1996). Four scales contributed to the construct of 'motivation for teaching': personal effectiveness: context, personal effectiveness: general, interest, and effort. A semi-structured interview was conducted with all participants of a one-year instructional development course for novice teachers organized at the University of Antwerp in 2005-2006. This interview focused on the motivational themes of perceived personal effectiveness, interest, and effort for teaching. A hierarchical cluster analysis was performed on the questionnaire data to explore homogeneous clusters of cases within the data. Average linkage within groups and squared euclidean distance were used to calculate the mean distance between all possible cluster pairs. A one-way ANOVA was performed to see whether the clusters differed on the four scales. The Tukey B-test was used as post-hoc test to identify which clusters differed from each other on which scales. All interviews were independently analysed by two researchers. Afterwards, the analyses of both researchers were compared and adjusted to a combined codebook including the variation identified by both researchers. Ultimately, the teachers were assigned to the final categories.

Findings

The hierarchical cluster analyses showed six clusters with a meaningful difference. On all scales the clusters differed significantly. On the basis of their properties the six clusters can be characterised as follows: Expert teacher: high capacities, interest, and effort (n=130). Moderate teacher: moderate capacity and interest, and high effort (n=36). Subject specialist: high capacities for specific subject, and very high effort, moderate interest and general teaching capacity (n=46). Passionate teacher: capacity below average, high interest and effort (n=54). Low commitment teacher: relatively low capacity, moderate interest, and low effort (n=9). Weak teacher: low capacity, low interest, and moderate effort (n=5).

The combination of the quantitative data and the qualitative analysis led to more detailed pictures of the six clusters. The number of interviewed participants in the six clusters varies between 1 (F) and 6 (C). For 'personal effectiveness' the main division was on the level the teachers estimated themselves, being good, moderate, or weak. The argumentation for these estimations varied from 'experience' (low) to 'content knowledge' (low or excellent) and 'teaching practice' (transmissive or student-centred). The theme 'interest' was divided in four categories:

content/negative (no interest, because of subject), content/positive (interest, because of subject), teaching/content (interest, because of teaching of specific subject), teaching/process (interest, because of the process of teaching). The theme 'effort' was related to respondents' perceptions of their professional identities: researchers put lowest effort, teacher/researchers tried to balance their effort for both tasks, teachers dedicated most effort to teaching.

Summarised, the qualitative analysis showed the following characteristics: Cluster Personal effectiveness: context Personal effectiveness: general Interest Effort A Good Good Teaching/process and Teaching/content Teacher/Researcher and Teacher B Moderate or Good Moderate or Good Teaching/content Teacher/Researcher C Moderate or Good Moderate Teaching/content and Teaching/process Teacher/Researcher D Low Low Teaching/content and

Content/positive Teacher/Researcher E Low Low Content/positive Researcher F Low Low Content/negative Researcher Significance Motivation is easily overlooked as a significant factor in the quality of teaching. Especially programmes for instructional development focus mainly on competencies of teachers. If motivation is taken into account this is rarely diversified in rationales for motivation. Our research showed that a high effort was characteristic for most teachers; only one group was not willing to put that much effort in teaching as they considered research far more important. Dividing time and effort between research and teaching was, nonetheless, an issue for many teachers. For some teachers their motivation is highly affected by the subject they have to teach, either in a positive or negative way. For other teachers self-efficacy stands out: for example a lower self-efficacy for novice teachers. It would be interesting to investigate in future research in what ways the different rationales for motivation influence teachers' professional development.

References

- Ambrose, M.L. & Kulik, C.T. (1999). Old friends, new faces: motivation research in the 1990s. *Journal of Management*, 25(3), 231-292.
- Deci, E.L. & Ryan, R.M. (n.d.) Intrinsic Motivation Inventory (IMI), http://www.psych.rochester.edu/SDT/measures/IMI_description.php
- Schimank, U. & Winnes, M. (2000). Beyond Humboldt? The relationship between teaching and research in European university systems. *Science and Public Policy*, 27(6), 397-408.
- Soodak & Podell (1996). Teacher efficacy: toward the understanding of a multi-faceted construct. *Teaching and Teacher Education*, 12(4), 401-411.
- Trigwell, K., Ashwin, P., Lindblom-Ylänne, S., & Nevgi, A. (2004). Variation in approaches to university teaching: the role of regulation and motivation. Paper presented at the European Association for Research on Learning and Instruction (EARLI) Higher Education Special Interest Group conference, Stockholm, Sweden, 18-21 June.

PAPER PRESENTATION

Progress and stillstand? – Teaching competences in teacher education and first years in profession

Matthias Baer, University of Education Zurich / University of Zurich, Switzerland

There is empirical evidence enough to assume that teaching quality is strongly related to students' learning outcomes. Therefore, teachers should become experts in their fields, first of all by an effective teacher education, but also by learning through regularly experiencing teaching when they have started to work in their profession. However, still little is known on an empirical basis about the effects of teacher education and regularly teaching a class after graduation.

In our paper, we shed a light on the acquisition of teaching competences. With experienced teachers as a reference group, the focus of interest was the longitudinal analysis of teaching competences from the beginning up to the end of teacher education and into the first and second year as a novice teacher.

We report on three of totally eleven data collection instruments: (1) an online-questionnaire for self-estimating one's own teaching competences, (2) vignettes to trace competences for planning and implementation of teaching, and (3) videos of school lessons taught by the subjects of the research project. Each instrument was applied with student teachers, novice teachers in their first two years and experienced teachers with many years of successful teaching. In addition to the quantitative analyses, procedures for transforming qualitative data into quantitative data were developed and applied.

The results for the three years of teacher education show an overall increase in teaching competences for each year. However, for the first two years in profession surprisingly almost no further progress could be found.

PAPER PRESENTATION

Teachers seek but do not offer help: Factors which enhance or hinder teachers' help seeking

Kati Makitalo-Siegl, University of Jyväskylä, Germany; Anna-Maria Mekota, University of Munich, Germany; Silvia Schulz, University of Munich, Germany

Adult help seeking is influenced by numerous variables and deciding to seek help is not always an easy step. While several help-seeking studies in school and adult education exist, there are only few studies concerning teachers' help seeking directly at their workplace, especially focusing on teachers at their different career stages. This study investigates less and more experienced teachers' help-seeking behaviour and aims to identify which factors prevent or enhance help seeking in schools. Qualitative content analysis of 10 teachers' interviews (primary and secondary schools) reveals that a teacher, who is facing a problem, has to take a first step to seek help. In general, the teachers do not offer help to their colleagues without a help request, but a principal can take the role of a help-giver without receiving a help request from teachers. Teachers have several informal help sources in schools and outside their schools; for example former student fellows who are teachers at other schools. These help sources are selected based on the personal relationship or help-giver's expertise, status or willingness to give help. The help source is more often perceived as equal or higher in status as the help-seeker. For this reason, experienced teachers might find it more difficult to seek help than novice teachers. In order to design a successful support system for teachers, we suggest that the factors enhancing and hindering teachers' help seeking with the intergenerational aspect should be considered.

By 2015 over a million primary and secondary education teachers will have to be recruited and trained in Europe (Education and training, 2010; Report based on indicators and benchmarks, 2006). One third of all teachers are aged over 50 and many senior teachers are retiring as early as possible. At the same time a significant number of novice teachers leave their profession during their first years, due to various reasons, such as disciplinary problems, high workload, and low income. A mass escape might cause a shortage of trained educational personnel in Europe. Several support or mentoring systems have been implemented, especially for novice teachers, but the studies on help seeking, however, show that teachers do not seek help from formal sources (Wills, 1983; Tellez, 1992).

The growing number of teachers leaving their profession indicates a lack of adequate support. Therefore, a focus should lie on the identification of the factors that enhance or hinder teachers' help-seeking behaviour at different stages of their careers in various school levels in order to provide adequate help for teachers when they need it. Comparing the teacher profession with other professions, one major difference is evident: novice teachers are expected to be fully ready for the demands of teacher profession (Lortie, 1975). Therefore, a teacher who is seeking help may risk losing his face. This aspect might not only set a barrier for novice teachers to seek help, but also for senior teachers who are regarded as being an expert. The avoidance of help seeking might also be a way to assure the teachers' abilities and selfworth in the classroom (Retelsdorf et al., 2010). According to Glidewell et al. (1983), teachers' interdependency and the norms of autonomy and equality are likely to discourage teachers to seek and receive help. They also state that a request of help implies low status of a help-seeker. Furthermore, people are more likely to seek help from someone of equal or higher status than from one of lower status (Shapiro, 1983).

So far, there are hardly any studies focusing on teachers' help-seeking behaviour regarding the intergenerational aspect. In this study we investigate teachers' help-seeking behaviour at various stages of their career in different school levels focusing on the factors which enhance or hinder teachers' help seeking.

Method

Teachers were recruited individually and joined the study voluntarily. The data was collected by individual interviews with 10 teachers from primary- and secondary-school levels (one elementary school, two high schools and one special education school). Four teachers had less than 5 years of teaching experience after the pre-service education and they were named novice teachers (mean years of teaching experience = 1.4). Another four of the participants (named senior teachers including principals) had more than 20 years of teaching experience (mean years of teaching experiences = 30.5). Two so called middle-teachers had less than 20 years, but more than 5 years teaching experience (mean years of teaching experience = 7.5). The interviews were transcribed and content-analysed. The help-seeking analysis focuses on the following questions: Who takes the initiative when problems arise? Whom do they ask for help? What kind of persons and in what kind of situations do teachers ask for help? On the basis of these questions we will identify different kinds of help sources - informal or formal - and compare the status of help-giver and help-seeker.

Results

Based on the teachers' interviews, there is a common understanding that the person who needs help should ask for it. A principal, who has the highest status at the school, can be the one, who offers his help without a teacher requesting it. Our preliminary results show that the teachers in this study, sought help from informal sources, such as their colleagues in and outside their schools, family, and former teacher counsellors (see also Tellez, 1992; Wills, 1983). The colleagues from outside the school are usually former student fellows from pre-service or continuing education who are perceived more as friends than colleagues. Using more informal sources than formal sources seems to be common, because schools rarely have a formal support system (a system which is organised by the school administration and is taking place regularly) for novice or other teachers. Close and long-term relationships and trust enhance teachers' help seeking both in and outside their schools.

The data analysis reveals that the teachers are selective whom they ask for help. They seek help from people they perceive as friendly and caring and who are willing to help. The selection is based also on the help source's expertise. The results of our data analysis support the results of the earlier study by Shapiro (1983), that people are less likely to seek help from someone of lower status than from one of equal or higher status. For example, the teachers of this study turned to their former fellow students which are perceived as equal of status. There were no indications in the data that more experienced teachers sought help from their younger colleagues. It seems that the novice teachers possess positive expectations for collegial support, whereas the experienced teachers perceive a teacher as a lonely fighter, which might affect on their help-seeking behaviour. The teachers at the elementary school had more formal support than in the other school levels, which might affect on their perception of help seeking as appropriate coping behaviour. More results on the teachers' help-seeking behaviour at different stages of their career in various school levels will be presented and discussed in the conference presentation.

Discussion

As the preliminary results reveal, teachers' needs and demands varies at their different stages of their career as well as in different school levels. Help seeking should not be seen as a sign of weakness, but of appropriate and professional, coping behaviour. A successful support system is strongly needed: Therefore, the identification of the different elements, which affect teachers' help-seeking behaviour in their schools as well as the intergenerational aspect, should be taken into account and will be discussed in the conference presentation. Furthermore, we will consider the challenges and the possibilities to utilise the technology as a part of the successful support system based on the results of this study.

PAPER PRESENTATION

Effectiveness of a professional development intervention in the field of text-picture integration

Katrin Lintorf, Technical University of Dortmund, Germany; Nele McElvany, Technical University of Dortmund, Germany; Camilla Rjosk, Technical University of Dortmund, Germany; Jurgen Baumert, Max Planck Institute for Human Development, Germany; Wolfgang Schnotz, University of Landau, Germany; Holger Horz, University of Frankfurt, Germany; Mark Ullrich, University of Koblenz-Landau, Germany

Many textbooks contain instructional pictures such as graphs. Unfortunately, students often have difficulties to correctly integrate information from the two sources, texts and pictures. In this situation teachers need professional knowledge to diagnose such problems and to offer the necessary support. Within the expert paradigm of teacher research, professional knowledge is assumed to be learnable. So the aim of the present study was to develop and evaluate a professional development intervention in the field of text-picture integration. Two video based interventions were developed. Both presented text-picture related information with according examples. Additionally, the video content was deepened by exercises with feedback. The experimental group received information about relevant characteristics of students and the instructional materials as well as processes of text-picture integration. In contrast, the control group received a placebo intervention with only very general text-picture integration related information. Both interventions were examined in a pretest-posttest design. The results show that the chosen approach was highly successful since the experimental group showed a significant higher gain in instructional relevant knowledge than the control group. This knowledge gain was neither moderated by aspects of the instructional quality of the video nor by prior knowledge in terms of knowledge about text-picture integration. Instead, contradictory to the expectations, a higher work experience was associated with lower knowledge gains. The implications of these highly relevant results will be discussed with regard to teacher education and further research.

Aims

Most school textbooks contain instructional pictures such as graphs. The ability to correctly integrate the information from both sources, texts and pictures, is a critical condition for learning (Schnotz & Bannert, 2003). But students often

have misconceptions about the interpretation of instructional pictures. Unfortunately, many teachers are unaware of this. Indeed, neither is text-picture integration systematically taught in teacher education in Germany, nor is it recognized as an important instructional goal (McElvany et al., 2009).

However, theories of professional development emphasize that it is teachers' expert knowledge that constitutes the professional standing of teachers (Shulman, 1986). In the past, empirical support for this assumption was only gathered with indirect measures of knowledge (e.g. degrees: Hawkins, Stancavage, & Dossey, 1998). Recent studies show that the promising results of these studies may also be transferred to performance measures (e.g. instructional quality: Hill et al., 2008).

Integral part of this focus on knowledge is the assumption that professional knowledge is learnable (Berliner, 2001). In fact, results from inservice teacher education document the overall effectiveness of professional development programs (Smith & Gillespie, 2007). Whereas the effects of structural aspects are examined but not yet empirically proven (e.g. duration etc.: Kennedy, 1998), a differential effectiveness according to individual characteristics of the participants has not been studied. However, interpreting the teacher as a learner in this setting makes the application of results from instructional psychology reasonable. Most prominent results in this area of research imply that present learning depends on instructional quality and prior knowledge (Weinert & Helmke, 1995). Thereby the instructional quality is usually examined along different aspects and prior knowledge may be understood as knowledge in the relevant domain or as a more general expertise, e.g. work experience.

With regard to the theoretical background and the presented empirical results the following research questions were addressed:

- 1) Does the described professional development intervention enhance the knowledge of inservice teachers about the field of text-picture integration?
- 2) Within the intervention, is a gain in knowledge also positively associated with prior knowledge and the quality of instruction?

Methodology

The analyses are based on data of the German project BiTe, which examines student competencies about text-picture integration and teacher knowledge about the key aspects of this ability. As part of the project a video intervention was developed, which was administered to 58 Biology teachers. 36 of them took part in a text-picture integration related intervention whereas the other 22 teachers received a placebo intervention. Both videos presented text-picture related information with according examples. Additionally the video content was deepened by exercises with feedback. The text-picture related intervention contained information about relevant characteristics of the learner and the instructional material as well as processes of text-picture integration. In contrast, the placebo intervention contained only general text-picture related information. In an experimental design, knowledge gains were measured by means of a pretest-posttest design. The knowledge test was developed and piloted in an earlier phase of the project. It consisted of 20 multiple choice items, which measure knowledge about pictures, about instructional processes, about characteristics of students, and about processes of text-picture-integration.

Findings

Regression analyses and effect sizes were used to analyze whether the text-picture integration related intervention enhances the teachers' knowledge and respectively, whether this knowledge gain differs from that of the control group. The results revealed that under control of prior knowledge in the field of text-picture integration the posttest knowledge of the experimental group was significantly higher than that of the control group ($b = .51$, $p = 1.04$). In order to test potential moderators of the knowledge gain, interaction terms of the experimental condition with potential moderators were included in the regression equation. Neither teacher ratings of the instructional quality of the video, nor the prior knowledge in the relevant domain moderated the knowledge gain. Yet, work experience proved to be a significant moderator ($b = -.55$, $p = .010$). Contradictory to the expectations, teachers with a longer work experience showed significantly lower knowledge gains.

Theoretical and Educational Significance

The presented findings clearly show that the implemented intervention in the field of text-picture integration was very successful. Furthermore, the absent moderating effects of the instructional quality and prior knowledge in the relevant domain should be considered a positive sign in that the intervention had a uniform effect on all teachers. On the other hand the moderating effect of work experience might be a question of age. These results are highly relevant. From a theoretical point of view they underline the assumption that professional knowledge is learnable and that it shows a manifestation in performance measures. From a practical point of view the evaluated intervention

appears to be a promising approach for inservice teacher education by closing the substantial gap in text-picture integration in teacher education.

References

- Berliner, D.C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35(5), 463–482.
- Hawkins, E.F., Stancavage, F.B., & Dossey, J.A. (1998). School policies and practices affecting instruction in mathematics: Findings from the National Assessment of Educational Progress. Retrieved from: <http://www.eric.ed.gov/PDFS/ED424116.pdf> [26.10.2010].
- Hill, H.C., Blunk, M.L., Charalambous, C.Y., Lewis, J.M., Phelps, G.C., Sleep, L., & Ball, D.L. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction*, 26(4), 430–511.
- Kennedy, M.M. (1998). Form and substance in inservice teacher education. Madison, WI: National Institute for Science Education, University of Wisconsin.
- McElvany, N., Schroeder, S., Hachfeld, A., Baumert, J., Richter, T., Schnotz, W., Horz, H., & Ullrich, M. (2009). Diagnostische Fähigkeiten von Lehrkräften bei der Einschätzung von Schülerleistungen und Aufgabenschwierigkeiten bei Lernmedien mit instruktionalen Bildern [Teachers' diagnostic skills to assess student abilities and task difficulty of learning materials incorporating instructional pictures]. *Zeitschrift für Pädagogische Psychologie*, 23(3/4), 223–235.
- Schnotz, W., & Bannert, M. (2003). Construction and interference in learning from multiple representations. *Learning and Instruction*, 13, 141–156.
- Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Smith, C., & Gillespie, M. (2007). Research on professional development and teacher change: Implications for adult basic education. *Review of Adult Learning and Literacy*, 7, 205–244.
- Weinert, F.E., & Helmke, A. (1995). Interclassroom differences in instructional quality and interindividual differences in cognitive development. *Educational Psychologist*, 30(1) 15–20.

PAPER PRESENTATION

Teacher research in Dutch secondary education: Effects and issues of quality

Jacobiene Meirink, Leiden University, Netherlands; Paulien Meijer, Utrecht University, Netherlands; Helma Oolbekkink-Marchand, Radboud University, Netherlands; Ditte Lockhorst, Oberon research institute, Netherlands

This study describes an empirical exploration of three Dutch projects in which secondary education teachers (learn to) research their own practice in collaboration with research institutes within universities. These three projects are exemplary for a recent movement of doing research on education in close collaboration between teachers, schools, and universities. The study shows the results of the three projects for both teachers and schools, and how these results are related to organizational conditions within the three projects. Perceptions of revenues of 48 teachers and 17 managers of 11 schools were gathered with interviews. These data were analyzed using the criteria for practitioner research of Anderson and Herr (1999), consisting of five types of validity that together provided an indication of the quality of the teachers' research. The projects showed results mainly on the level of the individual teacher. Teachers reported development of their knowledge and skills with respect to doing research, a more critical attitude, and consciousness of and (intentions to) change of teaching performance. To a lesser extent results on school level were reported. Organizational conditions appeared to be related to results on school level, not to results on the level of individual teachers. The study concludes to state that, if these type of projects are about to lead to the collaborative development of more scientifically accepted knowledge, more attention needs to be paid to the dissemination of knowledge as well as to the quality assurance of the research performed.

Aims & research questions

Practitioner research, teacher research, inquiry learning, self-study: teacher research is popular in literature on teaching and teacher education. Recently, in Dutch secondary education various teacher research projects were financed to foster teacher professional development. Teacher research can be an effective way of professional development. This links to the idea of the teacher being the 'active knower' instead of using knowledge of others (Cochran-Smith & Lytle, 1999, Cochran-Smith & Demers, 2008). Although teacher research projects seem to be promising, in literature on teacher research only a few studies can be found that actually describe the effects and the quality of practitioner research (Wilson and Berne, 1999). In this study, we describe three teacher research projects that are exemplary for the recent movement in the Netherlands of doing research in education in a context of close collaboration between teachers, schools and universities.

Two research questions will be addressed: (1) What are the results of teacher research both for teachers and schools? and (2) how do these results relate to the organizational characteristics of the initiatives around practitioner research in schools.

Theoretical framework

Most teachers search for ways to improve their teaching practice. For this purpose, teacher research in which teachers are actively involved in knowledge generation can be an effective method (Cochran-Smith & Lytle, 1999; Henson, 2001; Burton & Bartlett, 2005). Coppola (2007) refers to scholarship when research and teaching coincide. Similar to scientific research, teacher research has to meet quality standards. Anderson and Herr (1999) described different validities which can indicate the quality of teacher research in the context of the school. These validities provide a useful method to describe teacher research outcomes, beside the individual outcomes which are often the only outcomes being described. We used four of these validities to describe the outcomes of the research projects in our study. Outcome validity was used to determine whether the research undertaken resulted in meaningful outcomes for teachers and schools. Democratic validity concerned the involvement of different parties in the problem under investigation, for instance students or colleagues. Catalytic validity illustrated if teachers required a better understanding that transformed their own knowledge and behavior and the knowledge and behavior of other parties. Dialogic validity demonstrates the way in which dialogue with peers was developed.

Methodology

Each project consisted of three to four schools in which teachers participated in research projects. In total 48 teachers and 17 school leaders were involved in the data collection. Semi-structured interviews with teachers and school leaders were used to examine the outcomes of these projects and how these outcomes might be related to organizational characteristics. The four validities described previously were used to analyze the data regarding the first research question. Quotations in the interviews relating to the different validities were identified, grouped and labeled by two researchers independently. Next, they discussed these groupings/labels until they reached consensus. Per type of validity the researchers calculated frequencies of the quotations per validity and per school. Relevant quotations from the interviews that related to the way teacher research was organized in schools were analyzed in a similar procedure.

Findings

The results of the three initiatives around practitioner research in schools are described in terms of the four validities. In general the projects were beneficial for the individual teachers who mentioned outcomes like an increase in research knowledge and skills, critical attitude to their own teaching practice and an intention to change their teaching practice. Results for the school focused on the development of a critical attitude towards school policy, but were reported less often. Concerning the organization of the initiatives no relation was found between the results at teacher level and the organization of research within the school. However, a relation between the way the project was organized and the results at school level was found. In schools where teachers reported a change in school culture explicit attention from school management, and sometimes teachers themselves, for the positioning of the projects was realized. Furthermore, the topic of research also related to outcomes on school level. In schools where teachers perform research which is closely related to school policy and management issues, a more critical attitude towards policy in general was reported. Theoretical and educational significance of the research This study shows that the quality validities of Anderson and Herr can be used to describe the outcomes of teacher research projects. Together, these validities provide a more comprehensive framework of analysis for effects of teacher research compared to merely determining direct outcomes for teachers. Furthermore, an in-depth study of teacher research and its results and quality, gives clues for the organization of this type of research in schools and universities and for organizing teachers' professional development. If teacher research aims at producing knowledge for the development of education, collaboration between different parties seems essential. Not only between teachers within the school but also between teachers and students, teachers of other schools, and parents. A very important aspect pertains to collaboration with academics around all aspects of the research process, which is essential for contributing to developing communities of research in teaching. Such collaboration should be viewed as professional development for all involved. Another implication for practice is the need to make results from teacher research accessible, and systematic attention should be paid to developing platforms where teachers can make their research results public, specifically for other teachers.

References

Anderson, G. L., & Herr, K. (1999). The new paradigm wars: Is there room for rigorous practitioner knowledge in schools and universities? *Educational Researcher*, 28(5), 12-21+40.

Burton, D., & Bartlett, S. (2005). *Practitioner research for teachers*. London: SAGE.

Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education*, 24, 249-305.

Cochran-Smith, M., & Demers, K. E. (2008). How do we know what we know? Research and teacher education. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of research on teacher education* (pp. 1009- 1016). New York: Routledge.

Coppola, B. P. (2007). The most beautiful theories. *Journal of Chemical Education*, 84, 1902-1912.

Henson, R. K. (2001). The effects of participation in teacher research on teacher efficacy. *Teaching and Teacher Education*, 17, 819-836.

Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. *Review of Research in Education*, 24, 173-209.

PAPER PRESENTATION

Improving competences of classroom management. Evaluation of a teacher training programme.

Valentina Piwowar, Free University of Berlin, Germany; Felicitas Thiel, Freie Universität Berlin, Germany; Diemut Ophardt, Freie Universität Berlin, Germany

The intervention study reports the evaluation of a training program for advancing competences in classroom management. Classroom management is a well established concept in US-American research, whereas there is a lack of empirical studies on teacher training in classroom management skills in Germany. The intervention is composed of three modules and contains theoretical input and the guided analysis of video recordings. 60 experienced secondary level teachers attended the program. The experimental group participated in all parts of the intervention whereas the experimental group received a shortened version. Effectiveness of the program will be assessed by direct and indirect measurements. Student, teacher and observer ratings were developed to measure the quality of classroom management. Additionally, the students' on- and off-task behavior is assessed as well as the acceptability of the intervention evaluated by the participants.

Theoretical Background

In German teacher education and training, building competences in classroom management was a neglected issue for a long time (Helmke, 2003). However, classroom management is a central process variable for student achievements (Wang, Haertel & Walberg, 1993; Brophy & Good, 1986) and therefore crucial for quality teaching. According to Ophardt & Thiel (2008), classroom management is constituted by three complementary approaches:- the behavioral approach focuses on encouraging desired behaviour and reducing misbehaviour,- the ecological approach refers to the works of Jacob Kounin (1970) and Walter Doyle (1984, 2006) and emphasizes proactive management techniques as smoothness, momentum or signal continuity,- the action theory is represented by Edmund T. Emmer, Carolyn M. Evertson and Carol S. Weinstein (Emmer, Evertson & Worsham, 2003; Evertson, Weinstein & Simon, 2006) and focuses on introducing and establishing efficient rules and procedures to formulate expected behaviour.

While in US-American research and literature the concept of classroom management is well established, there is a lack of German studies and data for an evidence based design of programs for conveying competences in classroom management in teacher education. Investigations of expertise in teaching evince that in addition to procedural knowledge partially unconscious routines are relevant for classroom management (Schlön, 1987). By analysing their own teaching behaviour, teachers become aware of their teaching competences. As Brophy (2004) points out, video based analysis is one of the most efficient methods that helps to develop the expertise pointed out above. The implementation of video documented lessons allows a specification and increase of personal knowledge and enables to reflect contextual conditions and alternative options of behaviour (Krammer & Reusser, 2006). Research aims Aim of the intervention study is the evaluation of a training programme for improving competences in classroom management. The programme contains the imparting of practice-oriented competences, establishing rules, preventing classroom disruptions, dealing with classroom disruptions and conflicts as well as effective classroom guidance strategies.

Method

Participants The study involves 60 experienced secondary level teachers who attend a programme that aims at improving their classroom management skills. Class sizes range from 8 to 31 students aged between 11 and 18 years.

Design

The effectiveness is measured with a quasi-experimental design: Participants choose themselves whether to participate in the experimental or control group. The experimental group received the described intervention (see

below), consisting of three parts, while the control group participated in a shortened version of the first and second part. In addition to the pre- and post-test, a follow-up will be realized four months after the intervention has taken place.

Intervention

The whole intervention is composed of three modules:

Module 1- Imparting declarative knowledge for central strategies of classroom management - Illustration of theoretical contents and important research findings by video examples

Module 2- Video extracts will be discussed in order to deepen the knowledge and develop the previously addressed strategies of classroom management - Explicating the practical knowledge and handling cognitive conflicts will be practiced by discussing contrastive examples

Module 3- Transferring newly acquired skills into practise and reflection in small groups- Video recordings from the participants' classes will be discussed in circles presented by a group leader for improving practical knowledge. Participants obtain a reader which contains the main aspects.

Material

The effectiveness of the programme will be measured by three objective and two self-report instruments. The objective measures contain a low-inferent student rating and an observer rating to quantify a teacher's classroom management skills. The ratings are based on the model of Ophardt & Thiel (2007). Furthermore, the Munich Observation of Attention Inventory MAI (Helmke, 1998), a standardized and systematic observation instrument, provides information about the frequency of students' on- and off-task behaviour. All raters were instructed in an intensive training course before using the observer rating and MAI respectively. A teacher self-rating is used to measure self-reported classroom management skills and knowledge on classroom management. Additionally, the professional self-efficacy is acquired (Schmitz & Schwarzer, 2000). Direct evaluation will be realized by a teacher questionnaire for the participants that facilitates the evaluation of the transfer of gained knowledge into practice, appropriateness of the exercises and quality of the seminar (organization and management).

Procedure

The described instruments are adopted in 60 secondary classes at each of the three times of measurement. In a first lesson, two raters are evaluating classroom management skills while the students' on- and off-task behaviour is assessed via MAI by one further rater. In a second lesson, students and teachers complete their ratings. Expected Data analysis By calculating a latent-change model, the amount of change on the level of performance as well as on the level of knowledge will be computed. It is expected, that only participants of the experimental group show improvement in their performance.

Prospects

The results of the evaluation will be presented and discussed.

PAPER PRESENTATION

Personalised teaching in Initial teacher education: school based activities and special educational needs

Hazel Lawson, University of Exeter, United Kingdom; Brahm Norwich, University of Exeter, United Kingdom; Tricia Nash, University of Exeter, United Kingdom

This paper reports initial findings from a research project which examined what and how PGCE trainee teachers learn about teaching pupils with special educational needs in their placement schools. The project addresses a gap in our understanding about the initial education of teachers as regards special educational needs (SEN), which has been source of concern for many years. Specifically the project examines the school based learning and outcomes of PGCE trainees in 6 primary and secondary university programmes in England that use different approaches to preparing teachers for the special needs aspects of teaching. Three kinds of school based approaches are examined: one that involves a practical teaching task (teaching a child with identified special educational needs), a second that involves a study of a pupil's learning (a pupil study task) and the third where there is no specific SEN task other than class teaching practice. Interviews, observations and survey questionnaires are used in each of the 18 participating schools (3 schools per programme). The research orientation enables a holistic and intensive analysis in each school based on a 2-3 day visit. The mixed data are analysed at a school level and then across the schools to draw out more general conclusions. The findings are used to identify practical principles and procedures about how to design and support planned school based activities relevant to learning to teach pupils with SEN.

Aims

The challenge for initial teacher training to prepare all teachers to teach a diversity of pupils, including children with special educational needs (SEN) and disabilities, is recognised internationally and given impetus from widespread moves towards inclusive education (Booth, Nes and Stromstad, 2003; Sharma Forlin and Loreman, 2008). In the UK (England), despite the Government's expectation that newly qualified teachers should be equipped to carry out their responsibilities, concerns have continued to be expressed about the inadequacy of initial training in this aspect of teaching (House of Commons, 2006, Ofsted, 2008).

This paper builds on recent work carried out by two of the authors (Nash and Norwich, 2010; Norwich and Nash, 2010) on a national project which conducted a trial and evaluation of a practical teaching task (SEN personalised learning task) for preparing primary and secondary teacher trainees to teach pupils with special educational needs. The evaluation of this trial underlined several key aspects, i. the challenge for initial teacher training to prepare all teachers to teach pupils with special educational needs, ii. the critical role of partnership between universities and practice schools in initial training and iii. the potential of ideas and practices about personalisation for including concepts about special educational needs pedagogy into wider pedagogic models.

The project reported here takes this work further by examining what and how PGCE teacher trainees, on their one year teacher training programme, learn about teaching pupils with SEN in the school-based part of their programme. The project has 3 specific aims:

1. To examine the context, the processes and the outcomes of PGCE trainees undertaking different planned SEN activities in primary and secondary schools in terms of school-university partnership arrangements and the schools' general arrangements for initial teacher training;
2. To compare the outcomes of undertaking a specific practical SEN teaching task for trainees and the schools over and above classroom teaching of pupils with SEN / disabilities with i. another kind of school based planned activity about SEN (such as a pupil study task) and ii. where there is only classroom teaching of pupils with SEN / disabilities;
3. To integrate the findings of this project into various forms that can be disseminated and communicated to PGCE providers, placement schools and other organisations with interests in teacher education, for example, to identify practical principles and procedures to design and support planned school based activities relevant to learning to teach pupils with SEN.

Methodology,

A detailed conceptual map was constructed to identify the areas for examination that included:

- i. Planned teaching task or other study task related to SEN;
- ii. Classroom teaching (planning, observation, teaching, supervision);
- iii. School's teacher training provision (supervision, support of trainees, seminars/presentations, place of SEN/inclusive teaching, roles of teacher training mentors/tutors, commitment to initial training partnership);
- iv. School's special needs and inclusive policy and practices (range, nature and incidence of additional needs, specialist resourced units, role of SEN Coordinator);
- v. School's overall policy and practice;
- vi. Partnership with PGCE provider (through visiting tutors, training of mentors/tutors, communication with university).

This framework was used flexibly to design the data collection methods (mainly qualitative with some quantitative aspects), that included documentary, observation and interview data. The participating schools were identified nationally as shown in the table below.

Overview of PGCE and school sample

The data were analysed using the starting conceptual framework but also by identifying emerging themes in a grounded way and summarised in school case analyses. These case analyses were then compared and contrasted to identify higher level themes and principles relevant to the research aims.

Findings:

This paper reports the analyses of the similarities and differences between participating schools as settings for the professional learning to teach pupils with SEN/disabilities. These analyses are set in terms of the partnership arrangements between the schools and the university providers and the schools' general arrangements for initial teacher training. How the trainees in these schools approached the planned school based tasks is also analysed in terms of the kinds of planned tasks compared to the schools with no planned teaching task.

Significance of the research: theoretical and educational:

The paper highlights some key issues in the initial professional learning of trainee teachers in a challenging area of teaching. This addresses both the school organisational and classroom pedagogic processes that improves our

knowledge and understanding about teacher education relevant to the special needs and inclusive education field. The paper will also contribute to practical knowledge about designing and supporting planned school based activities to enhance initial professional learning to teach pupils with SEN / disabilities.

References:

- Booth, T., Nes, K. & Stromstad, M. (eds) (2003) *Developing Inclusive Teacher Education*. London: Routledge Falmer.
- House of Commons (2006) *Special educational needs review*. Norwich: The Stationary Office
- Nash, T. and Norwich, B. (2010) The initial training of teachers to teach children with special educational needs: a national survey of English Post Graduate Certificate of Education programmes. *Teaching and Teacher Education* 26:1471-1481.
- Norwich, B. and Nash, T (2010) Preparing teachers to teach children with special educational needs and disabilities: the significance of a national PGCE development and evaluation project for inclusive teacher education. *Journal of Research in SEN* (in press)
- Ofsted (2008) How well new teachers are prepared to teach pupils with learning difficulties and/or disabilities. Reference no: 070223. London: Ofsted
- Sharma, U., Forlin, C. and Loreman, T. (2008) Impact of training on pre-service teachers' attitudes and concerns about inclusive education and sentiments about persons with disabilities. *Disability and Society*, 23, 7:773-785

PAPER PRESENTATION

Diversity at the start of teacher education?

Petra Herzmann, Universitat zu Koln, Germany; Johannes Konig, University of Cologne, Germany

Debates on the reform of teacher education in Germany underline the importance of evaluative information on teacher education programs, which is a challenge for empirical research. However, since the discussion on the effectiveness focuses on the output of teacher education, a question hardly taken into account is related to the diversity of candidates starting out to become a teacher: To what extent, for instance, do they differ in domain-specific learning preconditions right at the beginning of their teacher education? Such a question has to be taken into account when designing a new teacher education curriculum and correspondent evaluation designs. This presentation focuses on 56 future teachers who began their teacher education career in winter term 2009/2010, attending a new model program of educational opportunities to learn in teacher education at the University of Cologne. The model program is longitudinally evaluated with a range of quantitative indicators and qualitative instruments. An overview on the model program is given. First results from the first occasion of measurement on learning preconditions of future teachers are presented. Descriptive statistics and intercorrelations of various quantitative indicators are reported leading to the assumption of having a heterogeneous learning group. Empirical findings from qualitative evaluation give in-depth information on the diversity of future teachers and raise substantial questions about the design of adequate opportunities to learn in teacher education.

The introduction of and the current discussion on teacher education standards as well as the implementation of the BA/MA structure in teacher education according to the Bologna reform have led to a new understanding on how to design teacher education programs. Opportunities to learn and learning processes of teacher students, for example, are to be orientated towards professional tasks rather than structured by scientific disciplines (cf. Gehrman et al., 2010). Moreover, while the autonomy of universities regarding the design of teacher education programs has been increasing, evidence based information about strengths and weaknesses of specific programs implemented become more and more important at the same time. As a consequence, there is an increasing demand for evaluative information on recently designed programs or components in teacher education (Kßnig & Blßmeke, in press).

Against this background empirical teacher education research is challenged. Evaluation designs and measurement instruments have to be developed, for example, in order to precisely examine the outcomes of teacher education on the basis of educational standards. However, a question hardly taken into account when discussing the output of teacher education is related to the diversity of student teachers when they start out to become a teacher: To what extent do they differ in domain-specific learning preconditions right at the beginning of their teacher education? Do such differences contribute to differential development in future teachers? Although there is research findings on future teachers' vocational interests upon entry into teacher education (cf., e.g., Klusmann et al., 2009; Ziegler, 2009) as well as on the biographical perspective of professionalization (e.g., Terhart et al., 1994), in-depth research on various elements of their "professional profile" they might already have as early as when entering teacher education does hardly exist. However, learning preconditions of future teachers has to be taken into account, for example, when designing a new teacher education curriculum or adequate evaluation designs.

Thus our presentation focuses on future teachers who just entered teacher education. The theoretical framework is a model of professional competencies (Baumert et al., 2010; Blömeke et al., 2010a, b), allowing us to differentiate elements of professional knowledge (such as general pedagogical knowledge) from affective-motivational characteristics (such as vocational interest and domain-specific self-efficacy). Teacher education research looking at future teachers who have nearly finished their teacher education shows cognitive as well as affective-motivational characteristics are substantially intercorrelated (e.g., Blömeke et al., 2010a, b). When looking at our target group of future teachers at the beginning of teacher education, we also assume interdependency of cognitive characteristics on the one side and affective-motivational characteristics on the other side, which, however, should then be loosely connected only. Apart from correlation analysis of quantitative measures, our research also intends to provide possible explanations using qualitative methods to reconstruct the biographical approach of teacher students and their first pedagogical experiences.

A sample of 56 future teachers is used who attend a new model program of educational opportunities to learn in teacher education at the University of Cologne ("Kölner Modellkolleg Bildungswissenschaften"). Having started in winter term 2009/2010, the model program offers a new curriculum closely aligned to teacher education standards (KMK, 2004) and orientated towards profession-related tasks (Artmann, Herzmann, Karduck & Käßig, 2010). The curriculum's content is structured according to the four core competencies proposed by the KMK (2004): educating ("Erziehen"), teaching ("Unterrichten"), assessing ("Beurteilen"), and innovating ("Innovieren"). Currently, the model program is applied to a small group of 56 teacher students only before it will be implemented in the BA/MA structure of teacher education programs beginning in winter term 2011/2012. Aiming at a standard-based assessment of teacher education, a range of evaluative measures is assigned to it providing in-depth information on its effectiveness and allowing the application and development of innovative measurement instruments. The inventory of standardized instruments includes the TEDS-M achievement test measuring pedagogical knowledge (Käßig et al., in press), domain-specific self-efficacy scales (Schulte et al., 2008), and vocational interest scales (Pohlmann & Möller, 2010). The qualitative instrument design includes portfolios documenting self-reflection and knowledge of teacher students.

First we will give an overview on the model program, including a depiction on its intended curriculum and the evaluation design. Secondly, first results from the first occasion of measurement on learning preconditions of future teachers are presented. Apart from descriptive statistics giving basic information, intercorrelations of various quantitative measures such as future teachers' pedagogical knowledge, vocational interest, domain-specific efficacy, and pedagogical experience future teachers have gained before starting their teacher education are reported. According to our assumptions, there are small correlations that we interpret as future teachers' beginning professionalization: For instance, future teachers' intrinsic vocational interest for pedagogy and their pedagogical self-efficacy positively intercorrelates with their pedagogical knowledge. However in general, cognitive and affective-motivational characteristics are loosely intercorrelated only ($|r|$). As a consequence, pedagogical implications for the design of adequate opportunities to learn dealing with diversity of future teacher students at the start of their teacher education will be discussed. We will present good practice examples from the model program at the University of Cologne we assume to be successful and have the potential to give new impulses for improving teacher education.

PAPER PRESENTATION

Developing Socially Just Teachers for Urban Schools

Joan Whipp, Marquette University, United States

Drawing from literature in moral philosophy, culturally relevant teaching, and justice-oriented teacher education, this paper reports on a study of 12 graduates of an urban teacher preparation program in the United States who are now teaching in urban schools. Using an interpretive cross case study design, the study followed these teachers from the end of their student teaching experience into their first year of teaching to investigate their developing perceptions of socially just teaching, how they were enacting those perceptions in teaching practice, and what pre-program, program, and on-the-job knowledge, experiences, and dispositions were contributing to that development. Data sources included surveys, student teaching evaluations, and interviews. Data analysis revealed that at the end of student teaching ten of these teachers held individualistic views of socially just teaching but by the end of their first year of urban teaching, four of those teachers were moving toward a more structural approach to socially just teaching. Program factors most related to the development of structurally-oriented orientations to socially just teaching practices were: 1) field experiences in urban schools and community agencies with culturally diverse populations; 2) course content that sparked moral responses and challenged previous thinking; and 3) mentors and instructors who modeled and explicitly talked about culturally relevant teaching practices. Non-program factors that

encouraged structural approaches to justice-oriented teaching were: 1) immersion experiences in urban and/or high-poverty communities; 2) first-hand experiences with discrimination ; and 3) targeted support from colleagues and administrators during the first year of teaching.

Throughout the world, students from low-income racial, ethnic, and immigrant minority groups often do not have the same educational and life opportunities as their middle class, ethnic majority peers. As a response, teacher educators have continually asked: What knowledge, skills, and dispositions should teachers have who are teaching for social justice by actively working to remove classroom and institutional barriers that keep all students from academic success? This and related questions are the focus of research that my colleagues and I have been conducting on our teacher education program which is intentionally designed to prepare teachers to teach in urban schools in the United States.

This paper reports findings of an empirical study of 12 graduates who are now teaching in schools serving large numbers of children living in poverty. Using an interpretive cross case study design, the study followed these teachers from the end of their student teaching experience into their first year of teaching to investigate their developing perceptions of socially just teaching, how they were enacting those perceptions in their teaching practice, and what pre-program, program, and on-the-job knowledge, experiences, and dispositions were contributing to that development. Philosophical perspectives on the moral nature of teaching (Dewey, 1933; Dotti, 2009; Freire, 1970; Hansen, 2001; Noddings, 1992; Sockett, 2009), research on culturally responsive teaching practices (Cochran-Smith, 2004; Ladson-Billings, 1994; Villegas & Lucas, 2002), and theory and research on justice-oriented teacher education (Chubbuck, 2008; 2010; Chubbuck & Zembylas 2008; Cochran-Smith, Shakman, Jong, Terrell, Barnatt & McQuillan, 2009; Villegas, 2007; Watson, Charner-Laird, Kirkpatrick, Szczesiul & Gordon, 2006; Zeichner & Flessner, 2009) offer insights regarding the knowledge, dispositions, and skills needed for socially just teaching.

This literature maintains that justice-oriented teacher education should include both individualistic and structural approaches. Individualistic approaches emphasize fairness and providing equal learning opportunities within classrooms for students who have been traditionally marginalized in schools. Individualistically-oriented teachers work hard to build on their students' cultural knowledge and everyday experiences. They set high expectations and consistently provide academic challenge and opportunities for higher order thinking for all students. Teachers with structural approaches to teaching for social justice do more. They see themselves responsible not only for the learning of all students in their classrooms but also for critically addressing structural inequities in their schools and communities that diminish their students' "learning and life chances" (Cochran-Smith, 2004). They work to change unfair policies in their schools and communities; and they teach in ways that challenge all students "to envision themselves as active citizens with the power to transform unjust structures" (Chubbuck, 2010).

This study posed the following questions:

- 1) What is the demographic, educational, professional and dispositional profile of a sample of students from an urban teacher education program who choose to teach in urban schools?
- 2) How did these teachers' perceptions of socially just teaching develop during their teacher education program and during their first year of teaching?
- 3) How are these teachers enacting these perceptions in their teaching practices?
- 4) What pre-program, program, and post-program factors appeared to influence these teachers' socially just perceptions and teaching practices?

Data sources included interviews, surveys, and student teaching evaluations. With the help of a research assistant and NVivo software, I used the frameworks of moral philosophy, culturally responsive teaching practices, and justice-oriented teacher education to code all data and develop case reports for each of the 12 teachers. Cross-case analysis of surveys, interviews and student teaching evaluations for these students as they left the program revealed that all 12 were remarkably similar in dispositions and background experiences. Specifically, compassion, responsibility toward individuals, openness, and reflectivity were the most frequently coded dispositional categories across cases. Also, ten of the 12 entered the program with significant pre-program cross-cultural experiences. Similar to other recent studies of graduates from programs focusing on social justice (Cochran-Smith, 2009), however, these data indicated that at the end of their program, ten of these 12 students saw justice-oriented teaching individualistically. Notably absent in their interviews was the "critical consciousness" that many have argued is an essential element in socially just and culturally responsive teaching. Only two, Sarah and Michael, offered any vision of justice-oriented teaching that included structural as well as individual elements. Interviews at the end of their first year of teaching, however, indicated that, in addition to Sarah and Michael, four other teachers were developing structural orientations to socially just teaching and enacting those perceptions in their work. One described her campaign to change her school's policies around unfair grouping and curricular practices for students with disabilities; another spoke about

trying to change school discipline policies that set low and inconsistent expectations for student behavior; another described her attempts to introduce more challenging curriculum and fairer assessment practices in her "whole school"; and the fourth described how she saw her teaching as "improving the lives of students" who "have...been left behind in the social network," which she was doing through home visits with parents and building awareness in her students of "injustices" in "their own neighborhood" and "ways that they can help to change that."

Comparative analyses of interviews and surveys at the end of student teaching and a year later highlighted both program and non-program factors that related to the development of structural orientations to justice-oriented teaching in this group of teachers.

Program factors included:

1) field experiences and student teaching in urban schools and community agencies with culturally diverse populations; 2) course content that sparked moral responses and challenged previous thinking; and 3) mentors and instructors who modeled and explicitly talked about culturally relevant teaching practices. Non-program factors before, during and after teacher preparation that seemed to encourage structural approaches to justice-oriented teaching were: 1) immersion experiences in urban and/or high-poverty communities prior to college entrance; 2) first-hand experiences with discrimination or prejudice; and 3) targeted support from colleagues and administrators during the first year of teaching. These factors suggest ways that teacher education programs can more strategically design curriculum, field experiences and mentoring to support the development of socially just teachers for urban schools.

PAPER PRESENTATION

What undergraduate and postgraduate student teachers learn about learning and teaching through PBL

Collaborative Learning, Initial Teacher Education (Pre service), Problem Solving
Rosalind Murray-Harvey, Flinders University, Australia

The abundant literature on PBL provides convincing arguments, some supporting and others questioning its effectiveness in achieving desired learning outcomes. In a teacher education program where careful attention was given to aligning PBL aims and assessment, quantitative and qualitative data on students' experience of PBL as learners and prospective teachers were analyzed to ascertain: (1) the extent to which PBL achieved its stated learning and instructional aims, and (2) whether learning through PBL was experienced differently for undergraduate and postgraduate pre-service teachers.

Quantitative data capturing four dimensions of learning competence: problem solving, communication skills, knowledge building, and intra/inter-personal development were obtained via a 19-item questionnaire from 122 students twice in the semester. Using the combined score of all four dimensions students reported significantly increased competence over the semester. For separated dimensions, postgraduate females reported significantly more communication skills competence and knowledge building.

NVivo qualitative analysis software supported mapping of students' final course papers (that included reflections on PBL for learning and teaching) for social, emotional and cognitive engagement indicators of learning through PBL.

Four areas of engagement with PBL emerged: emotional, cognitive, social (collaborative) and transformational providing insight into students' experience of PBL as learners and their understandings about teaching, including benefits of and barriers to effective collaborative learning. Importantly, transformational learning differentiated the postgraduates' from the undergraduates' experience. A key message for tutors is the need be explicit about the PBL learning process itself to fully support students' transition to this holistic yet unfamiliar and challenging way of learning.

Relevance

Claims for and against PBL continue to be debated in the literature; some focusing on learning processes and others on instructional practices. This warrants a closer look at learning through and teaching with PBL, certainly within teacher education. Pre-service teachers should be familiar with a range of instructional approaches, yet PBL is an unfamiliar learning environment for most, so including PBL in a teacher education program ideally serves two purposes – one that attends to processes involved in learning as a student; the other to pedagogy.

Theoretical and Educational Significance

This paper argues that claims about the effectiveness of PBL rely on that research sufficiently representing and reflecting PBL aims. The literature however, reveals a lack of congruence in the way research has addressed the nexus between PBL aims and outcomes, with more data gathered on easily measured (content knowledge), than other outcomes. Such uneven treatment leaves unanswered questions about the social and emotional (e.g. collaboration and motivation) dimensions of learning, cognitive engagement (e.g. critical thinking), or professionally relevant communication skills. The PBL literature acknowledges this alignment gap.

Studies of PBL effectiveness have largely concentrated on comparing PBL with non-PBL approaches. As well, studies have looked at differences among students from different disciplines. No published research has investigated the PBL experience for students who are undergraduates compared with postgraduates; a consideration for course delivery.

Aims and Method

This study aimed to map student learning through PBL with particular interest in examining cognitive, affective, and social dimensions of students' learning that have received less empirically-based PBL research attention, among them, higher-order thinking, motivation, communicating effectively and working collaboratively. The guiding research question was: In what ways does PBL contribute to students' learning about learning and teaching? In answering this question consideration was given to undergraduate and postgraduate students' perspectives as both learners and as prospective teachers.

Context

The reported study was undertaken at an Australian university, drawing on both quantitative and qualitative data provided by pre-service teachers about their experience of PBL. Postgraduate students were enrolled in separate classes to undergraduates but undertook a matched program of study. This provided an ideal opportunity to explore the two student groups' experiences of PBL.

Participants were students who consented to researchers using their course assignments for analysis. They provided background information on sex, age, previous learning using PBL, major area of degree study and work experience. Of the 122 students for whom data were available 36% were males (proportionally representative of the cohort). Ages ranged from 19-52 years (Mean 24.5 years; SD 6.81) with an average difference of 10 years between undergraduates and postgraduates. Six students indicated previous involvement with PBL.

Sources of data

The Learning Evaluation

Students submitted a mid-term written report on their PBL experience and an end-of-semester learning evaluation paper (used for qualitative data analysis in this study).

Critical thinking scores

A 5-point scale critical thinking rubric (Angeli, & Valanides, 2009) was used to rate two papers submitted by students: their mid-term report on the PBL experience following the first case study and the final paper, completed after the second case study (6 weeks apart). This enabled analysis of critical thinking scores between two points in time.

Students' self-assessment of PBL performance

After completing each PBL case study students self-assessed their learning performance across four areas: problem solving, communication skills, knowledge building, and interpersonal relationships using a 19-item questionnaire. Students were asked to rate "your current level of competence developed through your participation in the small group that you have worked in on this PBL case" along a 4-point scale: 4 = Highly Competent, 3 = Competent, 2 = Becoming competent, and 1 = Not competent. The instrument itself was examined using PAF to determine the coherence of the scales.

Findings

NVivo qualitative analysis software was used to search for terms and concepts indicative of cognitive, affective, and social engagement; dimensions of learning that are well explicated in the literature. Analysis sought to confirm, through a targeted search of students' evaluations rather than merely explore, student learning in relation to the stated aims of PBL.

Four main themes emerged, labeled as: emotional, collaborative, cognitive, and transformational; the latter two displaying some overlapping features but distinctive enough to warrant identification as separate themes. The notable

difference between postgraduate and undergraduates was in Transformational Learning. This theme identified itself through comments made mainly by postgraduate students who connected PBL to their wider life experience and its impact on changing conceptions about professional practice citing how PBL could be applied in teaching their students.

Absent from this proposal are specific statements students made about teaching and learning that are included in the full version of this paper. Importantly, critical thinking scores were used to guide selection of highly reflective and well considered, exemplary comments.

For all four dimensions of students' self-assessed tutorial performance there was significant improvement ($t(83) = -8.347$; $p = 0.000$, $ES = 0.87$) over the semester with no significant difference between undergraduates and postgraduates or between males and females although females' competence improved marginally more than males'.

The Assessment of Performance instrument proved to be a reasonably robust tool to assess four areas of PBL learning and enabled measurement of that learning over time. Refinement of this instrument should provide students and teachers of PBL with a reliable, valid tool to measure an inclusive range of PBL outcomes.

Using the Wilcoxon Signed Ranks test, Mean Critical Thinking scores for the first and second assignments for 24 students revealed a significant difference between the scores, indicative of higher critical thinking on the final papers ($z = -2.37$, $p < 0.05$, $ES = 0.48$); the increase accounted for mostly by postgraduate females' increased critical thinking scores.

What students reported about learning through PBL shows that this approach operates across cognitive, affective and social dimensions to provide a holistic learning experience. Furthermore, according to these teacher education students, PBL made explicit a range of learning and teaching processes that will inform their future teaching practice.

PAPER PRESENTATION

What we measure with ratings of instructional quality - An application of generalizability theory

Anna-Katharina Praetorius, University Koblenz-Landau, Germany; Gerlinde Lenske, University Koblenz-Landau, Germany; Karina Karst, Deutsches Institut für Internationale Pädagogische Forschung (DIPF), Germany; Andreas Helmke, Universität Landau, Germany

Instructional quality is often measured through observer ratings (e.g., researchers). In other research fields many studies have been conducted to determine the amount and the causes for errors associated with such ratings. In contrast, in instructional research these topics have rarely been investigated as of yet. To bridge that research gap we analyzed ratings of a total of 110 participants' via generalizability theory. Each participant rated three lesson sequences on a basis of nine items at any one time. The results show that about 22 percent of the variance can be attributed to observed differences between instructional quality itself, about 12 percent to rater bias components and about 19 percent to an interaction between lesson sequence and items. These results are thought-provoking in respect of whether it is admissible to treat instructional quality ratings like measurements of instructional quality. As a conclusion, variance component analysis in the scope of generalizability theory seems to be a useful tool for further investigations concerning ratings about instructional quality.

If several people rate the instructional quality of the same lessons with rating scales, they often differ significantly in their ratings (e.g., Pietsch & Tosana, 2008; Hoyt, 2000). This variability is problematic: It implies that the judgments contain information (e.g., different item comprehension) in excess of the subject-matter which should be measured (equals: instructional quality). If the amount of such further information is large, conclusions from ratings for research on instructional quality as well as the development of instructional quality in school practice are difficult to make. For reducing these biases it is important to determine the amount and also the causes for biases associated with this variability. Surprisingly little investigations focused on this topic until now. The few existing investigations focus first and foremost on ratings of pupils and students (see e.g., Aleamoni, 1987). Thus we know only little about biases in measures of instructional quality made by observers. The aim of the current study is to gain a first insight into this topic. Therefore we will focus on two research questions:

- 1) How large is the amount of specific variance components like, for example, the instructional quality itself as well as rater effects?

2) Are there differences between diverse rater populations of observers (students, student teachers, schools inspectors) concerning these variance components?

Method

To investigate these research questions we used generalizability theory, which allows separating multiple sources of error via variance component analysis (Brennan, 2001; Shavelson & Webb, 1991). For analysis, the software urGENOVA (Brennan, 2001) was used.

The 110 participants (r) rated three ten-minute lesson sequences (s) of grade four in primary school (2 German lessons, 1 Math lesson). The participants can be divided into three different groups (g): students (14 raters), student teachers (69 raters), and schools inspectors (24 raters). The ratings were based on items (i) taken from a questionnaire of Helmke et al. (2010). The questionnaire deals with interdisciplinary instructional quality. For the present study 9 items of a total of 30 items were selected (example: "The whole time was used for the lesson content"; strongly disagree (1), disagree (2), agree (3), strongly agree (4)).

The design deduced from these data is an unbalanced, partially nested (r:g) x s x i design, thus all raters rating all sequences on all items with the add-on that the raters were nested in groups. Object of measurement (dependent variable) are the responses on the items.

Results

The analysis shows that the main effect for the lesson sequence is the second highest source of variance with about 22% of the whole variance. Hence, about one fifth of the variance in ratings is due to what is intended to measure. The third highest variance source is the sequence-by-items interaction (19%). Taking all effects together concerning the rater effects (rater main effect, rater-by-item and rater-by-sequence interaction; all these effects are nested in groups), about 12% of the variance is due to rater bias. In addition, the variance component analysis shows that the three rater groups (students, student teachers, and schools inspectors) differ in their ratings: The percentage of the whole variance dedicated to the group main effect, the rater-within-group effect, the group-by-items, group-by-sequence as well as group-by-sequence-by-items effect is about 7 percent. The biggest variance component (about 31% of the whole variance) is due to the highest order interaction (r:g) x s x i, which is confounded with an unspecific error component.

Discussion

Research on instructional quality often takes observer ratings as an indicator for instructional quality. However, as we know from other research fields (e.g., Cronbach, 1990; Myford & Wolfe, 2003), such ratings are error-prone. The amount of these errors has hardly been investigated as of yet and the errors themselves have not taken into account for conclusions from results in the field of instructional quality research. The results of the present study show that this would be necessary: Only about one-fifth of the variance in ratings about instructional quality really can be attributed to this quality.

A large variance source is due to rater bias. However, compared to results from other studies in instructional quality research (e.g., Pietsch & Tosana, 2008) as well as in other research fields (e.g., Hoyt, 2000) the amount found here is approximately as large as in these former studies. Whereas the raters in the studies mentioned above were trained raters, the raters in the present study were not trained to rate instructional quality. As one would expect trained raters to make fewer mistakes in their ratings, the same amount of rater bias for untrained as well as trained raters is kind of unexpected.

The present investigation also showed differences between rater groups. Causes for these differential functioning can in particular be clarified by using qualitative research approaches in future.

Summing up one can say that research in the field of instructional quality should treat observer ratings in future more differentiated. Ideally, one should use generalizability theory to clarify the amount of residual variances in a certain study and – if possible – to minimize these variances.

References

- Aleamoni, L.M. (1987). Student Rating Myths versus Research Facts. *Journal of Personnel Evaluation in Education*, 1, 111-119.
- Brennan, R.L. (2001a). *Generalizability theory*. New York: Springer-Verlag.
- Brennan, R.L. (2001b). *Manual for urGENOVA*. Iowa City, IA: Iowa Testing Programs, University of Iowa.
- Cronbach, L.J. (1990). *Essentials of Psychological Testing*. New York: Harper Collins Publishers.
- Shavelson, R.J. & Webb, N.M. (1991). *Generalizability theory: A primer*. Newbury Park, CA: Sage.
- Helmke, A., Helmke, T., Lenske, G., Pham, G., Praetorius, A.-K., Schrader, F.-W. & Ade-Thurrow, M. (2010). *Studienbrief Unterrichtsdiagnostik. Projekt UdiKom der Kultusministerkonferenz. Universität Koblenz-Landau, Campus Landau*.
- Hoyt, W.T. (2000). Rater Bias in Psychological Research: When is it a Problem and what can we do about it? *Psychological Methods*, 5, 64-86.

Myford, C.M. & Wolfe, E.W. (2003). Detecting and Measuring Rater Effects using Many-Facet Rasch Measurement. Part 1. *Journal of Applied Measurement*, 4, 386-422.

Pietsch, M. & Tosana, S. (2008). Beurteilereffekte bei der Messung von Unterrichtsqualität: Das Multifacetten-Rasch-Modell und die Generalisierbarkeitstheorie als Methoden der Qualitätssicherung in der externen Evaluation von Schulen. *Zeitschrift für Erziehungswissenschaft*, 11, 430-452.

PAPER PRESENTATION

Comparing peer and expert assessment of science web-portfolios

Olia Tsivitanidou, University Of Cyprus, Cyprus; Zacharias Zacharia, University of Cyprus, Cyprus; Tasos Hovardas, University of Cyprus, Cyprus

The purpose of this study was to investigate how peer assessment compares to expert assessment, in a context of a reciprocal online peer-assessment of web-portfolios in a science course in secondary education. In doing so, 28 students anonymously assessed the web-portfolios that their peers prepared after studying web-based material that concerned a unit on CO₂ friendly houses. All of the student web-portfolios were also assessed by two experts. Four data sources were used for the purposes of the data analysis, namely, the peer and expert assessments produced, a questionnaire and the screen-video captured data taken throughout the intervention. Findings showed that both the validity (correlation between expert assessments and peer assessments for the same web-portfolio) and the reliability of peer assessment (correlation between different peer assessments for the same web-portfolio) were low, which implies that there is a strong need for training or supporting students while they enact peer assessment. Moreover, it was found that although a significant majority of assessees stated that they favor expert feedback over peer feedback, changes adopted by assessees were significantly related only to parameters of their peers' feedback, namely, the number of negative judgments (incorrect or incomplete handling of aspects related to a student's work) and feedback size (word count).

Introduction

Peer assessment is conceptualized as an educational arrangement where students judge peers' performance by providing grades, and/or offering written or oral feedback. It is most often integrated in the wider context of formative assessment. Research revealed through numerous studies the positive impact of peer assessment on students' cognitive, meta-cognitive and social-affective domain and emphasized the need for its presence in a learning environment (Kollar & Fischer, 2010). However, researchers have argued that the enactment of such an assessment is a rather complex undertaking, because it requires understanding of the goals of the task(s), the criteria for success and the ability to make judgments about the relationship of the product or performance to these (Topping, 2009).

Aims

Given this complexity, we investigated whether secondary-school students can implement peer assessment when receiving the assessment criteria to be used. Up-to-date, research has not provided a thorough picture in terms of what students are capable of doing on their own when it comes to assessing their peers' work (even when the assessment criteria are available), especially at the secondary-school level (Authors, 2010). In light of the fact that peer assessment can be operationalized in many forms (e.g., paper-based or computer-based) and types (e.g., one-way, reciprocal, mutual), any research in the peer assessment domain should be well defined, both in terms of its form and type, in order to avoid confounded conclusions (Topping, 2009). In the case of this study we focused on reciprocal (peers assess each other, e.g., in pairs; hence, a student undertakes both the roles of the assessor and of the assessee), supported (students were given the assessment criteria), anonymous, and on-line (asynchronous) peer assessment context. Given this context, we asked secondary-school students to create (in pairs) web-portfolios and then to assess (individually) the web-portfolio of another pair/group (see Figure 1). The same web-portfolios were also given to two experts to assess them, while using the same criteria as the ones given to the students. All assessors had the opportunity to accompany a criterion with both a grade and written comments. After both the students and the experts completed their assessments, we compared (a) the peer assessments with the expert assessments and (b) the peer assessments of the peer assessors who assessed the same web-portfolio between them. These comparisons aimed at answering the following research questions: 1. How do the peer and expert assessment compare in terms of their validity and reliability? 2. How do the peer and expert assessments compare in terms of their structural components, namely, positive judgments, negative judgments, and changes proposed by assessors? 3. Do assessees respond in a different way when receiving peer and expert assessments? 3.1. More specifically, does the time they spent on reviewing their peer and expert assessors' assessments differ? 3.2. Do they adopt any changes from the peer and expert assessments? If yes, how do these changes compare? 4. Do students perceive the same way the usefulness of peer and expert assessments?

Methods

The participants were 28 seventh-graders, who studied web-based material that were developed for the purposes of the SCY project (Authors et al,2010) and concerned the construction of CO2-friendly houses. The data collection process involved four data sources, namely, peer and expert feedback, each participant's response to the feedback received (through the use of a questionnaire) and the screen-video data that were captured throughout the intervention. The data analysis involved both qualitative and quantitative procedures. Specifically, we followed open coding from grounded research methodology (Strauss & Corbin,1998) to analyse the peer and expert feedback and the participants' responses to the feedback received. In the case of the screen and video captured data we followed a contextual inquiry based analysis (Druin et al.,1999). All of the data that resulted from the qualitative analysis were also coded and treaded quantitatively through the use of: Spearman's rrank correlation index, k-means clustering, Kendall's tau b correlations, Kruskal-Wallis testMann-Whitney test. ,

Results

Findings showed that both the validity (correlation between expert assessments and peer assessments for the same web-portfolio) and the reliability of peer assessment (correlation between different peer assessments for the same web-portfolio) were low. We also found that both peer and expert assessors provided both grades and written comments for every assessment criterion in their feedback. However, it was found that the structural components included in these written comments differed between the students and the experts. Specifically, it was found that the peer assessments included more positive judgments and proposed fewer changes than the expert assessments. Concerning the responses of assessee groups to peer and expert feedback, the results showed that assessee groups devoted more time to review expert feedback and revisited expert comments more frequently than they did with their peers' feedback. This finding complied with the fact that the majority of assessees, as stated in their questionnaires, perceived expert feedback as more useful that the peer feedback. Moreover, it was found that the assessees were resistant in proceeding with changing their web-portfolio. In the cases where they proceeded with changes, it was found that they were significantly related only to parameters of their peers' feedback, namely, the number of negative judgments (incorrect or incomplete handling of aspects related to a student's work) and feedback size (word count).

Conclusions

The findings of this study showed that the peer-assessment procedure was problematic across several aspects (e.g. validity, reliability), even though the participants were provided the assessment criteria. This indicates how complex peer assessment is in nature and points to the need for training and scaffolding students' before and while enacting peer assessment. A finding that seems to be quite peculiar and needs to be further investigated is the fact that expert feedback was not found to have influence on the changes actually adopted by peer assessees, even though the students considered it as more valid than the peer one.

References

- Authors (2010). Learning and Instruction. Authors et al. (2010). British Journal of Educational Technology
Kollar,I., & Fischer,F. (2010). Peer assessment as collaborative learning: A cognitive perspective. Learning and Instruction, 20, 344-348.
Topping, K. J. (2009). Peer assessment. Theory into Practice, 48, 20-27.

PAPER PRESENTATION

Differential effects of low-stakes mandatory testing on data based school improvement

Uwe Maier, University Erlangen-Nuernberg, Germany; Carolin Ramsteck, University Erlangen-Nuremberg, Germany; Annette Fruehwacht, University of Wurzburg, Germany

This study investigates differential effects of low-stakes mandatory testing systems in two German federal states on acceptance and usage of performance feedback data in schools. We first analyzed the mandatory testing systems and their implementation in Baden-Wurttemberg and Thuringia on the basis of a theoretical framework for school performance feedback systems (SPFS). Although both states implemented low-stakes mandatory testing, the "Kompetenztests" in Thuringia provide more elaborated and reliable feedback information and a more coherent support strategy for schools compared to the "Vergleichsarbeiten" in Baden-Wurttemberg. A quantitative survey study revealed that teachers in Thuringia are more likely to discuss feedback data in faculty meetings and to use mandatory tests for self evaluation. This qualitative follow-up study aims at elaborating the quantitative differences of data usage and at determining what aspects of the SPFS-model account for the differential effect on feedback usage. We therefore conducted a qualitative interview study with secondary school teachers in Thuringia (N=27) and Baden-

Wurttemberg (N=38) on how they interpret and use school performance feedback data on the classroom level and on the level of faculty meetings. Results show that a majority of teachers in both German states rejects the idea of test data based instructional improvement. We only found some teachers in Thuringia who described pedagogical relevant faculty discussions around performance feedback data or who integrated demanding test assignments into future teaching.

In the last decades, educational policy makers implemented test-based school accountability systems to enhance both, internal school improvement and external quality assurance of public schooling. Anglo-Saxon countries have a long tradition of high-stakes testing whereas policy makers in many European countries, e.g. the German federal states, did not attach any severe sanctions to test results and argue that teachers and principals should be the owner of feedback data. However, it is not clear if low stakes testing is an effective approach to school improvement. Another problem within Germany is that some federal states developed and implemented different strategies to report feedback data to schools and teachers. The overall aim of this paper is to investigate differential effects of low-stakes mandatory testing systems in two German states on acceptance and usage of performance feedback data in schools.

Research on the effects of test-based school accountability is very complex and diverse. An abundance of research literature in the U.S. or England investigated negative side effects of high-stakes testing on teaching or student motivation (e.g. Amrein & Berliner 2003). Another strand of research focused on how teachers, department heads and principals understand and make use of mandatory performance feedback data for the purpose of school improvement (e.g. Louis, Feby & Schroeder 2005). Visscher and Coe (2003) and Verhaeghe et al. (2010) reviewed this literature and provided a theoretical framework for synthesizing relevant factors of school performance feedback systems (SPFS) influencing data usage in schools such as design process, SPFS-features, implementation process and school organization features.

This theoretical model allows to analyze similarities and differences in implementation and feedback strategy between low-stakes mandatory testing systems in Thuringia and Baden-Wurttemberg. Both states administer external tests in secondary education to assess academic student achievement at the end of two year learning periods in math, German language and English language. Thuringia administers mandatory tests ("Kompetenztests"), monitors the implementation, offers a set of further instruments for school self evaluation and provides up to three feedback reports for schools and teachers with detailed and value-added measures. In contrast, Baden-Wurttemberg does not monitor the process of implementing the "Vergleichsarbeiten" and does not provide any external or tailored feedback reports to schools.

According to the SPFS-model we assumed that the acceptance and usage of performance feedback data is supposed to be more intensified in Thuringia than in Baden-Wurttemberg. We were already able to test this assumption in a pre-study (Maier 2009). Analysis of quantitative survey data showed that teachers in Thuringia rather accept mandatory testing and describe performance feedback information as more useful for educational diagnosis, student tutoring, and repetition. Although these differences in teacher evaluation of mandatory testing were significant, it is not clear if they are relevant for school improvement and the quantitative study also does not reveal what features of the testing system account for the differences. Our research questions:

- (1) Can we describe pedagogical relevant differences in interpretation, usage and discussion of performance feedback data between teachers/schools in Thuringia and Baden-Wurttemberg?
- (2) What factors of the SPFS-model account for the differences in teacher evaluation of mandatory testing in Baden-Wurttemberg and Thuringia?

We conducted an interview study with secondary teachers in Thuringia (N=27) and Baden-Wurttemberg (N=38) to answer our research questions. The interviews were held on the basis of a semi-structured questionnaire involving teachers' individual acceptance and usage of performance feedback data and the process of interpreting and discussing feedback data in faculty meetings. We used qualitative content analysis (Mayring 2010) to summarize, categorize, and relate different types of acceptance and usage to the respective factors of the theoretical framework. The results show that some teachers use performance feedback data on the classroom level to evaluate their teaching and to complete their diagnostic information on student achievement. But teachers in both states also said that the upcoming test influences their instruction in the weeks before (test preparation, teaching of test-taking skills). However, only few teachers in Thuringia describe that they integrated demanding and complex test assignments into regular teaching and that this made them think about the cognitive level of their instruction. Faculty discussions on interpretation and usage of performance feedback are rare in both German federal states and only some teachers in Thuringia reported pedagogical relevant discussions.

We also found versatile reasons for dismissing the concept of feedback data as an instrument for self evaluation. These reasons can be linked to the theoretical framework of Visscher and Coe (2003) and Verhaeghe et al. (2010). Design process: Teachers in both states understand mandatory testing as bureaucratic part of the school administration and were not able to take ownership of the data. SPFS-features: Although Thuringia developed value-added feedback data, teachers still complain about the amount of feedback reports and bad feedback timing. School organization features: Some teachers complain about problems, like poor school financing, which inhibit any further efforts of data-based school improvement.

On the one hand, this study gives some suggestions on how to understand the differences in acceptance and usage of performance feedback data revealed by the quantitative study. On the other hand, this qualitative study shows that even an elaborated feedback system such as the "Kompetenztests" in Thuringia had no broad and relevant impact on school improvement. It is suggested that theoretically relevant similarities of both mandatory testing systems are responsible for a low level of acceptance and usage of feedback data in schools.

Amrein, A. L. & Berliner, D. C. (2003). The effects of high-stakes testing on student motivation and learning. *Educational Leadership*, 60/5, 32-38.

Louis, K. S., Febey, K. & Schroeder, R. (2005). State-Mandated Accountability in High Schools: Teachers' Interpretations of a New Era. *Educational Evaluation and Policy Analysis*, 27/2, 177-204.

Maier, U. (2009). Accountability policies and teachers' acceptance and usage of school performance feedback - a comparative study. *School Effectiveness & School Improvement*, 20/4, 1-21.

Mayring, P. (2010). *Qualitative Inhaltsanalyse. Grundlagen und Techniken*. Weinheim: Beltz.

Verhaeghe, G., Vanhoof, J., Valcke, M. & Petegem, J. v. (2010). Using school performance feedback: perceptions of primary school principals. *School Effectiveness and School Improvement*, 21/2, 167-188.

PAPER PRESENTATION

Teacher-Student perceptions of assessment practices as predictors of student motivation to learn

Ron Pat-El, Leiden University, Netherlands; Harm Tillema, Universiteit Leiden, Netherlands; Mien Segers, Maastricht University, Netherlands; Paul Vedder, Leiden University, Netherlands

Self-Determination theory proposes that the needs for autonomy, competence and relatedness need to be fostered for a student to become intrinsically motivated. Student's perceived teacher support is often touted as important for learning motivation. Recent studies, however, have indicated that efficacious teachers and students with lower language proficiency misalign in their perceptions of instructional support through provision of "assessment for learning" activities: monitoring and scaffolding (Pat-El, Tillema, Segers, & Vedder, 2010). These perception-disagreements may lead to a loss in intrinsic motivation in students. Multilevel Structural Equation Modeling (MSEM) was used to test this hypothesis. The study was conducted, using a cross-sectional questionnaire design, in a sample of 650 students and 38 teachers in seven pre-vocational high schools in the Netherlands. MSEM confirmed the hypothesis ($\chi^2(28) = 27.840$; CFI = .993; Gamma = .996; SRMR = .036; RMSEA = .035). Alignment in teacher-student perceptions of scaffolding and monitoring activities positively predicted intrinsic motivation. The relationship between Scaffolding and intrinsic motivation was mediated by relatedness and perceived competence. Monitoring had a direct positive effect on intrinsic motivation and was partially mediated by relatedness. The results of this study indicate that the relative perceptions of both teachers and students have a significant impact on student motivation. The results have implications for educational design in that designers should take into account that teachers' efforts could still be lost in translation.

Aims

Learning enhancement through students' self-motivation, is regarded as the pinnacle of learning achievements in literature on student motivation and assessment for learning. Student's perceived teacher support is often touted as important for learning motivation and interest regulation. Recent studies, however, have indicated that efficacious teachers and students with lower language proficiency misalign in their perceptions of instructional support (Pat-El, Tillema, Segers, & Vedder, 2010). But it is still unclear why perception-misalignments between students and their teacher may lead to a loss in intrinsic motivation in students.

It has been found that learning activities that are being perceived as autonomy-supportive are associated with higher levels of students' intrinsic motivation for those learning activities (Black & Deci, 2000). And students who perceive

teachers as having failed to provide support show less interest and enjoyment in school. (Dray et al, 1999). Self-determination theory of motivation proposes a framework for the relation between alignment and motivation (Ryan & Deci, 2000). Perceptions of support by both students and teachers have been found to correspond with these three basic needs: Learning environments that are perceived as autonomy supportive tend to foster students' perceived competence (Black & Deci, 2000), relatedness to the teacher (Jang, 2008) and perceived autonomy (Levesque, Zuehlke, Stanek, & Ryan, 2004). Therefore we contend that students' motivation depends on the perceived instructional support for learning in the interactions between students and their teachers (Covington, 2000).

The notion of Assessment for Learning (AfL) describes the instructional support given to students by stressing the role of formative use of assessments through feedback and classroom dialogue to promote student learning (James & Pedder, 2006). It is therefore of interest to look into the degree of alignment between teacher and students' perception on the provision of assessment meant to foster learning in the classroom (Birenbaum, 2009). Teachers efficacious in constructing supportive learning environments and students low in language proficiency tend to show larger disagreements in perceptions of the provision of activities that monitor student progress and scaffold learning to realize growth (Pat-El, Tillema, Segers, & Vedder, under review). We are interested in possible misalignment in the perceptions of assessment practices between teachers and students as they may lead to a loss in motivation, caused by misunderstanding and misinterpretation of the assessment information (Norman, 1986, Bartholomew, Parcel, Kok, & Gottlieb, 2001).

The aim of this study is to test whether teacher efficacy and student language proficiency, as predictors of student-teacher alignment in perception of the supportive nature of assessment practice, will affect intrinsic motivation. A positive AfL alignment would positively predict fulfillment of the needs for autonomy, competence and relatedness and interest regulation.

Method

Sample. A sample of 650 students (323 girls, 326 boys; 1 missing) and 38 teachers (20 females, 18 males) across seven vocational high schools in the Netherlands took part in this cross-sectional questionnaire study. Teachers represented a broad domain of subjects, ranging from arts to sciences. The average class size was 17.6 students (SD = 4.88; min = 11; max = 27). Students were on average 13.9 years old (SD = 1.13). Teachers were on average 44.5 years old (SD = 11.21).

Instruments. Students and teachers received self-report questionnaires measuring teacher's and students AfL perceptions of Monitoring and Scaffolding (AfL-Q; Pat-El, Tillema, Segers, & Vedder, 2008) for a specific class, in conjunction with teachers' efficacy for teaching (OSTES; Tschannen-Moran & Hoy, 2001), students' language proficiency (Berry, Phinney, Sam, & Vedder, 2006) and the three basic needs for motivation, namely need for autonomy, competence and relatedness; and their interest/enjoyment (IMI; Deci, Schwarz, Sheinman, & Ryan, 1981). **Analyses.** Multilevel structural equation modelling (MSEM) with MUML estimation in EQS version 6.1 was used to test whether the teacher-student differences in perceived monitoring and scaffolding were negatively related to basic need fulfilment and interest. In the hypothesized (2-(1-1)-(1-1-1)-1) upper-level mediation teacher efficacy was measured at level-2 while all other variables were available at level 1. The following criteria for good fitting models were used: RMSEA and SRMR below 0.05 and CFI and Gamma scores above 0.95 (Browne & Cudeck, 1992; Fan & Sivo, 2007).

Results

Intraclass correlations (ICC) (Table 1) indicate that multilevel procedures are desirable. Especially the high ICCs of the differences in perceptions of monitoring and scaffolding show that there is a strong homogeneous level of perception (dis)agreement within classrooms.

The upper-level mediation model was tested in a multilevel structural equation model. Models were tested on the student-level based on the within-covariance matrix and the class-level based on the between-covariance matrix. The combination of the between and within models in a MSEM fitted the data very well ($\chi^2(28) = 27.840$; CFI = .993; Gamma = .996; SRMR = .036; RMSEA = .035). Aligned teacher-student perceptions of scaffolding and monitoring positively predicted intrinsic motivation. The relationship between Scaffolding and intrinsic motivation was fully mediated by relatedness and perceived competence. Monitoring had a direct positive effect on intrinsic motivation, was partially mediated by relatedness. As hypothesized Teacher efficacy negatively predicted, and Language proficiency positively predicted, monitoring and scaffolding alignment.

Conclusions

The initial model analyzed; that misaligned monitoring and scaffolding perceptions could be predicted by both teacher efficacy (negatively) and student language proficiency and would lead to reduced effectiveness in intrinsic regulation was confirmed in this study. Research on instructional effectiveness usually focuses on the perceptions of students, or teachers. The results of this study indicate that the relative perceptions of both teachers and students have a significant impact on student motivation. The important role of relatedness in the explanation of the relationship between alignment and motivation elicits the question whether aligned perceptions might foster students' feelings of interpersonal safety. The results have implications for educational design in that designers should take into account that teachers' efforts could still be lost in translation.

PAPER PRESENTATION

Effectiveness of Voluntary Postsecondary Remediation Programs in Mathematics

Dirk Tempelaar, Maastricht University, Netherlands; Bart Rienties, Maastricht University, Netherlands; Bas Giesbers, Maastricht University, Netherlands

This contribution evaluates a postsecondary remediation program in mathematics, aiming to ease the transition from high school to college and to improve the success rates in the first year of bachelor studies. The remediation program consists of the administration of a diagnostic test and the organisation of voluntary bridging education in the format of an 80 hours online summer course. Participants of the summer course are prospective students of the international university programs business and economics of Maastricht University, and are mainly students educated in different secondary schooling systems than the Dutch one. Large dissimilarities in European high school programs, and schooling discontinuities rather common in several European countries, cause strong heterogeneity in mathematics mastery of these freshmen.

Focus of this contribution is the investigation of the effectiveness of the bridging course. Since participation in the course is on voluntary basis, the design relevant for this effect analysis is that of the quasi-experiment. This design brings along several risks in the estimation of effects, such as the presence of self-selection. In order to address these risks, the treatment effect found by comparing participants and non-participants in terms of academic success, is corrected by applying the propensity score method, taking into consideration a large set of student background data collected on both participants and non-participants: type of secondary education, high school mathematics level, learning styles, achievement goal orientations, metacognition, academic motivations, and subject-specific achievement motivations. This study is based on six cohorts of students, containing 5000 freshmen, of whom 68% are international students, with 650 participants in the bridging courses.

This article focuses on bridging education directed at easing the transition from high school to college and improving the success rates in the first year of bachelor studies. In Europe, bridging education has a specific focus beyond that of addressing learning deficits: that of internationalisation of European higher education. Secondary school systems, even in neighbouring countries, are very different, producing strong heterogeneity in knowledge and skills of prospective students. The longest tradition of bridging education is to be found in the Anglo-Saxon educational settings and specifically in the US. Therefore, most empirical studies into the effect refer to the US context: Bahr (2008), Bettinger and Long (2008), Jamelske (2009). The specific US context determines the way of doing effect research: entrance to US higher education is selection-based, and part of most selection procedures is that prospective students participate in a placement test and, scoring less than a certain cut-off point, are required to take developmental education. In such a context impact studies compare the academic success of students scoring just below the cut-off score (obliged to participate bridging education) with that of students who score just above the cut-off score (excluded from bridging education), using so-called regression-discontinuity models. In the European context, generally no selection takes place upon entering university, so the option is missing to obligate some, and to exclude other, students from bridging education (Brants & Struyven, 2009; Rienties et al., submitted). Still, both contexts share important characteristics: absence of experimental design, since participation is not by random assignment but on the basis of the outcome of a placement test or self-selection. Direct comparison of academic success of participants and non-participants is therefore no proper way to find treatment effects, the two groups being non-equivalent, requiring a correction of the differences observed between experimental and control groups on the basis of differences in background statistics of students in both groups. In the US based empirical studies, it is the score on the placement test that distinguishes students in both groups and allows the use of regression discontinuity methods. The typical European case lacks such a discontinuity, and directs the investigator to methods for the quasi-experimental setup with non-equivalent groups: propensity-score based correction methods (Fraas, 2007; Guo & Fraser, 2010; Shadish, Cook, & Campbell, 2002; Yanovitzky, Zanutto, & Hornik, 2005). Against a US background of cumulating evidence that developmental education is expensive, but doubtful in its effects, the central question of

this European study is if an optional summer course is an effective instrument to help international students bridge math deficiencies caused by differences in national secondary school systems?

Methods

The adaptive e-tutorial ALEKS

Summer courses are delivered with the adaptive, electronic tutorial: ALEKS College Algebra module. The ALEKS system is an intelligent tutoring system based on principles of knowledge space theory, a branch of artificial intelligence (Doignon & Falmagne, 1999; Falmagne, Cosyn, Doignon, & Thiééry, 2006). The system combines adaptive, diagnostic testing with an electronic learning and practice tutorial. Participants

This study is based on six cohorts of first year students in the programs business and economics, containing about 5000 first year students, with 68% international students.

Statistical analyses

Participation in the summer being voluntary, a quasi-experimental setup is relevant. Our design contains a post-test, but no pre-test, so is best characterized as quasi-experimental with non-equivalent groups and post-test only (Shadish et al., 2002). This embodies the risk of self-selection. In line with advices on finding causal effects in observational studies (AERA 'think tank white paper': Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007), a broad range of students' background factors potentially related to self-selection effects is included. These are used to correct the treatment effect for non-equivalent group composition (Fraas, 2007; Guo & Fraser, 2010; Shadish et al., 2002; Yanovitzky et al., 2005), using propensity scores: the conditional probabilities that an individual belongs to the experimental group, or to the control group, given a set of covariates. The correction can take place in different ways of data balancing: using propensity scores as matching variables, as stratification variables, or as covariate (Guo & Fraser, 2010). In this study both of these last approaches will be used: given the unequal size of treatment and control groups, stratification is regarded as more appropriate than matching.

The covariates: students' background characteristics

Covariates originated from long term research into study achievements in the first year. Background factors refer to students' approaches to learning according the learning patterns model of Vermunt (Entwistle & Peterson, 2004). Vermunt distinguishes four domains/components of learning: cognitive processing strategies, metacognitive regulation strategies, learning conceptions, and learning orientations. Next, students' goal orientations are measured with an instrument designed by Grant and Dweck (2003) that classifies goal orientations into six types: intrapersonal outcome goals, intrapersonal ability goals, normative outcome goals, normative ability goals, and two different types of learning goals. Metacognitive abilities are measured by the ALLI instrument (Tempelaar, 2006), based on Flavell's three component model of metacognition: knowledge, skills, and attitudes. The Academic Motivation Scale (AMS; Vallerand et al., 1992), based upon Ryan and Deci's (2000) model of intrinsic and extrinsic motivation, is applied to achieve motivational profiles of students containing different types of intrinsic, extrinsic, and a-motivation. Lastly, subject achievement motivations based on Eccles' expectancy-value theory (Eccles & Wigfield, 2002) are measured with an instrument derived from the SATS developed by Schau and co-authors (Tempelaar et al., 2007).

Results

Effect analysis suggests that bridging education with a broad coverage of topics and flexible content steered by adaptive testing can be very effective: the non-corrected effect of successful participation in our summer course exceeds the effect of math prior schooling at advanced level, with basic schooling as reference. Correction on the basis of the propensity score method indicates that indeed part of the non-corrected treatment effect should be attributed to selection-effects, but that after correction for non-equivalent group composition, substantial treatment effects remain, in the order of size of about half the effect size of being educated at advanced math level in high school.

PAPER PRESENTATION

Reliability of Examinee Proficiency Classifications based on the European Framework of Reference

Simon Tiffin-Richards, Freie Universität Berlin / Institute for Educational Quality Improvement (IQB) Berlin, Germany;
Hans Anand Pant, Institute for Educational Progress (IQB) Berlin, Germany

Criterion-referenced assessments allow the classification of examinee ability on discrete levels of proficiency, such as basic, proficient and advanced, where each level is defined by criteria of increasing qualitative and quantitative demand. Proportions of examinees falling into different proficiency levels can yield valuable information for

stakeholders and form a basis of educational accountability systems. However, when reporting measures of a continuous trait on a discrete ordinal scale it is important to address the issue of individual measurement error.

The present study considers an item response theory (IRT) based approach (Rudner, 2001) and the implications of increasing numbers of proficiency levels on examinee proficiency classification reliability.

The method was implemented with the response data of a representative sample of German secondary school examinees (N=31,426), assessed on their reading comprehension in English as a foreign language (EFL). The items employed in the assessment were based on the guidelines of the German National Educational Standards (KMK, 2003) and the European Framework of Reference for Languages (CEFR, Council of Europe, 2001).

PAPER PRESENTATION

Comparing Primary and High-School Teachers' Attitudes towards Testing and Accountability

Beno Csapo, University of Szeged, Hungary; Edit Toth, University of Szeged, Hungary

As a part of a major project aiming at developing an online diagnostic assessment system for the first six grades of primary school, a survey was carried out to map out teachers' attitudes towards testing and accountability. Research questions of the present paper focus on the differences between primary and secondary teachers, assuming that their different involvement in several assessment processes result in different attitudes. An online system was used to survey 1150 primary and 1147 secondary school teachers. The schools were representatively chosen from the schools of Hungary. The online questionnaire consisted of ten blocks of questions, each block representing a particular assessment or accountability procedure. For analyses of results we used descriptive statistics, parametric tests and relation analyses. Results indicate that teachers consider regular assessments as an important incentive to improve achievements. This tendency is more characteristic of primary school teachers especially who began to prepare their students well before the tests. Primary school teachers feel significantly pressurized by national mandatory assessments and a little less pressurized by international standardized measurements. Secondary school teachers feel under pressure rather due to maturity exams. Primary school teachers consider preparing students for the assessments more important. They tend to change their instructional practice more likely than their secondary school counterparts. The survey showed overall positive attitudes, it also indicated several points where better training and improved presentation of assessment results may increase teachers' engagement.

Background

In the economically developed countries the evaluation of students' achievement with standardized tests in international and national context has an essential role in monitoring public education, in policymakers' decision-making and in comparing educational systems or institutions (OECD, 2007). Depending on the purpose of the survey certain stakes are connected to the large-scale achievement tests. Increasing number of countries use mandatory assessments, which form the bases of accountability. Due to the stakes, achievement assessments may have a lot of positive and negative effects on teaching and learning process (e.g. Koretz, 2005; Stecher, 2002; Hanushek, 2005). Teachers' understanding of assessment, acceptance of the goals and their cooperation is an essential precondition of an efficient monitoring and feedback system. Therefore, research of teachers' reactions on testing programs is highlighted in the educational sciences both in national (e.g. Hamilton et al., 2007) and in international contexts (e.g. OECD, 2009).

Aims

Hungary participates in large-scale international testing programs (PIRLS, TIMSS, PISA) and a national assessment system has been introduced that measures every student's achievement in reading and mathematical literacy in grades 4, 6, 8, 10; furthermore, there is a maturity exam for every student finishing high school at the end of grade 12. Until recently, teachers' attitudes towards these assessments have been a largely uncovered area. The aim of our study was, on the one hand, the examination of the differences of primary and secondary school teachers' attitudes towards international and national testing programs and the maturity exam, and, on the other hand, to identify the differences in the attitudes of teachers, who prepare their students for national assessments and who do not.

Methods

Participants

1150 teachers from 245 representatively selected primary schools participated in the survey. A comparable sample of high school teacher was chosen (1147 teachers from 100 schools) and surveyed in the same way. Teachers were selected into the sample based on the subjects they teach.

Instruments

The questionnaire consisted of ten blocks of questions, each block representing a particular assessment or accountability procedure. The questions in the study focus on teachers' view on regular assessments and their reports, test preparation strategies and perceived pressure. To allow international comparison, some parts of the instrument were composed of questions known from literature, while other parts contained country specific questions. The questionnaire is reliable (Cronbach's alpha 0,811–0,897). Teachers' opinions were mainly assessed on a four and five level Likert scale (1=disagree; 4/5=agree).

Procedures

Data were collected anonymously from March to June, 2010, electronically by the TAO-CAPI system, participation was voluntary. For analyses of results we used descriptive statistics, parametric tests and relation analyses.

Analysis and results

Teachers in secondary schools rather think that achievement tests should be conducted on a regular basis than primary school teachers. Assessments rather cause trouble and problem for primary school teachers; however, they also feel more motivated by them. Teachers, who are preparing their students for state assessments, experience achievement assessments more useful. Regarding large-scale assessments primary school teachers perceive the strongest pressure when it comes to national mandatory assessment, 50% of them feel somewhat pressured, 19% of them a lot, and the ratio in the other group is 45% and 10%.

Teachers who practiced with students for the measurement feel more pressurized. 64% of the primary and 52% of the secondary school teachers start practicing several months before the test. Teachers tend to prepare their students for the tests by trying to improve students' test taking skills, motivation, and practice test formats, tasks that are similar in the mandatory assessment. Their instruction mostly changed in that they search more effective teaching methods, focus more on educational standards, and on the competences assessed. These are less characteristic of secondary school teachers than of primary school teachers and it is more characteristic of those who spend at least one month with preparing students for the forthcoming mandatory assessment.

Among the achievement assessments the maturity exam pressurizes secondary school teachers mostly. Half of the secondary school teachers think that there is a need to further clarify the frameworks of the two levels of the maturity exam, 60% claims that a life science subject should be integrated into the assessment programs as well. 40% of primary school teachers and 20% of secondary school teachers are not familiar with the feedback international assessment programs provide. Teachers partly agree that the reports of the Hungarian mandatory assessments are clear and comprehensible, however, they are less convinced that the feedback data mirrors Hungarian students' knowledge. In all mentioned cases differences between groups and variables are significant ($p < 0,05$).

Educational and scientific importance

The present work is a part of a major project aiming at introducing an online diagnostic assessment system for the first six grades of primary school. The diagnostic assessment system is designed to improve educational outcomes by providing students and teachers with frequent, detailed student level feedback. These low-stake assessments try to minimize stress and perceived pressure. Implementing such a system in the everyday practice requires teachers' positive attitudes in general, understanding the outcomes of the assessment and willingness to be engaged in interpreting and utilizing feedback information in their everyday teaching practice. The survey showed overall positive attitudes, it also indicated several points where better training and improved presentation of assessment results may increase teachers' engagement.

References

- Hamilton, L.S., Stecher, B.M., Marsh, J.A., McCombs, J.S., Robyn, A., Russell, J.L., Naftel, S., and Barney, H. (2007): Standards-Based Accountability under No Child Left Behind: Experiences of Teachers and Administrators in Three States. RAND, Santa Monica.
- Hanushek E.M. Raymond (2005): "Does School Accountability Lead to Student Improvements? Journal of Policy Analysis and Management, 24. 297–327.
- Koretz, D. (2005): Alignment, high stakes, and the inflation of test scores. In Herman J. and Haertel E. (Eds.): Uses and misuses of data in accountability testing. Yearbook of the National Society for the Study of Education. 104. 2. Blackwell Publishing, Malden. 99–118.
- OECD (2009): Creating Effective Teaching and Learning Environments. First Results from TALIS. OECD, Paris.
- OECD (2007): Education at a Glance. OECD, Paris.
- Stecher, B.M. (2002): Consequences of large-scale, high-stakes testing on school and

classroom practices. In Hamilton, L.S., Stecher B.M., and Klein S.P. (Eds.): Making sense of test-based accountability in education. RAND, Santa Monica. 79–100.

PAPER PRESENTATION

Does it count? The effect of item order on test performance

Rianne Janssen, K.U. Leuven, Belgium; Dries Debeer, K.U. Leuven, Belgium

The question whether order of the items in the test has an effect on the test score already has been investigated in different fields, such as personality and clinical psychology, survey research, and educational measurement. Several models have been proposed to investigate the effect of item order on the test scores. These models differ along the following dimensions: (a) whether the effect is investigated in a design of test administration where different item orders are presented or not; (b) whether the effect is investigated at the level of the test score versus at the level of individual items and (c) whether individual differences in the effect of item position are taken into account or not. A new model is proposed that analyzes the item-order effect at the level of items but that takes individual differences into account as well. It is applied to a computer-based test on listening comprehension of French as a foreign language.

Introduction

The question whether the position of an item has an effect on the obtained test score already has a long past in educational measurement. For example, Guertin (1954) showed that the order of item presentation yielded a significant difference in performance on the arithmetic subtest of the Wechsler-Bellevue. As another example, Hambleton and Traub (1974) investigated the effects of item order on test performance and stress. They found for a mathematics test that the mean number of correct answers was significantly lower for questions arranged in the difficult-to-easy order than for the reverse order. The difficult-to-easy order also increased heart rate more than the easy-to-difficult order. In current practice, test constructors have different opinions about the order in which items should be presented to the testees, for example, should item difficulty be taken into account or not?

Apart from educational measurement, item-order effects have been studied in different research fields, such as personality and social psychology, clinical psychology, and survey research. Studies on the item-order effect in different contexts obtained opposite results. For example, in educational measurement, both an increased performance (or so-called practice effect) and a decreased performance (or a so-called fatigue effect) towards the end of the test have been reported (Bejar, 1985; Kingston & Dorans, 1982). A more intriguing example of opposite results is related to effect of item order on the relationship of the item with the latent trait. Findings in personality assessment suggest that the number of items preceding the item may increase the correlation with the latent trait (e.g., Hamilton & Shuminsky, 1990; Knowles, 1988). In educational measurement on the other hand, a decrease in the correlation of the end-of-test items with the latent trait can be expected in some situations given that test takers may change to a pure guessing strategy (e.g., Yamamoto & Everson, 1997). Hence, as Knowles (1988) concluded, studies on the item-order effect show that measuring may change the measure.

Aims

The purpose of the present paper is to give an overview of the existing research designs and models that have been proposed to study item-order effects. Moreover, a new, general framework for studying item-order effects is proposed. The framework will be illustrated with several examples relevant to the field of educational assessment.

Overview of Existing Frameworks and Models.

Two main types of research designs can be discerned to study item-order effects: designs with a single test administration on a single group of respondents and between-group designs with a different order of presentation of the test items across groups of respondents. The former type of designs focuses on the effect of item order on the person side: individual differences in response behavior during the test administration (e.g., at the beginning or at the end of the test) are the focuses of interest. Hence, these designs focus on the measurement of change. The latter type of designs focuses on the effect of item order on the item side: differences in item parameters between the different orders of item administration are the focuses of interest. Hence, these designs focus on the change of the measure.

In both type of designs, two groups of models can be discerned: models based on classical test theory (CTT) or structural equation modeling (SEM), on the one hand, and models based on item response theory (IRT) on the other hand. Examples of the former type of models can be found in Knowles (1989), Hartig, Hßlzel, and Moosbrugger (2007) and Schweizer (2010). Examples of IRT-based models of item-order effects are Steinberg (1994), Hahne (2008), Kubinger (2008), and Verguts and De Boeck (2000).

It will be argued that models for studying item-order effects should take into account the individual item level. Hence, an IRT-based approach is generally to be preferred above a CTT or SEM approach, as will be illustrated with a small simulation study on a particular application. However, it will also be argued that both differences on the person side (measurement of change) and on the item side (change of the measure) should be taken into account when modeling item-order effects.

A new framework for studying item-order effects

A general IRT-model for studying item-order effects is presented, which encompasses possible effects at both the person and item side. The framework is based on the Generalized Linear Mixed Modeling (GLMM) approach to IRT proposed by De Boeck and Wilson (2004). The modeling framework is applicable in both types of research designs. Its main advantage is that specific hypotheses concerning item-order effects can be tested by significance testing of specific parameters. The model is illustrated with an application on a computer-based test on listening comprehension of French as a foreign language.

Educational Significance

The proposed general framework for studying item-order effects aims to present more conceptual and methodological clarity in the study of item-order effects. The main advantage of the general modeling framework is that specific hypotheses concerning item-order effects can be tested by significance testing on parameters. Within educational measurement the framework may allow to control for confounding effects of item order, but it may also be applied in cases where the change in the latent ability due to item order is the focus of interest (e.g., to investigate learning during the test, or stress-resistance).

PAPER PRESENTATION

Eco systems thinking and conceptual development

Diana Garavito-Bermudez, Stockholm University, Sweden; Cecilia Lundholm, Stockholm University, Sweden

Knowledge of social-ecological systems is required to promote adaptability in decision-making on natural resources (Folke, 2006). Therefore, research into possible conceptual challenges encountered by different professional groups is important for enhancing our understanding of decision-making. This study focuses on ecological knowledge and its implications for natural resource management. An interview study was carried out focussing on professional fishermen's conceptualizations of ecosystems, and how these conceptualizations are involved in processes of natural resource management. Two geographical areas in Sweden are in focus: Lake Vättern and the Archipelago of Blekinge (Baltic Sea). The results show the role of systems thinking in the organization of knowledge regarding structure and functional dynamics in the ecosystem. Invisibility of interrelations between biological components in aquatic ecosystems is a barrier for understanding biological, chemical and physical processes occurring comparing to other ecosystems such as mountains, forests, arid/semi-arid and agricultural. However, the fishermen are able to create hypothetical causal relations and elaborate on these using inductive and deductive reasoning. This study contributes to the comprehension of the conceptual challenges involved in the understanding of biological complex systems and its professional implications. Previous research has mainly investigated students' systems understanding in educational settings; however, this project addresses learning in informal and professional contexts. By this we hope to contribute to general and theoretical understanding of knowledge regarding systems complexity. Furthermore, the project has practical implications regarding the role of knowledge and learning in decision-making (on natural resources) in professional settings.

Aim

With the aim to describe the content of ecological knowledge and its conceptual development, the research questions for this study are:- What kind of reasoning is involved in these conceptualizations? What is the role played by systems thinking?- How do these conceptualizations affects resource extraction and processes of resource management? These questions are closely related to the populations' dynamics of Great charr (*Salvelinus umbla*) and American crayfish (*Pacifastacus leniusculus*) in Lake Vättern, in terms of their ecological state and their economical and traditional value in the region.

Methodology

Geographical area

The geographical area studied in this paper is Lake Vättern, which is situated in the middle of four counties, and twenty-one municipalities in the south of Sweden. Lake Vättern is the sixth biggest lake in Europe, 1912 km².

Nowadays, about 250.000 people take water from Vättern for their daily consumption and some of them benefit of fishing (Länsstyrelsen i Jönköpings län, 2009). The fishing of Great charr (*Salvelinus umbla*) has been strongly reduced and economically compensated by the fishing of crayfishing. Today the foreign specie, American crayfish (*Pacifastacus leniusculus*), derives a significant income for some stakeholders, especially professional fishermen. Moreover, this unique aquatic system was one of six "pilot" projects selected for a 'co-management initiative' by the Swedish Board of Fisheries in 2004. This "Co-management Initiative Project" worked successfully for the development of regional co-management of fishing. In 2009 this process, characterized by including multiple stakeholders into decision-making, finished with an official document – a management plan - that will be the road map for future management. Fishing in Lake Vättern is classified into four categories: leisure fishing (sport fishing and households fishing), tourist fishing, fish farming and professional fishing (Länsstyrelsen i Jönköpings län, 2009). This last category requires the possession of a professional fishing licence given by the Local County Administrative Board. These categories are defined by different types of catch methods, species focus and fish water. Fishing is common both for sustenance and recreation, hence, professional fishing is main target group for this study. The kind of fishing in the study area is small-scale fishing. 11 of 22 professional fishermen have been interviewed so far. All of them are men and the majority of them are localized in the northern part of the study area. They are between 27 and over 66 years old (in 2009).

Data collection

The data collection method was basically structured interviews and a few direct observations during fishing. The interview format was structured around central themes such as knowledge of ecosystem, knowledge generation and its effects on resource management, and communication of ecological knowledge among scientists, managers and local stakeholders. This paper presents results on the first of these aspects.

Findings

An overview of the whole material shows that fishermen's fishing concern 13 species of the 30 existents at Lake Vättern (in Sweden there are around 50 species). American crayfish (*Pacifastacus leniusculus*) is today the most frequent specie in professional fishing occupying the first place, followed by European perch (*Perca fluviatilis*) in second place, and Common whitefish (*Coregonus* sp.) and Great charr (*Salvelinus alpinus*) in third place. We identify two main levels of understanding ecosystems complexity, which are structure and functional dynamics (Hmelo et al., 2000; Hmelo-Silver & Green Pfeffer, 2004; Hmel-Silver et al., 2008). When looking at the structural level, we find different ways of understanding the relationships between ecosystems biological (food webs) and non-biological (disturbance factors influence the whole system) components among fishermen. Similarly, looking at the functional dynamics level, there is understanding of some processes considering complexity such as hierarchy, feedback effects, non-linear causality and emergence proprieties of ecosystems components.

Systems

Invisibility in aquatic systems is a barrier for the understanding of ecosystems structure and functional dynamics. But this does not prevent fishermen from creating explanations based on experience, beliefs and guesswork. In this way, fishermen are able to produce hypothetical connections between biological and non-biological component using deductive and inductive reasoning. However, the understanding of ecosystems functional dynamics seems to be more difficult than the identification of ecosystems structure and requires a deeper comprehension of invisible processes and decentralized thinking (Hmelo-Silver & Green Pfeffer, 2004). Likewise, the results show strong connections between resource dependence and knowledge elaboration. It seems that fishermen who focus their fishing on several fish species generate a greater understanding of ecosystems functions and dynamics, compared to those who only focus on American crayfish fishing. Time and place are also two relevant elements in the understanding of ecosystems functional dynamics in relation to populations' dynamics and biological changes of fishing species (reproduction, nutrition and temporal-spatial distribution).

Discussion

The paper discusses the role of systems understanding in relation to the profession of being a fisherman, and we highlight some questions; Is systems understanding of functional dynamics part of core knowledge? Is it part of their professional reflection (cf. Schön (1983, 1987) and reflection-in-action)? Secondly, it seems that scientific knowledge represented by experts, and knowledge represented by fishermen is complementary, and have different origins when relating to theory, and experiences of time and place.

Theoretical and educational significance

This study contributes to the comprehension of the conceptual challenges involved in the understanding of biological complex systems and its professional implications. Previous research has mainly studied addressed systems understanding in educational settings; however, in this project we are looking at learning in informal and professional contexts. By this we hope to contribute to our general and theoretical understanding of knowledge regarding systems

complexity. Furthermore, the project has practical implications regarding the role of knowledge and learning in professional contexts where decision-making (on natural resources) is of particular interest.

References

- Folke, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16, 253-267.
- Hmelo, C., Holton, D. & Kolodner. (2000). Designing to learn about complex systems. *The Journal of Learning Sciences*. 9(3), 247-298.
- Hmelo-Silver, C., Green Pfeffer, M. (2004). Comparing expert and novice understanding of a complex system from a perspective of structures, behaviors, and functions. *Cognitive Science*, 28, 127-138.
- Hmelo-Silver, C., Jordan, R., Liu, L., Gray, S., Demeter, M., Rugaber, S., Vattam, S., Goel, A. (2008). Focusing on function: thinking below the surface of complex natural systems. *Science Scope*. Summer.
- Länsstyrelsen/County Council i Jönköping län. (2009). Förvaltningsplan för fisk & fiske i Vättern/ Management plan for fish and fishery in Vättern. Jönköping, Sweden:
- Author.Schön, Donald, A. (1983). *The Reflective Practitioner, How Professionals Think in Action*. Basic Books.
- Schön, Donald, A. (1987). *Education the reflective Practitioner, Toward a New Design for Teaching and learning in the Professions*. San Francisco: Jossey-Bass Inc Publishers.

PAPER PRESENTATION

The Effect of Answering Questions that Differ in Specificity on Mental Effort and Text Retention

Liesbeth Kester, Open University of the Netherlands, Netherlands; Huib Tabbers, Erasmus University Rotterdam, Netherlands; Chantal Gorissen, Open University of the Netherlands, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Tested information is retained longer than studied information. This, so called, testing effect is thoroughly studied in memory research. Recently, a renewed interest in the testing effect in an educational context can be observed. This study is placed within this line of research and investigates two aspects of the testing effect, namely, effortful retrieval and retrieval induced facilitation. Participants were randomly assigned to one of three experimental conditions that differed in the learning strategy used. Participants either restudied a text that they had received, answered specific questions after studying the text, or answered less specific questions after studying the text. It is assumed that more effort is needed to answer the less specific questions than to answer the specific questions. Therefore, we hypothesize that the less specific questions will produce a stronger testing effect than the specific questions. In addition, we investigate if the benefits of taking an initial test spill over to answering questions that were not initially tested. The results of this study confirm that answering less specific questions requires more effort, however, this does not pay off in a better retention of facts after a week. Nevertheless, a testing was found for the specific questions. No spill over effects were found.

Tested information is retained longer than studied information. This, so called, testing effect is thoroughly studied in memory research (Roediger & Karpicke, 2006). Recently, a renewed interest in the testing effect in an educational context can be observed. This study is placed within this line of research and investigates two aspects of the testing effect, namely, effortful retrieval and retrieval induced facilitation. The effortful retrieval hypothesis holds that the testing effect occurs because it costs less effort to restudy a wordlist or word-pair list than to retrieve it from memory and that the extra effort that is invested to retrieve a fact results in a stronger and more elaborated memory trace of that fact which makes it easier to retrieve the fact at a later moment (Bjork, 1994). Retrieval induced facilitation means that the benefits of testing on retention spill over to related facts that were not initially tested (Chan, McDermott & Roediger, 2006).

To investigate the effortful retrieval hypothesis, this study examines the effects of specific (e.g., 'What did the dogs in Pavlov's experiments do when they heard a bell ringing?') and less specific questions (e.g., 'Describe how Pavlov proved that dogs can distinguish between different stimuli') on expository text retention. It is assumed that more effort is needed to answer the less specific questions than to answer the specific questions. Therefore, we hypothesize that the less specific questions will produce a stronger testing effect than the specific questions. In addition, we investigate if the benefits of taking an initial test spill over to answering questions that were not initially tested.

Method

Participants

Ninety-three Dutch high school juniors and seniors (57 males, 36 females; mean age = 16.32, SD = .90) from general secondary education participated in this experiment during regular school hours.

Materials

Instructional text. An expository text on the 'Pavlov reaction' (861 words) was used as learning content. The text was divided in ten paragraphs printed on separate pages.

Initial specific test. Ten specific, short-answer questions were formulated to determine recall of specific facts from the text. These questions required a one-or-two-words response and their answers were literally available in the text. Each correct answer received 1 point.

Initial less specific test. Ten less specific, short-answer questions to measure how well the participants could recall combinations of facts from the text were formulated. The questions allowed for a few-sentences response and their answers could be found literally in the text. Each correct fact received 1 point.

Final test. The final test consisted of the initial specific test with four new, specific questions and the initial less specific test with four new, less specific questions. The final test was scored in the same manner as the initial tests.

Effort measure. Paas' (1992) subjective 9 point rating scale was used to measure retrieval effort. It ranged from very, very, very low effort (1) to very, very, very high effort (9). Participants were asked 'How much effort did it cost you to understand the paragraph?' or 'How much effort did it cost you to answer the question?'.

Design and Procedure

Participants were randomly assigned to one of three experimental conditions that differed in the learning strategy used. Participants either restudied a text that they had received ($n = 29$), answered specific questions ($n = 35$) after studying the text, or answered less specific questions ($n = 29$) after studying the text.

The participants had 1 minute to study each paragraph and fill in the effort scale, then 5 minutes to perform a distracter task. Next depending on the experimental condition they were in, they restudied the text, answered the specific or less specific questions. They had 1 minute to restudy each paragraph or answer each question and fill in the effort scale, then 5 minutes to perform a distracter task. After a week, they took the final test. They were given 1 minute to answer each less specific test-question and 30 seconds to answer each specific test-question.

Results and Discussion

ANOVA revealed a significant effect of learning strategy on mean effort invested during the 'learning strategy phase', $F(2, 90) = 35.41$; $MSE = 52.52$; p

A MANOVA revealed a significant effect of learning strategy on the initially tested specific questions, $F(2,90) = 7.57$; $MSE = 18.98$; $p .05$. A Bonferroni post-hoc test revealed that participants who had answered the specific questions before performed better on these questions after a week than participants who had restudied the text or who answered the less specific questions (both ps

Discussion

Although a testing effect was found for the specific questions, no testing effect was found using the less specific questions and no spill over effects were found in this study. Reasons for these unexpected results will be discussed during our presentation at EARLI.

Bjork, R. A. (1994). Memory and meta memory considerations in the training of human beings. In J. Metcalfe & A. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 185-205). Cambridge, MA: MIT press.

Chan, J. C. K., McDermott, K. B., & Roediger, H. L. (2006). Retrieval-induced facilitation: Initially nontested material can benefit from prior testing of related material. *Journal of Experimental Psychology: General*, 135, 553-571.

Paas, F. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology*, 84, 429-434.

Roediger, H. L. & Karpicke, J. D. (2006). The power of testing memory. Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1(3), 181-210.

PAPER PRESENTATION

Conceptual Change in Physical Science: Ontological, Epistemic and Meta-representational Changes.

NATASSA / ANASTASIA KYRIAKOPOULOU, UNIVERSITY OF ATHENS, Greece; Stella Vosniadou, National and Kapodistrian University of Athens, Greece

In this article we will argue that conceptual change requires the reorganization of children's intuitive theories, but it also involves changes in children's understanding of the mental world (Theory of Mind) and in the way they come to know the world and justify, interpret and construct knowledge and knowing (Personal Epistemology). In order to empirically investigate these relations, we combined instruments from the Theory of Mind, Personal Epistemology and Conceptual Change research tradition. Forty-six fifth graders were administered measures of their ability to attribute false beliefs, of their epistemic stance and of their ability to reason about different conceptual models of the physical world. The results showed statistically significant correlation between the ability to understand different beliefs and children's epistemic beliefs. The results also showed statistically significant correlations between children's beliefs about their mental states and nature of knowledge in general and their ability to reason about different conceptual models of the physical world. A set of hierarchical regression analyses showed that children's theory of mind and epistemic beliefs appear to be strong predictors for children's ability to reason on different interpretations of the physical world. The cluster analysis with k-means method also showed that the epistemological distinction in the physical world is accompanied by better performance on Theory of mind and epistemic tasks as opposed to non-resolution of the ontological problem, where children can not attribute false beliefs and believe in absolute truth.

Most researchers in the area of cognitive development agree that at the end of the pre-school age and before the time that the systematic science instruction starts, most children have constructed initial naïve theories that makes it possible for them to interpret phenomena of the physical world. These "theories" are very different from the scientific theories in terms of their broadness, their explanatory significance, their internal coherence and their social acceptance.

The difficulty for the children is how to reconcile in an internally consistent framework their everyday intuitive experiences of the phenomena with the scientifically accepted explanations of these phenomena. This requires a reorganization of the initial cognitive structures and a replacement of the established beliefs with a new explanatory framework. Learning science can be conceptualized as a process of conceptual change in the context of theory change.

In this article we will argue that conceptual change requires the reorganization of children's intuitive theories, but it also requires the reorganization of children's perceptions of knowledge, learning and knowing, as well as changes in their ability to think and manipulate different representations of the world.

In particular, we will argue that this process also involves changes in children's understanding of the mental world (Theory of Mind) and in the way they come to know the world and justify, interpret and construct knowledge and knowing (Personal Epistemology). The underlying feature of all these changes is the awareness of our and others beliefs, the ability to recognize them as different perspectives and to understand how these perspectives can affect the interpretations of our experiences.

We will report an exploratory study that investigates the possible theoretical relationship between the constructs of Theory of Mind and Personal Epistemology and Conceptual change in Physical Science.

According to our proposed theoretical framework, the development of the representational nature of beliefs and the awareness of our beliefs (Theory of Mind) precedes the development of a more general Personal Epistemology. Understandings of the different interpretations of the same situation in the world, of the different knowledge claims that can arise through exposure to different aspects of knowledge, of the importance of the sources of knowledge, are the first metaconceptual steps towards a view of the knowledge as an individual construct. These metaconceptual abilities are assumed to positively contribute to the development of the coordination between the subjective and objective dimensions of knowledge and to the subsequent recognition of the uncertain and constructive nature of knowledge (Personal Epistemology).

Finally, we have assumed that the initial recognition that knowledge is constructible and uncertain goes along with and facilitates considerably the comprehension of phenomena of the physical world where the child should recognize that representations of situations in the world are theoretical entities, hypotheses that can be tested, found wrong and replaced by others (Conceptual Change).

In order to empirically investigate these relations, we combined instruments from the Theory of Mind, Personal Epistemology and Conceptual Change research tradition. Forty-six fifth graders were administered measures of their ability to attribute false beliefs, of their epistemic stance and of their ability to reason about different conceptual models of the physical world.

The results showed statistically significant correlation between the ability to understand different beliefs and children's epistemic beliefs. A set of regression analyses seemed to support the proposed theoretical model. Theory of mind seemed to be a strong predictor for children's epistemic views.

The results also showed statistically significant correlations between children's beliefs about their mental states and nature of knowledge in general and their ability to reason about different conceptual models of the physical world. The awareness of our and others beliefs, as well as the appreciation that knowledge is constructible and not determined from an exterior reality, appeared to significantly relate with the understanding of physical phenomena where the child should recognize that there are contradictory conceptions of reality and not a simple and reliable causal relation between the real situation of the world and our scientific explanations for it. A set of hierarchical regression analyses showed that children's theory of mind and epistemic beliefs appear to be strong predictors for children's ability to reason on different interpretations of the physical world.

The cluster analysis with k-means method also showed that the epistemological distinction in the physical world is accompanied by better performance on Theory of mind and epistemic tasks as opposed to non-resolution of the ontological problem, where children can not attribute false beliefs and believe in absolute truth. Discriminant function analysis showed that theory of mind of 3rd order and beliefs about the nature of science are good predictors for group membership. Factor analysis extracted two factors, one that refers to our meta-representational ability and one that refers to the coordination of the subjective and objective dimensions of knowledge.

Understanding that representations of our world are those that determine our actions and not the world itself, is the most important achievement which governs all three domains. In the domain of Theory of mind develops the representational aspect of belief, in the domain of Personal Epistemology develops the understanding of the uncertain and non-absolute knowledge which is not based on simple observations of the external world but is constructed by humans, and in the domain of Conceptual Change in the Physical world develops the understanding that there can be different representations of the same external reality and we can shift from one representation to another.

If we want to have students who think in a critical way, we should take into consideration the possible relation of these three theoretical constructs and how it develops as a foundation of instruction.

PAPER PRESENTATION

Exploring the development of leadership epistemology in adolescents

Cynthia Knechtges, University of Toledo, United States; Florian Feucht, The University of Toledo, United States

Little is known about beliefs of teenagers about leadership in education for a global networked society. The study explores the beliefs of students ($n = 80$) about leadership and the nature of knowledge and knowing (i.e., epistemic beliefs). A cross-sectional design (i.e., 6th to 12th grade) was applied to identify potential developmental progressions and interrelations between leadership beliefs and epistemic beliefs using interview and picture drawing techniques. The preliminary data analysis reveals that younger students define leadership in their family settings and close friendship circles while older students broaden the context of leadership to their local community and national politics. Most of the students believed that leadership knowledge is domain-specific and can be acquired over time, while less students believe in universal, often innate leadership knowledge. Results provide important information on how to development and improve leadership programs for high school students.

Exploring the development of leadership epistemology in adolescentsMost research on leadership focuses on adult leadership, and more specifically, the focus is on defining the leadership competencies, categorizing leadership, and predicting who will be a future leader. Identifying individuals with the propensity to become good leaders has financial implications for organizations pertaining to selection, training, and development of people (Bono & Judge, 2004). McKinsey and Company states that "there is a growing shortage of people willing to take on leadership roles in their careers," and as the large population of baby boomer retire, the shortage is expected to intensify (cited in Michael, Kartford-Jones & Axelrod, 2001). However, research yields little success in identifying criteria for predicting future leaders in global networked societies (Bono & Judge, 2004). Currently, little is known regarding youth's beliefs about leadership. Most of the existing research about leadership is conducted with adults. Therefore, many researchers

make one of two assumptions: (1) the youth and adult definitions are the same or (2) youth do not have a fully/ properly developed belief system about leadership. One study suggests that youth have a fully developed belief system about leadership, which is different than the belief system commonly held by adults (Roach, 1999). Therefore, more research is needed to explore what youth know about leadership, how youth develop knowledge about leadership, and how they use this knowledge to understand the world around them (i.e., epistemic beliefs) (Haerle & Bendixen, 2008; Kuhn & Weinstock, 2002).

Purpose of the Study

This study aims to explore the overlap between the leadership beliefs and epistemic beliefs in youth. Specifically, the interest is in the characteristics of these beliefs, their developmental progression, and their potential interplay. The overlap is characterized, for example, by beliefs about the definition, behavior, and attitudes of leadership as well as beliefs about the nature of leadership knowledge and processes of knowing (i.e., epistemic beliefs) (Haerle & Bendixen, 2008; Kuhn & Weinstock, 2002; Roach, 1999).

Method

A cross-sectional research design was used to tap the beliefs system of youth about leadership, their potential developmental progression, and to explore their epistemological underpinnings. Semi-Structured interviews were conducted.

Participants

The overall sample ($n = 80$) of the study encompassed students from the grades 6th, 8th, 10th, and 12th and was randomly drawn from a Midwest suburban school district. The sample was stratified to account for an even balance of male and female students per grade level (male students $n = 10$; female students $n = 10$).

Materials

The interview protocol revolved around the following example questions: 1. Could you explain to me what a leader is? 2. Please draw a picture of a good leader in action. Use speaking bubbles to describe what the leader would typically say or think. 3. How does a leader know what to say and what to do? 4. Does this knowledge change? To complete the drawing task, participants were provided with a black marker and a square piece of white paper.

Procedure

We conducted semi-structured interviews with all participants. This technique combines a structured interview protocol with the flexibility to ask ad hoc questions (i.e., subsequent questions that emerge during the interview). Ad hoc questions were posed to interviewees to verify and/or elaborate on aspects of their answers. The total interview time was approximately 25-30 minutes for each participant. The picture drawing task took place in the first third of the interview. Participants had up to 5 minutes time to silently complete their picture using a black.

Analyses

We will use the method of qualitative content analysis (Mayring, 2002), which evolved from the classical, more quantitative method of content analysis (Kohlbacher, 2005; Titscher, Meyer, Wodak, & Vetter, 2000). The more quantitative content analysis has been criticized for its inability to account for context, underlying themes, and distinctions among individual cases/participants (Ritsert, 1972). Qualitative content analysis aims to overcome these shortcomings by applying a systematic, theory-guided approach to text analysis using inductive coding schemes. Mayring's approach is guided by a sequential model that encompasses three distinct analytical procedures (Kohlbacher, 2005; Mayring, 2002): summarizing, explicating, and structuring. In our data analysis, we will apply all three of the above procedures. The software ATLAS.ti will be used to facilitate that process of data analysis.

Preliminary Results

A brief screening of the data indicates that the majority of participants believes that a leader is a responsible person who is in charge of a group of people. A developmental progress might be identifiable across the different age section of the sample. That is, 6th and 8th graders seem to refer to leadership within their micro system, such as their family (e.g., siblings or parents) or friends. Older students tend to refer to project leader at school (e.g., art project), athletic clubs (e.g., captain of the soccer team), and/or at the state and national level (e.g., President Obama). Most participants stated that leadership is an acquired skill and not an innate ability per se. Most participants seem to believe that knowledge about leadership is changing. Around 60 percent of the participants seem to believe that leadership knowledge is domain specific, while the answers of the remaining students suggest more a domain-general belief. A more systematic data analysis is required to complete and inform the future result section of the paper. The data set will be completely analyzed at the time of the presentation.

Educational Implication

This exploration provides evidence on what youth know about leadership, how youth grow their knowledge about leadership, and how they apply this knowledge to understand their world. By knowing more about the development of leadership beliefs and epistemic beliefs in youth and their potential interplay, educators can identify the youth's knowledge gaps or misconceptions of leadership, thereby more effectively targeting performance and learning objectives for the youth leadership development program (Conger, 1999; Roach, 1999).

References

- Bono, J., Judge, T. (2004). Personality and Transformational and Transactional Leadership: A Meta-Analysis. *Journal of Applied Psychology*, 901-910.
- Conger, J. (1999). Charismatic and transformational leadership in organizations: An insider's perspective on these developing streams of research. *Leadership Quarterly*, 145-170.
- Haerle, F. C. & Bendixen, L. D. (2008). Personal epistemology in elementary classrooms: A conceptual comparison of Germany and the United States and a guide for future cross-cultural research (pp. 165-190). In M.S. Khine (Ed.), *Knowing, knowledge and beliefs: Epistemological studies across diverse cultures*. Dordrecht, Netherlands: Springer.
- Kuhn, D. & Weinstock, M. (2002). What is epistemological thinking and why does it matter? In B.K. Hofer & P.R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 121-144). Mahwah, NJ: Lawrence Erlbaum Associates.(...)

PAPER PRESENTATION

Applying a western learning model across cultures: an Activity Theory analysis

Janneke Frambach, Maastricht University, Netherlands

Educational methods are often distributed from western to non-western countries, which some characterize as (neo)colonialism. Applying western learning models in contrasting cultural settings can indeed be problematic, regarding differences in students' learning behaviors and beliefs across cultures. This research aims to analyze the process of applying a western educational model in contrasting cultural contexts in terms of a two-directional influence: a) the colonization of local students' learning backgrounds, b) the domestication of the western model.

This influence is based on Habermas' notions of colonization of the lifeworld and domestication of the system. Socio-cultural Activity Theory serves as a framework to analyze this complex issue. Problem-based Learning (PBL) serves as a case example of a western educational model. A comparative case study was conducted in three PBL universities located in different cultural regions: Egypt, Hong Kong and The Netherlands. Data were collected through interviews with first and third year students, teachers and staff; class observations of PBL sessions; documents about PBL application; and context information. Template Analysis was used as method of analysis.

Several themes were identified concerning the mutual influence and development of students' learning backgrounds and the PBL model. A combination of cultural and contextual factors and domesticating measures determine the extent of colonization of students' learning backgrounds. These results serve institutes worldwide in better knowing and preparing what they choose for when adopting foreign educational models. Furthermore, the results indicate a global convergence of applying western educational models, and simultaneously a divergence into culture-specific models.

Problem statement

Educational methods are increasingly being distributed around the world, which often means a one-way export of western methods to non-western countries. Some therefore characterize educational globalization as westernization or (neo)colonialism, since inherently western cultural traits steeped in these methods are rarely questioned, along with their applicability in different cultural settings (Tikly, 2004; Bleakley et al., 2008; Nguyen et al., 2009). This applicability can indeed be problematic, for it may not consider differences in students' learning behaviors and beliefs across cultures (Tweed and Lehman, 2002; Li, 2005; Chinn, 2007; Nguyen et al., 2009).

Practice however shows numerous cases of successful adoption of western educational models by non-western institutes. This raises the question of how these adoption processes take place: do students adapt to the foreign model? Or does the model adapt to the students? Furthermore, how can these processes inform the ongoing educational globalization debate? This research aims to analyze a two-directional adaptation influence when applying a western educational model in a contrasting cultural context. The following research questions are addressed: How

and to what extent does the western model mediate (or: colonize) the cultural-specific learning beliefs and behaviors of students in contrasting cultural settings? How and to what extent do these students' learning backgrounds mediate (or: domesticate) the western model?

Theoretical and conceptual framework

The above concepts of colonization and domestication are derived from Habermas' notions of colonization of the lifeworld and domestication of the system (Habermas, 1984; 1987). The original learning behaviors and beliefs of students show similarities with Habermas' concept of lifeworld, which becomes colonized by the system. The western learning model shows similarities with this concept of system, which consequently can be domesticated by the lifeworld. Investigating the cross-cultural application of western learning models in these sociological and philosophical Habermasian terms, can inform and shed a new light on the educational post colonialism debate.

Socio-cultural Activity Theory (AT), originating from Vygotsky (1978) and expanded by Engeström (1999), serves as a theoretical framework to analyze this complex issue. The organizing principle in AT is the activity system, which takes the relevant actors, their goals, the mediating artifacts, and contextual matters that are part of a particular activity into account, as well as their mutual interactions. A western learning model can be regarded as a mediating artifact likely to contradict with other system components when it is implemented in an educational activity system in a contrasting cultural setting. In the dynamics that result from these contradictions lie the answers to the research questions.

The concept of western learning model is based on the Socratic learning model defined by Tweed and Lehman (2002). This model is characterized by students' verbal expression, individualism, independence, rationality, self-directedness and critical and questioning tendencies, and is argued to be more common in western students and institutes, while not being restricted to them, nor being employed by all of them. Problem-based Learning (PBL), as described by Barrows (1996), serves as a case example of a Socratic/western educational model.

Methods

A comparative cross-cultural case study was conducted in three higher education institutes (Medical Schools) which extensively apply the PBL model and are located in different cultural regions: Suez Canal University in Egypt, The University of Hong Kong, and Maastricht University in The Netherlands. The institutes were purposively selected based on suggestions made by experts in international medical education according to several criteria. A qualitative approach, based on principles of ethnography, was used to grasp the complex nature of the activity systems and their interrelated components.

Data were collected through various instruments and sources. First, individual semi-structured interviews were conducted with first and third year students, PBL teachers and educational leaders (30 per case, 90 in total). Sampling of a target participant group was purposive, while participants from that group were self-selected. Second, class observations of first and third year PBL sessions were conducted. Third, documents about the application of PBL were gathered. Fourth, context information was gathered by document analyses and participant observation.

Measures enhancing trustworthiness included: method triangulation, inclusion of western and non-western cases, data saturation, member checking, iterative data collection and analysis, and analysis by multiple researchers. The study was approved by the ethical review boards of the institutes, and informed consent was obtained from the participants. The transcribed interviews, field notes, and documents were analyzed according to the Template Analysis method (King, 2010).

Results and conclusions

A number of themes was identified concerning the nature, interrelations, and development of the students and the PBL model. The analysis revealed certain 'universal' student behaviors, which consequently can be enhanced or weakened by cultural and contextual factors. Students in the three cases are able to adapt their way of learning to the PBL model and experience change, e.g. learning more self-directed. In this sense, they can be said to be (partly) colonized by the PBL model. The opposite occurs as well: the PBL model is adapted or domesticated by the students and the institutes to better suit their needs, e.g. adding more lectures to the model. However, besides these similarities, the activity systems look different across the cases due to interactions with different cultural and contextual factors. The Dutch AT system shows less contradictions when PBL is introduced than the Egyptian and Hong Kong systems. Consequently, Dutch students appear to be less colonized than Egyptian students, who significantly change their learning beliefs. On the contrary, Hong Kong students do not experience such a development, but they do significantly domesticate the PBL model into a hybrid approach.

Concluding, a combination of cultural and contextual factors, and domesticating measures determine the extent of colonization of students' learning beliefs and behaviors when a western learning model is applied. These results might help institutes worldwide in better knowing and preparing what they choose for when adopting a foreign educational model, and in predicting how feasible their expectations are. Regarding the issue of educational globalization, the results indicate a global convergence of applying western educational models, but at the same time a divergence into culture-specific models.

PAPER PRESENTATION

Understanding academic performance of international students in a globalised networked society

Bart Rienties, University of Surrey, United Kingdom; Simon Beausaert, Maastricht University, Netherlands; Susan Niemantsverdriet, Hogeschool Leiden, Netherlands; Piet Kommers, Universiteit Twente, Netherlands; Ria Jacobi, Universiteit Leiden, Netherlands

More than 3 million students study outside their home country, primarily at a Western university. A common belief among educators is that international students are insufficiently adjusted to higher education in their host country, both academically and socially. Furthermore, several groups of international students experience considerable amounts of stress while adapting to the culture of the host-institute. Several researchers argue that studies on adaptation of international students should widen its focus to the underlying mechanisms that leads towards this "misalignment". In a cross-institutional comparison among 958 students at five business schools in the Netherlands, differences in academic performance between local and international students were identified by focussing on their levels of academic and social integration. Students' academic integration was measured with the Students' Adaptation to College Questionnaire (SACQ), while students' social integration was measured with a newly developed and validated questionnaire.

The results indicate that the degree of academic success of international students is multi-faceted. International students with a (mixed) western ethnic background perform well on both academic and social integration, and also attained higher study-performance in comparison to domestic students. In contrast, international students with a non-Western background are less integrated compared to other international students. Nevertheless, they have a similar study-performance. Finally, academic adjustment is the main predictor of study-performance for Dutch, Western and Mixed-Western students. Social adjustment was negatively related to study-performance. The lack of fit for predicting long-term study success of non-Western students indicates that their academic and social integration processes are more complex and non-linear.

1. Aim of study

An increasing number of students prefer to study at a university abroad (Russell, Rosenthal, & Thomson, 2010). In 2007, 3 million students studied abroad, which is almost three times higher compared to the figures of 1990 (OECD, 2009). A common assumption in higher education is that academic integration, that is the extent to which students adapt to the academic way-of-life (Tinto, 1975), of international students is not well-aligned with the requirements of higher educational institutes (Asmar, 2005; Morrison et al., 2005). Recent research has found a mixed picture on whether international students underperform in academic integration and academic performance. Therefore, Morrison et al. (2005) claim that research should widen its focus from comparing international - versus domestic students' performances to finding out the underlying mechanisms of academic and social integration. We define social integration as the extent to which students adapt to the social way-of-life at university. The prime goal of this paper is to characterise the typical differences in academic- and social integration between domestic and international students. Secondly, we assess whether differences in academic and social integration between domestic and international students have an impact on study-success after their first year of study.

2. Methodology

Students' academic integration was measured amongst 957 first-year bachelor students at five business schools in the Netherlands by the Student Adaptation to College Questionnaire (Baker & Siryk, 1999), which consists of 62 items and is divided into four scales, namely: academic adjustment; social adjustment; personal-emotional adjustment; and attachment. Students' social integration was measured by our own developed questionnaire (Author A, 2010), which consists of 15 items, divided into four constructs, namely: perception of the faculty; study support; student's satisfaction with social life; and financial support. The scales were validated by exploratory and confirmatory factor analysis. The Cronbach's alpha for eight scales ranged .67-.87

Ethnicity was measured by four open questions, namely mother's mother tongue, father's mother tongue, own mother tongue and official citizenship(s). 79 nationalities and 129 ethnic identities were present in the database. In order to prevent a fragmented approach of comparing a limited number of students within each ethnic category, students were categorized according to the "degree of Westernness", which is inspired by the cultural classification system of Hofstede (2001). We assumed that the more Western influences a student underwent, the easier it is for the student to adjust to the Dutch educational culture. Thus, in each of the four categories a distinction was made between Western (EU, USA, Canada, Australia, New Zealand) versus non-Western cultures. Consequently, four groups (Dutch, Western, mixed-Western, non-Western) were distinguished.

3. Findings

Correlation analysis illustrate that GPA is significantly positively correlated with academic adjustment, personal-emotional adjustment, attachment and the perception of the faculty, while ECTS only correlates with academic adjustment and attachment. The students' GPA and ECTS do not correlate significantly with the newly added social integration scales.

Subsequent ANOVA analyses among the different (sub)groups of international students show that Western students score significantly higher on all scales of academic integration with the exception of personal/emotional adjustment. Western students attain a higher GPA and a higher number of ECTS than Mixed-Western, Dutch and non-Western students. Mixed-Western student score significantly higher on all dimensions of academic integration and indicate to have more support by family and friends and social life. GPA and ECTS scores of mixed-Western students are similar to Dutch students but significantly lower than those of Western students. Finally, non-Western students score significantly lower on all elements of academic integration with the exception of academic adjustment, which indicates that adaptation to the ('Western') way of life at university is more difficult. Despite lower scores on academic and social integration, non-Western students perform similar to the domestic and the mixed-Western students.

The hierarchical regression analysis of the academic integration components on ECTS and GPA, controlling for the background variables gender and ethnicity, showed that academic adjustment ($b = .25$; p

4. Theoretical and educational significance of research

A main significant finding is that study-success is affected positively by academic integration irrespective of ethnic background. Quite surprisingly, mixed-Western students have significantly higher academic and social integration scores in comparison to domestic students. A possible explanation why mixed-Western students perform equally or better than domestic students may be due to job-prospects and subsequent reputation following business education, which may have a positive impact on motivation and support given by their social network. Furthermore, despite lower scores of non-Western students on academic and social integration in comparison to other students, non-Western students perform equally well after one year of study as domestic students, which is primarily due to the successful academic adjustment of non-Western students. Finally, in contrast to Tinto (1975) we find a compensatory relationship between academic and social adjustment and study-performance.

Most institutes for higher education provide several introduction activities and social support structures for new students in order to facilitate their academic and social integration. Based upon our findings, rather than focussing purely on social integration we encourage higher educational institutes to specifically address measures that can enhance academic adjustment of (international) students. This can for example be done by providing more information about the educational culture of the institute before international students move to the host university. Even better would be to allow international students to experience the educational learning approach of the host institute before starting with their bachelor program.

PAPER PRESENTATION

Net-based Communication in Higher Education: The Influence of Culture

Miriam Hansen, Goethe-University Frankfurt, Germany; Lisette Scholz, Goethe-University Frankfurt, Germany; Regina Jucks, WWU Munster, Germany

We report results of an online-study with 186 university lecturers teaching Psychology courses at German universities. The task was to respond to an email request of a student. The nationality of the requesting student (German vs. Chinese) and the communication style of the request (Western vs. Asian) were varied. Results showed that the nationality did have an effect on the lexical alignment, with more alignment in German nationality conditions, whereas the communication style influenced cultural adjustment, with more adjustment in Asian style conditions.

Regarding the appraisal of the student, incongruent conditions with Asian communication style and German nationality were particularly unfavorable, as the lecturers provided the highest number of negative descriptions in this condition.

1. Introduction

The internationalization of German universities increased enormously during the last years. For instance, lectures and courses are held in English, new international components are integrated in courses of studies or even new international courses of studies are established. As a consequence, more and more foreign students attend German universities and technical colleges. Contact with students from different countries and cultures means daily routine for lecturers at German universities. However, intercultural differences are likely to have an impact on the communication between lecturers and students.

2. Theoretical Background: Individualism-Collectivism and Communication

Particularly broad differences may be expected between cultures scoring on opposite sides of the individualism-collectivism dimension (Hofstede, 1980), which is often used in cross-cultural psychology. On this dimension, Germany is to rank as a more individualistic culture. A collectivistic culture is, for example, China.

Role perception of lecturers and communication style in teaching settings are two examples for intercultural differences between Germany and China that affect everyday life at universities: In China, the “professor” is perceived quite as a father and supports the students even with regard to general issues of studies and life (Lin-Huber, 2001). However, at German universities, the lecturers’ role is mainly limited to knowledge communication or support of knowledge acquisition. As in most individualistic cultures, a rather direct communication style is common practice in Germany; whereas a rather indirect communication style is predominant in collectivistic China (Gudykunst, 2002).

3. Aim of the Study

An important proportion of the communication between lecturer and student is net-based written communication. Thereby, cultural clues are mainly reduced to the name of the student as well as the communication style.

The aim of the study was to analyze, if there was an influence of the student’s nationality (indicated by the student’s name) or the communication style on the lecturer’s email response and/ or on the lecturer’s appraisal of the requesting student.

4. Participants and Task

186 lecturers from 22 German universities that gave courses in Psychology participated in the study. They were asked via email to participate. The task was to respond to an email request of a female student that has been created with the online survey-software Unipark. In this request, a pretended course participant of the lecturer was asking for a record of achievement even though she had been far more absent than permitted.

5. Design and Procedure

The nationality of the requesting student (German vs. Chinese) and the communication style of the request (Western vs. Asian) was varied in a 2x2-factorial design. A third factor consisted in the variation of single words (two synonymous versions) to allow the analysis of lexical alignment (Pickering & Garrod, 2004). The nationality of the student was indicated by the student’s name (Katrin Schneider vs. Li Hua); the communication style was operationalized as follows: The Western request was written in a direct style. The substantial items were written in a few sentences, concisely but politely strung together without any additional statements or explanations. The Asian request was written in an indirect style: To preserve the harmony and to meet the hierarchical differences, the personal situation of the student was illustrated in long introductory explanations and the course of the lecturer was praised. Only then the student asked for getting the record of achievement, continuously in a very polite and excessive manner. The Asian version was developed in cooperation with a Chinese colleague, who is well grounded in German language. Thus, incongruent conditions comprised a request written in Asian indirect communication style and signed by “Katrin Schneider” or respectively a request written in Western direct communication style and signed by “Li Hua”. In the other two conditions, nationality and communication style were congruent.

Each participant (lecturer in psychology) got access to one version. After reading the request, the participant had to compose an answer into a text box. Subsequently, the participant was requested to complete a short questionnaire consisting of socio-demographical questions as well as questions concerning the appraisal of the student.

A coding system was developed to analyze the answers as well as the appraisal of the student. We used three groups of dependent variables: (1) Lexical alignment (use of manipulated terms), (2) cultural adjustment (directness and politeness), and (3) appraisal of the student (number of negative descriptions).

6. Results and Discussion

A calculation of MANOVA revealed the following effects: The nationality of the student had an effect on lexical alignment: In conditions with German nationality of the student, the lecturers did use more of the terms written in the request (instead of synonymous terms) than in conditions with Chinese nationality. This shows a strategic component of lexical alignment, as the lecturers did align their answers depending on the information on the student's nationality.

The communication style had an effect on cultural adjustment regarding directness and politeness: In conditions with Asian communication style lecturers wrote longer answers and did also use more words for introduction as in Western communication style conditions. Further, they formulated more utterances showing understanding. This indicates an automatic process of cultural adjustment, as the lecturers adapted their cultural style directly to the student's regardless whether she had a German or a Chinese name.

There was a significant interaction of nationality and communication style on the appraisal of the student: The lecturers did not use a single negative description in the congruent condition of German nationality and Western communication style, whereas the incongruent condition of German nationality and Asian communication style caused the highest number of negative descriptions. The lecturers felt annoyed because of the 'strange' behavior of the student, as they had no evidence for a culturally grounded communication style. This is of practical relevance, as some students may have German or European names but still stem from other cultures.

Based on these results, intercultural trainings could be developed aiming to sensitize lecturers for culture, cultural effects on communication, or on role perception and to improve intercultural communication in university teachings.

References

- Gudykunst, W. B. (2002). Handbook of international and intercultural communication. Thousand Oaks: Sage.
Hofstede, G. (1980). Culture's Consequences: International Differences in Work-Related Values. London: Sage.
Lin-Heber, M. A. (2001). Chinesen verstehen lernen. [Learning to understand Chinese people] Bern: Huber.
Pickering, M. J., & S. Garrod (2004). Toward a mechanistic psychology of dialogue. Behavior and Brain Sciences, 27(2), 169-226.

PAPER PRESENTATION

Visual Skills Development in Adolescence: from Child Art to Networked Visual Culture

Andrea Karpati, UNESCO Centre for Multimedia in Education, Hungary; Laszlo Papp, Graduate School of Educational Sciences, University of Szeged, Hungary

This paper introduces new methods of evaluation of the development of visual skills and abilities in adolescence. Investigation goes beyond drawing and surveys areas of creation identified in an initial survey as important areas of visual language use: photography, film making, digital imaging and multimedia design (of cartoons, avatars, web pages etc.), street and land art, dressing and make-up. Adolescents practice these art forms in creative groups, so we conducted case studies on the media and genres of creative practice; content and style of creations; technical and creative skills and abilities involved; patterns of school, peer and self teaching and learning. We also described networked creation: the social aspects of adolescent art making.

In 2009, 297 Visual Creation Communities were identified in Hungary, with more than 1400 members actively engaged in 7 visual media. In 2010-11, a case studies are being conducted in each genre. The paper presents a video film production group that is network based, uses a peer learning model, and engages in a series of filming genres to express ideas about self and society. An evaluation of visual learning in the community shows significant growth in content management (understandable and effective expression of ideas), compositional skills, abilities related to media technology and collaboration. Works by 15-18-year-olds disprove the traditional model of artistic development where the age of adolescence is considered as a period of decline of visual creativity.

Adolescence is considered by many researchers (for example Efland, 1976, Gardner and Winner, 1984, Davis, 1991, Pariser, Kindler, Van den Berg, Dias, B. & Chen Liu, 2007) is considered the end of creative and expressive "child art", the period of decline of visual skills and the onset of technological deficiencies, copying and general disinterest in art making. Other researchers (for example, Lowenfeld and Britain, 1975, Korzenik, 1996, Wilson, 1981, 2006, Haanstra, Damen & Van Hoorn, 2010) document the unique and creative use of visual language by adolescents and its role in the

process of identity construction. As some studies employed evaluation of a collection of works by trained jurors while others employed standardised tests, results and conclusions are difficult to compare. In the meantime, art programs in secondary schools are reduced because educational policy makers who believe there is no significant visual skills development in adolescence. Therefore, art education should only be offered as an elective with broadly formulated and rarely assessed developmental goals.

In the first phase of our research, we wanted to prove that visual skills and abilities significantly develop during adolescence and quantitative measures may be employed in their assessment. We studied 700 Hungarian 12-18-year-old secondary school students through a battery of standardised tests and revealed significant improvement in performance. The Clark Drawing Development Test and our own Spatial Abilities Test showed substantial growth in mental manipulations in space, reconstruction and spatial memory, especially in late adolescence, ages 17-18. The Visual Narrative Task by Wilson (1986) revealed improvement in compositional structures, figure variation and combination as well as detailed and proportionally correct representation of humans between 15 and 17 years of age. The Test for Creative Thinking – Drawing Tasks (Urban and Jellen, 1986) showed significant increase in performance, especially in ages 14-16.

In the second phase of our study, therefore, we decided to go beyond drawing and survey other areas of creation among adolescents. An initial survey involving all the secondary schools (20 in total) in one Hungarian county revealed photography, filmmaking, digital imaging and multimedia design (of cartoons, avatars, web pages etc.), street and land art, dressing and make-up as major areas of visual creation. Students indicated creative communities as places of engagement in these activities, so we conducted an internet search to identify communities of practice and describe, through case studies done by participant observation, the following aspects of these Visual Creation Communities:

- media and genres of creative practice
- content and style of creations
- technical and creative skills and abilities involved
- patterns of school, peer and self teaching and learning
- networked creation: the social aspects of adolescent art making

In order to prove that the creative use of visual language is actively used in adolescence, we restricted our sample to non-professional groups where the majority of members were 15-18 years of age that practised their art form as a hobby, in their free time and achieved high levels of expression. Groups were considered non-professional when their creation was unrelated to vocational studies, involved regular engagement and ongoing learning behaviour. Artistic excellence was evaluated by a list of criteria developed by media education experts. In 2009, 297 Visual Creation Communities were identified, with more than 1400 members actively engaged in 7 visual media. In 2010-11, 7 case studies are being conducted to describe activities of a group in each media to describe the characteristics and developmental patterns of the visual language of adolescents and show the significance of these interdisciplinary creative endeavours for Art and Design, Media and Information and Communication Technologies (ICT) education.

In this paper, we report findings about one of the most popular forms of visual expression in adolescence: video film production. Our internet search and interviews with teachers of the elective discipline "The Moving Image and Media Science", we identified a large national network of adolescent film makers (about 80 active groups). The case study was done in one of the largest groups (43 students), active, with changing members, for more than 2 decades. All group members were involved in the study with their mentor as participant observant. Data collection was done between February and June 2010. The study began with an assessment of written and media works (electronic portfolios) of group members to identify visual skills involved in media production, skill levels characteristic for different age groups and compare production with works collected at media competitions and final examinations that served as benchmarks. Three rounds of focus group interviews followed, and the study ended with a questionnaire filled out by all members individually to clarify some aspects of learning and creation in the group.

Results indicate that production in adolescent media works are social constructions, co-creations of pairs and triads. The community is network based, tasks are distributed, handed in and criticised using Social Web tools. Communication is frequent and involves peer learning as well as motivation, management and criticism. Members are 15-20 years of age, girls and boys are almost equally represented. They work in the media group between 10-18 hours a week and stay with the group for 5-6 years. They prefer documentary genres and interviews to express ideas about self and society. Some of their productions are shown on community television and receive professional feedback, others are discussed in Social Web arenas. Text analysis of portfolio entries of junior and senior members integrate these knowledge elements, show growing media literacy and sensitivity to creative processes. When

describing reasons for joining the community, media literacy development and emotional attachment are mentioned with an almost equal frequency though professional gains are more relevant.

An evaluation of visual learning in the community (based on 3-6 works of members produced in the course of 2 years and evaluated by two experts) shows significant growth in content management (understandable and effective expression of ideas); compositional skills; abilities related to media technology; and collaboration.

Works by the media community disprove the traditional model of artistic development where the age of adolescence is considered an age of decline of visual creativity and indicate a need for integration of ICT, Media and Visual Arts studies for the development of a 21. century visual literacy.

PAPER PRESENTATION

Challenges, Limits and Perspectives Regarding Teaching Practices in Mathematics, Sciences and Techno

Ghislain Samson, Université du Québec à Trois-Rivières, Canada

In a study subsidized by Fonds québécois de la recherche sur la société et la culture (FQRSC), questionnaires were sent out to over 200 math, science and technology teachers in the province of Québec to document their opinion on interdisciplinary practices in high schools. Interviews (N=10) were also conducted to better understand their perceptions regarding the challenges, limits and perspectives of both teaching practices and future research. Based on a literature review and preliminary results pertaining to integrative approaches, creating connections between math, science and technology (MST) and other subjects (Samson, 2004; Hasni, 2006) in high school is an issue. Interdisciplinarity is generally accepted, however the concept is highly ambiguous and its implementation creates many challenges for school faculty. Suggestions are made regarding initial training (in university) and continuous learning (in the workplace). Integration and interdisciplinarity in scientific and technological education are considered.

Towards integrated approaches such as interdisciplinarity- Many studies underline the determinant effect of teaching practices on learning and academic achievement (Bru, Altet & Blanchard-Laville, 2004; Mottier-Lopez, 2003). Therefore, the ability to articulate science and technology teaching practices to the students' daily reality is a major issue. It is difficult to maintain their interest and achievement in these courses (Davis, 2003; Gibson & Chase, 2002). As mentioned by Conseil de la science et de la technologie (CST, 2004), when teaching scientific courses, it is important to use approaches that are based on « discovery and production pedagogy, experimental and contextualized learning situations » (p.68). Some authors consider science and technology pedagogy to be contextualized and integrated. Interdisciplinarity improves integration in S&T courses. These approaches support the Ministry of Education's (MEQ, 2004; MELS, 2007) current expectations to favor contextualized teaching methods as well as open and integrated situations.

Teacher training and professional development- In Québec as in other OCDE countries (Council for Excellence in Government, 2003; OCDE, 2006), using knowledge from research is a crucial factor to insure the improvement of teaching practices and to promote better professional development. New S&T programs promote interdisciplinarity. Québec universities offer teachers a monodisciplinary approach. Authors underline limits pertaining to initial training with regards to teaching strategies and methods (Lenoir & Vanhule, 2006; Tardif, Lessard & Gauthier, 1998). They also criticize the traditional framework of the tools used for continuous learning that often favor an application based model. As underlined by the Conseil supérieur de l'éducation (CSE, 2005, 2006), recent literature on teacher professionalism emphasizes both theoretical (from research) and practical knowledge.

Objective-

The objective of this study is to examine the implementation of MST integration and interdisciplinarity in high school. Specifically, it aims to : 1) describe teaching methods and approaches used by S&T teachers in high school; 2) support teachers in the development, implementation and validation of interdisciplinary methods related to S&T learning for high school students; 3) describe teaching practices implemented in S&T courses and determine the professional development needs of teachers.

Method-

The methodology framework is based on two key concepts : a) collaborative research (Desgagné, 2001), based on the active participation of all the concerned actors (researchers, students, school faculty). Scientific knowledge and

school faculty mobilization are expected outcomes; b) teaching methods (Altet, 2002; Bru, 2002; Robert & Rogalski, 2005). Teaching practices implemented before, during and after class (preactive, interactive and postactive phases), while taking into account the content, the goals, the learning methods, the context and the didactical resources used.

Two types of data are retrieved : a1) individual interviews (N=10) and questionnaires completed by teachers (N=55) voice their opinion on integrative approaches and teaching practices. a2) descriptive information on effective teaching practices (N=10). This procedure requires three phases : an interview on teacher planning (preactive phase); teaching practices observed in class (video taping was necessary) (interactive phase); an interview on the teacher's impression of the class activity (postactive phase). The data analysis is inspired by methods previously used in other studies regarding representations and teaching practices (Larose & Ponton, 2000). The data retrieved by the questionnaires and the preactive and postactive phases are analysed using quantitative and qualitative techniques (Larose & Lenoir, 1995), content analysis (Bardin, 2001), lexicometric analysis as well as statistical analyses using textual data (Larose, Jonnaert & Lenoir, 1996). The direct observation sequences are analysed using grids developed according to the conceptual framework used in previous studies.

Results-

The results from the questionnaires (N=55) show that teachers believe that connections between subjects (in general) are very important, whereas it seems to be important when it comes to scientific disciplines. The level of difficulty perceived by teachers regarding the connections between scientific disciplines varies from difficult to very difficult. However, these connections are considered mostly important or very important for most teachers. Finally, many teachers consider it easier to establish links between physics and math than between biology and math.

Our results also show that : 1) teachers are open to interdisciplinarity; 2) S&T teachers say that they use interdisciplinarity less than other teachers; 3) S&T and math teachers use other disciplines in their interdisciplinary practices, whereas their disciplines are rarely used by other teachers; 4) teachers mention many constraints when implementing interdisciplinarity (Hasni & Samson, in press).

Discussion and conclusion-

Conceptually, integration challenges the traditional model of scientific training which addresses disciplines individually when taught in high school. The new Québec curriculum seems to promote decompartmentalization. Furthermore, the ambiguous definition of integration does not facilitate the task.

According to teachers, operationalizing interdisciplinarity is not clearly described in the Québec program and the repartition of the disciplinary content is a major obstacle. For example, some mathematical content that could easily be taught in relation to S&T content in the secondary first cycle is only taught in the second cycle.

Regarding the organizational aspect, time management, teacher workloads and the organization of student groups must be reviewed to guarantee the most favorable conditions for the implementation of interdisciplinary approaches as specified by government officials (Gouvernement du Québec, 2004; 2007).

Principals References

- Bardin, L. (2001). *L'analyse de contenu*, (11e éd.), Paris, Presses Universitaires de France.
- Davis, J. R. (1995). *Interdisciplinary courses and team teaching. New arrangements for learning*. Phoenix: American Council of Education / Oryx Press.
- Gouvernement du Québec (2001). *La formation à l'enseignement. Les orientations; les compétences professionnelles*. Québec : Gouvernement du Québec.
- Gouvernement du Québec (2007). *Programme de formation de l'école québécoise. Enseignement secondaire, 2e cycle*. Québec : Gouvernement du Québec.
- Hasni, A. (2006) – *Statut des disciplines scientifiques dans le cadre de la formation par compétences à l'enseignement des sciences au secondaire* ». Dans Hasni, A., Lenoir, Y. et Lebaume, J. (Dir.) *La formation à l'enseignement des sciences et des technologies au secondaire. Dans le contexte des réformes par compétences*. Presses de l'Université du Québec., pp. 121-156
- SAMSON, Gh. (2004). *Étude exploratoire du transfert des connaissances entre les mathématiques et les sciences auprès d'une clientèle de 4e secondaire*. Thèse de doctorat inédite, Université du Québec à Trois-Rivières.

Teachers as designers of modeling-centered curriculum materials

Marios Papaevripidou, University of Cyprus, Cyprus; Costas Constantinou, University of Cyprus, Cyprus; Zacharias Zacharia, University of Cyprus, Cyprus

The purpose of this study was to examine the influence of a professional development course on the development of teachers' curricular knowledge about Modeling-Centered Scientific Inquiry (MCSI) and curriculum design skills. The participants were twenty science teachers enrolled in 13 three-hour sessions of a professional development course about MCSI. The course was organized in two phases. During Phase 1 ("Teachers as Learners"), a curriculum titled "Modeling 1-D elastic collisions" was implemented through which teachers were engaged in multiple cycles of model development and deployment of collision phenomena. During Phase 2 ("Teachers as Thinkers of Curriculum Design") teachers shifted from learners to thinkers of the underlying design principles of curricula that were grounded on the MCSI perspective, and were also asked to re-design an existing unit from their science curriculum to foster the development of understanding of the unit's concepts through a MCSI approach. Teachers' responses to a written pre/post questionnaire about their understanding of modeling as both a learning process and a teaching approach, and their own created curriculum designs served as data sources for evaluating their informed understandings about the underlying design principles of MCSI instruction. Findings revealed that the participants expanded their curricular knowledge about MCSI and, at the same time, efficiently transformed this knowledge for the purposes of the design of their own MCSI curriculum.

Background

In spite of persistent calls of reform documents in science education for Modeling-Centered Scientific Inquiry (MCSI) as an instructional approach, evidence in the literature (Duschl et al., 2007) attests that modeling is not routinely practiced at schools. It has also been reported that teachers (i) possess limited and/or alternative views of the role of models and modeling in science (Crawford & Cullin, 2004), (ii) appear to have difficulty with or are resistant to creating classroom environments in which students are supported in creating their own constructions of knowledge through model building (Windschitl & Thomson, 2006), and (iii) have not been adequately equipped with knowledge and skills to enact science instruction through modeling (Schwarz & Gwekwerere, 2006). These findings can be attributed to the absence of teaching practices within teachers' professional development that emphasize the development of scientific knowledge as a continuous process of building and refining models (Justi & van Driel, 2005). Consequently, there is an emergent need to explore possible ways of how to design instructional settings that would better support teachers' professional development about the design and enactment of science instruction through MCSI.

Purpose

The purpose of this study was to examine the influence of a professional development course on the development of teachers' Curricular Knowledge (CK) about MCSI and curriculum design skills. Specifically, the two research questions that this study aims to address are:

- (i) In what ways a professional development course influences teachers' development of CK about MCSI?
- (ii) What are the characteristics of teachers' MCSI curriculum designs?

Methods

The participants were twenty science teachers enrolled in 13 three-hour sessions of a professional development science education course about MCSI. The teacher training approach followed placed the teacher directly in the role of inquirer in simulated research experiences throughout the course (Crawford, 2005).

The course was organized in two phases. During Phase 1 ("Teachers as Learners"), a curriculum titled "Modeling 1-D collisions" was implemented through which the teachers (working in dyads) were engaged in multiple cycles of model development and deployment of elastic collision phenomena. Specifically, teachers observed collision phenomena, created models with the use of Stagecast Creator to represent the observed phenomena, revised their models, compared their models with their peers' models, and validated their models by applying it in new collision phenomena.

During Phase 2 ("Teachers as Thinkers of Curriculum Design") teachers shifted from learners to thinkers of the underlying design principles of curricula that were grounded on the MCSI perspective, and were asked to re-design an existing unit from their science curriculum to foster the development of understanding of the unit's concepts through a MCSI approach. To better scaffold teachers' work, we organized various reflective activities (e.g., teachers revisited the curriculum that were engaged with during Phase 1 and identified the learning objectives of each set of activities). As part of the requirements for their curriculum designs, teachers were asked to: (i) formulate learning objectives, (ii) organize the activity sequence of their curriculum in a map, (iii) provide descriptions of the design and

the implementation of each activity,(iv)design activity sheets based on their activities' descriptions, and (v)design assessment tasks to evaluate their learning objectives.

Data sources and analysis

Two sources of data were used for the purposes of this study. The first one was a questionnaire (administered before and after Phase 1) through which we collected data about teachers' understandings of MCSI as both a learning process and a teaching approach, and their knowledge about the types of teaching activities and the assessment tasks that are involved within a unit that is fostered through a MCSI approach. The second source of data was the MCSI curriculum that teachers created after Phase 2 of the study.

The data were analyzed qualitatively using open coding from grounded research methodology (Strauss&Corbin,1998). The written responses of teachers in the questionnaire were reviewed, one by one, to characterize each participant's CK for MCSI. Additionally, the focus during the analysis of teachers' curriculum designs was on the content and the structure of the activities that teachers incorporated within their curriculum designs, while at the same time an attempt was made to identify possible links between these activities and their CK for MCSI.

Findings

At the beginning of the course, all teachers' responses to the questionnaire revealed a limited understanding of how MCSI approach should look like in a science class. Moreover, their knowledge about the types of teaching activities and the assessment tasks that are involved within a unit that is fostered through a MCSI approach was found to be inadequate or incomplete. After their engagement with the MCSI curriculum materials of Phase 1, the majority of teachers seemed to have developed comprehensive understandings of the design principles of MCSI approach. They also stated that their experiences with the course helped them refine their view of MCSI, revealing that it was a more complex and dynamic process than they had originally presumed.

With respect to the characteristics of teachers' MCSI curriculum designs, it was found that all curriculum designs encompassed 19 different types of activities that were grouped in three clusters of activities (see Table 1,Appendix). However, the nature of the models that teachers created and anticipated to be developed from their students was different in some cases. For instance, the majority of teachers' models represented aspects of the phenomenon under study, provided a mechanism for how the phenomenon functions, and enabled the formulation and test of prediction. In a few other cases, the teachers' models represented only observable patterns from a phenomenon, lacked of a mechanism that explains how the phenomenon evolves over time, and had a limited predicting power.

Conclusions

The teachers who participated in our long-term course as both active learners and thinkers expanded their CK about MCSI and, at the same time, they efficiently transformed this knowledge for the design of their own MCSI curriculum. The findings of the present study designate that by positioning teachers in the active role of designers of curriculum materials enabled them to efficiently transform the knowledge and experiences obtained throughout the course for designing productive MCSI curriculum materials. We believe that by allowing teachers to design their own curriculum materials, we offered them opportunities to think of issues like "How does MCSI look like in practice?" or "What do I expect from my students to develop during their engagement with MCSI activities?" Hence, we argue that without teachers' personal involvement in developing these materials, the understanding and implementation of the aspects of MCSI, to the extent that appeared to occur because of their personal involvement, wouldn't be possible.

PAPER PRESENTATION

Teaching Magnetism to Primary School Children by Combining Expository Instruction and Guided Inquiry

Christof Wecker, University of Munich, Germany; Alexander Rachel, University of Munich, Germany; Eva Heran-Dorr, University of Bamberg, Germany; Christine Waltner, University of Munich, Germany; Hartmut Wiesner, University of Munich, Germany; Frank Fischer, Universitat Munchen, Germany

The idea behind inquiry learning is that learners discover relations among observable phenomena themselves. A problem during inquiry learning might be that theories that assume unobservable entities such as (theoretical) molecular magnets cannot easily be discovered because the learners' hypothesis space will hardly contain assumptions about them. Therefore this study investigated whether primary school children can acquire knowledge about functional relations among observable variables and understanding of scientific theory during inquiry activities if supported appropriately. In particular, we investigated the short- and longer-term effects of prior and summary expository instruction as well as guidance of high vs. low content-specificity. A 2x2x2-factorial design with the factors

content-specificity of guidance (low/high), prior expository instruction (without/with) and summary expository instruction (without/with) was implemented in a curriculum unit about magnetism with a sample of 684 4th-grade students from 31 classes. Knowledge about functional relations and understanding of the scientific theory were measured in immediate and delayed posttests. In the presence of prior expository instruction, summary expository instruction or both, learners acquired deeper understanding of the scientific theory than without both of them. In the delayed posttest, however, this effect disappeared. Instead, there was a significant main effect in favour of the conditions with prior expository instruction. Prior expository instruction also had a positive effect on knowledge about functional relations in the delayed posttest. In sum, this study demonstrates that primary school children can learn about challenging topics involving scientific theories that cannot readily be discovered, provided that they are supported appropriately.

The idea behind inquiry learning is that learners discover relations among observable phenomena themselves (de Jong, 2006). A more far-reaching goal of science education, however, is acquiring an understanding of explanatory scientific theories that go beyond observable relationships. For example, in phenomena related to magnetism, (theoretical) molecular magnets cannot be observed directly. A problem during inquiry learning might be that theories that assume such unobservable entities cannot easily be discovered because the learners' hypothesis space (Klahr & Dunbar, 1988) will hardly contain assumptions about them. In a prior study we found that secondary school students can acquire better understanding of explanatory scientific theories if they receive prior expository instruction about such a theory before investigating the phenomena themselves, whereas summary expository instruction about the same theory after an inquiry phase had no lasting effect (Rachel et al., 2010). The current study focused on the question whether primary school children can likewise learn during inquiry activities if supported appropriately. In particular, we investigated the short- and longer-term effects of prior and summary expository instruction and guidance of high vs. low content-specificity.

Method

Participants.

The participants in this study were 684 German primary school students from 31 4th grade classes (49 % female, 51 % male; age: $M = 9.26$, $SD = 0.52$). Design. Three to four intact classes were randomly assigned to each condition of a 2x2x2-factorial design with content-specificity of guidance (low/high), prior expository instruction (without/with) and summary expository instruction (without/with) as independent variables.

Procedure and learning environment.

The students first completed a 20 minute pretest. Then they worked on an inquiry unit about magnetism for 120 minutes in which they conducted hands-on experiments in dyads at up to eleven learning stations. Finally they completed a 25 minute posttest. Two months later they completed a 25 minute delayed posttest in their classrooms. Independent variables. Dyads in the low content-specificity guidance condition received general prompts to engage in the three inquiry activities of predicting, describing and explaining. Dyads in the high content-specificity guidance condition received content- and task-specific prompts for these inquiry. In the conditions with prior expository instruction, initially a 30-minute introduction to the theoretical background of magnetism was provided by a teacher. No such introduction was given in the conditions without prior expository instruction. In the conditions with summary expository instruction a 30-minute teacher-led wrap-up phase about the same topics as in prior expository instruction took place at the end of the learning phase, while there was no such phase in the conditions without summary expository instruction.

Dependent variables.

Knowledge about functional relations among observable variables was measured by 15 multiple-choice and true-false items (immediate posttest Cronbach's $\alpha = .63$; delayed posttest Cronbach's $\alpha = .64$). Understanding of the scientific theory was measured by means of 15 multiple-choice and true-false items (immediate posttest Cronbach's $\alpha = .79$; delayed posttest Cronbach's $\alpha = .81$). A shorter version of the test for knowledge about functional relations was used for the pretest (9 items, Cronbach's $\alpha = .52$).

Statistical analysis.

Data were analyzed by means of single ANCOVAs with the respective posttest measure as the dependent variable, content-specificity of guidance, prior expository instruction and summary expository instruction as fixed factors, class as a random factor nested within the cells of the design and the pretest as a covariate. The significance level was set to 5 %.

Results

With respect to knowledge about functional relations, in the immediate posttest no significant main or interaction effects of the independent variables were found. In the delayed posttest a small main effect in favour of the conditions with prior expository instruction was detected, $F(1; 23.36) = 4.48$; $p = .01$. With respect to understanding of the scientific theory, in the immediate posttest significant main effects in favour of the conditions with low content-specificity of guidance, $F(1; 23.12) = 9.50$; $p = .05$, and the conditions with summary expository instruction, $F(1; 23.12) = 6.62$; $p = .03$, as well as an interaction effect between prior expository instruction and summary expository instruction, $F(1; 23.13) = 6.32$; $p = .03$, were found: In the presence of prior expository instruction, summary expository instruction or both, learners acquired deeper understanding of the scientific theory than without both of them. In the delayed posttest, however, this interaction effect and the main effect of summary expository instruction disappeared. Instead, there was a significant main effect in favour of the conditions with prior expository instruction, $F(1; 23.28) = 9.24$; $p = .03$.

Discussion

The results indicate a superiority of low content-specificity of guidance during inquiry activities with respect to the understanding of scientific theory. With general prompts for inquiry, the function of the current activity in the investigation of theoretical assumptions might be more transparent to the learners than with highly content-specific questions. Furthermore, prior expository instruction proved beneficial for knowledge about functional relations among observable phenomena and understanding of the scientific theory. While immediately after the learning phase a summary might be at least a functional equivalent to prior expository instruction – as evidenced by the interaction of prior and summary expository instruction –, in the long run prior expository instruction proves superior. This effect might be explained by the opportunity provided by prior expository instruction to apply the theory to be learned during inquiry activities, thereby yielding deeper theoretical understanding. In sum, this study demonstrates that primary school children can learn about challenging topics involving scientific theories that cannot readily be discovered, provided that they are supported appropriately.

References

- de Jong, T. (2006). Technological advances in inquiry learning. *Science*, 312, 532
- f.Klahr, D. & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science*, 12(1), 1-48.
- Rachel, A., Wecker, C., Heran-Dßrr, E., Waltner, C., Wiesner, H. & Fischer, F. (2010). A Place and a Time for Expository Instruction During Inquiry Learning? Its Role for the Understanding of Scientific Theories that Are Hard to Discover. Paper presented at the AERA 2010, Denver.

PAPER PRESENTATION

Use of concept maps to follow up the effect of discussing atmosphere dynamics with satellite images

Camila Cicuto, Universidade de Sao Paulo, Brazil; Paulo Correia, Universidade de Sao Paulo, Brazil

Concept maps (Cmaps) are useful for representing students' knowledge to foster meaningful learning. However, assessment of Cmaps in real classrooms is a time-consuming task which hinders its application by teachers. We proposed an assessment procedure based on the use of a compulsory concept and its neighbors to check the students' understanding about a specific aspect of a topic. Our case study involved a discussion about climate change during the Natural Science course offered for 1st-year higher education students. Preliminary results confirmed the possibility to get relevant information from Cmaps after assessing only part of the whole propositional network.

Aims

Concept maps (Cmaps) were proposed by Novak and colleagues during the 1970s. They can be defined as a set of concepts embedded into a propositional framework. Concept mapping plays a key role as a tool to represent knowledge held by a learner, and also the structure of knowledge in any subject matter domain (Novak, 2010). The aim of this work is to propose a new way to evaluate students' Cmaps, based on the use a compulsory concept to check the quantity and the quality of propositions established from it. Our hypothesis suggests this analysis reduces the time required for assessing the Cmaps without compromise the information obtained about the students' understanding about the compulsory concept.

Methodology

Data collection

Individual Cmaps ($n=69$) were produced by 1st-year higher education students during the Natural Science course offered at Universidade de Sao Paulo (Correia et al., 2010). Climate change was the topic under discussion (classes 6-10) and a video with satellite images (NOAA, USA) was used to show the atmospheric dynamics (class-8). Dispersion

(of pollutants) was assumed as the key-concept to allow an in-depth understanding about climate change local and global consequences (Fenger, 2009; Ungar, 2000). Therefore, dispersion was the compulsory concept and must be used by the students during the Cmap elaboration (class-10).

Data analysis

All Cmaps were analyzed considering only the propositions (n=175) that involved “dispersion” as the initial or final concept. They form the data subset to be considered in this paper. The evaluation of Cmaps followed these steps:

1. Count the number of “neighbor concepts” associated with dispersion through propositions.
2. Check what are the “neighbor concepts” more used by the students, by using the word cloud provided by Wordle (wordle.net).
3. Categorize the propositions considering their semantic meaning (content analysis). Two different researchers took part into the process of category creation to minimize subjectivity.
4. Compare the number of “neighbor concepts” (1) and the categories assigned for the propositions for each Cmap (3).

Results and discussion

All Cmaps presented a total of 985 propositions. The concept “dispersion” was present in 175 propositions (18% of the total), and it was used as the final concept in 60% (n=102) of them. Two or three “neighbor concepts” were associated with “dispersion” in 73% of the Cmaps (Figure 2).

The frequency of the concepts used in the propositions containing “dispersion” was qualitatively estimated by using the word cloud obtained in Wordle website (Figure 3). More frequent concepts (e.g. climate change, global, greenhouse gases, and pollution) are in bigger fonts, while the less frequent ones (e.g. atmosphere, energy, fossil, and technology) are in small fonts. It should be highlighted that the frequent concepts were not always used by the students to express ideas accepted by the current scientific understanding about climate change. The naive use of this concept may be related to the previous knowledge that the students have about the current environmental problems, which are noticed by the mass media. On other words, the evaluation of the propositional meaning (right/wrong) was not considered until now.

The content analysis classified the propositions into eight different categories. Table 2 shows that the category environment predominated in the Cmaps with 1-5 neighbor concepts. Students who used 2-3 neighbors presented a broad understanding of dispersion and how to relate this concept into the propositional framework. On the other hand, the Cmaps with 6 and nine concepts showed a large number of meaningless and wrong propositions, suggesting these students used “dispersion” without any concern.

Two illustrative Cmaps (Figure 4) were selected to highlight the bad (Fig.4a) and the good (Fig.4b) use of dispersion.

Theoretical and educational significance of the research

The comparison of these Cmaps suggests the proposed Cmap analysis using only the neighbor concepts and propositions may be useful for speeding up the assessment of a large number of Cmaps. This strategy overcomes one of the main obstacles to the constant use of Cmaps in real classrooms.

References

- Correia, P.R.M. et al. J. Clean. Prod. 18 (2010) 678-85.
Fenger, J. Atmos. Environ. 43 (2009) 13-22.
Novak, J. D. (2010). Learning, creating, and using knowledge: concept maps as facilitative tools in schools and corporations. 2nd Ed. New York: Routledge.
Ungar, S. Public Underst. Sci. 9 (2000) 297-312.

PAPER PRESENTATION

Comparing three theories of visual expertise: A meta-analysis of eye movements

Andreas Gegenfurtner, University of Turku, Germany

The purpose of this study was to compare three theories of visual expertise by a meta-analysis of eye movements. The theories were the theory of long-term working memory (Ericsson & Kintsch, 1995), the information-reduction hypothesis (Haider & Frensch, 1996), and the holistic model of image perception (Kundel et al., 2007). Analysis

included forty-four eye-tracking studies which compared experts, intermediates, and novices during comprehension of domain-specific visualizations; domains represented sports, medicine, transportation, and science. Meta-analytic procedures were used to correct for sampling error and to integrate research findings across studies. Results indicated support of the hypotheses. Contrary to expectations, however, experts partly had longer fixation durations than novices, indicating less efficient information processing. New directions for future research are suggested, and instructional implications of the findings are discussed with regard to attention guidance in professional training environments.

1. Aims and Hypotheses

The simple purpose of this study was to compare three theories of visual expertise by a meta-analysis of eye movements. Visual expertise refers to reproducibly high performance in comprehending domain-specific graphics (e.g., X-ray slides, flight traffic maps). The basic assumption of the study was that eye movements can reflect processes underlying expert performance. To explain expertise differences, research on graphics comprehension frequently cites three theories: the theory of long-term working memory (Ericsson & Kintsch, 1995), the information-reduction hypothesis (Haider & Frensch, 1996), and the holistic model of image perception (Kundel et al., 2007). The current meta-analysis was designed to test the assumptions of those three theories.

First, the theory of long-term working memory assumes that expertise extends the capacities for information processing owing to the acquisition of retrieval cues. Experts with retrieval cues access long-term memory directly and rapidly; novices without retrieval cues access long-term memory less efficiently. It follows that rapid processing of information during graphics comprehension should be reflected in shorter dwell times.

Hypothesis 1: Compared to intermediates and novices, experts have shorter fixation durations.

Second, the information-reduction hypothesis holds that expertise optimizes the amount of processed information by a neglect of task-irrelevant information and an active focusing on task-relevant information, which is accomplished through strategic considerations to selectively allocate attentional resources. If this hypothesis is true, experts and non-experts should employ a different amount of visual fixations.

Hypothesis 2: Compared to intermediates and novices, experts have a larger number of fixations on task-relevant areas and a smaller number of fixations on task-irrelevant areas.

Third, the holistic model of image perception holds that expertise changes the temporal organization of perceptual processes: advanced learners are able to start from an initial global analysis and to extract information from parafoveal regions. It follows that expertise encompasses an extended visual span. This should be visible at saccade length and initial fixation time.

Hypothesis 3: Compared to intermediates and novices, experts have longer saccades and a shorter time to first fixate task-relevant areas.

2. Method

2.1. Meta-analysis

Meta-analysis seemed appropriate to test the three hypotheses. Because eye-tracking studies usually have a small sample size, sampling error is likely to bias individual research findings. Meta-analytic procedures can correct for sampling error and integrate research findings across studies (Hunter & Schmidt, 2004).

2.2. Literature search and coding

Studies published up to September 2010 were searched using the PsycINFO and PubMed databases. 44 studies were located. Domains included sports, medicine, transportation, and science. Key words were (1) for expertise: expert, novice, skilled, elite, expertise and (2) for eye movements: eye tracking, fixations, saccades, eye movements. Eye movements were coded as duration of fixations on task-relevant, task-irrelevant, and total areas; as number of fixations on task-relevant, task-irrelevant, and total areas; as time to first fixate task-relevant areas; and as saccade length. Additionally, performance measures were collected and coded as performance accuracy and decision time.

2.3. Analysis

Point-biserial correlation coefficients r_{pb} were used to analyze between-group differences (expert-novice, expert-intermediate, intermediate-novice). Effect sizes other than r_{pb} (Cohen's d , Hedges' g , F , t , c^2 , or Z statistics) were converted using formulae provided by Rosenthal and DiMatteo (2001). Correlations were then individually corrected for sampling error (rc ; Hunter & Schmidt, 2004).

3. Results

3.1. Study characteristics

The 44 articles averaged a total of 530 experts, 166 intermediates, and 596 novices ($N_{\text{total}} = 1,292$). Experts had a mean age of 26.07 years ($SD=6.39$) and 10.76 years of domain experience ($SD=5.61$). Intermediates had a mean age of 24.26 years ($SD=8.09$) and 6.49 years of domain experience ($SD=7.89$). Novices had a mean age of 22.46 years ($SD=4.43$) and 2.09 years of domain experience ($SD=2.95$).

3.2. Eye movement measures

3.2.1. Hypothesis 1: Fixation duration. Results indicated that experts had shorter fixation durations than novices on task-irrelevant ($r_c=-.37$) and total areas ($r_c=-.06$). Contrary to expectations, experts had longer fixation durations on task-relevant areas ($r_c=.25$).

3.2.2. Hypothesis 2: Number of fixations. Experts compared to novices had more fixations on task-relevant ($r_c=.33$) and less fixations on task-irrelevant areas ($r_c=-.26$). Experts and novices differed marginally on total areas ($r_c=-.02$); there, experts had less fixations than intermediates ($r_c=-.26$), who had less fixations than novices ($r_c=-.25$).

3.2.3. Hypothesis 3: Saccade length and time to first hit task-relevant areas. Results indicated that experts had shorter times to first fixate task-relevant areas than novices ($r_c=-.31$). Experts also had longer saccades than intermediates ($r_c=.38$) and novices ($r_c=.31$); intermediates had shorter saccade lengths than novices ($r_c=-.12$).

3.3. Performance measures

Experts were more accurate and more rapid than both intermediates ($r_c=.45$ and $r_c=-.41$, respectively) and novices ($r_c=.45$ and $r_c=-.31$, respectively); intermediates were more accurate ($r_c=.44$) and more rapid ($r_c=-.43$) than novices.

4. Discussion

The purpose of this study had been to compare three theories of visual expertise by a meta-analysis of eye movements. Results confirmed the assumptions of information-reduction hypothesis (Haider & Frensch, 1996) and the holistic model of image perception (Kundel et al., 2007). However, results only partly confirmed the theory of long-term working memory (Ericsson & Kintsch, 1995): contrary to expectations, gaze durations on task-relevant areas had been longer for experts than for non-experts.

4.1. Implications for future research

There are at least two explanations why experts needed more time than novices to comprehend task-relevant information. First, this finding may be moderated by different criteria used in the primary studies to categorize participants' relative expertise, which may imply within-group heterogeneity regarding retrieval cue acquisition. Second, this finding may be moderated by the visual modality, for primary studies used stimuli at different levels of realism and information transience. Future moderator analyses may examine these two directions.

4.2. Implications for instruction

Eye movements have been indicated to uncover some of the processes underlying expert performance. Despite doubts on the validity of process measures for informing professional training (e.g., Feldon, 2007), superimposing expert gaze on graphic stimuli can guide attentional resources of novice learners (Grant & Spivey, 2003). The effectiveness of using eye movements as attentional procedure cues needs further exploration with complex graphic stimuli as they are representative for vision-intensive workplaces.

PAPER PRESENTATION

Education for creativity: Understanding and developing adolescent creativity

Carly Lassig, Queensland University of Technology, Australia

In the knowledge age, creativity and innovation are becoming increasingly valued as driving forces for our global society. For successful participation in society, now and in the future, students will require transferable lifelong learning skills, such as creative thinking, to manage increasing change, ambiguity and complexity. This paper will report findings from a grounded theory study designed to describe and theorise about adolescents' experience of creativity. Twenty creative students were selected to participate in the study, and data were collected through focus groups, individual interviews, and an online discussion forum. Participants were selected from two academically selective schools: 10 students from an arts school; and 10 students from a science, mathematics and technology

school. Results revealed that the adolescent creative process involves six components: creativity motivation; creativity stimuli; the sub-processes of creativity; managing challenges in the creative process; producing divergent outcomes; and creativity affecting self/others. The success of the adolescent creative process is affected by: (a) internal influences from the individual students; and (b) supportive and inhibiting external influences, many of which relate to teaching and learning environments. Today's creative adolescents are tomorrow's leaders. Understanding adolescent creativity and the conditions that foster the development of creative achievement is a matter of significance for all educational stakeholders who aim to nurture our future leaders.

Introduction

A consequence of the contemporary knowledge age is that knowledge becomes obsolete at an accelerated rate (Michael, 2001), necessitating a refocusing of schooling on the skills of knowledge production or creativity (McWilliam, 2008). In a world where the fabric of society will surely be tested, individuals and communities will depend on the intellectual skills and creativity of our young people. Solving the mounting personal, social, health, environmental, and political problems facing our global society will require creative thinkers as leaders. This paper proposes that educational stakeholders need a shared understanding of students' creative processes and products, and the conditions that influence their creative abilities, to improve educational effectiveness in teaching for creativity. This study aims to contribute to those understandings, by exploring the experiences of creative students, to propose a grounded theory of adolescent creativity.

Aims of the Research

The aim of the research was to explore adolescents' experiences of creativity to create a substantive theory of adolescent creativity. To develop a multidimensional perspective of creativity, Rhodes's (1961) four P's framework – person, process, product, and press (environment) – was adopted. Therefore, the study explored: (a) the adolescent as a creative person, and the personal factors that influence adolescents' creativity; (b) the creative process of creative adolescents; (c) adolescent creativity manifested as a creative product; and (d) social and environmental press factors that influence adolescents' creativity.

Research Design and Methods

Given the limited research on adolescent creativity, a grounded theory methodology guided data collection and analysis. Grounded theory is a qualitative approach intended to develop theory that is grounded in the data (Glaser & Strauss, 1967). The study adopted Strauss and Corbin's procedures for coding and analysing data (Corbin & Strauss, 2008; Strauss & Corbin, 1998), and Charmaz's (2006) constructivist approach to analysis and theory development as a co-construction of the researcher's and participants' views and interpretations. The fundamental elements of both approaches are: (a) gathering rich, detailed data; (b) theoretical sampling; (c) the constant comparative method of analysis conducted simultaneously with data collection; and (d) integrating categories and moving to a high level of abstraction to construct theory (Charmaz, 2006; Corbin & Strauss, 2008). The study was conducted at two academically selective high schools in Australia, one with a focus on science, mathematics and/or technology and the other in the arts (including music, visual arts, theatre arts, and film and multimedia). Ten creative students, aged 15 to 17 years, from each school were selected to participate. Theoretical sampling for participant selection was based on Creative Personality Scale (Gough, 1979) scores, Creative Self-Efficacy measure (Tierney & Farmer, 2002) scores, and teacher, peer and self nominations of creativity. Data sources included focus groups, individual interviews, and an online discussion forum.

Findings

Analysis revealed that the adolescent creative process entails the following six, interactive components: creativity motivation; creativity stimuli; the sub-processes of creativity; managing challenges in the creative process; producing divergent outcomes; and creativity affecting self/others. The study also recognised that the creative process occurs within, and is influenced by, a range of micro and macro environments. Exploration of these contextual conditions revealed contributing internal influences, as well as supportive and inhibiting external influences. The overarching core category of adolescent creativity was "difference". First, creativity requires a different perspective, and a different way of using existing knowledge and skills. Second, creativity results in the development of products that are different from what is known, either by the individual, by others, or both. Finally, supporting and developing creativity requires different educational pedagogies. The proposed paper will provide an overview of findings regarding the adolescent creative process, but will then focus predominately on the conditions influencing creativity to discuss how creativity can be encouraged and developed in schools.

Significance and Implications

Creativity requires something different: students who think differently and produce original outcomes, supported by different pedagogies in schools. This research was conducted with students who were creative in diverse domains,

from the arts, to humanities, to science, mathematics and technology. Although there were some domain-specific differences, overall the research revealed numerous similarities in adolescents' creative processes and the conditions that influence their creativity across domains. Existing empirical research of adolescent creativity is limited. This study is novel in its multidimensional approach to studying the creative experience from the perspective of creative adolescents. It builds on existing understandings about personal, social and environmental factors that can support or inhibit creativity, with a particular focus on the role of schools. The research has theoretical implications for educational researchers in cognition, learning and instruction, and policy and pedagogical implications for educational stakeholders in all curriculum areas. This substantive theory of adolescent creativity can contribute to establishing empirically-based learning and instructional practices to enhance educational effectiveness in developing students' creativity.

References

- Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. London: SAGE Publications.
- Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine Publishing Company.
- Gough, H. G. (1979). A creative personality scale for the Adjective Check List. *Journal of Personality and Social Psychology*, 37 (8), 1398-1405.
- McWilliam, E. (2008). *The creative workforce: How to launch young people into high-flying futures*. Sydney, Australia: University of New South Wales Press.
- Michel, A. (2001). Schools for an emerging new world. In Organisation for Economic Cooperation and Development, *Schooling for tomorrow: What schools for the future?* Paris: OECD Publications.
- Rhodes, M. (1961). An analysis of creativity. *Phi Delta Kappan*, 42, 305-310.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, 45 (6), 1137-1148.

PAPER PRESENTATION

Fortune Favors the Bold (and the Italicized), but Why? Revisiting the Disfluency Effect

Katharina Scheiter, Knowledge Media Research Center, Germany; Anne Schueler, Knowledge Media Research Center, Germany

Recent research has shown that texts that are printed in less legible format (e.g., in terms of font type and style) result in better verbal retention than a regular layout. The reason for the occurrence of this disfluency effect is yet unclear: Possibly, learners with less legible texts spend more effort into processing low-quality instructional materials, thereby overcompensating for potential harmful effects. In the current study, we aimed at replicating the disfluency effect while at the same assessing eye tracking data to get a better insight into its underlying mechanisms. It was assumed that learners with less legible text would invest more effort into reading as indicated by slower overall reading times, a higher number of fixations on the text, and longer average fixation durations as an indicator of processing difficulty. Moreover, we were interested in whether verbal as well as visual working memory capacity would play a moderating role in the disfluency effect. Seventy-four university students were randomly assigned to a condition with either high or a low legible text. Subsequently to reading the text, learners were asked to answer eight retention questions. The study replicated the disfluency effect in that learners showed better retention after having read low legible texts; however, students' reading behavior remained unaffected by the manipulation. Moreover, only learners with low visual working memory capacity benefited from low legible text. To conclude, these findings run against the predominant recommendation to always aim at optimizing instructional design to facilitate learning.

Diemand-Yaumann, Oppenheimer, and Vaughan (in press) have shown that contrary to what one would expect texts that are printed in less legible format (e.g., in terms of font type and style) result in better verbal retention than a regular layout. Even more astonishingly, this disfluency effect is not limited to the retention of simple facts in laboratory tasks. In a second study, Diemand-Yaumann et al. asked high-school teachers to submit their supplementary teaching materials. For half of the classes, the materials were sent back unaltered, whereas for the other half, the materials' quality was reduced before sending them back to the teachers (e.g., by making blurry photocopies or printed materials or by altering the appearance of digital materials). Teachers were then asked to use

these materials for their teaching. Achievement on regular assessment tests served as dependent variable. Again the results showed that across a variety of different domains and levels learners with less legible materials performed better in the assessment tests.

While the effect appears to be robust, there is little evidence pointing towards a possible explanation. Possibly, learners with less legible texts spend more effort into processing low-quality instructional materials, thereby overcompensating for potential harmful effects. In the current study, we aimed at replicating the findings by Diemand-Yaumann et al. using their materials from the laboratory study, while at the same time assessing eye tracking data to get a better insight into possible mechanisms underlying the disfluency effect. It was assumed that learners with less legible text would invest more effort into reading as indicated by slower overall reading times, a higher number of fixations on the text (e.g., caused by regressions within the text), and longer average fixation durations as an indicator of processing difficulty.

Moreover, we were interested in whether working memory capacity would play a moderating role in the disfluency effect. On the one hand, one might assume that learners with low verbal working memory capacity might show less improvement with less legible text, because they have fewer resources available to counteract its potentially harmful effects. On the other hand, research by Logie, Della Sala, Wynn, and Baddeley (2000) suggests that manipulations of superficial text features like the ones used in the before mentioned studies impact processing in visual working memory. Hence, it might well be that learners with low visual working memory capacity will be most affected by disfluency manipulations, whereas learners with high visual working memory capacity will learn well regardless of the text layout.

Method

Seventy-four university students were randomly assigned to one of two experimental conditions. In the high legibility condition, two texts each describing 13 characteristics of inhabitants of a fictitious star were printed in regular Arial black font type with 16 pt font size. In the low legibility condition, the same texts were printed in italics, Comic Sans MS 75% greyscale font type with 12 pt font size. The presentation order of the two texts was counterbalanced. Students could read the texts for as long as they liked. Eye movements were recording during reading. Because the manipulation was embedded as a distractor task in a different study, the learning phase of this study was presented after the disfluency materials (the combination of experimental conditions of the disfluency experiment and the second study was counterbalanced). Afterwards, learners were asked to answer eight retention questions asking for specific facts from the two texts. Prior to the experiment, students' verbal working memory capacity was assessed with the digit span test (Wechsler, 2000), whereas visual working memory capacity was measured with the Visual Pattern Test (Della Sala, Gray, Baddeley & Wilson, 1997).

Results

Two separate ANOVAs with experimental condition as a between-subjects factor and each of the two capacity measures serving as continuous factors were used to analyze verbal retention performance. The ANOVA with verbal working memory capacity revealed a marginal significant disfluency effect only ($p = .07$), but no effect of working memory capacity and no interaction. Instead, the ANOVA with visual working memory capacity revealed a significant disfluency effect ($p = .03$), a main effect of working memory capacity with better retention achieved by those with a higher capacity ($p = .01$), and an interaction ($p = .03$). Follow-up simple slope analyses revealed a disfluency effect only for those learners with low visual working memory capacity ($p = .003$), but not for learners with high capacity. Finally, and contrary to our expectations there were no reliable effects of experimental condition on any of the eye tracking parameters. Moreover, a mediation analysis did not confirm that changes in reading behavior cause the disfluency effect either.

Discussion

The study replicated the findings by Diemand et al. (in press); however, there is yet no idea as to its possible cause since students' reading behavior remained unaffected by the manipulation. Moreover, the findings showed that only learners with less favorable entry characteristics, namely low visual working memory capacity, benefited from this counterintuitive instructional manipulation. Future research needs to investigate whether the effect is limited to retention or whether less legible texts will also improve deeper comprehension. In any case, these findings run against the predominant recommendation to always aim at optimizing instructional design to facilitate learning that is, for instance, being pushed forward in Cognitive Load Theory research (e.g., Sweller, van Merriënboer, & Paas, 1998).

References

Della Sala, S., Gray, C., Baddeley, A., & Wilson, L. (1997). *The Visual Patterns Test: A new test of short-term visual recall*. Suffolk, England: Thames Valley Test Company.

Diemand-Yauman, C., Oppenheimer, D.M., & Vaughan, E.B. (in press). Fortune favors the bold (and the italicized): Effects of disfluency on retention. *Cognition*.

Logie, R. H., Della Sala, S., Wynn, V., & Baddeley, A.D. (2000). Visual similarity effects in immediate verbal serial recall. *Quarterly Journal of Experimental Psychology*. 53A, 626-646

Sweller, J., van Merriënboer, J. J. G., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10, 251-296.

Wechsler, D. (2000). Wechsler-Gedächtnistest – Revidierte Fassung: WMS-R. Deutsche Adaptation der revidierten Fassung der Wechsler Memory Scale. Bern: Huber.

PAPER PRESENTATION

The development of cognitive skills and abilities as an effect of competence-based trainings

Tibor Vidakovich, University of Szeged, Hungary; Edit Katalin Molnar, University of Szeged, Hungary

This study was carried out in the framework of an experimental project, aimed at the development of competences of students. Two areas were in the focus of the project: (1) text processing competence, and (2) mathematical competence. Some further cognitive skills and abilities were not developed directly, but their development was also hypothesized. Two tests served the assessment of the basic skills and abilities underlying the competence models: (A) deductive and inductive reasoning, and (B) systematizing and combinative abilities. Two other tests assessed the skills and abilities targeted in the competence-based programs: (C) written composition, and (D) word problem solving. The program was piloted in 90 volunteering schools. In the analysis, the samples of 5-6th graders, approximately 1,950 subjects were involved. On the tests of skills and abilities (A and B), the performances showed significant improvements. On both tests, students participating simultaneously in text processing and mathematical programs outperformed the others, but the development of students participating only in one program was not significantly different. On the tests of target variables (C and D), the improvement of the achievements was significant as well. On the written composition test, the results of students improved similarly, but on the word problem solving test, the improvement of students participating in both programs were significantly greater. Our results verified the significant effect of simultaneous application of the two competence-based programs on the development of basic skills and abilities. The results did not verify the hypothesized effects in reducing group inhomogeneity.

OBJECTIVES

This research was carried out in the framework of an experimental project, aimed at the development of text processing and mathematical competences of students (specifically targeting reading literacy and written composition; and mathematical understanding and word problem solving, respectively). It was also hypothesised that cognitive skills and abilities will be indirectly effected by the intervention; of these deductive and inductive reasoning, and systematizing and combinative abilities were monitored. When reporting the findings of the project, the following issues are discussed: (1) the development of cognitive skills and abilities underlying the applied competence models, (2) the differences in the development of groups participating in text processing and/or mathematical competence programs.

THEORETICAL FRAMEWORK

To implement competence-based education in schools, an experimental project has been running since 2005, with programs developed for several key competence areas. Two of these are in the focus of the present study: (1) text processing competence, and (2) mathematical competence; both are prioritised in international assessment programs as well. In the competence-based program, the frameworks of development and assessment were based on combined models. As regards text processing, the training program focused on reading literacy and written composition (e.g. Kirsch, 2003; Hayes, 1996). In the field of mathematical competence, the model was informed by factor analytic research (e.g. Carroll, 1996), and the program focused on the development of mathematical understanding and word problem solving in everyday contexts. There were other basic components (deductive and inductive reasoning, and systematizing and combinative abilities), that were not directly targeted by developmental efforts, but which, because of their importance in cognitive development (c.f. Royer, 2003), were assessed as well. Over and above text processing and mathematical achievements, a significant improvement in performances and a decrease in standard deviations of these basic components were also expected.

ASSESSMENT TOOLS

When designing the assessment tools, the main objective was that they should be appropriate for identifying students' developmental stage, and for comparisons between the development of basic skills and abilities as well as text processing and mathematical competences. Two tests covered the basic skills and abilities of the applied

competence models, namely, (A) deductive and inductive reasoning, and (B) systematizing and combinative abilities. Two other tests were selected to provide indicators for the assessment of the skills and abilities targeted in the training programs, i.e. (C) written composition, and (D) word problem solving. All tests were of good reliability (with Cronbach alphas of about 0.9). The basic principles and the standard process of test development (Vidákovich, 2002) warranted the content and structural validity of the tests. Our hypothesis was that both text processing and mathematical competence training would result in the development of basic skills and abilities too, and this effect could be strengthened by the simultaneous application of the two programs.

DATA SOURCES

The experimental competence-based program was piloted in 90 volunteering schools. Schools had the opportunity to participate in one or more of key competence programs. The analysis presented is based on data from the sample of 5-6th graders. The number of students participating in both the pre- and the post-test was about 1,950. This sample was further divided into four sub-samples, groups of students participating (1) both in the text processing and the mathematical programs, (2) only in the text processing program, (3) only in the mathematical program, and (4) only in other competence-based programs of the project. At the beginning and the end of the one-year experimental period, all students were administered tests of deductive and inductive reasoning, and systematizing and combinative abilities (i.e. tests A and B). Students in the text processing and/or mathematical programs were administered the appropriate written composition test (C) and/or word problem solving test (D) as well.

RESULTS

Performances were examined to assess the effects of the given programs on basic skills and abilities, and on text processing and mathematical competences as well. Both on the tests of reasoning (A) and abilities (B), there was a possibility to compare the achievements of the four groups, while the results of the tests of text composition (C) and word problem solving (D) could be compared between groups (1) and (2), and groups (1) and (3), respectively. In the case of basic skills and abilities (tests A and B), the performances of the four groups were similar on the pre-test. On the post-test, all groups showed significant improvements (p). The improvements in the achievements were significant (p

EDUCATIONAL SIGNIFICANCE

The results verified the significant effect of the simultaneous application of the two competence-based programs on the development of basic skills and abilities. The findings showed that the development of written composition was independent from the mathematical competence program, while the development of word problem solving seemed to be effected by the text processing competence program. The results did not verify the hypothesized effects in reducing group inhomogeneity, neither in the case of cognitive skills and abilities, nor in the case of target variables.

PAPER PRESENTATION

Evaluating the educational effectiveness of an intervention programme for social-emotional learning.

Mary Sheard, University of York, United Kingdom

The paper presents a critical reflection on the first two years of a longitudinal randomised evaluation of Together 4 All, a social and emotional intervention programme introduced in the Craigavon area of Northern Ireland in 2008. The evaluation uses quantitative and qualitative methods to investigate possible changes in children's personal development, attitudes and behaviour associated with the implementation of the programme. These include interviews with a range of stakeholders in the school community, teacher ratings of pupil behaviour and individual assessments of children's social-emotional development. Observation measures were developed to capture a range of teaching and pupil behaviours associated with the aims of the Together 4 All programme. The paper argues that an evaluation of the educational effectiveness of a teaching programme should carefully consider the processes of implementation and pedagogic change as well as outcomes related to pupil achievement and attainment. The paper reports on the development and reliability of observation measures of teaching behaviours and pupil behaviours and findings obtained from the observation measures, and from statistical analysis of teacher ratings completed prior to and during the implementation period. From a socio-cultural perspective, the paper draws conclusions about the evaluation process and the contribution made by the various measures to our understanding of educational effectiveness in the context of a social and emotional intervention programme.

The paper presents a critical reflection on a longitudinal randomised evaluation of Together 4 All (T4A), a social and emotional intervention programme introduced into six Primary Schools in an area of religious, cultural, social and economic diversity in Northern Ireland in 2008. T4A focuses on promoting children's self esteem, emotional

intelligence, pro-social behaviour and mutual respect and understanding. The main evaluation question is 'What are the impacts of the programme on children's pro-social and classroom behaviour, mutual respect and understanding, and emotional and social development?'

Theoretical framework

The T4A programme is an agent of cultural change and social action. It focuses on children's interactions with other people, objects and events in the environment and on activities that require cognitive and communicative participation.

From this socio-cultural perspective, teachers, parents and other significant adults are more experienced social partners from whom children learn the social practices and cultural conventions of social interactions characteristic of conflict as well as co-operation. The social emotional language of T4A and its associated discourses and visual representations, for example compliment slips, Child for the Day, and control signals, may be viewed as mediating cultural change. Central to the evaluation is how the programme impacts on the pedagogic behaviours of teachers as pupils' social partners and agents of cultural change.

Methods

The evaluation draws on a range of quantitative and qualitative methods to investigate possible changes in children's personal development, attitudes and behaviour associated with the programme's implementation. Instruments used include interviews, teacher ratings of pupil behaviour, classroom observations of teaching and pupil behaviours, playtime observations of pupil behaviour, and individual assessments of pupils' social and emotional competence.

Interviews

Structured interviews conducted with key stakeholders in the school community at three points over the course of the evaluation period focus on changes in children's confidence, self-esteem, behaviour, and recognition and self-regulation of emotions.

Teacher ratings of pupil behaviour

Teachers rated children's behaviour on 26 items using the following 6 point scale: 'Never or almost never', 'Rarely', 'Sometimes', 'Often', 'Very often', and 'Almost always'.

1711 teacher ratings were completed at pretest and again after six and eighteen months of implementation.

Classroom Observations and playtime observations

Lesson observation measures were developed to capture thirteen teaching behaviours associated with the programme's aims, such as emotion modelling, positive behaviour modelling, and supporting peer interaction, and nine pupil behaviours including items on positive coping strategies, co-operation in learning, and showing mutual respect and understanding. The focus of pupil behaviour in the playtime observations includes turn-taking, including others and showing mutual respect and understanding.

Observations were rated on a 4 point scale for prevalence and frequency.

Individual assessments of pupils' social - emotional development

Several measures of social-emotional development at pretest and posttest are obtained for each participating child.

Findings

Teacher ratings of pupil behaviour

Teacher ratings of pupil behaviour analysed using an analysis of covariance (ANCOVA). To statistically control for baseline differences in teacher ratings, "adjusted" posttest means were computed for the intervention and control groups. A clustering design was not used with teacher rating data in the preliminary analysis; liberal analyses with high power was considered to be more appropriate since the intervention was fairly recent and implementation was at an early stage. However, subsequent ratings data was analysed by clustering within teachers, as a replication analysis using basic and HLM analyses.

In a comparison of pretest with interim teacher ratings after six months of programme implementation for children aged 5 and 6, the non-statistically significant directional pattern of comparison between means across the 26 rated items favoured the intervention group on 13 items and the control on 10 items (identical means were obtained on 2 items).

For children aged 9 and 10, statistically significant differences (p < 0.05) were found for 3 items and the directional pattern of the comparisons between means favoured the control group on an additional 9 items.

After eighteen months of programme implementation, for the younger cohort (P2/P3), the intervention group was significantly superior on 16 (64%) of the behaviours (median effect size = +0.26), whereas the control group was significantly superior on only 2 behaviours (8%).

For the older cohort, the intervention group was significantly superior on 7 behaviours (median ES = +0.22) (28%), and directionally superior on 11 behaviours (44%). The control group had no significant advantages (0%) and only 5 (20%) small directional advantages.

Classroom Observations and playtime observations

Analysis of baseline classroom observations of teaching behaviour undertaken after 6 months of implementation suggests superior teaching behaviour in the intervention classes on 10 out of 11 items, including positive behaviour management, provision of interpersonal support and emotion modelling.

Analysis of baseline classroom observations of pupil behaviour after 6 months of implementation suggests superior pupil behaviours in the intervention classes in:

- Showing mutual respect and understanding
- Positive coping strategies
- Self expression of feelings
- Identifying feelings of others

Directional advantage for the control group was found in co-operative learning.

Analysis did not reveal strong patterns in pupils' playtime behaviour. Directional advantage included less physically aggressive behaviour in the intervention group and more turn-taking in the control group.

Using the same observational measures after eighteen months of programme implementation, findings were equivocal for intervention and control groups.

Individual assessments of pupils' social - emotional development

While analysis is ongoing, preliminary findings will be reported.

Educational importance

The paper takes a critical stance in arguing that evaluating the educational effectiveness of teaching programmes should carefully consider the processes of implementation and pedagogic change, as well as outcomes related to pupil achievement and attainment.

Implications for educational research and educational effectiveness are critically appraised in reference to the various instruments and measures used. In evaluating the contribution of teacher ratings and individual child assessments, important considerations are raised about the coding and interpretation of children's responses in problem-solving scenarios.

PAPER PRESENTATION

Towards an Understanding of Motivation Regulation in Collaborative Learning Groups

Thomas Martens, German Institute for International Educational Research, Germany; Ana Remesal-Ortiz, Universidad de Barcelona, Spain

In this study university students were provided with specific information on the motivational process in a collaborative learning group in order to evoke motivational self- and coregulation and thus improve intrinsic motivation. Therefore the "Quality of Working in Groups Instrument (QWIGI)" from Boekaerts and Minnaert (2003) was used. Each member of a learning group has to answer eight questions on a regular base measuring Interest and the three psychological

needs proposed by Deci & Ryan: Autonomy, Competency and Social Relatedness. The used online version of the QWIGI provided a tailored visual feedback of their scores compared to the group scores. Two courses in Educational Psychology (n=30, n= 55) participated. The students had to solve five complex problem-based authentic activities in groups of 4-6 members. Twice in the course, special discussions are carried out in order to promote groups' reflection about their motivational processes. At the end of the course a final questionnaire was collected from the students measuring different antecedents of motivation, motivation and different aspects of the QWIGI usage. These data were combined with longitudinal data assessed by the QWIGI and qualitative self-reported data describing the learning process. The results show that the usage of the graphical feedback is one key factor for enhancing intrinsic motivation.

In higher education, a lack of motivation for learning is frequent. This is particularly outstanding in teaching and learning contexts in which new information and communication technologies are applied. Students are not willing to actively invest time and effort in their studies and if they do so, an often heard complaint is that they rely on passive strategies, without showing any real interest in the subject matter. The use of collaborative learning is one way of influencing the quality of student learning concerns. Of course, collaborative learning may suffer strongly from suboptimal group processes such as the free rider effect, in which team members feel that some group members do less than others (Strijbos, Kirschner, & Martens, 2004).

To prevent such effects, students in this study were provided with specific information on the motivational group process in order to evoke motivational coregulation and thus improve intrinsic motivation. This would lead to - so the authors hypothesized - increasing engagement in learning and assessment activities.

For this purpose the "Quality of Working in Groups Instrument (QWIGI)" from Boekaerts and Minnaert (2003) was used. Each member of a learning group has to answer eight questions on a regular base measuring Interest and the three psychological needs proposed by Ryan & Deci (2000): Perceived Autonomy, Perceived Competency and Perceived Social Relatedness. The used online version provided an additional feedback modus, so that students got a tailored visual feedback of their scores compared to the group scores.

Ideally, the QWIGI and the associated graphical feedback work in 3 steps:

- 1.) Answering the QWIGI: first reflections about personal motivational start.
- 2.) Looking at the graphical feedback: reflections about personal motivational situation in comparison to the motivational group situation take place. A perceived discrepancy between personal and group mean scores can be the starting point of regulation processes. The questions of the QWIGI provide a "language" to communicate about motivational problems.
- 3.) Participate in group discussion: The group gets room and space for regulating their basic needs. Reasons for motivational discrepancies of group members are identified. The need for changing these discrepancies will be discussed. Ways of changing the group learning situation accordingly are reflected.

It has been demonstrated in a control group experiment that graphical feedback associated with the QWIGI questionnaire, improves intrinsic motivation in a collaborative setting for learning statistics (Martens & Martens, 2009).

So, the here presented work is built upon these five premises: (1) The Basic Needs sensu Decy & Ryan are necessary for Intrinsic Motivation. (2) Intrinsic Motivation is necessary for Academic Learning. (3) Intrinsic Motivation can compensate negative side effects of CSCL. (4) Measuring and graphical feedback of the Basic Needs with the QWIGI increase Intrinsic Motivation. (5) The increase of Intrinsic Motivation is a result of regulation processes.

The research presented in this paper aims to reveal the underlying mechanisms for motivational co- and self-regulation. The improvement of intrinsic motivation might be an effect of motivational self-regulation or motivational co-regulation in the group or most probably a mixture of both regulation processes. Furthermore is not clear which of the basic needs is in the focus of regulation processes using the QWIGI. A first step to reveal the processes of motivational regulation and co-regulation will be the analysis of the actual QWIGI usage: is the usage of the QWIGI feedback, especially the usage of the graphical feedback, the key factor for regulation processes regarding intrinsic motivation?

A Spanish online version of the questionnaire was implemented in a teacher education course of Educational Psychology. Two courses of students (n=30, n= 55) working in teams of 4-6 members participated. The questionnaire was embedded in the general course program for one complete academic year. The students had to perform five different complex collaborative and problem-based activities. Twice in the course, special discussions are carried out

in order to promote groups' reflection about their motivational processes. At the end of the course a final questionnaire was collected from the students measuring different antecedents of motivation, motivation and different aspects of the QWIGI usage. These data were combined with longitudinal data assessed by the QWIGI and qualitative self-reported data describing the learning process.

A regression model predicting motivation demonstrates that the measures for the QWIGI usage, namely "Graphical Information", "Graphical Benefit" and "Evaluation of Experience" provide a significant change of R-square. So the results point to the interpretation that the usage of the graphical feedback within the learning group is one key factor for enhancing intrinsic motivation. This finding also explains results from a previous study where the usage of the QWIGI didn't include an explicit time slot for discussing the graphical feedback and therefore resulted in no significant change in intrinsic motivation.

Next steps of analysis will focus on participants' conceptions and attitudes towards collaborative learning and collaborative skills/working style; individual learning strategies and learning approach, and how these factors might be moderating the data presented here.

Boekaerts, M., & Minnaert, A. (2003). Assessment of students' feelings of autonomy, competence, and social relatedness: A new approach to measuring the quality of the learning process through self-assessment. In M. S. R. Segers, F. J. R. C. Dochy & E. C. Cascallar (Eds.), *Optimizing new methods of assessment: In search of quality and standards* (pp. 225-246). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Martens, T. & Martens, R. (2009). Increasing Intrinsic Motivation in CSCL: a Monitoring Instrument for Motivational Co-regulation. In N. Brouwer, B. Giesbers, B. Rienties, L. Van Gastel (Eds). *Student Mobility and ICT: Dimensions of Transition* (pp. 257 - 266). Maastricht: FEBA ERD Press.

Strijbos, J.-W., Kirschner, P. A., & Martens, R. L. (2004). *What we know about CSCL in Higher Education*. Dordrecht, NL: Kluwer Academic Publisher.

PAPER PRESENTATION

Achievement Emotions In Different School Tasks And Subject-Matters

Daniela Raccanello, University of Verona, Italy; BIANCA DE BERNARDI, UNIVERSITY OF VERONA, Italy

This study focused on achievement emotions characterizing different contexts, in terms of both scholastic tasks and subject-matters, in students from elementary and middle school. Considering the pervasiveness of different emotions in school, many scholars have studied the mutual relationships between affect and motivational or cognitive dimensions related to learning, and recently particular interest has been focused on discrete emotions rather than states pertaining to different valences. Referring to the control-value theory on achievement emotions, our study involved 330 Italian students, attending the fourth grade and the seventh grade. They completed two questionnaires, one focused on Italian and the other on Mathematics. They were asked to evaluate ten discrete emotions about two non-evaluative tasks (attending a lesson, doing homework) and two evaluative tasks (standing a written test, standing an oral test) on 5-point Likert-type scales. Results showed that, as age increased, positive emotions decreased and negative emotions increased, with some exceptions. Moreover, non-evaluative tasks were characterized by higher levels of enjoyment, pride, relief, relaxation and boredom, while evaluative tasks were characterized by higher levels of hope, anxiety, anger and fault. Finally, boredom and hopelessness were stronger for Italian rather than Mathematics. These data point out that discrete emotions are sensitive to different contexts, mostly in terms of kind of learning tasks than in terms of school subject-matters, and that they follow different developmental trends.

Introduction.

In the light of the relevance of context within educational psychology (Anderman, 2004), this study focused on achievement emotions characterizing different contexts, in terms of both scholastic tasks and subject-matters, in students from elementary and middle school. While emotions can be defined as "multi-component, coordinated processes of psychological subsystems including affective, cognitive, motivational, expressive, and peripheral physiological processes" (Pekrun, 2006, p. 316), achievement emotions are those emotions related to achievement activities or achievement outcomes (Pekrun, 2006). Given the pervasiveness of different emotions in scholastic contexts, many scholars studied the mutual relationships between affect and motivational or cognitive dimensions related to learning (Linnenbrink, 2006; Pintrich, 2003; Schultz, 2006), and recently particular interest has been focused on discrete emotions rather than states pertaining to different valences (Kleine, Goetz, Pekrun, & Hall, 2005; Pekrun, Goetz, Titz, & Perry, 2002). According to the control-value theory, for example, academic achievement would be linked to positive-activating emotions in terms of beneficial effects and to negative-deactivating emotions in terms of

detrimental effects, while the role played by negative-activating and positive-deactivating emotions seems ambivalent (Pekrun et al., 2002; Pekrun, 2006).

As regards our specific aims, we focused on the transition from elementary to middle school, expecting decreases in positive emotions and increases in negative emotions, mirroring a trend typical of some motivational dimensions related to learning, such as self-efficacy, task-value, or achievement goals (Bouffard, Boileau, & Vezeau, 2001; Chouinard & Roy, 2008; Pintrich, 2000; Raccanello & De Bernardi, 2010; Wigfield & Eccles, 2000). Then, following suggestions about the possibility to generalize results related to university students in university settings (Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010), we explored differences in discrete emotions between different scholastic tasks, expecting higher positive emotions for non-evaluative tasks and higher negative emotions for evaluative tasks. Finally, we explored differences related to Italian and Mathematics, given that emotions such as enjoyment, anxiety and boredom seem to follow domain-specific lines, at least for students from grades 7 to 10 (Goetz, Frenzel, Pekrun, & Hall, 2006).

Method.

The participants were 330 Italian students, attending the fourth ($N = 159$; $M = 9$ years, 10 months) and the seventh grade ($N = 171$; $M = 12$ years, 10 months). For each age group, there was about the same number of females and males. They completed two questionnaires, one focused on Italian and the other on Mathematics. The students were asked to imagine to be involved into four different scholastic tasks, two non-evaluative tasks (attending a lesson, doing homework) and two evaluative tasks (standing a written test, standing an oral test). For each task, they were asked to evaluate, on a 5-point Likert-type scale, ten discrete emotions (Kleine et al., 2005). Among them, there were three positive-activating (enjoyment, pride, hope), two positive-deactivating (relief, relaxation), three negative-activating (anxiety, anger, guilt) and two negative-deactivating emotions (boredom, hopelessness). In addition, academic achievement related to the two subject-matters was asked.

Results and discussion.

For the analyses the mean values for items related to the same emotion and the same task, separately for the two subject-matters, were calculated. Repeated-measure ANOVAs were carried out on each emotion, with Level (4th, 7th graders) as between-subjects factor, and Task (non-evaluative, evaluative) and Subject (Italian, Mathematics) as within-subjects factors (p Level resulted significant for most of the emotions (enjoyment: $F(1,327) = 82.725$, $p < .001$; pride: $F(1,328) = 43.855$, $p < .001$; relief: $F(1,328) = 37.079$, $p < .001$; relaxation: $F(1,328) = 38.218$, $p < .001$; anger: $F(1,328) = 16.512$, $p < .001$; boredom: $F(1,328) = 11.438$, $p = .001$), and it interacted significantly with Task for hope ($F(1,327) = 27.136$, $p < .001$) and anxiety ($F(1,327) = 36.239$, $p < .001$). Specifically, as age increased, endorsement of most of the positive emotions decreased while endorsement of most of the negative emotions increased, with some exceptions. Among positive emotions, hope related to evaluative tasks increased. Among negative emotions, anxiety related to non-evaluative task decreased, and there were not differences for fault and hopelessness. Second, a significant effect of Task emerged for all the emotions with the exception of hopelessness (enjoyment: $F(1,327) = 84.766$, $p < .001$; pride: $F(1,328) = 12.708$, $p < .001$; hope: $F(1,327) = 62.049$, $p < .001$; relief: $F(1,328) = 85.328$, $p < .001$; relaxation: $F(1,328) = 152.713$, $p < .001$; anxiety: $F(1,327) = 192.818$, $p < .001$; anger: $F(1,328) = 39.637$, $p < .001$; fault: $F(1,328) = 22.324$, $p < .001$; boredom: $F(1,328) = 65.754$, $p < .001$). On the one hand, non-evaluative tasks were characterized by higher levels of enjoyment, pride, relief, relaxation and boredom compared to evaluative tasks. On the other hand, evaluative tasks were characterized by higher levels of hope, anxiety, anger and fault compared to non-evaluative tasks. Third, Subject was significant only for boredom ($F(1,328) = 12.159$, $p = .001$) and hopelessness ($F(1,327) = 10.192$, $p = .002$), that were stronger for Italian rather than Mathematics.

These results suggest, on the one hand, that discrete emotions are sensitive to different contexts, mostly in terms of kind of learning tasks than in terms of school subject-matters. On the other hand, they point out different developmental trends for the emotions, with decreasing positive emotions and increasing negative emotions in the transition from elementary to middle school. Considering both the theoretical and the applied relevance to focus on achievement emotions (Goetz et al., 2002; Pekrun, Hall, & Haag, 2006; Schultz, 2006), future studies should examine more deeply these issues, using for example qualitative methods such as interviews to explore students' reasons underlying the documented changes.

PAPER PRESENTATION

Effects of a reattribution training - combining quantitative and qualitative methods of evaluation

Several studies show when observing teachers in classroom the frequency of giving feedback is low, especially when looking at powerful feedback. Focusing feedback processes in every day school situations the aim of our project is to examine how attributional feedback impact on young children. A pre-post-follow up treatment-control group design is implemented to analyse the effects of a reattribution in 10 to 13 year old children. For this reason, we tested a sample of 527 children at three time points with standard psychological tests and questionnaires (using quantitative methods). Moreover, qualitative data like observations, interviews, and log books is used to have a deeper understanding of the implementation and helpful or obstructive factors of the training. First results of the quantitative study suggest that there were effects of the reattribution training in the individual data comparing both groups e.g. in the attributional style of the tested children. Results of the qualitative studies show that the teachers had several problems in implementing the training e.g. in "hard" subjects and direct instruction. Additionally, results of the qualitative data give hints for a deeper analysis and interpretation of the quantitative data. The study shows that training teachers to give adaptive and attributional feedback seems to be a good chance to improve dealing with individualized feedback in every-day classroom.

Introduction

Many empirical studies investigate the role of feedback during instruction. They are covering topics like task related feedback, process related feedback, timing of feedback, self-related feedback and so on (Hattie & Timperley, 2007). Nevertheless, when observing teachers in their every day classroom several studies show that the frequency of giving feedback is low, especially when looking at powerful feedback (Bond, 2000). Focusing these feedback processes the aim of our project is to examine how attributional feedback impact on young children. For this reason, a pre-post-follow up treatment-control group design is implemented to analyse the effects of a reattribution training (Ziegler & Schober, 2001, 2002) in 10 to 13 year old children. Moreover, qualitative data (observations, interviews, log books) is used to have a deeper understanding of the implementation and helpful or obstructive factors of the training (Dresel & Ziegler, 2006).

Theoretical Framework

According to the attribution theory students are more or less motivated due to their beliefs about causalities of success or failure. Concerning this, the aim of reattribution trainings is to change causal explanations from lack of ability to lack of effort and to improve the student's beliefs in the cause of their failures and successes to promote future motivation. Ziegler and Schober (2001, 2002) designed attributional retrainings to be applied in the classroom. Teachers are trained to comment written and verbal learning performances of their students. So far, only few studies have examined the effects of attributional feedback in young children and little is known about effects of attributional feedback used in reattribution trainings on self-related cognitions such as goal orientation, evaluation of mistakes, and so on.

Aims

The aim of our study is to investigate how the feedback given by the trained teachers impact on self related cognitions such as attributional style, self-concept etc. in comparison to the feedback given by untrained teachers. The design and analyses of the data will combine two perspectives: a) the role of attributional feedback in teaching and learning with respect to individual differences (using quantitative methods) and b) enhancing and hindering factors by implementing attributional training in every day classroom (using qualitative methods).

Method

Collection of individual data was conducted at three time points, namely as pre-, post-, and follow-up-test (one year after the intervention) to examine effects of the training. Five teachers applied the training for 15 weeks. Children were tested with standard psychological tests and questionnaires assessing self-concept, intelligence, memory capacity, goal orientation, attention, learning strategies, evaluation of mistakes, and epistemological beliefs. Furthermore, we collected data in several qualitative studies to get an impression of how the teachers implemented the training in their regular classroom, which kind of problems the teachers had, and which classroom factors or instruction variables were helpful or obstructive for the implementation of the training. For this reason, we observed the trained teachers during their school lessons for several hours. Moreover the teachers had to keep a weekly feedback diary over the whole training phase, and we conducted a half-structured interview with each of the five teachers at the end of the training.

Sample

We tested a sample of 527 children between the ages of 10 to 13 years (at the first data point) in their natural school setting. We investigated children of the German 5th (n = 256) and 6th (n= 271) grades. Half of the children (n = 260)

were assigned to the intervention group and got the reattribution training, half of them (n = 267) served as control group and got no training.

Results

First results of the quantitative study suggest that there were effects of the reattribution training in the individual data comparing both groups. For example, children in the control group rated significantly higher at the second data point on the attributional style in case of failure to a lack of ability than before the training ($F(1, 478)=8.25$, p

Results of the qualitative studies show that the teachers had several problems in implementing the training. The teachers told that it was easier for them to give feedback in group situations and in "softer" subjects (e.g. history, music) than in direct instructions and "harder" subjects as maths. Analyses of the feedback diaries suggest that there were phases in which the teachers had problems to concentrate on the training.

Data analyses of the follow-up-data are still running at this point. Further results concerning the effects of the training in relation to individual differences in regard with the results of the qualitative data will be presented on the conference.

Summary and Implications

First results of the study show that training teachers to give adaptive and attributional feedback seems to be a good chance to improve dealing with individualized feedback in every-day classroom. Bringing together the data of the quantitative and the qualitative studies we have a deeper understanding of what happened when the training was implemented. Moreover, the qualitative data allow us to improve the training for the teachers for future investigations and teacher education.

References

- Bond, L, Smith, R., Baker, W.K. & Hattie, J. (2000). Certification system of the National board for Professional Teaching Standards: A construct and consequential validity study. Washington: National Board for Professional Teaching Standards.
- Dresel, M. & Ziegler, A. (2006). Langfristige Förderung von Fähigkeitsselbstkonzept und impliziter Fähigkeitstheorie durch computerbasiertes attributionales Feedback. Zeitschrift für Pädagogische Psychologie, 20 (1/2), 49-63.
- Hattie, J. & Timperley, H. (2009). The power of feedback. Review of educational Research, 77(1), 81-112.
- Schober, B. & Ziegler, A. (2002). Theoretical Levels in the Evaluation of Motivational Trainings. European Journal of Psychological Assessment, 18, 204-213.
- Ziegler, A. & Schober, B. (2001). Theoretische Grundlagen und praktische Anwendungen von Reattributionstrainings. Regensburg: Roderer Verlag.

PAPER PRESENTATION

Mathematics Motivation, achievement, gender and social support in the classroom

Vera Monteiro, Instituto Superior Psicologia Aplicada, Portugal; Lourdes Mata, Instituto Superior de Psicologia Aplicada Instituto Universitario , Portugal; Francisco Peixoto, I.S.P.A. - Instituto Universitario, Portugal

The aims of this study were to characterize mathematics motivation among Portuguese students and analyse their relation with gender, classroom social support and achievement.

The participants were 925 Portuguese students from 5th grade to 9th grade. They completed two questionnaires, one that measured their maths motivation considering five domains: Value, Enjoyment, Choice, Competence and Pressure and another considering the social support of teacher and their colleagues in the maths classroom. The achievement level was calculated considering their grades in maths classroom.

Results allowed us to analyse the multidimensional profile of students' maths motivation. Findings show significant differences between boys and girls in maths motivation, with girls feeling more pressure about maths, perceiving themselves as less competent but considering maths as a more valuable subject than boys. Social Support in classroom was also an important variable related with motivation as well as the achievement status of the student (low, medium, high).

Self-determination theory (Deci & Ryan, 1991) is a social theory of motivation that when is applied to education, is focused on promoting in students an interest in learning, a valuing of education, and a confidence in their own capacities and attributes (Deci, Vallerand, Pelletier & Ryan, 1991). According to the authors, high levels in these dimensions mean being intrinsically motivated. The results of their researches suggest that the social environment

affects people's intrinsic motivation. One important aspect of self-determination theory is that social contexts that support relatedness (e.g., the interpersonal involvement of teachers) will increase motivation in general but also will increase intrinsic motivation, especially if this is an autonomy support that provides choices (Grolnick & Ryan, 1989). In terms of classroom climate, the social support given by teachers and peers has been shown to be positively related to intrinsic motivation (Sousa, Monteiro, Mata & Peixoto, 2010).

Some empirical studies have revealed an association between academic achievement and classroom motivation. Goldberg and Cornell (1998) found a positive relationship between intrinsic motivation and academic achievement in second and third graders. Gottfried (1985, 1990), in his researches with elementary- and middle-school-aged children, verified the relevance of academic intrinsic motivation on children's school achievement. He showed that young children with higher academic intrinsic motivation had significantly higher achievement and were more successful in school. The results of the study conducted by Broussard and Garrison (2004) supported that intrinsic classroom motivation was positively related to academic achievement in maths, particularly for third-grade children.

For many years the literature presents gender differences in favor of boys in maths achievement for many years. According to Georgiou, Stavriniades, and Kalavana (2007) this has created the stereotype that girls are not good at maths. However, no significant differences were found between boys and girls in actual maths achievement. These authors found significant differences in the way boys and girls explain their success and failure. It seems that boys tend to attribute their success to ability, while girls attribute to effort. Girls attribute their failure in maths to lack of ability whereas boys to the lack of effort. These kinds of attributions are going to affect girls' and boys' motivation and attitudes towards maths.

Aims

The aims of this study were to characterize mathematics motivation among Portuguese students and analyze their relation with gender, classroom social support and achievement

Method Participants

The participants were 925 students from fifth- to ninth-grade mathematics classrooms in several schools in Lisbon and around Lisbon. There were 458 (49,5%) boys and 467 (50,5%) girls. The age range was from 10 to 16 years old.

Measures

We used two instruments: The Mathematics Motivation Questionnaire and The Social Support Questionnaire. Students' perceptions of teachers' and peers' support were assessed by The Social Support Questionnaire, comprising 10 items (Cronbach's Alpha=.838). Students were asked to rate a series of statements, to assess the degree to which they felt their teachers' and peers' support at the mathematics classroom. For all (Cronbach's Alpha=.838) the items a 6-point Likert-type scale (ranging from 1=strongly disagree to 6=strongly agree) was used. To assess mathematics motivation we used the Mathematics Motivation Questionnaire, a 22 item questionnaire adapted from the IMI (Intrinsic Motivation Inventory, from Ryan, Koestner & Deci, 1991). This is a multidimensional instrument that assesses students' enjoyment (Cronbach's Alpha=.911), perceived competence (Cronbach's Alpha=.786), value (Cronbach's Alpha=.897), felt pressure (Cronbach's Alpha=.748), and perceived choice (Cronbach's Alpha=.848) while performing mathematics, thus yielding five subscale scores. All items were rated on a 1-6 Likert scale.

Results

Gender, achievement and social support effects on mathematic motivation

A multivariate analysis of variance, considering gender, achievement and support, revealed statistically significant differences for gender (Pillai's Trace=0,044, $F(5,866)=7,945$ p

Considering gender, the analyses revealed effects of gender on three subscales: the Value subscale ($F(1,881)=4.007$ p=0.046), the Perceived Competence subscale ($F(1,881)=10,220$ p=0.001) and the Pressure subscale ($F(1,881)=5,380$ p=0.021). Girls felt more pressure about maths, perceived themselves as less competent but considered maths as a more valuable subject than boys.

Regarding achievement, the analysis considering three levels of students' achievement (Low, Medium, High) revealed reliable effects on all the five subscales: the Value subscale ($F(2,881)=47.999$ pppp

Finally the analyses considering Social Support also revealed significant effects in four motivational dimensions with those students who felt lower Social Support being less motivated in all these dimensions (Value ($F(1,881)=117.230$ p In terms of the relations between mathematics motivation and gender, grades and social support (teacher and peers) results in this study indicated that significant gender, social support and grades differences were found. No significant differences were found for gender in the actual achievement in mathematics, but girls perceived themselves as less competent than boys. They also felt more pressure about maths and considered maths as a more valuable subject

than boys. The findings also suggested that students with high maths achievement have a significantly higher mean score in all dimensions of motivation and felt less pressure on maths activities, when compared with students with medium and low achievement. Additionally, students who felt a more positive social support in their maths classroom present higher mean scores in motivation than students that perceived to have less social support in their classes.

Implications of these results for learning and learning motivation will be discussed.

PAPER PRESENTATION

Effects of reading motivation on reading competence: Do they depend on students' achievement levels?

Maik Philipp, University of Applied Sciences Northwestern Switzerland, Switzerland

Past research has demonstrated positive effects of intrinsic reading motivation on reading competence (cf. Baker & Wigfield, 1999). It is supposed that high reading motivation enhances reading frequency leading thereby to improved text comprehension (cf. Guthrie & Anderson, 1999). However, we expect such improvements to be larger for students of high-achieving (HA) school tracks as opposed to low-achieving (LA) school tracks. HA-students are better self-regulated learners and may read more difficult text types in their spare time (e.g., novels versus comics). Thus, their reading competence should be more improved as a consequence of high reading motivation than LA-students' reading competence. To test this assumption, we examined the effects of intrinsic reading motivation on reading competence between grades 5 and 6 in samples of HA- students ($n=198$) and LA-students ($n=207$). Correlations confirmed that intrinsic reading motivation (grade 5) was significantly associated with reading competence (grade 6) in the sample of HA-students, but not in the sample of LA-students. By means of structural equation modeling, it was further confirmed that HA-students' intrinsic reading motivation in grade 5 significantly predicted the development of reading competence between grades 5 and 6 (controlling for gender and migration background). In the sample of LA-students, however, intrinsic reading motivation proved to be unrelated to changes in reading competence between grades 5 and 6. In sum, the present findings suggest that intrinsic reading motivation contributes to increased reading skills only in high-achieving students but not in low-achieving students.

A number of studies (e.g., Baker & Wigfield, 1999; Mucherah & Yoder, 2009) provided empirical evidence that intrinsic reading motivation fosters independent out-of-school reading and, consequently, reading achievement (cf. Guthrie & Anderson, 1999). However, these effects have been rarely investigated longitudinally. Furthermore, there is a lack of studies exploring the effects of intrinsic reading motivation separately for students of high-achieving versus low-achieving school tracks. Students of high-achieving school tracks probably read more difficult texts as a consequence of high intrinsic reading motivation, e.g. because they have more elaborated interests, and more sophisticated books available. In contrast, students of low-achieving tracks with high reading motivation are likely to prefer comics or magazines which are less conducive to their reading competence. Thus, the major objective of this study was to test the assumption that intrinsic reading motivation is a better predictor of reading competence for high-achieving than for low-achieving students.

Four hundred and five students were tested in grade 5 and, seventeen months later, in grade 6 (students who participated only once, in grade 5 or grade 6, were excluded from the present analyses). One hundred ninety-eight students attended a high-achieving school track (Gymnasium); two hundred and seven students were of school tracks with a low (Hauptschule) or medium achievement level (Realschule; both levels are summarized here as "low"). At both time points, intrinsic reading motivation and reading achievement were assessed. Intrinsic reading motivation was measured by a seven-item questionnaire (e.g., "I read for pleasure during spare time"; $\alpha = .84/.89$ in grade 5/6). To assess reading achievement in the 5th grade, we used teacher judgments on reading competence as well as German grades ($\alpha = .58$). In grade 6, standardized tests on reading comprehension ($\alpha = .87$) and reading speed ($\alpha = .84$) were administered (LGTV 6-12; Schneider, Schlagmüller & Ennemoser, 2007). In addition, gender and migration background were assessed. Missing values were estimated by NORM 2.03 (Schafer, 1999).

In line with our assumptions, correlations revealed that in the sample of high-achieving students, intrinsic reading motivation in grade 5 was significantly associated with reading competence in grade 6, whereas no such relation was found in the sample of low-achieving students. To test the assumption that intrinsic reading motivation in grade 5 predicts the development of reading achievement between grades 5 and 6, structural equation modeling was applied. The hypothesized cross-lagged panel model (Figure 1) included four latent variables: reading motivation in grade 5 and in grade 6 (items as indicators), reading achievement in grade 5 (teachers' judgments and German grades as indicators) and reading achievement in grade 6 (reading comprehension and reading speed as indicators). We assumed that intrinsic reading motivation in grade 5 contributes independently of prior reading achievement (grade 5)

to the prediction of reading achievement in grade 6. The model also hypothesizes the reversed effect of 5th grade reading achievement on 6th grade intrinsic reading motivation as has been suggested by Morgan and Fuchs (2007). Effects of gender and migration background on all variables were taken into account. The model was tested separately for students of high-achieving and low-achieving school tracks by means of Mplus (cf. Muthen & Muthen 1998-2006). The fit of the model proved to be acceptable for both high-achieving students ($\chi^2_{[55df]} = 94.3$, p

References

- Baker, L. & Wigfield, A. (1999). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly*, 34, 452-477.
- Guthrie, J. T. & Anderson, E. (1999). Engagement in reading: Processes of motivated, strategic, knowledgeable, social readers. In J. T. Guthrie & D. E. Alvermann (Hrsg.), *Engaged reading: Processes, practices, and policy implications* (S. 17-46). New York: Teachers College Press.
- Morgan, P. L. & Fuchs, D. (2007). Is there a bidirectional relationship between children's reading skills and reading motivation? *Exceptional Child*, 73, 165-183.
- Mucherah, W. & Yoder, A. (2008). Motivation for reading and middle school students' performance on standardized testing in reading. *Reading Psychology*, 29, 214-235.
- Muthen, L. K. & Muthen, B. O. (1998-2006). *Mplus User's Guide*. Los Angeles, CA: Muthen & Muthen. Schafer, J. L. (1999).
- NORM 2.03 for Windows 95/98/NT [software]. Available: <http://www.stat.psu.edu/~jls> [2006-04-05].
- Schneider, W., Schlagmüller, M. & Ennemoser, M. (2007). LGVT 6-12. Lesegeschwindigkeits- und -verständnistest für die Klassenstufen 6-12. Göttingen: Hogrefe.

PAPER PRESENTATION

The Identification Of Core Motivational Strategies During Physical Education

Nathalie Aelterman, Ghent University, Belgium; Maarten Vansteenkiste, Ghent University, Belgium; Bart Soenens, Ghent University, Belgium; Lynn Van den Berghe, Ghent University, Belgium; Jotie De Meyer, Ghent University, Belgium; Leen Haerens, Ghent University, Belgium

Self-determination theory proposes that the provision of autonomy support and the creation of a well-structured and warm environment contribute to the satisfaction of the basic psychological needs of autonomy, competence and relatedness. Previous studies measuring a need-supportive learning climate in physical education solely relied on questionnaires to assess the subjective perceptions of need support. This study went beyond the assessment of subjective perceptions and aimed at developing a reliable and valid coding scheme for observing PE teachers' teaching behaviors. Video-images of 102 PE teachers during PE class (60.8% male, M age = 37.51 \pm 10.78) were coded using a 25-item observation protocol. The items had acceptable inter-rater (91% ICC > .50) and intra-rater (92% ICC > .70) reliabilities. Exploratory factor-analysis (Promax) resulted in three factors explaining 50.67% of the variance in the teaching behavior items: 1) Vitality (e.g. being enthusiastic), 2) Autonomy-support (e.g. offering choice), and 3) Structure (e.g. providing positive feedback). Inter rater reliabilities for the total scores of each component were satisfactory for Vitality (ICC = .54), Autonomy support (ICC = .53) and Structure (ICC = .52). In line with previous research providing evidence for three distinguishable components of autonomy support, structure and involvement, the 25 specific motivational strategies observed in the present study were also allocated to similar constructs. This observation tool allows us to formulate evidence-based recommendations towards specific motivational teaching behaviors.

Introduction

Self-determination theory proposes that students are more likely to be intrinsically motivated if their basic needs for autonomy (e.g., experiencing a sense of volition and psychological freedom), competence (e.g., feeling effective), and relatedness (e.g., experiencing a sense of closeness and friendship with the teacher) are fulfilled. Hence, to understand how to structure physical education (PE) classes to foster optimal motivation, it is important to understand which social-contextual factors, including teaching behaviors, contribute to the satisfaction of the three basic needs. According to SDT, a need-nurturing environment is characterized by the provision of autonomy support and by the creation of a well-structured and warm environment.

To date, many studies focused on the relationship between subjective perceptions of need support (measured by questionnaires) and need satisfaction to identify features of need-supportive class environments. These studies have a number of shortcomings, however, both in terms of methodology and in terms of practical implications. At the methodological level, due to the self-reported nature of perceived need support measures, many studies in this area cannot rule out the possibility of shared method variance. Further, to develop interventions aimed at increasing

teachers' need support, we need a detailed account of what need-supportive teachers actually do. For these reasons, this study went beyond the assessment of subjective perceptions and aimed at developing a reliable and valid coding scheme for observing PE teachers' teaching behaviors.

Methods

An initial broad list of 25 need-supportive teaching behaviors was developed based on a review of the literature supplemented with expert observations of video tapes of PE classes. Inter-rater and intra-rater reliability was tested based on videotapes of 30 PE classes using single measure intra class correlation coefficients (ICC). Additionally, 102 video-images of PE lessons taught by different PE teachers (60.8% male, M age = 37.51 \pm 10.78) were coded by means of the protocol. At the end of each lesson, 1163 secondary school pupils (52.2% boys, M age = 14.71 \pm 1.90) filled out a questionnaire measuring their perceptions of teachers' need support.

The 25 need-supportive teaching behaviors were subjected to an exploratory factor-analysis relying on a principal component analysis (PCA) with oblique rotation (Promax). Multilevel regression analyses with pupils nested within classes were used to investigate whether specific observed need-supportive behaviors were related to perceptions of need support by the students. This abstract includes preliminary regression results based on a subsample of 60 PE teachers and 657 pupils. Results of the full sample will be presented at the conference.

Results

Intra rater reliability was acceptable (ICC > .70) for 92% of the observed items, inter rater reliability was acceptable (ICC > .50) for 91% of the observed items.

Because we expected the theoretical constructs of autonomy support, structure and involvement to emerge, we fixed the number of factors to extract on three. Three factors with an eigen value above 2 (i.e., 5.20, 3.72, and 2.74) could be retained, together explaining 50.67% of the variance in the teaching behavior items. After Promax rotation the three factors could be interpreted as 1) a Vitality component, including items such as being enthusiastic and empathic, providing clear instructions and being energetic, 2) an Autonomy-support component including behaviors such as offering choice, asking questions and providing the opportunity to work independently, and 3) a Structure component including items such as providing positive feedback and offering help. Vitality was found to be positively correlated to Autonomy support, $r(1163) = .22$, $p < .001$, and Autonomy support and Structure, $r(1163) = .00$, ns were not significant.

Internal consistencies were acceptable for the three components, with Cronbach's alpha coefficients of $\alpha = .80$, $\alpha = .71$ and $\alpha = .66$ for Vitality, Autonomy support and Structure, respectively. Inter rater reliabilities for the total scores of each component were satisfactory for Vitality (ICC = .54), Autonomy support (ICC = .53) and Structure (ICC = .52).

To assess external validity of the three factors retained, relationships with pupil's perceptions of teachers' teaching behaviors were explored. Preliminary multilevel regression analyses in a subsample of 657 pupils from 60 secondary school classes showed that perceptions of autonomy support were significantly positively related to the following observed behaviors: a) teachers asking questions about students interests, values or problems ($b = 0.60$, $SE = 0.27$), b) teachers offering choice to the students ($b = 0.89$, $SE = 0.41$) and c) teachers paying attention to what students are saying ($b = 0.58$, $SE = 0.17$). Perceptions of structure were significantly positively predicted by modeling behaviors ($b = 0.51$, $SE = 0.20$).

Discussion

Previous research using factor-analysis on self-reports of a need-supportive environment already provided evidence for three distinguishable components of autonomy support, structure and involvement. The present study is unique because based on observations the same components of a motivational climate could be identified. In addition, this study allowed to identify specific 'core' need-supportive strategies that are likely to be perceived as motivating by many students. Teachers' asking questions, offering choice and listening to the students are perceived as more autonomy supportive by their students. The results furthermore revealed that modeling is perceived as an effective strategy to implement structure during PE. The results of the present study will, in a second step, form the basis for the development of an intervention aimed at creating need supportive class environments by training PE teachers on how to teach in a need supportive way.

References

Deci, E. L. and Ryan, R. M. (2000) 'The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior', *Psychological Inquiry* 11: 227-68.

PAPER PRESENTATION

How does the perceived degree of their teacher's fairness affect the marks of high school students?

Karsten Stegmann, University of Landau, Germany; Hannah Freienstein, University of Munich, Germany

The degree of perceived fairness within organizational structures is regarded an important factor for the performance outcome of employees because it positively affects motivation and behaviour in organizations. Our contribution addresses the question whether this relation can also be found in school. Four aspects of fairness can be differentiated: distributive, procedural, informational and interpersonal fairness. These aspects may positively affect effort via intrinsic motivation. Furthermore, effort usually correlates with performance. To test our model, we conducted a survey with 95 high-school students (13th grade – final school year). We measured the perceived fairness regarding a self-selected course, as well as intrinsic motivation, effort and grade in the respective course. In order to control the effects of prior knowledge and intelligence on marks, we also included the marks in the respective subject that had been achieved two years before and the overall grade of the final high school exam. To test our model, we conducted a path analysis using AMOS. We observed a good model fit. The results show that interpersonal and informational fairness are significant positive predictors for intrinsic motivation. Intrinsic motivation is a significant positive predictor for effort and finally effort is positively correlated with marks. The results provide evidence that fairness is not only an important factor in organizations, but also in schools. Further experimental research has to provide evidence to what extent teachers can affect intrinsic motivation and effort by increasing the degrees of interpersonal and informational fairness.

How does high school teachers' fairness affect motivation, effort and grades of learners? So far, the degree of perceived fairness within organizational structures has been regarded an important factor for the performance of employees. Perceived fairness positively affects employee/s motivation and behaviour (Cohen-Carah & Spector, 2001; Colquitt, et al. 2001). Four aspects of fairness can be differentiated (Colquitt 2001). (a) Distributive fairness is based on the equity theory by Adams (1965): an outcome is perceived as fair if one's task input vs. one's task output corresponds with the input and output ratio of others. (b) Procedural fairness includes aspects like consistency and accuracy of procedures, as well as the extent to which a person can express his view during the process of decision making (voice effect; Lind and Tyler 1988). Interactional fairness (Bies & Moag 1986) can be divided into two factors (Greenberg 1993): (c) Informational fairness describes to what extent prompt and elaborated information about decision procedures is provided. (d) Interpersonal fairness describes the dignity and respect in communication during the decision making process. The four aspects of fairness may positively affect effort mediated by motivation. Effort usually correlates with performance.

Whereas traditional organizational research focussed on the effects of procedural fairness on performance and reported modest relationships between both (see meta-analysis by Cohen-Carah & Spector 2001; Colquitt, et al. 2001) more recent work might argue that the concepts of interpersonal and informational fairness might influence performance (Masterson, et al. 2000; Robbins, et al. 2000). Our research question addresses the extent of relationships between fairness, intrinsic motivation, effort and grades within a high school setting.

Method

To test our model, we conducted a survey with 95 high-school students (13th grade, final school year), aged between 18 and 22 ($M = 19.06$, $SD = 0.63$), 67, 4 % of which were female. We measured the perceived fairness regarding a self-selected course, as well as intrinsic motivation, effort and grade in the respective courses using self-reporting measures. The reliability of all scales was sufficiently high. To control the effects of prior knowledge and intelligence on marks, we also included the marks of the respective subject achieved two years before and the overall grade of the final high school exam. To test our model, we conducted a path analysis using AMOS. The global fit indexes of the model indicate that the hypothesized factor structure fits the data well ($\chi^2 = 23,302$, $df = 16$; n.s.; CFI, GFI, IFI, TLI $>.94$, RMSEA $<.08$).

Results

Our results show that interpersonal and informational fairness are significant positive predictors for intrinsic motivation. No significant beta weights could be found regarding distributive and procedural fairness. Intrinsic motivation is a significant positive predictor for effort and effort positively correlates with marks (controlled for prior knowledge and intelligence). In our study, we also checked whether fairness could explain variance of the marks that is not mediated by motivation/effort. We found a significant beta weight of procedural fairness that was not mediated by effort.

Conclusions

Our results provide evidence that fairness is not only an important factor in organizations, but also in schools. The outcome matches findings in organizational settings which highlight the importance of informational and interpersonal fairness for performance. Further experimental research has to provide evidence whether teachers can affect intrinsic motivation and effort by increasing interpersonal and informational fairness. However, our results raise questions regarding the relation between objective and perceived fairness. The outcome that procedural fairness, including the aspect that a person has a say during the procedure, is related with marks even if the mediator motivation is controlled, allows a serious question: Are some teachers discussing and adjusting their marks until students are satisfied? However, this question requires observations, not self-report studies.

References

- Adams, J. S. (Ed.). (1965). *Inequity in social exchange* (Vol. 2). New York: Academic Press.
- Bies, J. R. & Moag, J. S. (1986). *Interactional justice: Communication criteria of fairness*. *Advances in Organizational Justice*. Stanford, CA, Stanford University Press.
- Cohen-Carah, Y. & P. E. Spector (2001). The role of justice in organizations: A meta-analysis. *Organizational Behavior and Human Decision Processes*, 86, 278-321.
- Colquitt, J. A. (2001). On the dimensionality of organizational justice: A construct validation of a measure. *Journal of Applied Psychology*, 86, 386-400.
- Colquitt, J. A., Conlon, D. E., Wesson, M. J., Porter, C. O., & Ng, K. Y. (2001). Justice at the millenium: A meta-analytic review of 25 years of organizational justice research. *Journal of Applied Psychology*, 86, 425-445.
- Greenberg, J. (1993). *The social side of fairness: interpersonal and informational classes of organizational justice. Justice in the workplace: Approaching fairness in human resource management*. Hillsdale, NY, Erlbaum.
- Lind, E. A. & Tyler, T. R. (1988). *The social psychology of procedural justice*. New York, Plenum Press.
- Masterson, S. S., K. Lewis, Goldman, B.M. & Taylor, M.S.(2000). Integrating justice and social exchange: The differing effects of fair procedures and treatment on work relationships. *Academy of Management Journal*, 43, 738-748.
- Robbins, T. L., T. P. Summers, Miller, J. L. & Hendrix, W. H. (2000). Using the group-value model to explain the role of noninstrumental justice in distinguishing the effects of distributive and procedural justice. *Journal of Occupational and Organizational Psychology*, 73, 511-518.

PAPER PRESENTATION

Social language environment, social practices and events in Swedish preschools

Martina Norling, School of Education and Communication, Sweden; Lena Almqvist, Malardalen University, Sweden

The aim of this study is to develop knowledge about language and literacy stimulated activities in preschool. Children have own experiences which depends on culture and values. Children come to preschool with those values and try to understand the environment by their own experiences. Making meaning and also share this values with peers and teachers. According to Barton (2007) it is important to create such situations, we learn all the time, we change values and "this change is the key to learning".

This study has mix methods design. Questionnaires, observations and focus groups interviews were used, in order to create a larger picture about the social language environment in Swedish preschools.

The results among other things showed that most teachers received high ratings in items such as Responsiveness and Child perspective which are aspects of the quality dimension Emotional support, but low ratings in Concept development which is an aspect of the quality dimension Instructional Support.

Further and extended findings will be exposed during the presentation.

Background

Children's language and literacy practices are situated in broader social relations in preschool. That makes it necessary for preschool teachers to arrange social settings of language and literacy events and support children's interaction with adults and peers (Barton, 2007).

Social events make opportunities for practical language modeling and develop the child's own thinking and cognition. This requires a child perspective and education to create good conditions for children's language development. It also depends on preschool teacher's values what decisions that are made in the language environment, also how

preschool teachers structure and plan activities, values and how preschool children fit into the language environment (Barton, 2007).

Aims

This study is a part of the research project Preschool as a context for language development in children and the overall aim is to investigate the social language environment in Swedish preschools. The aim of this study is to develop knowledge about language and literacy stimulated activities in preschool. Focus is on the emotional tone of the preschool environment and the interaction between teachers and children. The study wants to explore the kind of relations that occur, as eye contacts, and physical contacts like hugging. Also preschool teacher's attitudes to listen and ask questions and respond for deeper understanding how children think and learn, in preschool activities (Pianta, 2006).

We investigate and analyze the social setting of language, communication and literacy events, to understand the social language environments. Following research questions are investigated: How do teachers structure and organize children's language environment at preschool to improve their language development? What quality has the language environment in preschool?

Methodology

This study has mix methods design. Questionnaires, observations and focus groups interviews were used, in order to create a larger picture about the social language environment in Swedish preschools.

The questionnaires were designed with twenty statements about the social language environment. The participants scored each question from one to seven. The questionnaires were coded and were personally collected by the researchers during next visit at the preschool units. The questionnaires were processed in data programme, SPSS.

The observations were carried out at various activities in the preschool environment. The observation instrument is inspired and also piloted (Sandberg, 2007) by the observation instrument, Classroom Assessment Scoring System (CLASS). CLASS instrument is measuring the social language environment and four main divisions are measured, Emotional support, Preschool Organisation, Instructional Support and Child Outcomes (Pianta, 2006).

The researchers observed each preschool teacher for twenty minutes, and the observations of the social language environment were scored based on the four main groups that mentioned above. The scoring scale was from one to seven.

The focus group interviews (Krueger, 1994; Morgan 1998) lasted one and a half hour and the preschool teachers that worked in the same team were interviewed together. The most common number of participants was three in each focus interview, but sometimes there was one more or less, because of illness or working shifts. The focus group interviews started with feedback from the researcher regarding to the observation procedures and the diverse scorings. Then the focus group interviews continued with open ended questions, regarding the teacher's conceptions and vision about the social language environment in preschools.

Findings

In general, the preschool teachers scored the social language environment in the preschools fairly high. When dichotomizing the social language environment into the categories low quality social language environments (1-4, 46.8%) and high quality social language environment (5-7, 53.2%), the distribution was quite even. The distribution between separate statements were not, as even as in the general social language quality score. Descriptive analyses showed that there was an overweight of preschool teachers who scored low in statements such as "we challenge the children's ideas by posing thought provoking questions that do not demand a correct answer but space for several possible answers" and "we encourage the children to make up their own stories", but high in item such as "we deliberately use everyday situations in order to create opportunities to stimulate language learning" and "play is considered a deliberate and significant aspect of the preschool activities".

The instrument CLASS was used to observe teachers' interaction/ how teacher interact with the children in the preschool environments. The observation scores were tricotomized into the categories, low quality 1-2, mid quality 3-4 and high quality 6-7. The results among other things showed that most teachers received high ratings in items such as Responsiveness and Child perspective which are aspects of the quality dimension Emotional support, but low ratings in Concept development which is an aspect of the quality dimension Instructional Support. Further and extended findings will be exposed during the presentation.

Theoretical and educational significance of the research

This paper seeks to identify key issues which need to be addressed in order for successful, social language environments in preschools to develop, and to reflect on the implications for practice. Conclusions are drawn with reference to the implications for the development of real and meaningful experiences for preschool teachers and children in early childhood education. Concerning education, preschool teachers can use the results appearing in this study to discuss the social language environment from their own experience to make visible and discuss the values and attitudes that exist about the social language environment in preschools. Probably the findings will open for new theoretical discussions on social language environments.

References

- Barton, D (2007). *Literacy an introduction to the ecology of Written Language*. London: Blackwell Publishing.
- Krueger, R.A. (1994). *Focus Groups. A Practical Guide for Applied Research*. Second Ed. Thousands Oak, California: Sage.
- Morgan, D.L. (1998). *Planning Focus Groups. Focus Group Kit no2*. Thousands Oak, California: Sage.
- Pianta, R. C.(2006). *Teacher-child relationships an early literacy*. ID. Dickinson & S. Newman (red.), *Handbook of Early Literacy Research*, Vol.11 (s. 149-162). New York: the Guilford Press.
- Sandberg, A. (2007). *Språkutvecklande arbetssätt I BeKå f8rskolor I Enk8pings kommun*. Mälardalens Högskola.
- Vygotskij, L.S. (1971). *The Psychology of Art*. Cambridge, MA: MIT-Press.

PAPER PRESENTATION

Orchestrating collaboration based on complementary expertise

Raija Hamalainen, University of Jyväskylä, Finland

Future research needs to focus on flexible ways to orchestrate learning in future technology-enhanced learning environments. It must also refer to the challenge of supporting collaboration in naturalistic, complex learning settings. The aim of this paper is to discuss the theoretical grounding for need to orchestrate computer-supported collaborative learning (CSCL). Secondly, this knowledge is used to further orchestrate collaboration in naturalistic learning setting based on previous research findings. Thirdly, we will illustrate how groups' knowledge construction is mediated mainly by shared problem solving, providing information, contextual questions and management of interaction in orchestrated learning setting. To conclude, this theoretical paper will illustrate orchestrating CSCL based on research findings of productive collaboration. Added to this empirical examples will illuminate why orchestrating learning is beneficial for collaboration. More specifically, how and why teachers pre- and real time orchestration mediate groups' knowledge construction activities.

The aim of this paper is to discuss the theoretical grounding for need to orchestrate computer-supported collaborative learning (CSCL). Secondly, this knowledge is used to further orchestrate collaboration in naturalistic learning setting based on previous research findings. Thirdly, we will illustrate how teacher's pre and real time orchestration mediate groups' knowledge construction.

Theoretical grounding

The potential of technology-enhanced learning (TEL) in supporting collaboration is widely agreed. However, even collaboration is often set as a target in CSCL contexts; in reality "ideal" high level and productive collaboration is relatively rare (Hämäläinen 2010), and is challenging to "create" (Kollar, 2010) in technology-enhanced school settings yet. The CSCL research has typically focused on how environments itself can support collaboration. For example on collaboration scripts as a particular kind of instructional approach to support CSCL, typically without real time teachers activity (Kobbe et al., 2007). Recent critical studies have suggested that focusing only on specific scripts reduces—or even negates—the role of teachers in supporting collaboration (Dillenbourg & Jermann, 2010). Thus, there should also be an emphasis on how to support collaborative learning with technology and human guidance, as any technology alone cannot replace the teacher in supporting creative collaboration processes (Littleton 2009), for example how teacher can pre-design and offer real time support for productive knowledge construction activities. Recently, within CSCL research society, flexible orchestration has widely been suggested as a solution for arranging collaboration in naturalistic learning situations. As such, the concept of orchestrated learning is not new (Brown, 1992); along with the development of new technologies, orchestrating has again become a topical issue because new learning spaces challenge the teacher to support collaborative learning in new ways. Thus, with the development of collaboration scripts, it is necessary to pay attention to the effective and flexible use of the potential offered by future learning environments with regard to orchestrated learning.

At the current state "orchestrating learning" has been used to refer different types of activities; teacher orchestrating collaboration in the classroom (Brown, 1992), relation of organization and learning styles (Watts, 2003), improving individual students learning (Braaksma et al., 2004), enhancing productive peer learning (Palincsar & Herrenkohl, 2002), or organization of collaborative learning scenarios (Pinkwart et al., 2003). Thus, a common feature of orchestrating CSCL is that it draws systematically on research-based productive collaborative learning situations in the design and implementation of teaching. The main idea is to combine the design and the improvisation. The curriculum sets the starting points for activities, environment supports collaboration, teacher designs and orchestrates the structure for learning processes (based on research findings of productive collaboration; e.g. solving cognitive conflicts) and then the learners are given a certain freedom for shared knowledge construction. More over during the collaborative learning situation the teacher simultaneously designs, monitors and supports learning processes during the groups' work based on contextual needs.

This empirical example will illuminate how and why teachers pre- and real time orchestration mediate groups' knowledge construction activities. The study orchestrates learning in naturalistic learning setting and lies in between socio-cultural approaches and instructional design (Dillenbourg & Tchounikine, 2007). The subjects of the study are one teacher and 26 students of online course "Learning and Interaction" that took place at the Open University of Jyväskylä University (OUJY), Finland.

Firstly, the analysis addressed whether students were active during the course (total = 293 utterances). Since students' activity levels in a virtual environment does not necessarily illustrate collaboration processes itself, focus is on students knowledge construction activities mediated by teacher's pre and real time orchestration (based on quantitative and qualitative content analysis, Berelson, 1952). First (1), the learners received different sets of theoretical background information (all the students were novices in this phase). Two groups of students (n=13) read an article which focus was more on the socio-cultural perspective of collaboration (Puntambekar, 2006), whereas the two other groups (n=13) read an article concerning collaboration more on the socio-cognitive perspective (Weinberger, & Fischer, 2006). This procedure based collaborative knowledge construction on scientific knowledge. In the second phase (2), each student participated in the discussion (total 133 utterances) with other students reading the same background materials and become experts in their own perspective (socio-cultural or socio-cognitive) (Perkins, 1993). Teacher pre orchestrated this procedure with instructive questions (based on external recourses) for students to facilitate their reading and understanding of the materials. In the third phase (3), students worked in pairs with the complementary expertise (Hermann, Rummel, & Spada, 2001) of the socio-cultural and socio-cognitive perspectives. Each of the students participated in discussion (total 160 utterances) (both as an expert and a novice (e.g. expert of socio-cultural perspective was novice in socio-cognitive approach).

The aim of this phase was to make the opposite sides visible and to lead to shared knowledge construction. To achieve these goals, the teacher pre orchestrated this procedure with open-ended, ill-structured themes or questions for the group discussions. In this presentation we will illuminate that groups' knowledge construction was mediated mainly by shared problem solving (39 % of the utterances) and providing information (32 % of the utterances), contextual questions (5 % of the utterances) and management of interaction (9 % of the utterances). Added to this, presentation will illustrate empirical examples (with 35 subcategories) how and why teachers pre- and real time orchestration mediated knowledge construction.

Main references

- Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2(2), 141-178.
- Dillenbourg, P., & Jermann, P. (2010). Technology for Classroom Orchestration. In M. S. Khine and I. M. Saleh, (Eds.). *New Science of Learning*. Springer Science+Business Media, New York, 525-552.
- Kobbe L., Weinberger A., Dillenbourg P., Harrer A., Hämäläinen R., Häkkinen P. et al.(2007). Specifying computer-supported collaboration scripts. *International Journal of Computer-Supported Collaborative Learning*2(2/3), 211-224.
- Kollar, I. (2010). Turning the classroom of the future into the classroom of the present. In K. Mäkitalo-Siegl, J. Zottmann, F. Kaplan & F. Fischer (Eds.), *The Classroom of the Future: Orchestrating collaborative learning spaces*. Rotterdam: Sense, 245-255.

PAPER PRESENTATION

Developing Scholarly Identity – Becoming a PhD in Teacher Education

Auli Toom, University of Helsinki, Finland; Kirsi Pyhälto, Helsinki University, Finland

Although PhD students within the context of teacher education are highly motivated and talented, many of them never finish. There is variation among students: doctoral project in teacher education is often launched either because educational practitioners find doctoral studies as route for professional development, or because a professional research career is the aim. This study explores critical incidents of PhD candidates within teacher education. The participants reported critical incidents related to resources; supervision and scholarly community; and internal factors regulating PhD process. In the incidents, the notions of development of scholarly identity were related to participation, appreciation, task, and role within the scholarly community. Motivation, emotional factors and identity development play an important part when becoming a professional researcher. Multiple professional and scholarly communities produce multiple identities for doctoral students in teacher education. The pedagogical means for supporting students to overcome critical barriers during PhD process within teacher education should be developed.

INTRODUCTION

Research on doctoral education has identified factors influencing to doctoral experience. Supervisory relationship (e.g., Aspland, Edwards, O'Leary & Ryan, 1999; Mackinnon, 2004; Hasrati, 2005; Murphy, Bain & Conrad, 2007; Sambrook, Stewart & Roberts, 2008), scholarly community (Beauchamp, Jazvac-Martek, Mc Alpine, 2009; Authors, 2009) and students' and supervisors' beliefs about research (e.g., Brew, 2001; Kiley & Mullins, 2005; Meyer, Shanahan & Laugksch, 2005; Åkerlind, 2008; Lee, 2008) contribute to doctoral experience and to scholarly identity. A better understanding of the nature of PhD process is needed in order to develop PhD education further.

This study explores the PhD process within teacher education. The research questions are:

- 1) What kind of critical incidents do PhD students find either promoting or hindering their studies?
- 2) What kinds of topics concerning the development of scholarly identity dominate the PhD students' critical incident descriptions?

THEORETICAL FRAMEWORK

Scholarly community plays an important role in students' experiences of doctoral journey and perceptions as scholars (Bair & Haworth, 1999; Gardner, 2008; Authors, 2009b). Doctoral students are exposed to various subcultures; they participate in peer groups, adopt roles and get experiences of memberships (cf. Becher, 1989; Becher & Trowler, 2001; Authors, 2009). Interactions within and between the scholarly communities provide often tensed opportunities for agency, avoidance, and opposition and resistance (Authors, 2010b).

Developing professional identities refers to various meanings of one's work, oneself and meanings attributed by others (Beijaard, Meijer & Verloop, 2004). Becoming an academic expert is about knowledge, but also developing scholarly identities (McAlpine, Jazvac-Martek & Hopwood, 2008; Authors, 2009a; Authors, 2010). The development of scholarly identity is reflected in PhD students' engagement, perceptions of peers and things they learn (Archer, 2000, 2003; Billet & Somerville, 2004) and is related with participation in communities of practice (Wenger, 1999). Attaining and developing one's membership continuously and cyclically plays an important part in professional learning starting from PhD process throughout academic career. It provides opportunities for developing professional autonomy and contributing to community (Eteläpelto & Vähäsantanen, 2008).

THE STUDY

This study is a part of a larger research project on PhD education in Finland. It aims to understand the factors students perceive promoting or hindering their studies. PhD students (n=66) in different phases of studies responded in the survey at Department of Teacher Education, University of Helsinki.

Data and methods

The qualitative data is gathered with open-ended question addressing PhD students' experiences: "Describe your PhD process! What are the key events or turning points that have had significant effect on your PhD process?" Doctoral students pass challenges which affect on their striving towards doctorate. We use critical incidents as a tool for reflection (cf. Woods, 1993; Tripp, 1993; Tripp, 1994; Francis, 1997; Angelides, 2001). When the incidents are chosen by students, the basic elements of personal ways of feeling, thinking and acting during PhD process could be considered.

The data were content analyzed using an abductive strategy. First, the data was coded into two categories: hindering and promoting incidents. Then categories were classified into three contentual categories and validated by the research group (cf. Miles & Huberman, 1994; Yin, 1994). Critical incident descriptions were analyzed in a more detailed way focusing on development of scholarly identity (cf. Becher, 1989; Becher & Trowler, 2001).

PRELIMINARY RESULTS

The promoting and hindering critical incidents during the PhD studies

About 76% of critical incidents were promoting, whereas 24% were challenging. Their amounts and focuses are in Figure 1.

The majority of incidents (51%) related to internal factors regulating the PhD process like identity development, domain specific questions and learning of generic skills. Students described incidents promoting their personal interest, self-efficacy, empowerment and engagement as positive resources. Interesting results and acceptance of first article were important. Good self-regulation and academic writing skills and deadlines were identified as significant assets. In turn, events undermining students' sense of agency, competence and identity development were burdening. About 35% of incidents related to supervision and scholarly community. Students emphasized getting constructive feedback, encouragement and emotional support from supervisors. Dialogue with peers and members of scholarly community were considered positively. Lack of supervision, its destructive frictions and lack of scholarly community were highly problematic.

A minority of incidents (14%) related to working facilities and resources. Getting funding for doctoral studies – or not getting it – was emphasized. Some reported external working facilities and structures important.

Figure 1. The promoting (blue) and hindering (red) critical incidents during the PhD studies.

The development of scholarly identity in the PhD students' critical incident descriptions

Doctoral students reflected their identity in terms of (I) participation in scholarly community. They problematised traditions of community, familiarized themselves with ways of communicating and took a stand towards professional norms. Students experienced their community positively, though different interpretations existed. Some interpreted the relation between themselves and community problematic and felt isolation and marginality.

Students deliberated their identity from the viewpoint of (II) appreciation and respect from community by describing the valuations and treatment from peers. They experienced strong appreciation and felt themselves important "flag bearers" of their discipline. Conversely, some had experienced weak appreciation by being the lowest in the hierarchy, undervalued and "exile".

Scholarly identity was reflected as a (III) task within community. Students emphasized the quality, core and meaningfulness of research work and their important duty in creating new scientific knowledge. They also mentioned – quite conversely – their task as a mere completion of duties, like bringing money and credits and completing the goals set on administrative level.

Students described their (IV) role in scholarly community. They memorized their development and pondered possible professional ways. Some perceived themselves as appreciated novices or apprentices – or growing research professionals, full members of scientific community rather than mere novices.

EDUCATIONAL IMPORTANCE OF THE STUDY

Motivation, emotional factors and identity development play an important part when becoming a professional researcher. Multiple professional and scholarly communities produce identities for doctoral students in teacher education. Pedagogical practices promoting learning of research and generic skills, sense of agency, competence and sense of belonging should be in focus of doctoral education within teacher education.

PAPER PRESENTATION

Teacher learning – The Norwegian model in an international context

Cecilie Flo Jahreie, University of Oslo, Norway

Over the last 30 years, teacher learning has become one of the most important concerns of the educational establishment. It has been more or less assumed that teachers who know more, teach better. Discourses regarding teacher education are regarded traditionally as national issues. In the last decade however, educational reforms have become embedded in an escalating globalization process. The aim of the paper is to review the historical evolution of the education of teachers Norway, in an international perspective. A special emphasis will be on the relationships between universities and schools. This implies that the development of the Norwegian model will be reviewed, followed by a review of the models in England, Finland, and the Professional development schools (PDS) in the US.

This paper discusses these models by using three conceptualizations of knowledge (Cochran-Smith & Lytle, 1999). The analyses revealed striking differences, based on radically different conceptions of teacher learning, but also significant international trends, in the design of different teacher education programs. The paper concludes with a theoretical discussion of the three forms of knowledge and proposes an alternative conceptualization of teachers' learning grounded in cultural historical activity theory (CHAT).

Over the last 30 years, teacher learning has become one of the most important concerns of the educational establishment. It has been more or less assumed that teachers who know more, teach better. Discourses regarding teacher education are regarded traditionally as national issues. In the last decade however, educational reforms have become embedded in an escalating globalization process. Even though, teacher education in Europe has a high degree of complexity and variation in relation to structure, curriculum, length of education, and achievement standards (Garm & Karlsen, 2004). The aim of the paper is to review the historical evolution of the education of teachers in Norway, in an international perspective. A special emphasis will be on the relationships between universities and schools. This implies that the development of the Norwegian model will be reviewed, followed by a review of the models in England, Finland, and the Professional development schools (PDS) in the US. The review is based on the Norwegian white papers, national and international documents and evaluations of teacher education, and research literature. The four models are analyzed and discussed by using three conceptualizations of knowledge (Cochran-Smith & Lytle, 1999). The paper concludes by proposing an alternative conceptualization of teachers' learning grounded in Cultural historical activity theory (CHAT). From this backdrop, the following research questions are raised:

What characterizes the historical evolution of teacher education in Norway and internationally?

What is the dominant conception of teacher learning in the four models reviewed?

How can CHAT be a fruitful approach for understanding teacher learning?

Knowledge and learning in the educational system, as in professional life, are increasingly stretched beyond the nation state and into an extended globalized market. This expansion is related to the construction, adaptation and enactment of transnational discourses of knowledge. The 'logics of practice' inherent to knowledge production and validation in other areas of society, diffuses into the educational sector (Nerland, 2010). This contributes to what is often called an overall epistemification in society (Knorr Cetina, 2006). Epistemification is used to describe the developments in which the general significance of expert knowledge is increasing, as is the prevalence of science-generated knowledge in the organization of everyday life. It is not possible to understand the evolution of teacher education without this societal trend.

Cochran-Smith and Lytle (1999) divide between three prominent conceptions of knowledge. The first conception is referred to as knowledge-for-practice and teaching is understood as a process of implementing, translating, or otherwise putting into practice what is learned of the knowledge base. The second conception is knowledge-in-practice. The emphasis is now placed on knowledge in action: the knowledge is expressed or embedded in practice and in teachers' reflections of practice. The third conceptualization is knowledge-of-practice where formal and practical knowledge is seen as different forms of knowledge which is constructed with others in a community.

In the analysis it was found radically different conceptions of teacher learning. The analyses revealed striking differences, but also significant international trends, in the design of different teacher education programs. One can conclude that the concept of teacher education is both complex and ambiguous when looking at the relationships between universities and schools. Discussing the findings with Cochran-Smith and Lytle's conceptualization of knowledge, it is argued that the English model can be conceptualized as knowledge-in-practice. While the English model emphasizes practice to qualify as a professional teacher, the Finnish approach claims that the positive potential of practice can only be utilized if it is research-based. It is therefore argued that the Finnish model is emphasizing knowledge-for-practice. In the discussion of the Norwegian model the paper will highlight an ongoing tension between two conflicting conceptualizations of knowledge: knowledge-for-practice and knowledge-in-practice. PDS are supposed to provide new spaces for student teachers to learn along with experienced teachers as they construct knowledge of their practice and are ideally based on a knowledge-of-practice approach. However, research literature suggests that PDSs are driven by each of the conceptions of teacher learning, and takes many forms and has many different meanings (Cochran-Smith & Lytle, 1999).

The paper ends with a theoretical discussion of the three forms of knowledge. In knowledge-in-practice and knowledge-for-practice, theory and practice are seen as a dichotomy that has to be bridged or integrated. According to Cochran-Smith and Lytle, the conceptualization of knowledge-of-practice has transcended the dichotomy between theory and practice, while seeing them as two types of knowledge. The paper proposes CHAT as an alternative perspective in which theory and practice are conceptualized as different types of cultural practices or activity systems.

While research on teacher learning is either studied as a teacher's individual development or as organizational change (Jahreie, 2010), it is proposed to understand learning to teach as a societal activity that incorporates historical tools, rules, and the division of labor from the cultural practices or activity systems of both universities and schools.

There is little research focusing on the historical evolution of the education of teachers. The educational contribution of this paper is an awareness of how various structures of teacher education lead to very different ideas in terms of how to improve teacher education and professional development. Theoretically, the paper contributes to a view of teacher learning that goes beyond the leading approaches in teacher education.

Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. In A. Iran-Nejad & C. Pearson, D. (Eds.), *Review of research in education* (Vol. 24). Washington DC: American Educational Research Association.

Garm, N., & Karlsen, G. E. (2004). Teacher education reform in Europe: the case of Norway; trends and tensions in a global perspective. *Teaching and Teacher Education*, 20, 731–744.

Jahreie, C. (2010). Learning to teach. An activity-theoretical study of student teachers' participation trajectories across boundaries. Thesis submitted for the degree of PhD, University of Oslo, Oslo.

Knorr Cetina, K. (2006). Knowledge in a knowledge society: Five transitions. *Knowledge, Work and Society*, 4(3), 23–41.

Nerland, M. (2010). Transnational discourses of knowledge and learning in professional work: Examples from computer engineering Studies in Philosophy and Education, 29, 183–195.

PAPER PRESENTATION

Whole-class talk – a criterion of teaching effectiveness in Biology Education

Julia Rixius, Biology Education, Germany

The question how to improve teaching effectiveness in science education – recently asked by international assessment studies like PISA or TIMSS – is important for any educational system which wants to raise the pupils' learning achievement (Johnson, Kahle & Fargo, 2006). In this context, the presented project focuses on the interaction between whole-class talk in science classrooms and pupils' learning achievement. In order to explore whole-class talk, a sample of 47 videotaped 9th grade grammar school biology lessons on the topic 'blood and blood circulation' has been analyzed through a differentiated coding tool: 7 categories define different kinds of speech acts of whole-class talk. The pupils' learning achievement variables were collected by a pre-post-achievement-test, and concept maps (Tiemann, Rumann, Jatzwauk, & Sandmann, 2006; Wadouh, Sandmann & Neuhaus, 2009). The Pearson correlation coefficient was calculated to measure correlations between the data obtained from the video analysis and the pupils' outcome.

One of the findings is a positive correlation between the amount of 'pupil-questions' and the accuracy of the knowledge structure ($r = .41$, $p \leq .02$; $N = 45$), indicating the importance of pupils' development of own questions for their learning processes. A deeper understanding of biological content might therefore be triggered by providing teaching time for pupils to verbalize questions (Scardamalia & Bereiter, 1992).

1. Theory

The question how to improve teaching effectiveness in science education – recently asked by international assessment studies like PISA or TIMSS – is important for any educational system which wants to raise the pupils' learning achievement (Johnson, Kahle & Fargo, 2006). The impact of teaching on the pupils' learning achievement is still not consistently proven (Seidel & Shavelson, 2007). To obtain distinct results, Seidel and Shavelson (2007) suggest choosing variables of high importance for the pupils' learning process. Whole-class talk should be important, because an interaction between knowledge construction and language is expected by cognitive psychologists (e.g. Anderson, 2005).

So far, whole-class talk in science education, mostly analyzed within case studies except for the TIMSS 1999 Video Study (Roth et al., 2006), is interpreted qualitatively by applying general analytic instruments which rarely consider individual speech acts (SA) (Scott et al. 2006). Thereby, the influence of whole-class talk on the pupils' learning achievement can only be assumed. To prove its influence empirically and enable in-depth analysis of whole-class talk, the following elementary research question will be answered:

Does the frequency of different SA within the whole-class talk correlate with the pupils' learning achievement?

2. Methodology

The whole-class talk was analyzed through the coding of a sample of 48 videotaped 9th grade secondary school biology lessons on the topic 'blood and blood circulation'. Each lesson had been taught by a different teacher.

To deepen the understanding of whole-class talk, this study applies a differentiated coding scheme with 7 categories using video data. A teacher's SA is coded either as a 'teacher-task', a 'teacher-feedback', or 'teacher-information'. A task is defined as a request to think or to act. A feedback is a descriptive or evaluative uptake of a pupil's assertion, whereas a content-related input or descriptions of the learning process defines 'teacher-information'. A pupils' SA is categorized as a 'pupil-assertion' in case of the verbalization of their opinion, or as a 'pupil-question', if information is asked for. All SA were coded using the software Videograph.

To test the objectivity of the coding manual, we calculated the interrater reliability of 10 % of the video sample regarding the number of identified SA, which is 85 %, and the coded category of SA, which is 88 %. The Pearson correlation coefficient was calculated with SPSS 17.0 to compute correlations between the data obtained from the video analysis and the pupils' outcome.

The pupils' learning achievement variables were collected by a pre-post-achievement-test and concept maps (Tiemann, Rumann, Jatzwauk, & Sandmann, 2006; Wadoudh, Sandmann & Neuhaus, 2009).

3. Results

Description of the observed SA

In 37 % of the SA teachers use 'teacher-tasks', whereas they only use 12 % of the SA to provide 'teacher-information'. Teachers use 14 % of their SA to give 'teacher-feedback'. Pupils ask fewer questions (4 %) compared to the number of 'pupil-assertions' they develop (27 %).

Examples for correlations between the SA and the pupils' learning achievement

The amount of 'teacher-tasks' correlates negatively with the pupils' factual knowledge gain ($r = -.36$, $p \leq .02$, $N = 45$), whereas the amount of 'pupil-questions' correlates positively with the accuracy of the pupils' knowledge structure ($r = .41$, $p \leq .02$, $N = 45$).

4. Discussion

Description of the observed SA

The result of former studies (e.g. TIMSS), that pupils' opportunity to take part in whole-class talk is restricted by the amount of teacher talk (Roth et al., 2006), can be confirmed for German biology lessons. Regarding the different kinds of SA, the high amount of 'teacher-task' compared to the small amount of 'pupil-questions' points out that whole-class talk is mostly initiated by the teacher – a finding which confirms the existence of the often described pattern of whole-class talk (Lemke, 1990).

Correlations between the SA and the pupils' outcome

The high density of 'teacher-tasks' might hinder the learning achievement, which can be explained by the cognitive overload: The higher the amount of tasks, the shorter the time slots in which the pupils can think about a possible answer (Dillon, 1882). In contrast, the pupils' verbalizations of their thinking process by asking questions seem to help to correctly construct knowledge.

5. Forecast

In the upcoming month, we will expand the coding tool by defining quality-variables of the various SA. After further video analysis, interaction-effects between the quality-variables and pupils' learning achievement variables will be calculated, and will be presented at the EARLI.

Considering these future results, a training concept for prospective secondary school teachers will be developed to enhance the quality of their talk.

References

Anderson, J. R. (2005). Cognitive psychology and its implications. Sixth Edition. Worth Publishers, New York.

- Dillon, J. T. (1882). The effect of questions in education and other enterprises. *Journal of Curriculum Studies*, 14, 127-152.
- Johnson, C. C., Kahle, J. B. and Fargo, J. D. (2006). Effective teaching results in increased science achievement for all students. *Science Education*, 91, 371-383.
- Lemke, J. L. (1990). *Talking science: Language, learning and values*. Norwood, NJ: Ablex.
- Roth, K. J., Druker, S. L., Garnier, H. E., Lemmens, M., Chen, C., Kawanaka, T., Rasmussen, D., Trubacova, S., Warvi, D., Okamoto, Y., Gonzales, P., Stigler, J., and Gallimore, R. (2006). *Teaching Science in Five Countries: Results From the TIMSS 1999 Video Study*. U.S. Department of Education, National Center for Education Statistics, Washington, DC.
- Scott, P. H., Mortimer, E. F. & Aguiar, O. G (2006). The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. *Science Education*, 90(4), 605-631.
- Seidel, T. & Shavelson, R. J. (2007). Teaching Effectiveness Research in the Past Decade: The Role of Theory and Research Design in Distinguishing Meta-Analysis Results. *Review of Education Research*, 77, 454-449.
- Tiemann, R., Rumann, S, Jatzwauk, P. & Sandmann, A. (2006). Die Bedeutung von Aufgaben aus Lehrersicht. *Mathematisch Naturwissenschaftlicher Unterricht*, 59 (5), p. 304-313.
- Wadouh, J., Sandmann, A. and Neuhaus, B. (2009). Interconnecting subject matter in biology lessons – descriptive results of a video study. *Zeitschrift für Didaktik der Naturwissenschaften*; 15, 69-87.

PAPER PRESENTATION

The Use of Wikis in University Courses: How do Students Cooperate in Writing Articles?

Tatjana Hilbert, University of Mainz, Germany

The Wiki-technology enables Internet users to not only read contents but also to edit existing articles and to write about new topics. In a recent study, students from six university courses (N = 167) were advised to use a Wiki in a virtual learning platform for follow-up course-work. All students had to write at least one article about a topic discussed during the university course. Participants in two courses were only given technical support (n = 51). Two courses additionally were given a checklist on minimum standards for the articles (n = 59). In the remaining two courses, new articles additionally were read and discussed in the course (n = 57). The Wiki articles in each course were analysed according to their length, quality, and structuredness. Additionally, the interrelation of the articles in the Wiki and log data on how many students edited the articles and on how students edited their fellow students' articles gave information on how students cooperated in writing their articles. On the whole, the analysis showed that the quality of articles was better in courses where students discussed their fellow students' articles. However, students interlinked their articles more in the courses who were given the checklist on minimum standards. For using the Wiki-technology for follow-up course work, results indicate that more support helps students to write high-quality articles.

Background

Writing and summarising texts for learning in university courses is a long and often complex task. Thus, students often try to collaborate in producing understandable texts on different topics they have to learn for their exams. On the one hand, pooling their resources can lead to results that are richer and more complex than those produced by one individual. On the other hand, collaborative writing also makes the writing process more complex (Newman & Newman, 1992). Therefore, some projects are overseen by an editor or editorial team. If the collaborative writing task is part of a university course teachers will often adopt this role. To support the collaborative writing process, online tools can be used (Engstrom & Jewett, 2005). Ideally, these tools should enable all learners to add, edit and remove text. Thus, the writing process becomes a recursive task in which each change may prompt others to make more changes. The advantage of using online tools for collaborative writing also is the possibility to monitor what users are contributing and when they contribute. Individual responsibility for the progress of the writing process enhances students' motivation to participate in the collaborative writing task.

One such tool for collaborative writing are Wikis. The Wiki-technology enables Internet users to not only read contents but also to edit existing articles and to write about new topics. The perhaps most famous example of a Wiki surely is Wikipedia. The Wiki-technology, however, can also be used in closed online environments such as virtual learning platforms in university courses.

Research questions

The general aim of this study was to examine the use of the Wiki-technology for follow-up course work in university courses. Especially, the influence of several support methods on the quality of the writing process and product and students' collaboration was in the focal point of this study. We asked the following research questions: (1) Does more

support lead to qualitatively better articles in a collaborative writing task? (2) How do students contribute to their fellow students' articles in a Wiki? (3) How do students interlink their articles with their fellow students' articles? (4) Are there differences in students' collaboration caused by the different support?

Sample and Design

The sample consisted of 161 students (124 female, 37 male) from six university courses for teacher students in their fourth semester. In three courses, diagnostic issues like grading, quality criteria, and construction of exams were discussed, the other three courses dealt with school-related theories in social and personality psychology. Students from all six courses were given a collaborative writing task. We advised them to write a Wiki about the course-topics with the aim to create a library of understandable texts they could use for learning for their psychology exam which is due after their fifth semester. For each course, a Wiki was provided on the virtual learning platform (Moodle), only course members were able to read, write, and edit articles.

The courses were randomly assigned to one of three support conditions in a way that both types of course content appeared in each condition. Two courses were given only technical information on how to use the Wiki ("no support; n = 51). Two courses additionally were given a checklist on minimum standards (e.g., articles should be interlinked, headlines should be used for a good structure of the text, or information sources should be cited) for their articles ("minimum standards"; n = 59). In the remaining two courses, new articles additionally were read and discussed in the course ("discussion"; n = 57). Therefore, the course teacher printed the newest articles and handed them out at the beginning of the course. Groups of two students shortly discussed and annotated the articles, strength and weaknesses of the articles were then discussed with the whole course. The authors of discussed articles were given the annotations.

Data and Analysis

Quality of students' articles in the Wikis are analysed according to length (i.e. number of words), structuredness (i.e. number of headlines, tables etc.), and overall quality (rated from 1 = very bad to 6= very good). To assess, how students collaborated in producing the Wiki, the interrelation of the articles is assessed by the number of internal links. Log data were analysed according to the number of articles students wrote as first author, the number of articles students edited, how often students edited fellow students' articles, and according to the kind of revision students made.

Results

Up to now, the analyses of the quality have been completed for about 70% of the articles. First results show, that students in the minimum standard courses and in the discussion courses used more headlines etc. to structure their articles than students in courses without support. Students in the minimum standards courses also used more links to their fellow students' articles which indicates that they engaged in reading other articles in the Wiki. The overall quality of students' articles was highest in those courses which discussed new articles. Their articles contained many examples and very good explanations of the theories. The analyses of the articles' quality and on the log data should be finished soon. The presentation will focus specifically on data that indicate how students collaborated in this Wiki writing task. A first tentative conclusion of the results is that students need more than merely technical support. Especially the discussion of articles in the course led to high-quality articles.

Literature

Engstrom, M. E., & Jewett, D. (2005). Collaborative learning the wiki way. *TechTrends*, 49, 12-16.
Newman, J., & Newman, R. (1992). Three Modes of Collaborative Authoring. In P.O. Holt and N. Williams (Eds.), *Computers and Writing: State of the Art* (pp. 20-28). Oxford: Intellect Books.

PAPER PRESENTATION

Instructional Patterns remain the same across a Segregated Educational System: The Case of Chile

David Preiss, Pontificia Universidad Catolica de Chile, Chile; Valeska Grau, Pontificia Universidad Catolica de Chile, Chile; Monica Nunez, Pontificia Universidad Catolica de Chile, Chile; Isabel Alegria, Pontificia Universidad Catolica de Chile, Chile; Ana Espinoza, Pontificia Universidad Catolica de Chile, Chile; Llery Ponce, Pontificia Universidad Catolica de Chile, Chile

By assessing the patterned nature of mathematics teaching in Chile, the study tests the hypothesis that Chile has a country-specific pattern for mathematics teaching and assess whether this instructional pattern remains the same across different segments of the educational system. Specifically, the focus of this work is on the instructional

principles that, in Chile, provide cultural and personal meaning to the task of teaching mathematics and how these principles translate into real teaching practices. Thus, we infer folk pedagogies from the teaching practices they inform, using video surveys and looking at those aspects of teaching practice that most influence the learning process: teacher talk and lesson structure (Preiss, 2010). Schools from the main urban centers in Chile were randomly sampled and invited to participate. 18 public schools, 20 schools receiving mixed funding, and 22 private schools accepted to be part of the study. The results reveal that teachers basically display the same classroom structure and type of interaction regardless of the type of school where they teach. It is worth noting that the only differences found were at the variables that measured student talk. Hence, the striking differences in academic performance among the different types of schools do not seem to be explained by differences in teaching activities or interactions. Therefore, the educational gap seem to be related to students' cultural capital instead of classroom dynamics

By assessing the patterned nature of mathematics teaching in Chile, the study tests the hypothesis that Chile has a country-specific pattern for mathematics teaching and assess whether this instructional pattern remains the same across different segments of the educational system. Chile is one of the countries with the highest levels of inequality worldwide and the educational system reproduces this social segregation (Baker & LeTendre, 2005). Public schools and partially subsidized schools recruit the majority of students' population (around 44% for public education, 48% for partially subsidized, 7% for totally private schools) with public schools recruiting those from more disadvantaged backgrounds. Social segregation manifests in an entrenched educational gap between public and private schools –with subsidized schools in between- that has been replicated from the time the national standardized testing was established in Chile. By comparing the instructional pattern prevailing in these different kinds of schools, we intend to assess whether the educational gap is related to differences in the instructional pattern implemented at these different schools or whether they rest on variables other than classroom interaction. In so doing, we attempt to tap into teachers' folk pedagogies (Olson, 2003). Specifically, the focus of this work is on the instructional principles that, in Chile, provide cultural and personal meaning to the task of teaching mathematics and how these principles translate into real teaching practices. Thus, we infer folk pedagogies from the teaching practices they inform, using video surveys and looking at those aspects of teaching practice that most influence the learning process: teacher talk and lesson structure (Preiss, 2010).

Methods

Participants. Schools from the main urban centers in Chile were randomly sampled and invited to participate. 18 public schools, 20 schools receiving mixed public and private funding, and 22 private schools accepted to be part of the study.

Teacher Talk Study

Coding Scheme. The final coding scheme for teacher talk included three broad categories: teacher lecturing, teacher questions and teacher follow-ups, which were coded separately. Teacher lecturing included three codes: Task-related lecturing, content-related lecturing, and metacognitive lecturing. Teacher questions included the following codes: Control, Inform, Implement, Opinion, Demand, Elaborate and Review. Teachers' follow-ups were coded as Monosyllable/Neutral. Repeat. Evaluate. Reformulate. Student codes mirrored those used for teachers and included a specific code for student initiated IRF sequences (elicitations).

Coding Procedure for teacher talk

Two independent raters coded a transcript of the first 10 minutes of each lesson. All of the consistency ($r > .75$) and consensus values ($p > .7$) were acceptable

Results

Table 1 shows the descriptive information for all the talk variables. Student codes are identified. All other codes are teacher codes. The dominant code for lecturing was task-related lecturing; the questions teachers make more frequently during their lesson openings are inform, control, and implement; finally, repeat follow-ups are the most frequent. As regards, student talk, the most frequent interventions are definitions, followed by implement, elicitations, and report. All of the other codes had less than 3 interventions.

A multivariate analysis was performed on the teacher and student talk variables. The grouping variable was school type. There were not significant differences between school types in all the teacher variables. However, there were significant differences in the following student variables: elicitations, $F(2,59) = 6.5$, $pF(3,123) = 4.6$, $pF(3,123) = 3.97$, $pF(3,123) = 3.5$, p

Lesson Structure Study

The final coding scheme for lesson structure followed closely the coding scheme used by the TIMSS 1995 and 1999 video surveys and included three broad categories: mathematical-work, mathematical-organization and interaction. Mathematical work codes include time allocated to introducing new content, practicing new content, and reviewing content. If students were performing mathematical work, the coding scheme distinguished between solving independent or concurrent problems, discussing problems solved previously and discussing non-mathematical content. Mathematical organization codes included time allocated to discuss goals or summarize the contents of the lesson. Interaction included codes for teacher-lead exchanges, student-lead exchanges, individual private-work, and group private-work. The full lessons were coded using The Observer. Consensus was estimated by the index of percent agreement using adjacent categories and kappa. All of the consensus values were acceptable ($p=.76$; $\kappa=.71$)

Results

Values indicate seconds of time allocation. Average duration of the lessons was 4161 seconds ($SD=951$). Teachers allocated most of the time of their lessons to the practice of content ($M=2409$, $SD=998$), followed by time allocated to introducing new content ($M=744$, $SD=790$). Whereas teachers allocated most of the time to practice, the kind of practice they performed involved practice with concurrent problems mostly ($M=928$, $SD=1179$). As regards the kind of interaction that shaped most of the lessons, teachers favored the development of teacher-lead segments ($M=2597$, $SD=1021$) instead of the independent exploration of contents either in groups or individually. Surprisingly, there were not many significant differences per type of school in the variables related to the structure of the class. "Summarizing the content" was significantly higher in public schools ($F=4.037$; p In terms of interactions in the classroom, no significant differences were found in any of the variables (teacher-led interaction, student-led interaction, private-group interaction, private-individual interaction and no-interaction).

Educational significance

These results reveal that teachers basically have the same classroom structure and type of interaction regardless of the type of school where they teach. It is worth noting that the only differences found were at the variables that measured student talk. Hence, the striking differences in academic performance among the different types of schools do not seem to be explained by differences in teaching activities or interactions. Therefore, the educational gap seem to be related to students' cultural capital instead of classroom dynamics.

The study has some limitations: the sample was not representative and there may be some self-selection bias. Still, the findings obtained are very similar to others seen in other Chilean classrooms using analogue methodologies.

PAPER PRESENTATION

The role of Language-in-use in Knowledge Building activities

Albert Walsweer, Rijksuniversiteit Groningen, Netherlands

In this paper the first results are being presented of an ethnographic research project that was carried out from 2007 until 2010 on ten small primary schools in a bilingual region in the northern parts of the Netherlands. The aim was to describe the consequences of an intervention that provides a shift from direct instruction to a pedagogy of participation and knowledge building in classrooms and how this relates to changing interactional patterns. Drawn from observational and video data, but also from interviews and questionnaires we found that all teachers involved, were able to provide more space for students to 'work with ideas' and making them aware of their language-in-use. We also found that a few teachers were able to change their interactional behavior from 'instructional' to 'dialogic teaching': they participated more often as a guide in knowledge building activities by summarizing, nominating and asking 'information seeking questions'. In these situations also different interactional roles of the children are being observed. They changed into initiating participants, who commented and criticized statements of the teacher and of the other students and proposed alternatives.

In this paper the first results will be presented of a research project in Dutch primary schools, regarding the improvement of the language use of the pupils in classroom interaction by an important change of the instruction model. The project was carried out on small primary schools in a rural area of Fryslân, which is a bilingual region in the northern part of the Netherlands. The aim of this research was to describe the consequences of an intervention that provides more space for knowledge building for students and the relationship with changes in (classroom) interaction and teacher beliefs. At the start in 2007, the schools worked in the tradition of direct instruction. Although this instruction model is proven to be highly effective in general, in situations where teachers work with several classes in one classroom, with different textbooks for every level, teachers confine themselves to give instructions, but are not able to use the possibilities to interact and discuss problems with children.

This research project draws on two theoretical perspectives on learning & knowledge building: Learning as a social or cultural & situated process (Lave & Wenger, 1991) and learning as a knowledge building process (Bereiter, 2002). The theoretical framework is complemented by theories about the central role of the use of language in learning activities (Wells, 2007) and being translated into a set of basic principles for a pedagogy of learning and instruction, which we used as a framework for teacher instruction and evaluation. These principles involve a switch from education seen as knowledge transmission, to education seen as a process of participation and knowledge building, characterized by dialogic teaching (Alexander, 2004) and scaffolding (Wood, Bruner & Ross, 1976). According to this we informed teachers how to make efforts of integrating language and learning into the process of cultural learning (Gee, 2008). We oriented them on the possibilities of language tasks and on the importance of 'exploratory talk' in peer interaction (Barnes, 1976) for knowledge construction.

Methodology:

Intervention and research data

The teacher training program that was attached to the intervention can be described as a guided reinvention of the role of language use in knowledge building. The training consisted of the continually negotiation of meaning through interaction, leading to topics for their own 'action research'. The intervention aimed to reinstate the teacher as a professional by giving him or her the opportunity to translate principles of the theoretical framework into two projects a year. Each project lasted for three weeks and consists of different stages. In the first couple of days, teachers discussed the topic of the project with the pupils and tried to challenge them to write down their first ideas. This is what we called the 'chat session'. Children were writing and discussing all the possibilities and were making a plan what to do, that means: how to get the needed information, how to analyze it and how to present it. In the next couple of weeks small groups of children carried out their ideas, by selecting, and reading texts, by interviewing informants, by discussing important points in their own group and with the teacher, by writing and by presenting the answers to their questions into written and oral products, which were presented to the other children, but also to their parents etc.

The role of the teacher was to help the children to integrate talking, reading and writing into the knowledge building activities and to make the children aware of their language-in-use. The methodology we used in this research is ethnographic (Freebody, 2003). This means that developments are described in their relevant cultural and social contexts and that they are used to improve the practices of users. Most important for this paper are the observational and video data of whole classroom and peer interaction, collected with five teachers and their pupils of grade 6, 7 and 8 during three years. Their process of change is also being documented by using data from written down notes from their 'action research', and from interviews and three types of questionnaires. This data asked for triangulation in the description of patterns in the process of change of teachers and their pupils. Findings It was found that the changing of most teachers followed a general pattern. In the first stage of the intervention, the teachers focused on the pedagogy of 'giving space to pupils' and switching from 'activity driven' to 'working with ideas'. In the second stage we found that teachers were engaged in all the 'language-based tasks' in the projects and being able to share this with the pupils and to improve the quality of language-in-use.

Changing teachers behavior in classroom interaction was the most difficult part of the intervention. Some teachers hardly changed their interactional patterns, but with others we saw the interesting changes we had expected. A qualitative analysis of the development of the interactional patterns in the project lessons of one teacher will be presented. It will be pointed out how the teacher manages to change her role in classroom discussions from an instructor who mainly puts 'known information questions' (Mehan, 1978) to a 'guide' who participates in knowledge building activities, by summarizing, nominating and asking clarification questions. In line with this finding, different roles of the children could also be observed: they changed from replying in short answers and waiting for an evaluation of the teacher into initiating participants, who commented and criticized statements of the teacher and of the other students and proposed alternatives.

References

- Alexander, R. (2004). *Towards dialogic teaching: Rethinking classroom talk*. Cambridge: Dialogos.
- Barnes, D. (1976), *From Communication to Curriculum*, Harmondsworth: Penguin.
- Bereiter, C. (2002), *Education and Mind in the Knowledge Age*, Mahwah: Lawrence Erlbaum Associates, Inc.
- Freebody, P. (2003), *Qualitative Research in Education: Interaction and Practice*, London: SAGE Press.
- Gee, J.P. (2008), *Social Linguistics and Literacies: Ideology in Discourses*, 3th edition, London: Routledge/Taylor & Francis Group.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Mehan, H. (1978), *Learning Lessons*. Harvard University Press, Cambridge, MA.
Mercer, N. (1995), *The Guided Construction of Knowledge: Talk amongst teachers and learners*, Clevedon: Multilingual Matters.
Wells, G. (2007), The Mediating role of Discoursing in Activity, *Mind, Culture and Activity* 14(3), 160–177.
Wood, D., Bruner, J. S., & Ross, G. (1976). Role of Tutoring in Problem-Solving. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 17, 89-100.

PAPER PRESENTATION

Guided Cognition homework increases mathematics learning for low and average ability students

William B. Whitten II, Fordham University, United States; Mitchell Rabinowitz, Fordham University, United States; Sandra E. Whitten, Fordham University, United States

Our focus is on learning in unsupervised environments (represented by most homework). Guided Cognition structures study tasks to guide the learner to engage in specific, observable cognitive events. These events are hypothesized to elicit underlying theoretical cognitive processes that have been shown to improve learning.

Initial Guided Cognition experiments found that English literature students performed better on unexpected quizzes after Guided Cognition (GC) homework than after Traditional (T) homework (Whitten, Whitten, & Rabinowitz, 2006). More recent experiments demonstrated that Guided Cognition homework is also effective for learning mathematics. The current experiment was designed to evaluate the effectiveness of GC homework across mathematics ability levels. Low and average ability seventh-grade middle-school mathematics students participated.

“In-class homework” was given for two successive topics—multiplying fractions and mixed numbers, and dividing fractions and mixed numbers. Condition T problems were traditional story problems that required students to interpret and set up the problems, then to execute the calculations. Condition GC problems were identical, but also included one of four Cognitive Events that we have studied extensively in our previous research on learning English literature: relate to prior experience, visualize and illustrate, consider divergent answers, and role play. Within each ability level, half received T and half received GC homework.

An unexpected Review Activity (quiz) was given to measure students’ performance on problem interpretation and set up, and on calculation accuracy. Results clearly showed that low-ability and average-ability mathematics students performed better on story problems and numerical problems after GC homework than after T homework.

Our focus is on learning in unsupervised environments (represented by most homework). Guided Cognition structures study tasks to guide the learner to engage in specific, observable cognitive events. These events are hypothesized to elicit underlying theoretical cognitive processes that have been shown to improve learning.

Initial Guided Cognition experiments found performance on an unexpected three-day delayed quiz to be 21 and 18 percentage points better after Guided Cognition (GC) homework than after Traditional (T) homework, for average and advanced English literature students, respectively (Whitten, Whitten, & Rabinowitz, 2006). Subsequent experiments determined this advantage was not due to differences in time spent on the two forms of homework, to teaching that preceded the homework (Whitten, Rabinowitz, and Whitten, 2006a, 2006b), or to novelty (Whitten, Rabinowitz, and Whitten, 2007), and that Guided Cognition homework is effective for students from a wide range of ages (Whitten, Whitten, and Rabinowitz, 2009).

Our new experiments demonstrate that Guided Cognition homework is also effective for learning mathematics. The experiment we will report was designed to evaluate the effectiveness of GC homework across student ability levels.

Method

Participants.

Six classes of low-to-average ability seventh-grade middle-school mathematics students participated. Students were partitioned into two groups based on course performance, to create low and average ability groups.

Materials.

“In-class homework” materials were constructed for two successive topics—multiplying fractions and mixed numbers, and dividing fractions and mixed numbers. Condition T problems were traditional story problems that required students to interpret and set up the problems, then to execute the calculations. Condition GC problems were

identical, but also included one of four Guided Cognition Cognitive Events that we have studied extensively in our previous research on learning English literature: relate to prior experience, visualize and illustrate, consider divergent answers, and role play.

Review Activity materials were constructed to determine whether the GC experience helped students with problem interpretation and set up, or with executing calculations. The Review Activity consisted of 8 numerical problems that required only calculations and 8 story problems that required interpretation and set up, and calculations.

Design and Procedure.

Within each ability level, half received T and half received GC study activities. The mathematics topics were taught as usual, but evening homework was replaced by in-class homework to assure a high participation rate.

Following the teaching and in-class homework of the two topics, students were given a previously unannounced Review Activity consisting of 8 numerical problems and 8 story problems.

Results

Analysis of Review Activity (quiz) performance, without regard to problem type, confirmed a main effect of Condition, $GC > T$, $F(1, 92) = 7.925$, $p = .006$; a main effect of Ability Level, Average $>$ Low, $F(1, 92) = 12.577$, $p = .001$; and no interaction, $F(1, 92) = .108$, $p = .743$. Thus, GC facilitated learning similarly for low and average ability students.

This analysis gives more weight to story problems since each story problem was worth 5 points, and each numerical problem was worth 2 points. This analysis is, however, analogous to how an actual quiz might be graded, with more points based on more complex problems, and represents nearly a letter grade improvement due to GC, assuming that letter grades are 10 percentage points apart.

Condition means are given in Table 1 of the Appendix.

To equalize the weighting of story and numerical problems, point totals for each problem type were converted to percent correct values for each student. Analysis of in-class homework condition (T vs. GC) by Review Activity problem type (Numerical vs. Story) by Ability Level (Low vs. Average) revealed a main effect of condition, $GC > T$, $F(1,92) = 8.801$, $p = .004$; a main effect of problem type, Numerical $>$ Story, $F(1,92) = 239.281$, $p = .001$; a main effect of ability level, Average $>$ Low, $F(1,92) = 11.115$, $p = .001$, and no significant interactions. These results indicate that GC facilitated learning similarly for low and average ability students for both types of problems.

Condition means are given in Table 2 of the Appendix.

Summary

These results clearly show that mathematics students performing at low and average levels can benefit from Guided Cognition homework tasks. It is especially important to confirm that the lowest third of ability can benefit because these students are most at risk for failure.

To date, our reported research has demonstrated that the learning advantage of Guided Cognition study is not due to specific content, time-on-task, teaching effects, or novelty, and is obtained across a range of ages, abilities, and subject matters. Guided Cognition homework appears to be a very cost-effective instructional design strategy that can be implemented without extensive task analysis, new technology, new textbooks, or extensive training.

References

- Whitten, W. B., II, Whitten, S. E., and Rabinowitz, M. (2009). Guided cognition of unsupervised study increases learning for students from ages 12 to 18. Presented at the 13th Biennial Conference of the European Association for Research on Learning and Instruction, Amsterdam, Netherlands, August 26, 2009.
- Whitten, W. B., II, Rabinowitz, M., and Whitten, S. E. (2007). Are guided cognition learning advantages the result of novelty? Presented at the 12th Biennial Conference of the European Association for Research on Learning and Instruction, Budapest, Hungary, September 1, 2007.
- Whitten, W. B., II, Rabinowitz, M., and Whitten, S. E. (2006b). Guided cognition of unsupervised learning: Designing effective homework. Presented at the annual meeting of the Psychonomic Society, Houston, TX, November 18, 2006.
- Whitten, W. B., II, Rabinowitz, M., and Whitten, S. E. (2006a). Enhancing unsupervised learning through guided cognition. Presented at the annual meeting of the Association for Psychological Science, New York, NY, May 26, 2006.
- Whitten, W. B., II, Whitten, S. E., and Rabinowitz, M. (2006). Guided cognition of unsupervised learning. Presented at the annual meeting of the American Educational Research Association, San Francisco, CA, April 10, 2006.

PAPER PRESENTATION

The role of perceptions on using learning tools

Norma A. Juarez Collazo, Katholiek Universiteit Leuven, Belgium; Jan Elen, Katholiek Universiteit Leuven, Belgium; Geraldine Clarebout, Katholiek Universiteit Leuven, Belgium

Evidence on tool use gives rise to concerns about the role of learners' perceptions when confronted with the opportunity to use tools. These concerns relate more specifically to the question whether learners are able to perceive differences in tool functionalities. This paper addresses this question by employing a psychomotor task which consists of building a LEGO[®] figure and two tools: a high functional one (step-by-step guideline) and a low functional one (a high-paced video). According to Perkins' conditions (1985), and the Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989), tools functionality gets first assessed. Rather than measuring students' perceptions through questionnaires (Davis, 1989), this study deduced students' perceived functionality from their tool choice behavior. It is assumed that learners select the tools they perceive to be most functional. Additionally, research indicates self-efficacy and metacognition as variables influencing tool use, the mediating role of these variables was also addressed.

Results reveal that the tools are functional, the experimental conditions with video (V), with guideline (G) and with guideline and video (GV) outperformed the control (C) condition without tools. However, contrary to the expectations, the (V) condition outperformed all other experimental conditions. The observations of tool choice behavior in the (GV) condition suggest that learners perceived the tools functionality because they all picked a tool. However, they were not sufficiently equipped to identify the video as the most functional tool. Concerning the learner variables, no significant effects were found. Theoretical implications and specifications for further research are discussed.

Introduction

Perkins (1985) suggested that there are three conditions to grasp learning opportunities: The learning opportunity has to be there. Learners should recognize the functionality of the learning opportunity and they should be motivated to grasp it. Tools that are added in a learning environment can be considered as such a learning opportunity (Clarebout & Elen, 2009). Translated this means that a tool has to be functional, that the learners have to perceive this functionality and that they have to be motivated to use them. However, it appears that even when tools are proven to be functional, learners do not recognize their functionality. They seem to think they know how to use tools when they actually do not, and/or they are not motivated to use them effectively (Kvavik, 2005). Additionally, research revealed that not only motivational factors play a role in tool use, but also cognitive and metacognitive learner-related variables (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). As illustrated in the Technology Acceptance Model (TAM), learners' perceived functionality of the tools will influence whether or not they will use the tool. While in previous studies, perceived functionality was measured through questionnaires, evidence suggests that perceptions are subjective and do not necessarily reflect reality (Davis, 1989). Thus, we approach these perceptions through students' actual tool choices. The assumption is that learners will choose to use the tool they regard to be most functional. Given Perkin's conditions (1985), we wonder whether learners are capable of distinguishing between a highly functional tool and a low functional one. Second, the question is whether this perceived functionality is affected by students' self-efficacy and metacognition.

Method

Participants

Participants were fifty-eight university students. Seventy-four percent was female, on average 23 years old ($SD=3.51$). Design and procedure A quasi-experimental design was used with four conditions: with guideline (G, $n=17$), with video (V, $n=17$), with guideline and video (GV, $n=17$) and without tools (C, $n=7$). In a first session, an adapted questionnaire on self-efficacy ($\alpha=.89$) (Lodewyk & Winne, 2005; Pintrich, Smith, Garcia, & McKeachie, 1991) and the Metacognitive Awareness Inventory ($\alpha=.71$) (Schraw & Dennison, 1994) were administered. In a second session, participants were randomly assigned to a condition. They were asked to construct a figure with LEGO[®] bricks (learning phase) while they could access the tool(s). Then, they completed a word puzzle as a distracter. Finally, they received the bricks back to build the figure again but without tools (performance). One tool was a purposely-lowered-in-functionality video, showing hands building the figure without verbal instructions, pausing or guiding; The other tool was highly functional step-by-step guideline. Perceived functionality was measured through observation of tool choice behavior. First, the tool(s) learners picked was recorded. Second, if they chose multiple tools, the order in which they used them was noted.

Data analysis

To assess the tools functionality, an ANOVA with condition as independent variable and performance as dependent variable was performed. For perceived functionality, an observation in the (GV) condition was conducted. With this data, two Kruskal-Wallis (due to the amount of participants) were conducted. One with tool choice as independent variable and performance as dependent variable; another with tool choice order as independent variable. For learner variables, we checked if there was a difference between conditions and variables with ANOVA's. Then we ran different Kruskal-Wallis in the (GV) condition to see if variables interacted in the perceived functionality.

Results

The ANOVA indicates that the tools were functional, $F(3,54)=5.53$ $p=.024$. The experimental conditions outperformed the control conditions, but contrary to the expectations, the Tukey post hoc test revealed the video was the most functional tool. The perceived functionality observation showed that all participants picked a tool. Fifty-three percent picked both guideline and video and 47% the guideline. None picked the video only. From the 53% that opted for both tools; 67% started using the guideline and finalized with the video, 11% chose the video then ended with the guideline, 11% used the video, then guideline, and video. The rest used the guideline, then video and finally guideline. Learners with only the guideline did slightly better. However, it was not significantly affected by the tool(s) they picked $H(1)=.60$ $p=.44$, nor by the tool choice order $H(3)=3.96$ $p=.27$. No influence was found of self-efficacy and metacognition.

Discussion

The results indicate that both tools were functional, but that the video was the most functional. Learners did identify the tools functionality but could not perceive the video as the most functional one. It seems that having two tools in the (GV) condition "disoriented" the learner (Iiyoshi & Hannafin, 1998). Zydney (2008, 2010) already suggested that combined tools were not found as effective as individual tools. Furthermore, the video tool design was on purpose lowered in functionality. Learners might have perceived this and interpreted the tool as not the most functional. Thus, they might have eluded it to avoid complications –cognitively speaking- (Aleven et al., 2003) and selected what they perceived as the most functional tool (guideline). Additionally, in line with previous research (Iiyoshi & Hannafin, 1998), tool familiarity might also have affected the tool selection. Lastly, tool flexibility may have been another element that also influenced learners' perceptions in the (GV) condition. Evidence indicates that even when learners get the chance to explore and have control over their learning, it may also overwhelm them (Shapiro, 2008).

Conclusion

This study contributes in different ways to research on tool use. It establishes a baseline for studies on tool use using psychomotor tasks and on measuring perceptions on tool functionality. It sets a need for more research that explores perceived functionality and the learner variables that might be mediated by this perception. It also suggests more research on tool features such as tool design and tool type influencing learners' perceptions. Finally, while the TAM certainly provides a base model for tool use, these findings point to the necessity for establishing a model that specifically refers to tool use.

Acknowledgements

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PAPER PRESENTATION

Dealing with heterogeneity: Differentiated instruction in small rural schools in the alpine region

Robbert Smit, Pädagogische Hochschule St. Gallen, Switzerland

Rural areas in the alpine regions suffer from dwindling student numbers. Differentiated instruction could help to improve teaching culture to ensure adaptivity to heterogeneous mixed-age student groups. A survey with 162 teachers and 1180 students was conducted to examine the use of differentiating practises in the Eastern alpine regions of Switzerland.

Since the cross-sectional study is embedded within a school improvement project, we are interested about the linkages between school leadership, team and teacher. A SEM model for teacher data was constructed. It shows an effect from school leader on team culture but not on learning climate. Team culture seems to be the most effective variable, influencing climate and practice of differentiated instruction. Interestingly, there is no direct path from climate to practice of differentiated instruction. Further multilevel analyses show differences between schools for school leader, team culture and learning climate but not for differentiated instruction.

A multilevel path model, constructed with data from the student questionnaire, explores the relationship between the students' perception of teaching relating to differentiated instruction, the learning context and their motivation to learn. On class level we include their teacher's perception of the quality of his or her differentiated instruction. Teachers who differentiate their instruction foster students' motivation but not achievement. However, team collaboration, which positively influences differentiated instruction, favours student outcomes.

Introduction and research questions

Alpine and subalpine regions face a demographic decline, which threatens the survival of the rather small schools (Meusburger, 2005). Dwindling population numbers in rural regions are a key problem to schools in Europe (Hargreaves, Kvalsund & Galton, 2009), in the United States (Barley & Beesley, 2007) as well as in developing countries (Little, 2006).

The aim of our project "alpine schools" (www.schulealpin.org) is to provide research-based information for the local authority and policy makers as a help to ensure favourable conditions for teaching and learning in small classes with heterogeneous mixed-age groups. One well-known but not yet very well researched teaching concept for dealing with heterogeneity is differentiated instruction (Tomlinson et al., 2003). Our study focuses on the teachers' actual instruction habits of differentiation in the Eastern alpine regions of Switzerland. Besides we are interested in factors, which might support the use and quality of differentiated instruction.

This leads to the following research questions:

1. To what extent is differentiated instruction used in small rural alpine schools?
2. What is the influence of school factors on the use of differentiated instruction by teachers?
3. How do students perceive differentiated instruction?

Methodology

The sample includes 8 primary schools (grade 1 to 6) and 14 secondary schools (grade 7 to 9). All schools are situated in the rural alpine region of the Eastern part of Switzerland. 162 teachers (29 primary and 133 secondary school teachers) and 1180 pupils (154 primary and 929 secondary school students) responded to the questionnaires described below. For a part of the sample we could assign the data of a standardized achievement test in mathematics and German language to the survey data.

As instrument we used a questionnaire for teachers with 104 items and a few open questions. On teacher level a SEM-model was constructed with four latent variables: school leadership, pedagogical team culture (TC), differentiated instruction (DI) and learning climate. The latent variables were used for further analysis as second order factors. A parallel questionnaire for pupils with totally 72 items with similar and additional variables, e.g. learning context to describe the learning condition of the students, was constructed.

Results

The teachers stated that on average 38% (SD = 26%) of their weekly lessons were differentiated. Since our study is embedded within a school improvement project we are interested about the linkages between school leadership, team and teacher. The final SEM-model (fig. 1) shows an effect from school leader on team culture but not on learning climate. Team culture seems to be the most effective variable, influencing climate and practice of DI. In addition there is no direct path from climate to practice of DI. This implies that a good climate in school and classroom is not a precondition for implementation of DI, something teachers always use as an excuse for not practicing DI (Tomlinson, 2001). The final model has the following fit indices: chi-square = 79.37, df = 74, p = .31, CFI = .99, TLI = .99, RMSEA = .02. Further multilevel analyses show differences between schools for school leader, team culture and learning climate but not for differentiated learning.

A multilevel path model (fig. 2), constructed with data from the student questionnaire, explores the relationship between the students' perception of teaching relating to differentiated instruction, the learning context and their motivation to learn. On class level we include their teacher's perception of the quality of his or her differentiated instruction.

School type and teacher gender play no significant role and were eventually excluded from the final model. On student level only one – the times books are a topic at home – of three context variables is included in the final model. The fit indices are good: chi-square = 23.74, df = 7, p = .00, CFI = .96, TLI = .91, SRMRwithin = .05, SRMRbetween = .13, RMSEA = .05.

The quality of differentiated instruction as perceived by the teachers has a positive effect on the motivation of their classes ($\text{Beta} = .33$). Motivation in class is influenced by the learning context (e.g. school and classroom climate) ($\text{Beta} = .41$) and the context variable "books topic at home" ($\text{Beta} = .36$, $p = .08$). Teachers' and class' views on differentiated instruction correlate moderately ($r = .23$). Interestingly there is no significant path between perceived instruction and class' motivation in the final model.

On the individual level there is a strong relationship between perceived instruction and learning context ($r = .51$). Whereas there is a medium effect of learning context on student motivation ($\text{Beta} = .31$) relationship between student motivation and perceived instruction is low ($r = .18$). Finally there is some minor influence from the context variable "books topic at home" on student motivation ($\text{Beta} = .11$).

For about half of the sample, data from a standardised Mathematics and German language test was available to test for effects from differentiated instruction on students' achievement. DI shows no significant effect, neither on mathematics nor on German test results. Since DI is influenced by team culture (TC) a second model proofs whether TC influences achievement. Whereas TC shows a significant effect for Mathematics ($\text{Beta} = 1.65$), the effect for German is not significant due to the high standard error ($\text{Beta} = 2.05$).

To conclude, in our study we couldn't find any differences between schools regarding a culture of differentiated instruction, but there is some variation between teachers. The teachers' practice of differentiated instruction is over all not very elaborated. In our model there is no direct path between school leadership and DI, but there is an indirect one via team culture. Hence, the influence of a school leader for school improvement is limited without the involvement of the school team. As it was suggested by research, differentiated instruction seems to have positive influences for student motivation. Our model shows effects at class level and to a lesser extent at student level. However, this study could not confirm the positive results from DI on students' achievement.

PAPER PRESENTATION

Does the Testing Effect Apply to Learning from Worked Examples?

Tamara Van Gog, Erasmus University Rotterdam, Netherlands

A recent study showed, in line with the worked example effect, that for novice learners instruction consisting of examples only or of example-problem pairs was more effective than instruction consisting of problem-example pairs or problem solving only. There were no differences in mental effort invested or learning outcomes attained between the examples only and example-problem pairs conditions. However, only an immediate test was used in this study. Example-problem pairs allow students to retrieve what they have learned from the example during problem solving, and research on the testing effect has shown that retrieval is more effective for long-term retention than restudying, which the examples only condition does. So, if the testing effect would apply to learning from worked examples, one would predict that while there may be no differences between examples only and example-problem pairs at an immediate test, the example-problem pairs would lead to higher delayed test performance. This hypothesis was investigated with 27 university students learning about electrical circuits troubleshooting from examples only ($n = 13$) or example problem pairs ($n = 14$). In contrast to the prediction based on the testing effect, results showed that participants in the examples only condition performed better on the delayed test. Moreover, they had to invest less effort during learning.

Research on the worked example effect (Atkinson, Derry, Renkl, & Wortham, 2000) has shown that for novice learners, a heavier reliance on studying worked examples than on problem solving is more effective and efficient for learning. A recent study by Van Gog, Kester, and Paas (in press) showed that both example study only and example-problem pairs, in which example study is alternated with problem solving, were more effective for novices' learning than problem-example pairs or problem solving only. There were no significant differences in learning outcomes between the examples only and the example-problem pairs conditions, nor in invested mental effort. However, Van Gog et al. used an immediate test only. Based on research on the testing effect, one might expect the example-problem pairs condition to outperform the examples only condition after a delay.

The testing effect (Roediger & Karpicke, 2006a) has been demonstrated with word lists or texts, and recently also with multimedia learning materials (Johnson & Mayer, 2009), but –to the best of my knowledge– never with worked examples. It demonstrates that after an initial study opportunity, testing is more effective for long-term retention than restudying. At an immediate retention test after 5 minutes, there may be no difference or restudy may even be

more effective, but after a delay of one week, the testing condition outperforms the restudy condition (e.g., Roediger & Karpicke, 2006b).

Given that example-problem pairs allow learners to retrieve and apply what they have just learned from an example, whereas examples only allow for restudying, the testing effect might be expected to apply to worked examples. Therefore, the present study investigated effects of examples only and example-problem pairs on learning after 5 minutes and 1 week.

Method

Participants and Design

Participants were 27 university students (5 male; age $M = 20.67$, $SD = 4.18$), mostly enrolled in Psychology (3 were enrolled in other programs). They were randomly assigned to conditions (Examples only: $n = 13$; Example-problem pairs: $n = 14$). None of them took science classes in the later years of secondary education.

Materials and Procedure

The materials used concerned parallel electrical circuits troubleshooting tasks and were identical to those used by Van Gog et al. (in press); only an equivalent alternate version of the posttest was added. Participants first completed a conceptual knowledge pretest consisting of seven open-ended questions on troubleshooting and parallel circuits principles. In the learning phase, they either studied four worked examples, or studied an example followed by a problem to solve twice. The tasks were the same in both conditions, the only difference was that in the example-problem pairs condition tasks 2 and 4 did not have a worked-out solution. A filler task of approximately 5 minutes followed the learning phase, after which participants completed the immediate posttest. One week later they completed the delayed posttest. There were two equivalent versions (A and B) of the posttest (max. score on each test: 8 points), which each consisted of two troubleshooting problems. These were retention tasks; no new conceptual or procedural knowledge was required to solve them, only different values of voltage, current, and resistance were used. Half of the participants received version A for the immediate and version B for the delayed test, while the other half received version B for the immediate and version A for the delayed test. After each task in the learning and test phases, participants rated the amount of mental effort they invested on the 9-point rating scale developed by Paas (1992).

Results

There were no significant differences in pretest performance between the conditions.

Mental effort invested in the learning phase was significantly lower in the examples only condition ($M = 4.5$, $SD = 1.51$) than in the example-problem pairs condition ($M = 6.91$, $SD = 1.27$), $F(1,25) = 20.27$, $p = .000$. There were no significant differences in mental effort invested in the immediate or delayed posttest.

Performance on the immediate posttest did not differ significantly between conditions. Performance in both conditions significantly decreased from the immediate to the delayed posttest, $F(1,25) = 9.28$, $p = .005$. On the delayed posttest, however, the examples only condition ($M = 5.35$, $SD = 1.66$) outperformed the example-problem pairs condition ($M = 4.39$, $SD = 1.78$), $F(1,25) = 4.83$, $p = .037$.

Discussion

Based on the findings concerning the testing effect, one would have expected the example-problem pairs condition, in which students first studied an example and then had a chance to test their knowledge by attempting to solve an equivalent problem, to outperform the examples only condition on the delayed posttest. However, our results showed an opposite pattern, with the examples only condition performing better on the delayed posttest. Future research should attempt to address whether this could be due to differences in the nature or complexity of learning to solve problems compared to learning word lists or texts.

References

- Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, 70, 181-214.
- Johnson, S., & Mayer, R. E. (2009). A testing effect with multimedia learning. *Journal of Educational Psychology*, 101, 621-629.
- Paas, F. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive load approach. *Journal of Educational Psychology*, 84, 429-434.
- Roediger, H. L. & Karpicke, J. D. (2006a). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181-210.

Roediger, H.L. & Karpicke, J.D. (2006b). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science*, 17, 249-255.

Van Gog, T., Kester, L., & Paas, F. (in press). Effects of worked examples, example-problem, and problem-example pairs on novices' learning. *Contemporary Educational Psychology*.

PAPER PRESENTATION

Learning And Instructing With Objects: Tutor-student interaction in university dental training

Lewis Hyland, King's College London, United Kingdom

In this paper we explore the interaction which occurs in dental training around mannequin simulators and more specifically, the significance of the passing of objects from tutors to students during training conversations. Through the analysis of video data of naturally occurring interaction, these more mundane aspects of interaction are found to be critical to the organisation of tutor-student interaction in dental training. I begin by investigating the ways in which smaller objects used for teaching, such as individual teeth, the jaw, and x-rays, are exchanged between tutors and students. This is then expanded to explore the significance of exchange for the training encounter, in terms of how students display and tutors assess understanding. Finally, we review the relevance of the analysis for (i) our understanding of the interactional organisation of tutor-student conversations in dental training and (ii) the practical implications for the design of new simulator technologies (<http://www.haptel.ac.uk>). The paper is organised around the analysis of audio-visual recordings of naturally-occurring episodes of dental training. The methodological orientation of the paper is drawn from ethnomethodology and conversation analysis.

As part of the ESRC/EPSRC hapTEL project (<http://www.haptel.ac.uk>) which is designing, developing, and evaluating haptic dental simulators, this paper displays findings from an investigation of interaction with and around existing mannequin dental simulators which are currently being used for teaching. It takes precedence from the burgeoning area of research known as workplace studies which has revealed that; "there is more to the design and deployment of complex systems than simply identifying new functionalities for computer systems." (Luff et al. 2000: xii). It is also valuable to gain an understanding of learning and instruction using existing novel technologies, by analysing practices with and around those technologies (Jewitt 2006). This is because the success of technology is only possible if it is designed for the specific requirements of the users. To discover and analyse these existing practices, the methodological orientation is drawn from approaches in ethnomethodology and conversation analysis as applied to video data (Heath et al. 2010), which allows me to unpack the organisation of social interaction in dental training conversations. The paper is organised around the analysis of audio-visual recordings of naturally-occurring episodes of dental training. Full ethical approval for the study was secured from the University ethics committee, and all participants provided written consent for the collection, analysis and presentation of data.

Central to the focus of the paper is the exploration of the passing of objects which is a common occurrence found in the data. When around the simulator objects are often passed from tutor to student, and vice versa, at certain points in the training conversations. This is an interesting feature of instruction and learning because of the way the possession of the object needs to be negotiated. In this paper we explore this issue, notably focusing on how the passing of objects is achieved, and the relevance of these moments of exchange for the co-participants. Through the analysis of naturally occurring data, we are able to highlight the interactional organisation of exchanges involving smaller objects used for teaching, such as individual teeth, jaw, and x-rays. This is then expanded upon to reveal notions about the concept of exchange as a component in learning. By exploring the significance of the possession of an object in the changing of a topic or closing moments of a training conversation, the "terminal exchange" (Sacks 1973), the pedagogic relevance of such acts for both tutor and student is identified. Finally, we review the ways in which members create a context of dental training, and the responsibility hand held objects have in the process of learning dentistry more broadly.

The paper contributes then in three ways. (i) Analytically; In terms of identifying the ways conversation and body movement is interrelated into the environment, or 'furnished frame' (Goffman 1971: 284), in which one is situated. This involves contributing to our understanding of how the passing of objects is achieved sequentially in relation to sense making acts. (ii) Empirically; Despite there being a longstanding interest in the study of medical training, dentistry is massively underrepresented (Fugill 2005). Therefore, this study sheds light on dental education specifically, and begins to fill the gap in the literature on dentistry in the social sciences. Further to this, this work

relates to our understanding of learning and instruction with objects more broadly, which may have relevance for the vast array of other learning environments in which objects play a part. (iii) And finally, this study has a practical application by contributing to our understanding of what types of interactions will need to be supported and/or provided for by new forms of training simulator.

References

- Fugill, M. (2005) Teaching and learning in dental student clinical practice. *European Journal of Dental Education*, 9 (3), 131-136.
- Goffman, E. (1971). *Relations in Public: Micro studies of the Public Order*. Penguin Press.
- Heath, C. Hindmarsh, J. Luff, P. (2010). *Using Video in Qualitative Research*. Sage Publications.
- Jewitt, C. (2006) *Technology, Literacy, Learning: A multimodality approach*, London: Routledge.
- Luff, P. Hindmarsh, J. Heath, C. (eds). (2000) *Workplace Studies: Recovering Work Practice and Informing System Design*. Cambridge University Press.
- Sacks, H. Schegloff, A. Jefferson, G. (1974). A Simplest Systematics for the Organisation of Turn Taking for Conversation. In *Language*, 50:696–735.

PAPER PRESENTATION

Non-present Talk in Early Social Interaction at Home; Relevance for Literacy Development at Age 7

Akke De Blauw, Amsterdam Center for Language and Communication, Universiteit van Amsterdam, Netherlands; Anne Baker, Amsterdam Center of Language and Communication, Netherlands; Judith Rispens, Amsterdam Center for Language and Communication, Netherlands

Use of non-present talk in early adult-child interaction - discussing what is perceptually not here and now - promotes later literacy development (Ninio & Snow 1996; Tabors & Dickinson 2001). Information on the development of non-present talk is missing. This paper presents longitudinal data of an observational study of three children in interaction with their parents and focuses on the dimensions of non-present talk in spontaneous adult-child interaction in relation to later language proficiency. Three monolingual children were followed. Spontaneous interaction sessions from age 1; 9 to 3; 9 were analyzed on the development of non-present talk-interactions and the roles of adults and children in these interactions. At age 7 narrative ability was assessed. Results indicate that non-present talk interactions takes place in 10 -20% of the time. Deeper analysis reveals a variety of subcategories that are increasingly refined over time. Non-present talk interactions heavily depend on the adults. At age 7 all three perform well on the narrative ability tasks. Although there are differences in language proficiency. The findings highlight the importance of promoting high quality interactions on non-present topics in educational settings. Implications are discussed in relation to the school curriculum and teacher professionalisation on interaction strategies.

This paper focuses on the importance of high quality interaction in children's early years at home and in daycare centers for language and literacy education in primary school. Learning decontextualized features of ongoing face-to-face interaction are assumed to be necessary features in order to be able to report real or fictional events (Ninio & Snow 1996; Tomassello 2003). The use of non-present talk in early adult-child interaction - discussing what is perceptually not here and now - promotes later language and literacy development, especially narrative ability (Tabors & Dickinson 2001, Uccelli et al. 2005). Although we know that non-present talk starts in early adult-child interaction (Uccelli 2009, Hendrichs 2010) we still lack a clear and uniform definition of non-present talk and detailed information on what might be crucial developments from age 2 to 4 in relation to later school competencies.

This paper presents data of a ten year videotaped observational study of three children in interaction with their parents and focuses on the following research questions:

- (1) How does non-present talk emerge in parent-child interactions at home, and how does it develop up to age 4?
- (2) What are the prospective relations to the children's narrative ability at age 7?
- (3) What might be educational implications for school settings?

Method

Data from longitudinal case studies. Three monolingual, Dutch-speaking children in two middle class families, a boy and two twin-sisters were followed, three-monthly, from age 0 onward. Spontaneous parent child interactions in a variety of everyday activities were video recorded and the parents were interviewed. For this paper 14 sessions of 60

– 180 minutes between children's ages 1; 9 and 3; 9 were analyzed on the use and development of non-present talk-interactions and the roles of adults and children in these interactions.

All videos were analyzed and non-present talk segments were selected. These segments were fully transcribed, together with a description of the context. Analyses took place on quantitative and qualitative aspects of non-present talk in comparison to present talk, on the precise nature of non-present talk, and on the scaffolding role of the adults. At age 7 narrative ability was assessed with two narrative tasks: Mercer-Mayer's Frog story and Renfrew's Bus story.

Results

From age 1;9 on parents and children are engaged in non-present talk interactions, for 10-16% of the time. At children's age 3;9 for 12 -25% of the time. At 2;9 however non-present talk is much higher than at 3;9. More detailed analysis reveals that this result is due to one of the non-present talk subcategories: fantasy talk. Non-present talk reveals to contain subcategories such as discussing past events, discussing future events, fantasy talk, discussing knowledge. These subcategories gradually emerge and are increasingly getting refined over time. Up to 3;9 initiating moves as well as sustaining moves heavily depend on the adults. For fantasy talk however children initiate more frequently.

When the children are seven years old, all three children perform comparably well on the narrative ability tasks. Although there are differences in language proficiency, on syntax and vocabulary.

What had been found are relationships between individual developmental pathways and parental scaffolding strategies. Quantity of early child language production has an impact on the quality of parental feedback.

Educational implications

The children of this longitudinal study were engaged in non-present talk interactions from an early age on. On a regular basis they experienced and developed skills in discussions on past events, future events, fictional events, knowledge, memory. And so they got acquainted with the necessary features in order to report real or fictional events (Ninio & Snow 1996). Research on non-present talk in other settings, such as teachers at daycare centers (De Haan et al. 2009), in different cultures (Tabor & Dickinson 2001; Melzi & Ely 2008) and at home in comparison to primary education (Henrichs 2010) indicate great variety in the use of decontextualized interactions in the communication between adults and children.

The reported differences highlight the importance of promoting these high quality interactions on topics that are not-present early in educational settings. The findings are discussed in relation to primary school curriculum and the implications for teacher professionalisation on interaction strategies.

PAPER PRESENTATION

School's pedagogical practices as mediators for student participation and on task behaviour

Kirsi Pyhalto, Helsinki University, Finland; Suvi Krista Westling, University of Helsinki, Finland; Janne Pietarinen, University of Eastern Finland, Finland

Research on learning and instruction has shown that pedagogical practices guide and re-shape student learning and behavior in different ways. There is also evidence that by using collaborative and activating instruction, higher achievement, better improvement in conceptual and application skills, better mastery of goal orientation and more positive social relations have been promoted than by preferring learning by rote, competition or individual study.

This study aims to gain better understanding about the kinds of pedagogical practices pupils participate as part of their everyday school life. The classroom practices are analyzed in terms of what kind of forms, opportunities, restrictions and challenges for pupils' participation they provide. Data were collected with the semi structured observation. Semi structured observations included structured observations on classroom interactions, initiatives and boundary crossings made during the lesson and classroom climate and open-ended descriptions of classroom activities.

Classroom practices included teacher- and subject-matter oriented activities as well as more learner-centered, activating and collaborative activities that stimulated pupils to take responsibility for their own studying. Moreover preliminary results suggested that pupils made both more initiatives and on task boundary crossings in co-regulated and pupil regulated lessons. Results also suggested that pupils are not only influenced by the pedagogical practices

adopted by teachers. They also actively direct and re-direct their behaviour as well as the practices they participate in by making initiatives and by occasionally bringing their reality outside the classes into the lessons.

Learning and studying are situated in the pedagogical practices of school. Accordingly, pupils' success in studying is affected both by the quality of pedagogical practices as well as by their opportunities and abilities to participate in school activities (Zhao & Kuh, 2004). Research on learning and instruction has shown that pedagogical practices guide and re-shape student learning and behavior in different ways. Pedagogical practices adopted by teachers have been reported to have affected for example pupil cheating and help-seeking behavior in classes (Anderman & Midgley, 2004; Murdock, Hale & Weber, 2001). There is also evidence that by using collaborative and activating instruction, higher achievement, better improvement in conceptual and application skills (Gillies & Ashman, 2003), better mastery of goal orientation (Midgley, 2002) and more positive social relations (Blatchford, Baines, Rubie-Davies, Bassett, & Chowne, 2006; Tolmie, Topping, Christie, Donaldson, Howe, Jessiman, Livingston & Thurston, 2010) have been promoted than by preferring learning by rote, competition or individual study. Moreover, there is some evidence that promoting complex cognitive communication, for instance by using project-, inquiry- and problem based learning, stimulates the students' academic performance as well as the quality of peer interaction (Gillies & Ashman, 2003; Prince, 2004; Topping, Peters, Stephen & Whale, 2004). Yet, not that much is known about the variety of pedagogical practices pupils participate during their school day, especially in subject teacher system. This study focuses on exploring pedagogical practices pupils participate in a Finnish lower secondary school.

Aims

This study aims to gain better understanding about the kinds of pedagogical practices pupils participate as part of their everyday school life. The classroom practices are analyzed in terms of what kind of forms, opportunities, restrictions and challenges for pupils' participation they provide and how pupils engage in the practices. The study is part of a larger national research project: "Learning and Development in Comprehensive School" (2004-2009).

Methods

Data were collected with the semi structured observation. Observations were carried out during the spring 2010, in two 7th grade classes, in Finland. Observations were carried out in two periods each lasting for a week (altogether 4 weeks). Trained research assistants observed all the lessons during the period (altogether 120 lessons and over 20 subject teachers). Semi structured observations included structured observations on classroom interactions, initiatives and boundary crossings made during the lesson and classroom climate and open-ended descriptions of classroom activities. At first all the lesson reports were content analyzed to identify the variety of pedagogical practices carried out in the lessons. The analysis resulted three basic-categories: pupil regulated; teacher regulated and co-regulated activities. After this, the quality and quantity of initiatives within each basic-categories were coded. Also boundary crossings made by pupils and subject teachers were analyzed to find out if pupils' and teachers' experiences outside the classroom were utilized during the lessons.

Results

Results suggested that pupils face different kinds of pedagogical practices in subject teacher system. Classroom practices included teacher- and subject-matter oriented activities as well as more learner-centered, activating and collaborative activities that stimulated pupils to take responsibility for their own studying. However, teacher centered activities were the most dominant classroom practice.

Further investigation showed that there was also variation in the ways in which pupils engaged in the classroom practices. Pupils, for instance, made different kinds of initiatives concerning learning task, peers and teacher-pupil interaction. Both teachers and pupils also made boundary crossings by bringing their previous knowledge and experiences from informal settings into the classroom interaction. Moreover preliminary results suggested that pupils made both more initiatives and on task boundary crossings in co-regulated and pupil regulated lessons.

Discussion

Results suggested that pupils participate in a variety of pedagogical interactions and activities in their everyday school life and, indeed, during a single school day. Accordingly, they are exposed to various pedagogical subcultures and expectations, they engage in different kinds of peer groups and they adopt various roles in the school's dynamic and complex multilayered community of practice (Wenger, 1998). Moreover results suggested that pupils are not only influenced by the pedagogical practices adopted by teachers. They also actively direct and re-direct their behaviour as well as the practices they participate in by making initiatives and by occasionally bringing their reality outside the classes into the lessons. However, based on our findings it seems that pupils' opportunities for active agency and collaboration are still often quite limited in the pedagogical practices of classrooms.

PAPER PRESENTATION

Assessing lesson structures via videotaped lessons of Dutch and Indonesian secondary school teachers

Ridwan Maulana, GION - University of Groningen, Netherlands; Marie-Christine Opdenakker, University of Groningen, Netherlands; Kim Stroet, University of Groningen, Netherlands; Roel Bosker, University of Groningen, Netherlands

This study investigated the structures of Dutch and Indonesian secondary school lessons and explored between classes differences in terms of the structures of lessons across the school year. A procedure to assess lesson structures was developed which revealed six lesson segments characterizing the general structures of lessons in both countries. Twelve Dutch and 12 Indonesian mathematics and EFL teachers volunteered to participate in the study. Each class was videotaped 12 times across four different occasions and three videotaped lessons of each class were selected for analyses.

The preliminary results (of Dutch videotaped lessons) showed that all six segments were found. Of all six elements, reviewing and student work time appeared to be the most prevalent segments over time. Differences between homogeneous (high ability track) and heterogeneous (mixed ability track) classes regarding reviewing and student work time were found. Teachers in homogeneous and heterogeneous classes allocated much more time reviewing extensively across time. With respect to student work time, the results illustrated that both teachers in homogeneous and heterogeneous classes spent relatively more time having contact with individual/small group of students than having contact with the whole class. In general, teachers in heterogeneous classes dedicated more time making contact with individual/small group of students than their colleagues in homogeneous classes. On the contrary, teachers in heterogeneous classes spent less time making contact with the whole class than their colleagues in homogeneous classes.

Rationale

Research suggests that student engagement decreases during the first year of secondary education and that a decline in the quality of learning environments (structure, autonomy support and teacher involvement) plays an important role (Opdenakker & Maulana, 2010). Particularly, this research reveals that the structure support is higher in homogeneous classes (high ability track) compared to heterogeneous classes (mixed ability track) over time. Moreover, this study unravels that academic engagement decreases over time, with a higher rate in homogeneous classes compared to heterogeneous classes, but this decrease becomes less pronounced over time in homogeneous classes compared to heterogeneous classes.

Other studies indicate that the quality of teacher-student interpersonal relationships determines the decline of student motivation across the school year (Maulana, Opdenakker, den Brok & Bosker, 2010; in press). Furthermore, research indicates that the quality of instructional behaviour plays a significant role in the decrease of student motivation across the school year (Opdenakker & Maulana, 2010). It is unclear about the reasons for which the quality of teacher-student relationships deteriorates over time. Hence, a more detailed investigation of classroom practices is needed. Previous research indicates that assessing lessons according to type of situations can be of significant contribution (den Brok, et al. 2004) and that analysing lesson structures offers a promising account for understanding the complex interplay between teaching and learning outcomes (Savola, 2008). On this basis, this study was designed to investigate lesson structures that are common in Dutch and Indonesian secondary education and to explore the role of class type (homogeneous; high ability track vs. heterogeneous; mixed ability track) in explaining differences between classes across the school year.

Research questions

- (1). How do Dutch and Indonesian secondary school teachers configure the lesson across the school year? Specifically, how do they distribute time across lesson segments over time?
- (2). Are there differences between homogeneous and heterogeneous classes with respect to structuring the lessons across the school year?
- (3). Are there differences between Dutch and Indonesian teachers regarding the lesson structure over time?

Method

Sample

Twenty four Dutch and Indonesian secondary school teachers volunteered to participate in this longitudinal study. Each class of the teachers was video-taped 12 times across the school year.

Measure

A Coding scheme to analyze types of lesson segments was developed. The scheme focuses on the pedagogical function of lesson structures. An inductive process approach was applied including review and re-review lessons. The coding scheme consisted of four categories and within categories lesson segments were determined. Those categories were: Opening (Introduction and Review), Main content (New content and Student work time), Closing and Other.

Procedure

The final coding scheme was used to analyze 72 video-taped lessons from 24 teachers. Two raters with knowledge of lesson structure analysis coded about 15% of the videotaped lessons to establish inter-rater reliability. Cohen's Kappa of .89 was reached, indicating a satisfactory level of agreement between the coders.

Data analysis

Descriptive and multilevel analyses will be applied to answer the research questions.

Preliminary findings (Dutch data)

In general, the Dutch secondary school teachers seem to spend most time on student work time during the lesson over time. Reviewing material appears to be the second most prevalent segment characterizing Dutch secondary classrooms, followed by introducing new content. Merely less than 5% of class time is allocated for giving introduction and closing the lesson (Figure 1).

Figure 2 displays the comparison between homogeneous and heterogeneous classes regarding distribution of time for all six lesson segments. The results show that teachers in homogeneous classes tend to allocate more time on student work time segment, while their colleagues in heterogeneous classes spend more time on review segment. In both type of classes, teachers seem to spend time about the same on introducing new content. In addition, heterogeneous class teachers allocate more time on introduction and on closing segments.

An independent-samples t-test was conducted to compare relative proportion of time spend for the six segments between the two class types. The results show that differences in review ($t = -2.42, p = .03$) and student work time ($t = 3.11, p = .01$) between homogenous and heterogeneous classes are statistically significant.

A more detailed inspection of the Review segment in both class types (Figure 3) reveals that teachers in both class types allocate much more time reviewing extensively across time. Interestingly, teachers in heterogeneous classes never do short review, while their colleagues in homogeneous classes allocate little time to do short review over time. Figure 4 displays that all teachers spend relatively more time having contact with individual/small group of students than having contact with the whole class. In general, teachers in heterogeneous classes spend more time making contact with individual/small group of students than their colleagues in homogeneous classes. On the contrary, teachers in heterogeneous classes spend less time making contact with the whole class than their colleagues in homogeneous classes. Results from Indonesia will be included in the full paper.

Significance of research

The present study provides empirical evidence regarding common teaching practices in the Netherlands and Indonesia in terms of lesson structures that may reveal the importance of some lesson segments for student outcomes and may indicate some effectiveness-enhancing factors within lesson structures. This study may offer cues to improve the effectiveness of teachers and the quality of learning and instruction in terms of the organization of lesson structures. In addition, a new and promoted approach to analyze teaching practices was used: teaching practices were studied within a longitudinal design using a video-based approach paying attention to changes over time and to differences between classes.

References

- Den Brok, P., Veldman, I., Wubbels, T., & Tarwijk, J. (2004). Teacher interpersonal behavior in Dutch multicultural classes. Paper presented at AERA conference, San Diego.
- Maulana, R., Opdenakker, M-C., den Brok, P., & Bosker, R. (in press). Teacher-student interpersonal relationships in Indonesian secondary education: Profiles and importance to student motivation. *Asia Pacific Journal of education*.
- Maulana, R., Opdenakker, M-C., den Brok, P., & Bosker, R. (2010). Modeling teacher-student interpersonal relationships and academic motivation within one school year. Paper accepted for presentation at the AERA conference, New Orleans.

Opdenakker, M-C., & Maulana, R. (2010, April). Teacher-student relationships and academic engagement: How do they develop and link?. Paper presented at the ICIRE conference, Boulder.

Savola, L.S. (2008). Video-based analysis of mathematics classroom practice: Examples from Finland and Iceland: Columbia University.

PAPER PRESENTATION

Improvable objects, dialogue and the Interactive Whiteboard

Alison Twiner, The Open University, United Kingdom; Caroline Coffin, Open University, United Kingdom; Karen Littleton, Open University, United Kingdom; Denise Whitelock, Open University, United Kingdom

This presentation will focus on how a now-common educational tool – the interactive whiteboard (IWB) – can be orchestrated with talk to resource and evidence progressive construction of knowledge. We will outline a major pedagogic challenge teachers face, of how to support continuity and cumulation of learning experiences, and how use of psychological and technical tools (such as talk and the IWB) can be oriented to address this challenge. We will highlight some technical and pedagogic affordances of the IWB, including: supporting teacher planning of lessons and flexibility within them; potential for building a pre-prepared but 'improvable' frame of reference that can be viewed, reviewed and revised; and that changes can be saved or discarded as appropriate. Our research adopts a sociocultural approach to teaching and learning, based on a substantial data set collected from UK primary schools. We draw particularly on sociocultural principles of talk as the central meaning-making resource, and knowledge as mediated and discursive, co-constructed in interaction. In our Sociocultural Discourse Analysis we utilise the concept of the 'improvable object' (Wells, 1999).

The IWB is one mediational device on which users can project and play with 'objects' to resource activities. How talk is used to bring IWB resources or activity into focus, and to suggest, query or narrate physical interaction with projected resources, will be central in our interpretations. This presentation is of significance in addressing the multimodal orchestration of available resources, with a temporal view of how 'improvable objects' are used in the knowledge construction and stabilisation process.

This presentation will focus on how a now-common educational tool – the interactive whiteboard (IWB) – can be orchestrated with talk to resource and evidence progressive construction of knowledge. We will outline a major pedagogic challenge that teachers face, that of how to support continuity and cumulation in respect of learning experiences, and how use of psychological and technical tools (such as talk and the IWB) can be oriented to address and ease this challenge. We will highlight some of the technical and pedagogic affordances of the IWB, including: supporting teacher planning of lessons and flexibility within them; potential for building a pre-prepared but 'improvable' frame of reference that can be viewed, reviewed and revised; and that changes can be saved or discarded as appropriate. Our research is underpinned by a sociocultural approach to teaching and learning and is based on a substantial data set collected from UK primary schools. We draw particularly on the sociocultural principles of talk as the central meaning-making resource, and of knowledge as mediated and discursive, co-constructed in interaction.

Our presentation makes a significant practical contribution, addressing the orchestration of complex technologies that are now more common in teaching-learning environments but being used in new ways to offer a multimodal learning experience. It is important to explore how these digital resources are entering the knowledge construction processes in contemporary teaching and learning over a continuous series of lessons. This links to the theoretical significance of our presentation, as we explore how temporal challenges were addressed, using a sociocultural framework to view the role of 'improvable objects' (Wells, 1999) in this construction and 'stabilising' of knowledge (Ludvigsen, et al., 2011) within class interactions. Adopting a case study approach, we present data collected over four weeks in the 2009/10 academic year. Lessons were in a London primary school with a Year 2 class (aged 7-8 years), and covered the Great Fire of London history topic. The class had two lessons each week on the topic, one in the hall and one in the classroom. Both learning environments had a wall-mounted IWB. All eight lessons were video-recorded by one of the presenters. Consent was requested from pupils and their parents before pupils were recorded. Teachers were also interviewed before and after the series of lessons. A focus group was carried out with a small group of pupils after the eight lessons. In our Sociocultural Discourse Analysis we utilise the theoretical concept of the 'improvable object' (Wells, 1999).

The IWB is one mediational device on which teachers and learners can project and play with 'objects' to resource their activities. How talk is used to bring IWB resources or activity into play, and to suggest, query or narrate physical interaction with or modification to projected resources, will be central in our interpretations. In analysing this data, we

addressed the general research question: How do teachers and pupils use discursive and technological tools, to foster continuity and cumulation between learning experiences? From this we oriented to our more detailed research question: How do teachers employ talk and IWBs in developing improvable objects between themselves and their pupils, as progressive and historical records to resource developing understanding? In addressing these questions and presenting our findings, we will share video footage of the lessons. We will illustrate the teacher's use of one particular IWB resource across the eight topic lessons. As part of the Great Fire of London topic, the teacher addressed the learning objective 'locate the event on a timeline' largely through the discursive activity around and physical interactions with a focal pre-prepared IWB slide. We will demonstrate how displaying the slide –a timeline with numbered century markers – offered a means to contextualise the historical event. It also became a quick orientation cue to pupils in each lesson, encouraging them to think about the Great Fire and when it happened. This consistent but initially sparse resource was annotated in most lessons. Viewing the timeline slide as an 'improvable object', both temporary and permanent 'improvements' to the slide were made across the eight lessons. This demonstrates the IWB's capacity to support such flexible use.

Analysis revealed that talk around use of the resource remained crucial across the eight lessons, in keeping the depicted content relevant. This was true whether or not annotations were made, removed, or left as they were. We will demonstrate how pupils' questions and responses to the teacher's introduction of the topic offered a perhaps unexpected but equally important opportunity for the teacher to offer targeted and meaningful support to his pupils. The technical capacity of the IWB and teacher's knowledge of the topic and of his pupils (and of the technical capacity of the IWB) enabled him to improvise and be flexible in his verbal and written replies. Thus verbally and visually the class were building a context in which they could learn more about the topic. We will show how through the series of lessons the pupils refined their verbal expressions and historically-contextualised understanding of when the Great Fire of London happened. This was evident as they offered key information themselves, and fewer annotations were made to the slide. Thus the scaffold of the timeline slide which was initially used by the teacher to bring salience to key points both visually and verbally, provided a catalyst for pupils' own curiosity and concerns to check understanding. Subsequently direct use of the visual resource was faded because it was no longer needed as a key reference point. Through pupils participating in the verbal activity around the mediational IWB slide, they had constructed and appropriated a locally progressive discourse for some of the key but related facts about the historical event. Therefore through continuity of resource and activity, with sufficient change to allow cumulation of contextual information added to the progressing discourse and display, the teacher made effective use of the tools at his disposal in covering the stipulated learning objective.

PAPER PRESENTATION

Learning pathology in a virtual microscopy environment: a naturalistic experiment

Markus Nivala, University of Turku, Finland; Roger Saljo, Goteborg University, Sweden; Hans Rystedt, University of Gothenburg, Sweden; Erno Lehtinen, University of Turku, Finland

The objective of this paper is to explore how students' reasoning is shaped by collaborative use of virtual microscopy and different levels of visual and textual scaffolding.

Fifteen pairs of second-year medical students attending an introductory course in pathology examined six authentic tissue samples using a virtual microscopy application with different level of scaffolding in each case: from fully annotated slides with visual-textual cues to visual cues only or no cues whatsoever. Students' actions were videotaped and their written answers (findings and diagnosis) were assessed by an experienced pathologist.

The number of diagnostically relevant findings in student's answers increased along with the level of scaffolding. Yet, mere visual cues did not reduce the number of false findings, whereas cues with both textual and visual information reduced them remarkably. Furthermore, without cues, the false findings arise mostly while examining irrelevant features of the slide. The video recordings revealed a certain hierarchy of mistakes. Firstly, due to faulty or insufficient examination of the specimen, students often miss important findings altogether. Secondly, although visually detected, critical features of the specimen are overlooked and dismissed because of students' inability to discern abnormal from normal. Thirdly, findings are deemed relevant but are not recognized or are misinterpreted.

This study reveals both the difficulties medical students face while examining pathological specimens and how visual-textual cues can be used to help students to pay attention to the relevant features of the slide and thus reach a level of performance otherwise unattainable.

Introduction

In general, it seems that the capability of finding the relevant diagnostic information is where medical experts excel and novices fail (e.g. Elstein, 1978; Myles-Worsley et al., 1988). Furthermore, experts seem to reason from the "patient data to the diagnostic hypotheses" (Patel & Kaufman, 2001: p.9516) whereas novices mainly use hypothesis-driven reasoning. Yet, when faced with non-routine tasks, even experts resort to hypothesis-driven strategies. (Patel, et al., 2005) Novices, to whom almost all diagnostic tasks are more or less non-routine, mainly make use of hypothesis-driven reasoning because of "their lack of substantive knowledge or their inability to distinguish relevant from irrelevant knowledge" (Patel et al., 2005: p.8).

Recently it has been recognized that doctors "are not solitary thinkers, but live in a social world thick with artifacts and populated by other agents who jointly determine the decision processes and outcomes" (Patel et al., 2002). The context of this study, an introductory course in pathology, illustrates how the same applies to the medical students. Students engage in authentic diagnostic tasks and work in pairs to reach a shared understanding of the phenomenon. The cases students engage with are authentic (i.e. real patient cases) and complex, as even the simplest of cases requires biomedical knowledge of, and attention to, multiple levels: cellular, tissue and structural level. The learning process is truly "thick with artifacts" that also shape the future skills and practices of the practitioners (Kushniruk et al., 1996). Our aim is to explore how these practices are shaped by collaborative use of virtual microscopy and how visual and textual scaffolds support novices' reasoning.

Method

Fifteen pairs of medical students attending an introductory course in pathology took part in two video-taped problem solving sessions, one in the beginning and one at the end of the course. The pairs were given six authentic tissue samples using a virtual microscopy application called the WebMicroscope. Depending on the group they were assigned to the pairs had different level of scaffolding: five pairs had fully annotated slides with visual-textual cues, five only visual cues and five no cues whatsoever. The task was to write down the findings and diagnosis in collaboration with each other. Students' written answers were assessed by an experienced pathologist. The findings were classified into diagnostically relevant, irrelevant, or false. False findings were further classified according to whether students focused in the relevant area or level of the sample while coming up with the finding. In addition, students' diagnoses were rated from 0 to 2 points. In video analysis of the diagnostic episodes we focus on different difficulties students face and how annotations affect their reasoning.

Results

Table 1. shows the sum of relevant, irrelevant and false findings in each condition. Surprisingly, visual cues alone did not reduce, but increased, the number of false findings, whereas cues with textual and visual information reduced them remarkably.

Table 1. Number of findings and diagnostic accuracy in each condition

In Table 2., false findings are classified into wrong focus, correct focus and unclassified (findings not credited to any specific area). Without cues, the false findings arise mostly while examining irrelevant features of the slide. Although visual cues increase the amount of false findings (Table 1.), they arose while examining an appropriate part of the slide.

Table 2. Students' focus during the generation of false findings

The case of gastritis, caused by helicobacteria, illustrates the processes behind the aforementioned phenomena. With cues (visual or visual-textual), four out of five pairs were able to find helicobacteria, whereas only one pair in the "No cues" group was able to do the same. Although most of the pairs (7 out of 9) that found helicobacteria during the first session used hypothesis-driven reasoning (they were looking for the bacteria before visually encountering it), in two cases it was evident that this component of their diagnosis was triggered by the annotation.

As revealed in the video recordings, the most common reason for missing helicobacteria was failing to pay attention to the relevant areas or zooming levels in the specimen. Out of the seven pairs that missed the bacteria, four did not inspect the areas of the slide where helicobacteria are visible with appropriate magnification. Further, there was one pair in each group that clearly inspected and commented a relevant area but failed to recognize the bacteria.

Conclusions

Students often miss important findings due to insufficient examination of the specimen. Secondly, although visually detected, critical features of the specimen are dismissed because of inability to discern abnormal from normal. Thirdly, findings can be deemed relevant but are misinterpreted.

To reach a correct diagnosis, one must physically see the relevant diagnostic feature. Furthermore, one must be able to recognize it as an abnormality and thus attach a certain level of relevance to it. Finally, one must be able to conclude various facts into a coherent diagnosis. The new affordances WebMicroscope offers, i.e. visual-textual cues, support students' reasoning enabling them to avoid the most obvious pitfalls and thus reach a level of performance otherwise unattainable.

References

- Elstein et al. (1978). Medical problem solving: An analysis of clinical reasoning. Cambridge, MA: Harvard University Press.
- Patel et al. (2001). Medical Expertise, Cognitive Psychology Of. International Encyclopedia of the Social & Behavioral Sciences. Elsevier.
- Patel et al. (2005). Thinking and reasoning in medicine. In: Keith Holyoak: Cambridge Handbook of Thinking and Reasoning. Cambridge, UK: Cambridge University Press.
- Patel et al. (2002). Emerging paradigms of cognition in medical decision-making. Journal of Biomedical Informatics, 35 (1), 52-75.
- Kushniruk et al. (1996). Assessment of a computerized patient record system: a cognitive approach to evaluation of an emerging medical technology. MD Comp13, 406–15.
- Myles-Worsley et al. (1988). The influence of expertise on X-ray image processing. Journal of Experimental Psychology: Learning, Memory and Cognition, 14, 553–557.

PAPER PRESENTATION

Collaborative Argumentation In Structured And Unstructured Chat Environments In Secondary School

Timo Salminen, University of Jyväskylä, Finland; Miika Marttunen, University of Jyväskylä, Finland; Leena Laurinen, Agora, Psykocenter, University of Jyväskylä, Finland

Although many studies have shown positive learning effects when using computer-supported learning environments to practise argumentation skills, more research on students' argumentation in web-based environments, for example, on using chat facilities is needed. This study focuses on whether structured synchronous chat interaction promotes upper secondary school students' collaborative argumentation and knowledge co-construction. In the study 16 Finnish secondary school students engaged in dyadic chat discussions through structured and unstructured chat. The discussion themes were vivisection and gender equality. The argumentativeness of the students' speech turns, the quality on their counterarguments, and their counterargumentation strategies were investigated. The results suggest that secondary school students are able to engage in (counter)argumentative chat discussions. However, to foster the use of different counterargumentation strategies, attention should be paid to students' preparation for the discussions.

The ability to argue has been regarded as an important part of academic literacy in secondary school. However, it has been shown that both adolescents (e.g. Chan, 2001; Marttunen et al., 2005; Mikkonen, 2010) and university students (Marttunen, 1997) have difficulties in mastering argumentation skills. Although many studies have shown positive learning effects when using computer-supported learning environments to practise argumentation (see e.g. Andriessen et al., 2003), more research on students' argumentation in web-based environments, for example, on using chat facilities, is needed.

This study focuses on whether structured synchronous chat interaction promotes upper secondary school students' collaborative argumentation and knowledge co-construction. The study compares the quality of students' argumentation during structured and unstructured chat. The research questions are the following: 1) How argumentative are the students' dyadic chat debates? 2) Are the mode of chat (structured vs. unstructured) or the discussion topic (vivisection vs. gender equality) associated with the argumentativeness of the debates? and 3) What kind of counterargumentation strategies do the students use?

The data consist of students' 16 dyadic chat discussions. Eight discussions concerned vivisection and eight gender equality. Eight discussions were carried out through structured chat, and eight through unstructured chat. Before engaging in debates the students read three articles containing arguments both for and against the topic. The

students were asked to think about the different viewpoints towards the topics presented in the texts and how the viewpoints were supported. The teacher formed the student pairs as to maximise the number of mixed gender pairs. She also paired those students whom she knew could work well together. The students were asked to discuss the following topic-related claims: "Vivisection should be allowed." / "There is gender equality in Finland."

The data analyses focused on the argumentativeness of the students' speech turns (n=609), the quality on their counterarguments, and their counterargumentation strategies. The discussions were analysed by categorising the speech turns into eleven categories. In the categorisation the following analysis schemes were utilized: a model to analyse the process of argumentation by Björk and Räisänen (1996), the so-called Rainbow method for analysing functionally computer-mediated pedagogical debates by Baker et al. (2002), the regular patterns of argumentative strategies (i.e. the templates of the structured chat tool used in this study; Hirsch et al., 2004), and the respond-position taking classification of speech turns (Marttunen & Laurinen, 2002). Further, the students' ways to formulate their counterarguments in order to express a justified disagreement were categorised into three counterargumentation strategies (Leitão, 2000): 1) supporting the other side of the question, 2) bringing the truth of a claim into question, and 3) questioning a reason-position link.

The results showed that 44.7% of the students' speech turns were argumentative (justified disagreement 20.2%, argument 16.8%, request an argument 4.8%, main claim 1.6%, request a clarification 1.3%) and 55.3% were non-argumentative (comment 29.2%, opinion 10.5%, unjustified agreement 5.1%, off-task 5.1%, request an opinion 3.9%, unjustified disagreement 1.5%). The students engaged in counterargumentation quite often since 20.2 % of their speech turns were categorised as justified disagreement. The most often used counterargumentation strategy was questioning a reason-position link (41.7%) and the least used strategy was bringing the truth of a statement into question (18.9%). During the unstructured discussions justified disagreement was most often used to question the arguments supporting the claim of the interlocutor (47.4%), whereas during the structured discussions justified disagreement was mainly used as a strategy to support indirectly the person's own standpoint on the issue (43.1%).

The results suggest that secondary school students are able to engage in (counter)argumentative chat discussions. During structured interaction supporting indirectly one's own claim as a counterargumentation strategy is not a dialogical and constructive way to think critically because it does not bring the merit of the interlocutor's arguments into question (cf. Leitão, 2000). However, deep-level processing of the opponent's arguments, in addition to both formulating one's own arguments and managing the discussion may cause cognitive overload for a novice arguer (Kuhn & Udell, 2003) since several cognitively demanding activities must be processed simultaneously. To decrease students' cognitive load in order to enhance their learning through argumentation, more attention should be paid to students' preparation for the discussions, i.e. that students have sufficient knowledge on both the discussion topic and argument schemes (i.e. the logical structure of informal arguments).

References:

- Andriessen, J., Baker, M., & Suthers, D. (Ed.) (2003). *Arguing to learn. Confronting cognitions in computer-supported collaborative learning environments*. Kluwer, Dordrecht.
- Baker, M., Andriessen, J., Quignard, M., van Amelsvoort, M., Lund, K., Salminen, T., Litosseliti, L., & Munneke, L. (2002). A framework for analysing pedagogically-oriented computer mediated debates: Rainbow. *Cahiers de recherche/Research Report IC-3-2002*. Université Lumière Lyon 2, Équipe Interaction & Cognition.
- Björk, L., & Räisänen, C. (1996). *Academic writing. A university writing course*. Studentlitteratur, Lund.
- Chan, C. K. K. (2001). Peer collaboration and discourse patterns in learning from incompatible information. *Instructional Science*, 29, 443–479.
- Hirsch, L., Saeedi, M., Cornillon, J., & Litosseliti, L. (2004). A structured dialogue tool for argumentative learning. *Journal of Computer Assisted Learning*, 20(1), 72–80.
- Kuhn, D., & Udell, W. (2003). The development of argument skills. *Child Development*, 74(5), 1245–1260.
- Leitão, S. (2000). The potential of argument in knowledge building. *Human Development*, 43, 332–360.
- Marttunen, M. (1997). Studying argumentation in higher education by electronic mail. *Jyväskylä Studies in Education, Psychology and Social Research* 127. University of Jyväskylä, Jyväskylä.
- Marttunen, M., & Laurinen, L. (2002). Quality of students' argumentation by e-mail. *Learning Environments Research*, 5, 99–123.
- Marttunen, M., Laurinen, L., Litosseliti, L., & Lund, K. (2005). Argumentation skills as prerequisites for collaborative learning among Finnish, French, and English secondary school students. *Educational Research and Evaluation*, 11(4), August 2005, 365–384.
- Mikkonen, I. (2010). "Olen sita mielta, etta...". *Lukiolaisten yleisönosastotekstien rakenne ja argumentaatio*. ["In my opinion..." Structure and argumentation of letters to the editor written by upper secondary school students.] *Jyväskylä Studies in Humanities* 135. University of Jyväskylä, Jyväskylä.

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PAPER PRESENTATION

The Impact of Situated Learning on Knowledge Construction in an Ubiquitous Learning Environment

Birgit Reisenhofer, University of Salzburg, Austria; Gerhard Schrangl, University of Salzburg, Austria; Michael Schneider, University of Salzburg, Austria; Joerg Zumbach, University of Salzburg, Austria

In this research, the influence of a situated, ubiquitous and mobile learning scenario is compared to a paper-based and multimedia learning scenario. Three different versions of learning material in the area of science education content from Biology mixed with History were compared: A mere paper-based version, a multimedia learning program using audiovisual inputs and an outdoor educational trail using GPS devices. All three conditions contained the same information. Results reveal that the outdoor condition and the multimedia learning software lead to highest performances regarding knowledge acquisition. Subjective cognitive load was highest within the text-based version. Participants in the outdoor condition showed highest scores in intrinsic motivation regarding interest and the feeling of being challenged by the learning environment. Taken together, results indicate that explorative teaching scenarios and multimedia based learning environments might lead – if properly designed – to higher motivation and higher learning success.

Introduction

Active exploratory and inquiry-based learning plays a major role in current school reforming. The main focus of this kind of learning is, here, on active and problem-solving learning. The possibility of situated and active learning enables the opportunity of merging the instructional learning environment with the natural environment. The self-driven activity of learners is essential for designing lessons for situated and active problem-solving learning. A major goal is thereby to evoke and maintain cognitive information processing as well as motivation and interest in problem solving in order to avoid under- or overburdening of learners. There are many ways to implement exploratory and inquiry-based learning. One of the currently most popular ways of approaching the natural environment with instructional designed learning environments is Geocaching, Geocaching is a wide-spread private activity among students, which is also apt to navigate on virtual educational trails using GPS technology combined with instructional material. Practical experience provides learning opportunities for active problem solving within situated learning environments. This kind of learning enables learners a way of multi-modal and multi-codal learning that might not or only scarcely be realized within classroom instruction. Especially self-paced multimedia learning material provides learning opportunities that might not only provide situated learning in combination with ubiquitous learning technologies but also seems to be cognitively adequate (cf. Mayer, 2005; Low & Sweller, 2005). For this research, an action-oriented teaching scenario was designed, where students had the possibility to explore prepared learning paths by using GPS devices. As a result a situated learning environment has been created which allows knowledge transfer to everyday situations and, subsequently, intensely dealing with presented topics. Based on assumptions of situated cognition and motivational issues of self-determination theory, it can be assumed that such a kind of learning environment might be beneficial to the individual learning progress as well as supportive for intrinsic motivation in modern day teaching.

Method

Learning material

Three different versions of teaching material containing the same information were developed. The first version was a mere paper-based version; the second version was a multimedia program, using text, video, and animation. In the third version students had the possibility to go outdoors and see the visual material the learning material was about directly and additionally had the opportunity to listen to the auditory instructions after they reached their destinations by means of GPS devices.

Participants

Fifty-six participants took part in this study. They all were High School students with an average age of 14.27 years. Assignment to one of the three conditions was random (paper-based with n=19, multimedia with n=17, outdoor with n=20).

Instruments and Procedure

A multiple-choice test and a test with open questions were designed in order to assess knowledge acquisition. Cognitive load was measured by using the Mental Effort Rating Scale by Paas and van Merriënboer (1994). Motivational aspects were measured by using the FAM (Rheinberg et al., 2001). First, participants had to complete the

pre-test (knowledge acquisition, cognitive load, attribution) and were then randomly assigned to one of the three conditions, which lasted about 40 minutes each. Afterwards, the post-test was conducted. Participation in this study was voluntary and took about 60 minutes.

Results

For analyzing the differences between the three different conditions, a MANCOVA with the different treatments as independent variable, performance in knowledge pre-test as covariate and performance in knowledge post test as well as motivational scales in post-test as dependant variables was calculated. Both, the multimedia as well as the outdoor condition led to increased performance in the knowledge post test; participants using the text-only version achieved significantly lower results in knowledge acquisition (p). Regarding motivational aspects, participants showed significantly low interest in using the multimedia software than learning with the other two conditions. Participants assumed the outdoor condition to be most challenging (p). Discussion Results show that the multimedia learning software as well as the outdoor condition lead to best performance in the knowledge post-test. Cognitive load as experienced by the learners was highest within the paper-based version compared with the other two conditions.

These results seem to confirm in an applied educational setting what experimental research has foretold: students dealing with visual inputs only, apparently have to invest more effort in processing the information while a multimodal information contribution might contribute to reduced cognitive load and, thus, higher learning outcomes. Nevertheless, these findings have also to be interpreted carefully. First, the outdoor learning environment was not more effective regarding cognitive issues than a learning software program. This might at a first glance be an argument against outdoor experience. Nevertheless, it lead to comparable results although distracting stimuli and a dual-task (the GPS-navigation) have to be taken into account. And therefore it is astonishing that even experienced cognitive load was not significantly different from multimedia condition. But the rather and major advantage of the outdoor-condition remains in motivational issues: the outdoor condition was significantly rated as the most challenging but also most interesting condition. On the contrary, the multimedia condition was significantly rated the least interesting and least challenging condition.

An explanation for this shift from computer-assisted teaching methods to explorative teaching methods could be the contemporary extended use of new media in classroom situations. In general, results show that explorative teaching scenarios can contribute to higher motivation without risking deficits in cognitive parameters.

References

- Low, R. & Sweller, J. (2005). The modality principle in multimedia learning. In R.E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning*. New York, NY: Cambridge University Press, 147-158.
- Mayer, R.E. (2005). Cognitive Theory of Multimedia Learning. In R.E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning*. New York, NY: Cambridge University Press, 31-48.
- Paas, F.G.W. & Van Merriënboer, J.G. (1994). Instructional control of cognitive load in the training of complex tasks. *Educational Psychology Review*, 6, 351-372.
- Rheinberg, F., Vollmeyer, R. & Burns, B.D. (2001). FAM: Ein Fragebogen zur Erfassung aktueller Motivation in Lern- und Leistungssituationen. Universität Potsdam.

PAPER PRESENTATION

Effects of Electronic Outlining on Students' Argumentative Writing Performance

Milou de Smet, Open University of the Netherlands, Netherlands; Hein Broekkamp, UVA, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Writing is an important competence in a knowledge-driven society. Education therefore devotes much attention to its development. Students' writing skills may be further increased when they make use of widely available word processors and profit from the tools incorporated in them that support writing. Seemingly important but underused are, for instance, tools for electronic outlining. These tools help students to develop a structured list of ideas, which they can use as a writing plan.

The central aim of this study is to determine the effect of electronic outlining on the quality of students' writing products and on students' experienced cognitive load during the writing task. In addition it examined how students appropriate and appreciate the outline-tool and whether they need an explicit instruction in order to engage in planning. The writing products and self-report data from 34 ninth-grade students of a Dutch secondary school were analyzed. Students wrote two similar argumentative texts with or without an electronic outline-tool. Results indicate

that without instruction, students devote almost no time to planning their texts. This is regrettable since results show that electronic outlining improves the quality of students' argumentative texts. Furthermore, the cognitive load that students reported was lower for tasks that required the use of outline tools. Answers to a retrospective questionnaire showed that the short instruction on the outline-tool was sufficient for students to understand the working of the outline-tool and that most students experienced the outline-tool as beneficial to their writing.

Writing is an important competence in a knowledge-driven society. Education therefore devotes much attention to its development. Nevertheless, students often have trouble writing a well-structured text. Students' writing skills may be further enhanced if they learn to effectively use the widely available word processors profit from the tools incorporated in them that support writing such as the outline-tool. Outlines allow students to think about the organization and structure of a desired product or the steps according to which this product should be established. Outlining has proven to be the most successful planning strategy to benefit students' writing performance (Walvoord, et al., 1995). Using computer tools that support outlining can enhance beneficial effects (Kozma, 1991).

The aim of this study is to investigate the effects of using an electronic outline-tool on the quality of students' argumentative texts. Based on prior studies (Kozma, 1991; Walvoord et al., 1995), it is expected that for most students, a brief outline instruction will lead to an improvement of text quality. In addition, based on Kellogg's research on writing and cognitive load (2008), it is hypothesized that electronic outlining will decrease experienced cognitive load. Moreover, this study seeks to determine whether students appropriate and appreciate working with the outline-tool.

Method

Participants in this experiment were 34 Dutch ninth-grade students from an academic high school. The group consisted of 16 male and 18 female participants between the ages of 15 and 17 ($M=15.66$; $SD=0.60$). This study compared two experimental conditions in a combined within-subjects and between-subjects design. Students carried out two argumentative writing tasks about a much-discussed, current issue. For each task, 75 minutes were given to write a text of 600 to 800 words. According to the design below, students were or were not required to make an outline before elaborating their full text. Task1 Task2 O-O+ condition ($n=18$) No outline Outline O+O+ condition ($n=16$) Outline Outline (O+=With Outline-Tool; O?=Without Outline-Tool) All students first completed a general questionnaire on their computer skills, writing style, use of news media and prior knowledge of the argumentative text structure. Prior to the first writing task with outlining, students received a 10-minute instruction in which the tool and its working were explained; no instruction was given on outlining as a text-structuring technique. The tool used in the experiment was the outline function embedded in the 'view' menu in Microsoft Office Word 2007. After each writing task, students completed a retrospective questionnaire on tool use and on perceived cognitive load. To assess text quality, an assessment protocol for the assessment of argumentative text-quality developed by Erkens, Kanselaar, Prangma and Jaspers (2002) was adapted and applied. The evaluation procedure distinguished the degree to which students were able to (1) correctly and completely establish a text structure (i.e. distinguish and elaborate an introduction, text body and conclusion) and (2) clearly present this structure (i.e. distinguish paragraphs, use connectives and anaphors). Hypotheses concerning outlining effects were tested by univariate ANCOVAs for between subject comparisons. In the case of the within subjects comparisons, Paired Samples T tests (one-tailed; p

Results and conclusions

Results indicate that text quality was affected by electronic outlining in different ways. Students using the outline-tool during the first task, tended to elaborate their text's structure slightly more deeply than students who did not outline ($F(1, 30)=3.29$, $MSE=13.00$, $p=.081$, $\eta^2=.11$). Concerning the effects of repeated outlining, the second text of students from the O+O+ condition showed a significantly more deeply elaborated structure than that of students from the O?O+ condition ($F(1, 25)=7.97$, $MSE=12.09$, $p=.010$, $\eta^2=.27$). Moreover, students from the O+O+ condition showed a significant improvement in structure elaboration ($t=?1.95$, $p=.037$, $df=12$) and a marginal improvement in structure presentation ($t=-1.62$, $p=0.07$, $df=12$) over both tasks. Although positive effects of student's first experience with electronic outlining do not all reach statistical significance, there are trends that may not be neglected. Results suggest that electronic outlining has beneficial effects for structuring and presenting text structure. The fact that the positive effects are most prominent for the O+O+ condition on the second writing task, suggests that students profit more from electronic outlining when they use the tool more frequently. On the second writing task, students in the O+O+ condition reported a decrease in cognitive load as opposed to the first writing task ($t=1.75$, $p=.052$, $df=13$). What is more, students in the O?O+ condition reported a significant decrease in cognitive load over the two writing tasks ($t=2.80$, $p=.008$, $df=13$). The intervention (i.e. the outline-tool) during the second writing task reinforced the decrease in perceived cognitive load. According to self-report data, only 10% of the respondents reported having used the outline-tool prior to the experiment. Though this was the case, students indicated that they immediately understood the functioning of the tool. The O+O+ and the O?O+ condition scored 4.47 and 4.93 respectively on a 5-

point Likert scale on tool appropriation. Only a short outline instruction and the requirement to use the tool, appears to initiate a process of appropriating the tool for writing. After performing both writing tasks, 54 % from the O+O+ condition and 69% from the O?O+ reported that they intended to use the outline-tool for subsequent writing tasks.

The outline-tool's straightforward nature and its user-friendly design enabled students to quickly appropriate and appreciate it. It is important to realize that students, in general, do not spontaneously use the outline-tool, or any other planning strategy. Students may profit most from electronic outlining when it is combined with effective and explicit instruction by teachers. Therefore, future research should focus on developing valid guidelines for teachers to instruct students on using outline-tools and integrating them optimally in their education.

References

- Erkens, G., Kanselaar, G., Prangma, M., & Jaspers, J. (2002). Using tools and resources in computer supported collaborative writing. In G. Stahl (Ed.), *Computer support for collaborative learning: Foundations for a CSCL community* (pp. 389-399). Hillsdale, NJ: Lawrence Earlbaum Associates.
- Kellogg, R. (2008). Training writing skills: A cognitive developmental perspective. *Journal of writing research*, 1(1), 1-26.
- Kozma, R. (1991). The impact of computer-based tools and embedded prompts on writing processes and products of novice and advanced college writers. *Cognition and Instruction*, 8(1), 1-27.
- Walvoord, B., Anderson, V., Breihan, J., McCarthy, L., Robison, S., & Sherman, A. (1995). Functions of outlining among college students in four disciplines. *Research in the Teaching of English*, 29, 390-421.

PAPER PRESENTATION

Listening to an Educational Podcast While Walking or Jogging. Can Students Really Multitask?

Joke Coens, Katholieke Universiteit Leuven, Belgium; Ellen Degryse, Katholieke Universiteit Leuven, Belgium; Marie Paul Senecaut, Katholieke Universiteit Leuven, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium

The advent of podcasting offers opportunities for students to learn while performing another activity (e.g. listening to an educational podcast while jogging). Two experiments were set up to examine the effect of performing a secondary task while learning with an iPod. In the experimental group, the participants had to combine a learning task (listening to an educational podcast) with a secondary task (walking or jogging). The control group only had to perform the learning task. Afterwards, all the participants had to complete a learning test. In study one, there were no significant differences between the learning performances of students of the different conditions. In study two, the students who were sitting down outperformed the students who were jogging while studying.

Introduction

In recent years, podcasting has seen a significant growth in education (McGarr, 2009). A possible explanation may be that podcasting offers opportunities for education because it has the advantage of allowing learners to choose when and where they study (Evans, 2008). This increased flexibility relates to a specific feature of mobile learning in general and podcasting in particular: students can learn while performing another activity (e.g., listening to an educational podcast while waiting for the bus, while driving a car or while doing the dishes; studying while being on the move). Students can become real educational 'multitaskers'.

The main aim of the reported studies is to address the effect of multitasking while learning. Can students really multitask? Or is it a myth (Kirschner, 2010)? Research, often conducted within laboratory settings, reveals that, although people often believe that they can successfully combine two tasks, it is not so evident for people to do two things at the same time and to divide their attention between multiple tasks (e.g. Pashler, 1994). In the field of educational multitasking, the research results are not univocal. Some studies reveal clear significant effects of multitasking (learning with a mobile device while doing something else) on the learning performances of students (e.g., Doolittle & Mariano, 2008), other studies do not (e.g., Coens, Reynvoet, & Clarebout, 2009).

Two experiments were set up to examine the effect of performing a secondary task (walking or jogging; difference in intensity) while listening to an educational podcast. It was examined what the consequences are of multitasking for learning with a mobile device.

Method

Participants

In study 1, the participants were 36 first year Physical Education bachelor students from a Belgian university college (academic year 2009-2010). Twenty-five male and 11 female students, on average 18.81 years old ($SD = 1.09$), participated voluntarily. In study 2, 75 secondary education students participated (school year 2009-2010). Twenty-eight were male, 47 were female. They were on average 15.05 years old ($SD = 0.73$). Participation in the study was obligatory.

Procedure

In both studies, participants were randomly divided into three groups. Students of the control group listened to an educational podcast while they were sitting down. Students of the first experimental group were asked to walk while listening and students of the second experimental group had to jog at a moderate pace while listening.

In study 1, the podcast was part of the physiology course. The provision of the podcast replaced the traditional face-to-face lecture. The podcast took four minutes; students had to play the lesson twice. In study 2, the topic of the podcast was dyspraxia and the content was not part of a specific course. The podcast took 11 minutes and 40 seconds; students had to listen to the lesson once.

All students had to complete a prior knowledge test before they listened to the podcast. Afterwards, they completed a learning test.

Analyses

ANOVA's were performed with the learning performances of the students as dependent variable. Two independent variables were included. Condition (sitting – walking – jogging) was included to examine the effect of performing a walking or jogging task. Also possession of an MP3 player was included because it is assumable that students who possess an MP3 player are more used to listen to it while doing something else than students who do not possess their own player. It is assumable that it is easier for those students to learn while walking or jogging.

Results

Study 1

The descriptives show that students who were sitting down while listening to the podcast learned the most. Students who were jogging while learning learned the least. However, the differences between the learning performances of students of the different conditions (sitting – walking – jogging) are not significant; $F_{condition(2,30)} = .58$; $p_{condition} = .57$; $\eta^2_{condition} = .04$.

The descriptives also show that students who possess an MP3 player learned more than students who do not possess an MP3 player. However, also here the difference is not significant; $F_{MP3(1,30)} = .095$; $p_{MP3} = .76$; $\eta^2_{MP3} = .003$.

Study 2

The descriptives show that students who were sitting down while listening to the podcast learned the most. A significant effect was found of condition (sitting – walking – jogging) on the learning scores; $F_{condition(2,69)} = 3.09$; $p_{condition} \leq .05$; $\eta^2_{condition} = .08$. The post-hoc test reveals that students who studied while sitting down outperformed the students who studied while jogging; Bonferroni; $p = .05$. Students in the walking condition took a middle position. They did not differ significantly from one of the other conditions.

The descriptives show that students who possess an MP3 player got a better score on the learning test than the students who do not possess an MP3 player. However, the difference is not significant; $F_{MP3(1,69)} = 0.98$; $p_{MP3} = .33$; $\eta^2_{MP3} = .01$.

Conclusion and discussion

Two studies were presented where part of the participants were asked to walk or to jog while listening to an educational podcast. Both studies reveal different results. In study 1, no significant differences were found between the learning performances of students in the stationary condition, the learning performances of students in the walking condition and the learning performances of students in the jogging condition. In study 2, the learning outcomes of the participants in the different conditions differed significantly. Students who studied while sitting down outperformed the students who studied while jogging.

The results of both presented studies are not univocal. In a certain way, they are a reflection of the different research results found in the field of educational multitasking so far.

The different results of study 1 and study 2 could be caused by the different podcasts that were used. In study 1, the podcast took four minutes and students had to listen twice. In study 2, the podcast took almost 12 minutes and students had to listen only once. The different results of both studies could be an indication that the use of podcasts while being mobile is more suitable for situations in which small chunks of content have to be learned.

PAPER PRESENTATION

Teachers' reluctance to use ICT in their pedagogical practices

Karel Kreijns, Open Universiteit Nederland, Netherlands; Marjan Vermeulen, Open Universiteit Nederland, Netherlands; Hans van Buuren, Open Universiteit Nederland, Netherlands; Frederik Van Acker, Open Universiteit Nederland, Netherlands

Abstract

Teachers' reluctance to use ICT in their pedagogical practices is addressed in the context of teachers' usage of digital learning materials (DLMs). Analysis using structural equation modeling revealed that the dispositional variables attitude, subjective norm, and self-efficacy towards DLMs are significant predictors of teachers' intention to use DLMs. The contribution of subjective norm, however, is rather limited. The dispositional variables mediated the effects of the distal variables 1) previous use of DLMs, 2) perceived knowledge and skills to use DLMs, and 3) colleagues' usage of DLMs on intention. Persuasive communication and skills based training seem, therefore, appropriate interventions to promote a positive attitude towards DLM and improve self-efficacy in using DLMs.

Introduction

Information and communication Technology (ICT) are considered to be a set of tools enabling, supporting, and reinforcing educational reform that fits the educational demands of the knowledge society (Ward, 2005). However, research on teachers' use of ICT revealed that teachers are reluctant to integrate ICT in their pedagogical practices. Therefore, the question arises why this is so. In this paper we address the question in the context of teachers' usage of digital learning materials (DLMs).

Theoretical framework

We use the Integrative Model of Behavior Prediction (IMBP, see Fishbein, 2000) to gain insight in the factors that explain teachers' reluctance to use ICT. In IMBP the three dispositional variables attitude, subjective norm, and self-efficacy towards DLMs use are the immediate antecedents of teachers' intention to use DLMs. Intention, in turn, is a predictor of real usage of DLMs by teachers. The relationship between intention and real usage of DLMs is moderated by environmental variables that may impede real usage (e.g., the non-availability of appropriate DLMs) and by teachers' actual knowledge and skills to use DLMs in a pedagogical manner. Figure 1 displays IMBP for the domain for the advancement of the integration of ICT in teachers' pedagogical practices. This figure also shows that the variables are grouped into proximal, distal and ultimate variables. Proximal variables include all the dispositional variables. The distal variables encompass all the variables at the level of teachers' characteristics and school organization, and the ultimate variables the variables at the level of local, regional, and governmental organization.

Research Questions

Two research questions are addressed in this paper: R(1): How is 1) attitude, 2) subjective norm, and 3) self-efficacy related to teachers' intention to use DLMs. R(2): What is the influence of 1) previous use of DLMs, 2) perceived knowledge and skills to use DLMs, and 3) colleagues' usage of DLMs on the three dispositional variables. Method A questionnaire encompassing all relevant measures was administered electronically in December 2009 to teachers of primary and secondary schools. Analysis and Results The data is, after the removal of outliers, analyzed using structural equation modeling (SEM) with SPSS AMOS version 18. Figure 2 depicts the initial model.

When inspecting the model, the initial model from Figure 2 showed poor fit. According to Byrne (2010) and others (Hu & Bentler, 1999) a Goodness of Fit Index (GFI), an Adjusted Goodness of Fit Index (AGFI) and a Comparative Fit Index (CFI) of between .9 and 1.0 indicate good fit. The Root Mean Square of Error of Approximation (RMSEA) should be between the .0 and .10. The initial model does not comply with the suggested requirements ($\chi^2(df = 8, N = 1207) = 749.2$, $p 2(df = 7, N = 1207) = 85.5$, p Figure 3 depicts the alternative model.

Path analysis using SEM revealed that a considerable part of the variance in intention is explained by the three dispositional variables attitude, subjective norm and self-efficacy ($R^2 = .73$, $p b = .56$, $p b = .35$, $p b = .09$, $p b = .22$, $p b = .22$, $p b = .21$, $p b = .06$, $p = ns$; $b = .02$, $p = ns$; $b = .07$, $p b = .18$, p Conclusion Interventions that are aimed to increase the use of DLMs in teachers' pedagogical practices should pay attention to improve self-efficacy of teachers,

for example, by providing them with skills based training programs. Besides, initiatives that promote a positive attitude towards DLMs use may also contribute to the use of these. For example, by means of campaigns that are based on the persuasion communication model (McGuire, 1985) and that elaborate the added value of DLMs in education. Furthermore, personnel policy should, if teachers apply for a job, favor those teachers that already have some experience with DLMs.

Literature

- Byrne, B. (2010). *Structured equation modeling with AMOS: Basic concepts, applications, and programming* (2nd ed.). New York: Psychology Press, Taylor & Francis Group
- Fishbein, M. (2000). The role of theory in HIV prevention. *AIDS Care*, 12, 273–278.
- Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.
- McGuire, W. J. (1985). Attitudes and attitude change. In G. Lindzey & E. Aronson (Eds.), *Handbook of social psychology* (3rd ed., Vol. 2, pp. 233-246). New York: Random House.
- Ward, L. (2005). *Putting policy into practice: Pedagogical reform through ICT*. Unpublished doctoral thesis, The University of Auckland, New Zealand.

PAPER PRESENTATION

Learning with interactive videos: the interplay of features, training and task characteristics.

Martin Merkt, Knowledge Media Research Center, Germany; Stephan Schwan, Knowledge Media Research Center, Germany

Whereas recent research with videos revealed the necessity of self-regulated information processing on a local level, the usefulness of features facilitating the location of information has not gone undisputed (Merkt, Weigand, Heier, & Schwan, in press). This study was designed to identify prerequisites for successful implementation of videos allowing different levels of interactivity in a classroom plus homework scenario. Before working with a common video allowing self-regulated information processing on a local level or an enhanced video additionally facilitating the location of information inside the video, 64 9th graders from eight German history classrooms finished either an experimental training demonstrating the efficient use of features facilitating the location of information or a control training focusing on the integration of new information with prior knowledge. While watching the video as a homework assignment, students wrote two essays (E1: summary; E2: inference) about the video's content and finished a search task. Whereas the enhanced video outperformed the common video on the search task independent of training, the experimental training was necessary for students to benefit from additional interactivity when summarizing the video's content. However, when inferences were required, the experimental training benefitted the common video, whereas there was no training effect for the enhanced video. These results indicate that even if students are aware of the distribution of facts across media, features allowing the location of information are most beneficial for tasks that require the extraction of information rather than inferencing about the contents.

Theoretical background

Videos are an integral component of the educational environment students face today (Feierabend & Klingler, 2003). However, earlier media comparisons found videos to be inferior to print when people learned complex content (e.g. Walma van der Molen & van der Voort, 2000). In contrast to print, videos used in these studies did not afford self-regulated information processing that positively affects learning outcomes (use of lookbacks: Hyßnä, Lorch, & Kaakinen, 2002; use of an index: Yussen, Stright, & Payne, 1993). Recent studies with videos affording self-regulated information processing revealed beneficial effects of interactivity (Schwan & Riempp, 2004), so that videos were comparable to print (Merkt, Weigand, Heier, & Schwan, in press). Whereas the use of features facilitating information processing on a local level (stopping, browsing) was unproblematic, the implementation of features facilitating the location of information in a medium (table of contents, index) led to the consideration of information from less chapters when students wrote essays about the media's contents. These results may be due to students' misconceptions about the distribution of information across media leading to a neglect of information from chapters that are not explicitly linked to the wording of an essay task. The current study aimed to back this explanation with evidence by implementing a training fixing potential misconceptions. Additionally, we tested for positive effects of features allowing the location of information on searching for isolated facts.

Method

The study was implemented in a classroom (two lessons à 45 minutes) plus homework context in eight German history classrooms (9th grade). Sixty-four students (38 female; mean age = 14.84) were randomly assigned to one of four

conditions and finished the entire experiment. In lesson 1, individual prerequisites (prior knowledge, interest and self-appraisal in history, reading strategies, homework motivation) that might influence the study's outcome were assessed. Then, the students were given a homework assignment which consisted of training and a video. Both training and the video were manipulated experimentally. The experimental training gave an overview of different characteristics of media (e.g. distribution of information) and about how features like table of contents and index could be used when locating information. Additionally, the activation of prior knowledge was addressed, because the control training described information acquisition as a process of integrating new information with prior knowledge. With regard to the video, the level of interactivity afforded by the videos was varied. Whereas a common video offered basic features like start / stop and browsing via forward and rewind, an enhanced video offered features like chapter selection via slider or table of contents as well as an index in addition to start / stop and browsing via slider.

After the training, students wrote two essays about the implementation of the Potsdam Treaty (essay 1) and about whether the separation of Germany was predictable from the events between 1945-1949 (essay 2) while watching the video about "Post-War Germany" after World War II. Whereas essay 1 required the extraction of information from various chapters of the video, essay 2 required inferences going beyond the information explicitly mentioned. After the essays, the students had five minutes to finish a search task in which they had to locate eleven details in the video. Due to changes to the search task after assessing the first classroom, results for the search task are only available for seven classrooms. The students' navigation through the video was recorded via logfiles. In lesson 2, a multiple-choice test about the content of the video as well as a questionnaire about the students' experiences with the videos was administered.

Results

The knowledge test revealed no difference between the experimental conditions, all $p > .17$. Essays were coded by two independent raters for the number of information mentioned. For essay 1, there was an interaction between the factors video and training, $F(1,60) = 3.98$, $p = .051$, with the enhanced video benefitting from the experimental training, whereas there was no training effect for the common video. For essay 2, there was an interaction between the factors video and training, $F(1,60) = 3.88$, $p = .054$, with the common video benefitting from the experimental training, whereas there was no training effect for the enhanced video. For the search task, the students working with the enhanced video found more facts - independent of training, $F(1,46) = 19.46$, p

Discussion

Ninth grade students can successfully use the enhanced video to search for information. However, when summarizing information from various chapters, awareness about the distribution of facts across media is necessary so that students can benefit from the enhanced video. In contrast, when inferences about the video's content are required, this awareness does not lead to an improvement in the enhanced video condition, but in the common video condition. These results indicate that features facilitating the location of information are most beneficial for tasks that merely require the extraction of information from videos rather than for tasks that require inferencing about the videos' contents.

References

- Feierabend, S., & Klingler, W. (2003). Lehrer/-Innen und Medien 2003. Medienpädagogischer Forschungsverbund Südwest.
- Hyßnä, J., Lorch, R., & Kaakinen, J. (2002). Individual differences in reading to summarize expository text: Evidence from eye fixation patterns. *Journal of Educational Psychology*, 94(1), 44-55.
- Merkt, M., Weigand, S., Heier, A., & Schwan, S. (in press). Wissenserwerb mit interaktiven Unterrichtsfilmen im Fach Geschichte. In J. Hodel & B. Ziegler (Eds.), *Forschungswerkstatt Geschichtsdidaktik 09 : Beiträge zur Tagung "geschichtsdidaktik empirisch 09"*. Bern: hep-Verlag.
- Schwan, S., & Riemp, R. (2004). The cognitive benefits of interactive videos: Learning to tie nautical knots. *Learning & Instruction*, 14, 293-305.
- Walma van der Molen, J., & van der Voort, T. (2000). Children's and adults' recall of television and print news in children's and adult news formats. *Communication Research*, 27(2), 132-160.
- Yussen, S., Stright, A., & Payne, B. (1993). Where is it? Searching for information in a college textbook. *Contemporary Educational Psychology*, 18(2), 240-257.

PAPER PRESENTATION

The Preparation of Teachers for Global Learning Environments - The Integration of Virtual and Actual

Ken Stevens, Victoria University of Wellington, New Zealand; Barbara Craig, Victoria University, New Zealand

Teachers are increasingly likely to teach in the spaces between schools as well as within the institutions to which they are appointed. Moreover, teachers are interacting with learners beyond the confines of the traditional school day. Teachers in some parts of the world are providing instruction beyond traditional classrooms in networks of schools that are located beyond major centres of population. In other places they are collaborating in networks of schools in inner city urban communities. Small, geographically isolated and large inner city urban schools alike are finding new opportunities in a global networked society. Using new digital technologies (Web 2.0) in the delivery of teaching and learning creates possibilities for teachers today to network and collaborate beyond their institutional walls (Granic, C'ukusic & Walker, 2009; O'Brien, Varga-Atkins & Qualter, 2008). Research on rural and urban learning networks is based on the convergence of two conceptual frameworks: (i) open and closed schools and (ii) horizontal and vertical integration. The convergence of these two frameworks guides the transfer of knowledge and skills from teacher education designed for teaching in traditional, physical, classrooms to include virtual teaching and learning based on a matrix of conceptual, pedagogical, technological and organizational change (Stevens, 2007). A process of teacher education is outlined in which teachers are prepared for the integration of actual (or physical) classes with virtual learning environments as schools are networked. The implications for teaching and learning in a global networked society have institutional, policy, financial and pedagogical implications.

This research is based on the convergence of two conceptual frameworks: (i) open and closed schools and (ii) horizontal and vertical integration. The convergence of these two frameworks will guide the transfer of knowledge and skills from traditional teacher education, focused on single classrooms, to open learning environments that include both inter-institutional teaching and learning and local and global community engagement. The two frameworks will be interpreted within a matrix of conceptual, pedagogical, technological and organizational change (Stevens, 2007). Schools as we have known them are autonomous institutions with their own teachers, their own students and their own cultures. Schools in each community to a considerable extent duplicate what schools are doing in other communities with students being taught by teachers assigned to teach face to face to whole classes, small groups and, in some cases, individually. There is nothing remarkable about this model of the school and it is an accepted part of the global educational landscape. Perhaps the most remarkable feature of this model of the school is that it remains largely unchallenged. This will be considered to be a "closed" model of the school. The "open" model is based on schools academically and administratively integrating with one another and with other institutions for at least part of a school day. Information and communication technologies facilitate the linking of classes in schools to share teaching, learning and resources. New digital technologies encourage learners to take control of their own learning, connecting them to experts locally and globally and allowing participation in virtual spaces. The open model challenges the closed model of the school by questioning the need for appointing all teachers to schools, rather than, in appropriate cases, some teachers being appointed to networks of schools (Ertl & Plante 2004). It questions the appropriateness of learners engaging solely with their peers within their own, physical classrooms and, it questions the very notion of a school itself. The open model of the school is grounded in the application of information and communication technologies to teaching and learning and the construction and deconstruction of virtual classes. In the open model of the school teaching and learning takes place electronically between as well as in classrooms. In the open model teaching and learning involves collaboration and connections between students, between students and teachers, students and experts, and, more often than not, beyond the confines of their own classrooms, their own school and their own country. In the closed model, teaching takes place only in classrooms.

The electronic linking of schools across dispersed sites to create academically and administratively integrated educational structures that support traditional, on-site teaching and learning, can be conceptualized as "horizontal integration" (Stevens & Stewart, 2005). By extending this model at the local or community level through connecting digitally with selected homes, services, libraries and businesses, "vertical integration" can be achieved. By vertically integrating homes into sites (local schools) that are horizontally integrated into federated teaching and learning structures (school district intranets), intellectual and skill capacity building can be leveraged. This model challenges the traditional concept of the school that is open only certain hours of the day and certain weeks of the year.

There are implications of the shift from closed to open classes and in the horizontal and vertical integration of schools for global learning (Barab, et. al., 2001). Schools can be extended in terms of time, space, organization and capacity. This will be demonstrated on the basis of New Zealand research in inner city urban environments (Craig & Coman, 2009) and from Canadian research in rural communities (Hawkes & Halverson, 2002; Stevens & Stewart, 2005). The New Zealand research considers the pedagogical advantages of aggregating 6 urban high schools into a learning network and connecting them to wider opportunities through a bridge onto the Kiwi Advanced Research and Education Network (KAREN).

There are implications for the professional education of teachers for schools that have the capacity to engage with global learning environments (Green & Hannon, 2007; Lai, 2005; Scardamalia & Bereiter, 2006). New Zealand and Canadian research identifies specific technology gaps, teacher preferences for training approaches as well as new ways of relating to learners, to learners' parents, to networks and to communities that have implications for teacher professional development. Five implications will be analyzed in concluding this paper and will, hopefully, generate discussion that will inform current and future research.

References

- Barab, S.A., Thomas, M.K. & Merrill, H. (2001). Online Learning: From Information Dissemination to Fostering Collaboration, *Journal of Interactive Learning Research*, Vol. 12, No.1, pp: 105 – 143
- Craig, Barbara & Clare Coman (2009). Wellington Loop Preliminary Report December 2009 Department of Internal Affairs, New Zealand Government.
- Ertl, H. & Plante, J. (2004). Connectivity and Learning in Canada's Schools, Ottawa, Statistics Canada, Government of Canada.
- Granic, Andrina, Maja C'ukusic & Rob Walker (2009). mLearning in a Europe-wide network of schools. *Educational Media International* Vol.46, No. 3, September 2009, 167-184.
- Green, H. & Hannon, C. (2007). *Their Space: Education for a Digital Generation*, London, Demos.
- Hawkes, M. & Halverson, P. (2002). Technology Facilitation in the Rural School: An Analysis of Options, *Journal of Research in Rural Education*, 17 (3), 162-170
- Lai, K-W. (2005). *e-Learning Communities: Teaching and Learning With the Web*, Dunedin, University of Otago Press
- O'Brien, M., Varga-Atkins, T. & Qualter, A. (2008). *The Liverpool learning networks: Developing, deepening, delivering*. Final report of the Liverpool learning networks research project. Liverpool: The University of Liverpool for Liverpool City of Learning.
- Scardamalia, M. & Bereiter, C. (2006). Knowledge-building: Theory, Pedagogy and Technology, In: R.K.Sawyer (ed), *The Cambridge Handbook of the Learning Sciences*, New York, Cambridge University Press.
- Stevens, K.J. (2007). A Matrix for e-Collaboration to Provide Extended Learning Opportunities in Rural Schools, In: Ned Kock (ed) *Encyclopedia of E-Collaboration*, Hershey & New York, Idea Group Reference.
- Stevens, K.J. & Stewart, D (2005). *Cybercells – Learning in Actual and Virtual Groups*, Melbourne, Thomson-Dunmore Press.

PAPER PRESENTATION

Dynamic model toward school changing experimentations

Nadia Rousseau, Universite du Quebec a Trois-Rivieres, Canada; Helene Fournier, U. du Quebec a Trois-Rivieres, Canada; Luc Prud'homme, Universite du Quebec a Trois-Rivieres, Canada; Caroline Vezina, Universite du Quebec a Trois-Rivieres, Canada

School plays a crucial role in student development and affects student perseverance. Quebec's high dropout rates induce the necessity for change. For instance, in 2007-2008, 25.7% of Quebec teenagers were not enrolled in school, had not completed high school and therefore were considered as dropouts (MELS, 2009). In this study, we consider the changing process in the Quebec school context that promotes student success and well-being. We examine specifically the essential requirements contributing to changes in schools pertaining to pedagogical and organisational practices.

An action research protocol focusing on training is chosen throughout the three years of the study (2007-2009). Various procedures are carried out and monitored: documenting the challenging issues faced by the four participating schools, planning the expected experimentations, and implementing them.

Introduction

School plays a crucial role in student development and affects student perseverance. Quebec's high dropout rates induce the necessity for change. For instance, in 2007-2008, 25.7% of Quebec teenagers were not enrolled in school, had not completed high school and therefore were considered as dropouts (MELS, 2009). In this study, we consider the changing process in the Quebec school context that promotes student success and well-being. We examine specifically the essential requirements contributing to changes in schools pertaining to pedagogical and organisational practices.

Objectives

- 1) Mobilise school teams (teachers and principals) to change their practices
- 2) Document and analyse the changing process
- 3) Create a theory of the research-supported change process

Theoretical Framework

An extensive literature review on the educational changing process is completed using six electronic documentary bases. 226 texts are selected regarding environment, teachers, schools, students, teaching, and education. This intensive literature review displays the complexity of change in Education (Schermerhorn, Hunt & Osborn, 2002) and the difficulty to support actors of the changing process in this context. (Garant, 2003).

Methodology

An action research protocol focusing on training is chosen throughout the three years of the study (2007-2009). Various procedures are carried out and monitored: documenting the challenging issues and critical incidents faced by the four participating schools, defining and planning the expected experimentations, and implementing them. 69 teachers, educators and school principals are involved in the study. A major data collection is carried out to document the procedures previously mentioned. Field observations, recordings of workshop group activities and reflections of the participants, and a questionnaire are the main instruments used. Also, the researchers were collecting data through their research journal.

A qualitative network analysis approach is used with Atlas-ti (Weitzman, 2000). An inductive coding is performed on 2,794 pages to obtain 106,352 meaning units and create 558 codes.

Findings and discussion

A dynamic model of school change is created based on the data collected. The changing process includes three steps: 1) identification of challenges associated with the school orientation and mission; 2) implementation of change; and 3) assessment and identification of new challenges. The model is composed of the following themes: challenges generated by the school orientation and mission; current context, school culture as well as proximal and distal actors.

Identification of the school orientation and mission reveals to be a crucial component of the school change process. Considered as the starting point for the actions to be carried out through the experience of change, the orientation appears as the keystone that maintains coherence between these actions, therefore acting as a lighthouse for participants, pointing toward these principles that they have agreed on. Furthermore, this orientation becomes the basis to help define concrete objectives to follow before planning experimentations. Along our process, we agreed that the school mission identify the process of articulating concrete objectives for action conveying a concrete vision of the orientation. This initial part of the process tends to help participants to observe the actions conducted in the school in order to evaluate their coherence and consistency, to look more attentively at what we preach (orientation and mission) and what we practice (culture of the school). In other words, it helps consider to what extent the school is ready for change.

A continuum of readiness is considered to situate the participants: 1) No, there is no need to change; 2) There is a need to change, but...; 3) Yes, there is a necessity to change.

Promoting conditions for change are numerous. Among these conditions are: personal and professional characteristics of the participants closely involved in the changing process, relationships with students, actual hope to change, and tolerance toward novelty. Obstacles, which can vary from one school or individual to the other, are the followings: narrow-mindedness, disengagement, lack of cohesion, personal and professional insecurity, lack of leadership, negative attitudes, resistance to change, lack of time, concerns for the extent of the task, and project feasibility. Promoting conditions and obstacles can affect minimally, moderately or fundamentally the participants.

Conclusion and Educational Significance of the Study

The proposed dynamic model is grounded on a wide-reaching empirical study. It can be applied in numerous school contexts. The many produced reports and created working instruments can guide numerous official bodies and individuals to implement changing. They can help government ministries and departments, universities, colleges, schools, professional bodies, and communities interested in student success and well-being.

References

Garant, M. (2003). Pilotage et accompagnement de l'innovation dans un établissement scolaire. Dans ministère de l'Éducation nationale, de la Recherche et de la technologie. L'innovation, levier de changement dans l'institution éducative. Paris : CNDP.

Ministère de l'Éducation, du Loisir & du Sport, (2009). Indicateurs de l'éducation – Éditions 2009. Québec : Québec Gouvernement.

Schermerhorn, J.R., Hunt, J.G. & Osborn, R.N. (2002). Comportement humain et organisation, (2e éd.). Saint-Laurent : Éditions du nouveau pédagogique Inc. Handbook of qualitative research (2e ed.). Thousand Oak, CA: Sage.

Weitzman, E.A. (2000). Software and qualitative research. In N.K. Denzin et Y.S. Lincoln, Handbook of qualitative research (2e ed.). Thousand Oak, CA: Sage.

PAPER PRESENTATION

Learning about Controversial Issues in Museums: Visitors' Attitudes towards Conflicting Information

Doris Lewalter-Manhart, TUM, Germany; Wolfgang Schnotz, University of Landau, Germany; Inga Specht, TU Munich, Germany; Rahel Gruninger, University of Landau, Germany

Museums are nowadays oft confronted with the fact that science cannot provide clear answers to specific questions, because there are unsolved controversies based on conflicting evidence. A relevant research question is how the audience can cope with this kind of conflicting information. It is assumed that specific personality variables such as tolerance for ambiguity, epistemological beliefs, self-efficacy and topic-specific interest have an impact on processing of conflicting information. An empirical study was carried out which aimed at (1) identification of visitor profiles on the basis of these individual person variables, (2) assessing the domain specificity of these visitor profiles, and (3) assessing differences in the frequency of visitor profiles connected with the visitor's age, gender and habitual museum visits. A questionnaire was presented to 1002 visitors from two scientific and technological museums and two cultural and historical museums was conducted. A cluster analysis revealed seven different clusters, ranging from visitors who dislike ambiguity to visitors who can be described as "independent thinkers". Findings indicate domain-specific differences in the frequency of visitors allocated in the different clusters. Domain-specific differences were only identified for topic-specific interest and epistemological beliefs. The findings indicate also differences between clusters regarding gender and habitual museum visits, but not on age. The heterogeneity of visitors is a specific challenge for the design of exhibitions in museums as informal learning settings.

Theoretical background and research aims

Learning occurs at many different places. Besides formal learning settings such as schools or universities, informal learning settings can also be found at other places such as museums, which play an important role as sources of information for the general public. Visitor studies have shown that almost half of the German population can be reached by this learning context (Wersig & Graf 2000). Adult visitors of museums are not a homogenous group regarding learning relevant characteristics (cf. Gibbs, Sani & Thompson, 2006). They differ, for example, with regard to their professional qualification, life experience or personal affinities. Furthermore it has to be considered that museums are free choice learning settings which are used by the audience in an autonomous and self-regulated manner. That implies among other things that visitors stop paying attention to an exhibit if it does not appeal to them. Nowadays, museums are confronted with the task to present unsolved issues based on fragile or even conflicting evidence. Therefore museums have to meet the challenge to present fragile information to laypersons instead of well founded secure knowledge in an attractive and simulating manner.

But how does the audience cope with the fact that the presented information is fragile or even conflicting?

It is assumed that beneath situational factors (e.g. characteristics of information presentation) individual person variables of the visitors have an impact on information reception and the handling of divergent information. It is therefore an important aim of research to identify the individual factors that have an influence on the visitor's strategies in handling conflicting evidences in the domain of science and technology. To meet this aim, different visitor types need to be identified on the basis of individual person variables which are considered relevant for dealing with conflicting evidences. We assumed tolerance of ambiguity, epistemological beliefs, self-efficacy and topic-specific interest to be important personality characteristics that influence cognitive processing of conflicting information.

Ambiguity tolerance describes the ability to perceive ambiguity in information in a neutral and open way. It is assumed that tolerant individuals should perform well when confronted with contradicting information while intolerant individuals may tend to avoid or give up when encountering ambiguous information (e.g. Jonassen and Grabowski, 1993; Reis, 1997). Epistemological beliefs are fundamental assumptions about the nature of knowledge and learning as well as the limits, certainty, and criteria of knowing (e.g. Conley et al., 2004). They also focus on aspects to describe in which situations and from which sources knowledge can be obtained. Furthermore, they have an effect on the ways and results of learning processes by influencing the perceived credibility of information and its

source for example. Self-efficacy describes the belief in one's own ability to perform a task (e.g. Schwarzer & Jerusalem, 1999). It is important for the willingness to deal with demanding information. Finally topic-specific interest focuses on the motivation to engage with a certain topic (Hidi & Renninger, 2006). In order to assess domain specific aspects, museums of science and technology are contrasted with history museums.

In this study we focus on the following research aims:

- 1) Identification of visitor profiles on the basis of individual person variables relevant for the visitor's strategies in handling conflicting evidences
- 2) Assessing the domain specificity of these visitor profiles (natural science and technology vs. cultural history)
- 3) Assessing differences in the frequency of visitor profiles connected to the visitor's age, gender and habitual museum visits

Research design

To explore the individual background of the museum visitors we conducted a questionnaire study in four museums (two scientific and technological museums N=460: Deutsches Museum, Munich, and Technoseum, Mannheim, and two cultural and historical museums N=542: Germanisches Nationalmuseum, Nuremberg and Staatliches Museum für Völkerkunde, Munich). The overall sample size was 1002 visitors (48% male, average age M = 42,5 years).

For this study a questionnaire was developed which contained scales on the above mentioned individual person variables items about socio-demographic aspects, reasons for the museums visit and indicators to identify habitual museum visitors. Tolerance of ambiguity was measured by a scale adapted from Kruglanski et al. (1993) and Radant & Dalbert (2006); epistemological beliefs were assessed by three subscales focusing on sources, certainty and development, adapted from Conley et al. (2004); self-efficacy was investigated by three subscales focusing on general, natural science and conflict-orientated self-efficacy adapted from Schwarzer & Jerusalem (1999), Waltner (2007) and Krampen (1991); topic-specific interest was measured by a scale adapted from Frey and Schütte (2009).

Results and significance

To identify different visitor profiles a cluster analysis with ClustanGraphics was calculated. Seven clusters were identified in total. These clusters range from visitors who dislike ambiguity to visitors who can be described as "independent thinkers". Findings indicate domain-specific differences in the frequency of visitor allocated in the different clusters in both domains. Significant differences were identified for topic-specific interest. Regarding epistemological beliefs only the subscale focusing on the source of knowledge revealed significant domain-specific differences. No significant difference could be found for ambiguity tolerance. Furthermore the results indicate differences between the clusters regarding gender and habitual museum visits. However, we did not find age-related differences.

Our findings suggest that the museum visitors are heterogeneous with respect to personality variables relevant for cognitive processing of conflicting information. This heterogeneity is a special challenge for the design of exhibitions in museums that take into account the capabilities and individual characteristics of a majority of visitors in order to stimulate their learning.

Future studies on learning about conflicting issues in museums should focus on detailed analysis of information processing by museum visitors while dealing with conflicting information in an exhibition. Analyzing visitor profiles may help the designers of exhibitions in museums a clearer impression of the audience's most relevant characteristics.

PAPER PRESENTATION

Developing as Teacher in Higher Education: The relationship between Teaching Beliefs and Practice

Caroline Trautwein, Centre for Higher and Further Education, Germany

There is an ongoing discussion on how university teachers' beliefs or conceptions influence their teaching practice. Findings indicate that beliefs and practice are not related in a linear but rather in a dialectic more complex way. This relationship needs to be understood in order to gain insight into how university teachers learn to teach. This paper reports findings of the first stage of a research project investigating the development of eight university teachers attending a teaching development programme. It focuses on changes in teachers' beliefs and practice and how they relate to each other. Three different types of relationships are identified on a cross-case level: Changes in practice without a change of beliefs, changes in practice due to changed beliefs, changes in beliefs due to a changed practice.

On a case level it also becomes obvious that the same assumptions constituting ones beliefs about teaching determine ones strategies in developing as academic teacher. Conclusions for teaching development programmes in higher education are drawn.

Introduction

For a long time researchers are interested in what constitutes good teaching. In the 1970s research interests shifted with the cognitive revolution towards schoolteachers' knowledge and beliefs (Kane, Sandretto, & Heath, 2002; Thompson, 1992). The research on academic teachers' beliefs has educed a large body of literature on conceptions of university teaching (for reviews, see Kane et al., 2002; Kember, 1997). Usually different conceptions of teaching are described between the extreme categories of a teaching or content centred and a student or learning centred conception of teaching (N. Entwistle, Skinner, D. Entwistle, & Orr, 2000). It was recommended that teaching development initiatives should aim at changing teachers' conceptions in order to improve the quality of university teaching (McAlpine & Weston, 2000) and conceptual change programmes were introduced (Ho, 2000). Later instructional development programmes of university teachers were criticised as they lacked empirical proof of influence on daily teacher practice (Devlin, 2006; Stes, Coertjens, & Petegem, 2009). Devlin (2006) Kane et al. (2002) and Thompson (1997) supposed that conceptions of teaching are not related in a simple cause-and-effect way to instructional practice, rather a more complex, dialectic relationship should be expected and investigated. Shedding light on this relationship may lead to a better understanding of how university teachers learn to teach (Kane u. a., 2002).

This paper reports findings of a research project investigating the relationship between academic teachers' beliefs and changes in their teaching practice.

Theoretical Background

Research on (academic) teachers' beliefs has to deal with a confusing construct (Kane et al., 2002; Thompson, 1992). Different definitions of the terms beliefs and conceptions and their relationship will be discussed in this section. Reference to the theoretical framework of theories of action will be made (Argyris & Schön, 1974).

Method

We accompany eight university teachers who attend a two-year teaching-developing programme and examine their development as teachers. Teaching beliefs and practice are examined through semi-structured interviews, observations of teaching practice and documented reflection conducted at two different stages of the teaching-programme. As this paper reports findings from the first stage of our study we only draw upon experienced development from the teachers' perspective. At a later stage it will also be possible to refer to changes in beliefs and practice as perceived from the researchers perspective.

At this stage incidents of perceived development as university teacher were extracted from the interviews. In a grounded theory approach relationships between beliefs and practice concerning these incidents were categorised and different types of relationships were described across cases.

On a case level also beliefs about teaching and the perceived development as university teacher were related.

Outcomes

A) Types of relationships between teaching beliefs and practice concerning change

The following types of relationships between teaching beliefs and practice can be inferred from incidents of perceived development as university teacher:

- 1) Changes in practice without a change of beliefs: There are changes in practice, which seem not to involve changing beliefs. For example changes of order in an existing curriculum. These changes seem to be of minor extent.
- 2) Changes in practice due to changed beliefs: In this category two different types can be found:
 - a. Some changes in practice are linked to the fact that existing weaker or peripheral beliefs become stronger or more central (Green, 1971). E.g. one teacher says it always has mattered to him what competences students have acquired through his teaching. But now this question has become a central concern to him, which is reflected in his teaching practice.
 - b. Other changes in practice are connected to new beliefs. E.g. one teacher acquires the belief that teaching needs to activate students in order to foster learning processes through reflected experience, so she starts using learner-activating methods in her teaching.
- 3) Changes in beliefs due to a changed practice: Also change in practice can lead to changing beliefs e.g. when a new teaching method is given a try and has a positive outcome.

B) Relationship between teaching beliefs and perception of development as university teacher

On a case level it becomes obvious that the same assumptions that constitute one's beliefs about teaching underlie one's perception of development as academic teacher. For example one teacher feels urged to impress students by his scientific performance, as he perceives them as colleagues rather than learners. Consequently he strives to acquire further disciplinary knowledge and describes his development in teaching mainly as having a broader knowledge. These findings are in line with Åkerlind (2007) who identified different conceptions of developing as university teacher influencing development as teacher.

Conclusion

Findings confirm the stated influence academic teachers' beliefs have on teaching practice and on the development as teacher. Furthermore they shed light on the relationship between beliefs and practice concerning change. Implications for teaching development programmes in higher education will be described.

References

- Åkerlind, G. S. (2007). Constraints on academics' potential for developing as a teacher. *Studies in Higher Education*, 32(1), 21-37.
- Argyris, C., & Schön, D. A. (1974). *Theory in practice: Increasing professional effectiveness*. Jossey-Bass San Francisco.
- Devlin, M. (2006). Challenging accepted wisdom about the place of conceptions of teaching in university teaching improvement. *International Journal of Teaching and Learning in Higher Education*, 18(2), 112-119.
- Entwistle, N., Skinner, D., Entwistle, D., & Orr, S. (2000). Conceptions and beliefs about "good teaching": An integration of contrasting research areas. *Higher Education Research & Development*, 19(1), 5-26.
- Green, T. F. (1971). *The activities of teaching*. McGraw-Hill New York.
- Ho, A. S. P. (2000). A conceptual change approach to staff development: A model for programme design. *International Journal for Academic Development*, 5(1), 30.
- Kane, R., Sandretto, S., & Heath, C. (2002). Telling Half the Story: A Critical Review of Research on the Teaching Beliefs and Practices of University Academics. *Review of Educational Research*, 72(2), 177-228.
- McAlpine, L., & Weston, C. (2000). Reflection: Issues related to improving professors' teaching and students' learning. *Instructional Science*, 28(5), 363-385.
- Stes, A., Coertjens, L., & Petegem, P. (2009). Instructional development for teachers in higher education: impact on teaching approach. *Higher Education*, 60(2), 187-204.
- Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. *Handbook of research on mathematics teaching and learning*, 127, 146.

PAPER PRESENTATION

Threshold concepts and conceptual change in Dutch Ph.D. students

Marjon Fokkens-Bruinsma, University of Groningen, Netherlands; Marjolein Torenbeek, University of Groningen, Netherlands

This study focuses on identifying threshold concepts in Dutch Ph.D. students, which may interfere with their development of becoming a scientific researcher. In June 2010 five Ph.D. students and two Ph.D.s completed a questionnaire on their experience of threshold concepts in their doctoral research. First results show that all threshold concepts mentioned by Kiley (2009) were indicated by the (former) Ph.D. students. With respect to the type of conceptual change all Ph.D. students and Ph.D.s reported basic conceptual change and procedural conceptual change. Finally, they indicated which aspects they believed most contributed to the conceptual change during their doctoral research.

Objectives

How do Dutch Ph.D. students develop new levels of thinking and researching, and new ways of being a researcher? During their doctoral studies, Ph.D. students face the challenge of learning to become a researcher. They have to acquire the discourse of the educational research domain, and have to learn to become an educational researcher with the appropriate skills and knowledge to perform independent research. This can be a great challenge to Ph.D. students and may result in struggles, an exceeding of the formal duration of the doctoral research or even non-completion. This challenge of becoming a researcher can be viewed from the perspective of "threshold concepts" (Kiley, 2009; Kiley & Wisker, 2009; Trafford & Leshem, 2009), concepts that, according to Meyer and Land (2003, p.1), "lead to a transformed way of understanding, or viewing something that may represent how people 'think' in a particular discipline, or how they perceive, apprehend or experience particular phenomena within a discipline". This

study focuses on identifying threshold concepts in Dutch Ph.D. students. It will help us understand the difficulties Ph.D. students face in their becoming a researcher and identify the strategies supervisors might use to help them. As such it provides us with more insight in the problem of attrition and retention of Ph.D. students in the Netherlands. The following research questions will be answered: Which threshold concepts do Dutch Ph.D. students encounter in the four years of their Ph.D project? What type of conceptual change takes place in these Ph.D. students in terms of basic conceptual change, discipline conceptual change and procedural conceptual change? How can Ph.D. students be assisted in their transformation to a researcher?

Methodology

The data for this study was collected at the department of Pedagogy and Educational Sciences of a Dutch research university. A questionnaire composed of open questions on threshold concepts experienced during the doctoral research was completed in June 2010 by five Ph.D. students and two Ph.D.s in the Social Sciences. Data were analyzed with a coding scheme based on Kiley's (2009) study, which contains the following threshold concepts: argument/thesis, theory, framework, knowledge creation, analysis, and research paradigm. We used Davies and Mangan's (2007) scheme for describing the type of conceptual change that had taken place during the doctoral research. They describe threshold concepts from a conceptual change perspective, where a new concept emerges from reworking of prior understanding or restructuring existing naive knowledge. They suggested three types of conceptual change, namely profound or basic conceptual change which, concerns understanding of everyday experience, discipline conceptual change, that is, understanding of other subject discipline ideas, and procedural conceptual change that is the ability to construct discipline specific narratives and arguments transformed through acquisition of ways of practicing" (p. 715). Each of the answers of the Ph.D. students and Ph.D.s have been analyzed and coded independently by the two authors.

Findings

First results show that all threshold concepts mentioned by Kiley were indicated by the Ph.D. students and Ph.D.s. Knowledge creation was one of the most mentioned threshold concepts, whereas framework was the least mentioned threshold concept. It was interesting to see that one of the Ph.D.s mentioned all threshold concepts, whereas most Ph.D. students mentioned one or two types of threshold concepts. Some of the Ph.D. students mentioned some threshold concepts which were incompatible with Kiley's categorization. With respect to the type of conceptual change all Ph.D. students and Ph.D.s reported basic conceptual change and procedural conceptual change. Discipline conceptual change was only mentioned by the Ph.D.s who had experienced this discipline conceptual change after their Ph.D. To conclude, students indicated that learning on the job (learning by doing), presenting and publishing one's work, feedback or coaching from supervisors, interaction with and feedback from significant others and following courses were the aspects in the process of becoming a doctoral researcher that had most helped them in their understanding of scientific research.

Theoretical and educational significance

Our study has several practical and theoretical implications. More insight in the threshold concepts allows us to indicate the difficulties Ph.D. students experience. This will provide us with information on where to improve supervision and education of Ph.D. students. Our study contributes to the theoretical body of research on threshold concepts and conceptual change. It provides us with more information on how conceptual change may be best enhanced by the learning environment. Future research can, based on the insight into which threshold concepts are experienced by Ph.D. students acquired in our study, elaborate by examining, which the critical aspects of understanding of these threshold concepts are, similar to Taylor and Cope (2007) did in the Biology discipline. They indicated that threshold concepts have different aspects, and the degree to which the concept is understood is dependent on the understanding of these aspects. This will provide us with a more full understanding in the ideas of threshold concepts and conceptual change.

References

- Davies, P., & Mangan, J. (2007). Threshold concepts and the integration of understanding in economics. *Studies in Higher Education*, 32, 711 – 726.
- Kiley, M., (2009). 'Identifying threshold concepts and proposing strategies to support doctoral candidates', *Innovations in Education and Teaching International*, 46 (3), 293–304.
- Kiley, M. and Wisker, G. (2009) Threshold concepts in research education and evidence of threshold crossing, *Higher Education Research & Development*, 28 (4), 431–441.
- Meyer, J. & Land, R. (2003). *Threshold Concepts and Troublesome Knowledge: Linkages to Ways of Thinking and Practising within the Disciplines*. ETL-Project, Occasional Report 4.

Taylor, C. & Cope, C. (2007). Are there educationally critical aspects in the concept of evolution? *UniServe Science Teaching and Learning Research Proceedings*, 101-107. University of Sydney.

Trafford, V. and Leshem, S. (2009) Doctorateness as a threshold concept, *Innovations in Education and Teaching International*, 46 (3), 305-316.

PAPER PRESENTATION

Multifaceted supervision: A response to the complexity of educating doctoral students

Ali Leijen, Tartu University, Estonia; Aivar Ots, University of Tartu, Estonia; Margus Pedaste, University of Tartu, Estonia; Karin Scager, Utrecht University, Netherlands

Successful completion of PhD studies depends on several aspects. The scope of the current study is PhD supervision. We aim to point out different factors that contribute to the quality of successful supervision. This research draws on previous research (Scager & Sonneveld, 2008) on multifaceted supervision carried out in the Netherlands and extends on previous findings with the data collected from Estonia. Scager & Sonneveld (2008) created a model of multifaceted supervision that consists of six qualities. They hypothesised that all six qualities are necessary in a successful supervision. The theoretical significance of the current research is mainly related to testing the hypothesis using the data from 90 doctoral students in Estonia. The educational significance relates to discussion on the pedagogy of supervision in doctoral studies. The major target group of this research is PhD students in education. As a control group data from PhD students from natural sciences was used. An additional aim of this study was to investigate how satisfied PhD students in educational sciences are with their supervisors in diverse domains of supervision, and which implications these findings would present for the development of study programmes. PhD studies in education have recently gained considerable attention in Estonia owing to the low graduation rates and concerns regarding the sustainability and development of the domain.

Introduction

Successful completion of PhD studies depends on several aspects. Ballantyne (2001), Hockey (1991), McCormack (2005), Sinclair (2004) point out different factors which can be organized under four categories: psychological features of a doctoral student, social-economical situation of the student, discipline and type of research, and supervision. The scope of the current study is PhD supervision. We aim to point out different factors that contribute to the quality of successful supervision. This research draws on previous research (Scager & Sonneveld, 2008) carried out in the Netherlands and extends on previous findings with the data collected from Estonia.

The literature review on the components and features of successful PhD supervision carried out by Scager & Sonneveld (2008) resulted in a model consisting of six qualities: subject knowledge of the supervisor, research expertise of a supervisor, interpersonal relations between the PhD student and supervisor, management of the PhD process, coaching of the PhD student, and supporting PhD students' socialisation and integration in a research community. Scager & Sonneveld (2008) reasoned, in line with Pearson & Kayrooz (2004) and Brown & Atkinson (1991), that supervising is a complex activity that requires supervisor's multifaceted engagement. They hypothesised that all the above-mentioned six qualities are necessary in a successful supervision. One aim of the current study is to test this hypothesis and find out whether a more versatile satisfaction with different aspects of supervision corresponds to PhD students' progression in their studies.

The main target group of this research are PhD students in education. PhD studies in education have recently gained more attention in Estonia owing to the low graduation rates and concerns regarding the sustainability and development of the domain. An additional aim of the current study was to investigate how satisfied PhD students in education are with their supervisors, and what would be the implications of these findings for the development of study programmes. Current research is part of a larger study planned for the period of 2009 – 2014.

Methods

Participants Data was collected from 90 PhD students from two universities in Estonia. In order to find out whether the situation regarding doctoral students in education is unique or similar to the situation in other fields, it was decided to collect data from two fields (education and natural sciences). 53 PhD students from the field of education (54% of the total population in Estonia) studying in two universities and 34 PhD students from the curriculum of Molecular and Cell biology and Ecology and Earth Sciences (22% of the total population in Estonia) studying in one university participated in the study. Doctoral students in education were better represented in this sample; however, students from natural sciences formed a relatively homogeneous group in several aspects and diverged from doctoral

students in education. Overall, different study years (1st, 2nd, 3rd, 4th) were reasonably represented, varying from 21% to 28%.

Data collection and analysis

Data about supervision was collected with the PhD student experience questionnaire (Scager & Sonneveld, 2008). The questionnaire consists of 56 items measuring PhD students' satisfaction with their supervisor in six areas of supervision (see introduction). In addition, the questionnaire consists of several open questions that allow exploring further different aspects related to supervising. The original questionnaire was translated to Estonian and back-translated to English. A native speaker who is an expert of doctoral studies compared the original and back-translation. He approved the quality of the translation. Scager & Sonneveld (2008) report high inner-reliability scores of the questionnaire's six scales. Similarly, inner-reliability scores of the scales were also high in our study (Cronbach α varying from 0,89 to 0,95).

Data about the progression in studies was measured based on students' collection of credit points. In Estonia, PhD studies consist of 240 ECTS credit points (180 credit points are reserved for PhD research and dissertation and 60 credit points for courses). On average, a student is expected to collect 60 credit points per year. The nominal period of a doctoral study is four years.

Data was collected during December 2009 - January 2010 with an online questionnaire on voluntary basis. No incentives were given to students for participation.

A T-test was used to examine whether PhD students in education and natural sciences differ in satisfaction rates with their supervisors. Qualitative content analysis (Bogdan & Bilken, 1992) and chi square tests were used to analyse the answers given to the open questions. Chi square tests were used to find out whether the multifaceted satisfaction with supervision is related to the progression in PhD studies.

Results

T-tests showed that natural sciences doctoral students' satisfaction with their supervisors was generally higher in comparison to the satisfaction of students in education. Regarding two areas of supervision, the difference was statistically significant. Doctoral students in education evaluated their supervisors significantly lower as 1) supporters of acculturation in research community ($t = -2.38$; $df = 74$; $p < 0.05$) and 2) experts in the PhD research domain ($t = -2.38$; $df = 77$; $p < 0.05$). Chi square test showed that among students with faster progression in studies were more often those who reported multifaceted satisfaction with their supervisor ($\chi^2 (1, N = 41) = 4.21$; $p < 0.05$) in comparison to students with slower progression in studies. Correspondence was also found between some singular aspects of supervision and progression in studies. However, a more versatile satisfaction with supervision seemed to be more clearly associated with the progression rates. The given result is theoretically significant since it appears in accord with the hypothesis of multifaceted supervision (Scager & Sonneveld, 2008). Multifaceted supervision seems to enhance the complex task of educating doctoral candidates and presents new prospects for the pedagogy of supervision. The latter illuminates the educational significance of the current study.

PAPER PRESENTATION

The undergraduate research journey: a cross-disciplinary examination of student experience

Kylie Shaw, The University of Newcastle, Australia

Interest in undergraduate research is gaining momentum in higher education globally. In particular, ways of integrating a capstone research project into undergraduate programs are being explored in light of the need to strengthen the output and quality of postgraduate research. In this study, student experience was explored across a range of fourth-year undergraduate programs in an Australian university, using visualisation as a reflective tool. The aim was to accurately describe the research journey in a way that would permit comparisons of types of journey within and between programs. The sample for the study was 162 fourth-year students across 14 different disciplines. A questionnaire was disseminated to participants, asking for general information and details of their research program. They were asked to draw a plot of their undergraduate research journey on the provided axis, labelling the high and low points of their experience. Commonalities and differences in the journeys were explored using a mix of quantitative and qualitative data analysis techniques. This study highlighted students' orientation to research through their understanding of the nature of the journey, experienced across different disciplinary contexts. It is through

providing a substantial early experience of research in undergraduate education that confidence in the capacity to carry out research can develop and, equally, potential research talent can be uncovered. Successful graduates then have the opportunity to 'fast-track' to a doctoral research degree and higher levels of professional standing within their discipline.

The undergraduate research journey: a cross-disciplinary examination of student experience

Rationale and relevance

Interest in undergraduate research is gaining momentum in higher education globally. In particular, ways of integrating a capstone research project into undergraduate programs are being explored in light of the need to strengthen the output and quality of postgraduate research and production of knowledge. The notion of 'journey' has been used to describe personal experiences of the doctorate (Batchelor & Di Napoli, 2006) and to map the terrain, providing a commonality of process which lies beneath disciplinary contexts (Miller & Brimicombe, 2003). Furthermore, there are increasing numbers of studies turning to metaphor and representation to try to elucidate the doctoral experience, for example, the intensity and emotive aspects of the individual's doctoral student experience have been compared to that of an emotional rollercoaster (Kearns, Gardiner, Marshall & Banytis, 2005). However, there has been no attempt to develop quantitative measures of journey plots that allow journeys to be compared across individuals and groups.

Aims, Research Methods and Design

In this study, student experience was explored across a range of fourth-year undergraduate programs in an Australian university through the concept of a research journey, using visualisation as a reflective tool. The aim was to accurately describe the research journey in a way that would permit comparisons of types of journey within and between programs. An instrument was developed which asked respondents at the end of their research project to plot their research journey, from the start of the project to the point of submission for examination, on an axis and to self-identify the highs and lows of their journey. The study was designed to concentrate on one site, and within the site to sample multiple programs. The site for the study was a regional university, chosen because of its spread of students across demographic groups and the range of disciplines that offered fourth-year research projects. Major areas included: Architecture & Construction Management; Arts & Social Studies; Economics; Education; Engineering; Law; Medicine & Health Sciences; Music; Nursing; Science and Mathematics. Information to student participants was disseminated through the academic coordinators for the discipline and participation was both voluntary and anonymous. The sample for the study was 162 fourth-year students across 14 different disciplines at the site. A questionnaire was disseminated to participants, asking for general information about the respondent and about the components of their research program. They were also asked to draw a plot of their undergraduate research journey on the provided axis, labelling the high and low points of their experience. Commonalities and differences in the journeys were explored using a mix of quantitative and qualitative data analysis techniques. The emergent methodology used to analyse aspects of the journey by transcribing, coding and recording text from the plot and measuring the coordinates of the visual representation is a new approach to exploring student experience. This method allowed for a depth of information about the research project previously not examined through a survey instrument, allowing for a comparison of student experience of research across different programs. These data provided insight into the impact of both personal and research-related tasks on the journey for students. A range of measures were developed based on the research plot including: student disposition at the beginning of the journey, the types of journey experienced, the milestones identified along the way and the extent of the highs and lows experienced.

Results and conclusions

The different shapes of the journey plots that were recorded suggested that there were large differences in student dispositions towards the research project. While each journey was highly individual, the grid allowed comparison in key areas: the start and finish positions, the nature of the items labelled, the number of positive and negative peaks and the overall pattern of peaks. The exploration of the research journey added a depth of detail previously uncovered in the literature about student experience. The data identified tasks in undergraduate research which pose challenges for students as a whole, and also compared the elements across programs. The value of this new measure lies in its capacity to make the process of research visible. This study highlights students' orientation to research through their understanding of the nature of the journey, and the highs and lows experienced across different disciplinary contexts. Overall the research suggests that the disposition of a student at the commencement of a project contributes to their preparedness to complete the research task and how they perceive research. The data suggests, from the student perspective, some of the places within the undergraduate research project where students become 'stuck' in the form of low episodes in their experience of research and from the journey plot we can visualise

how students then emerge from these stuck places to continue their journey and successfully master a new way of thinking within their discipline (Kiley & Wisker, 2009).

Significance

Increasingly, students across disciplines need incentives to pursue careers in research, and in academe, to sustain the on-going development of disciplines and to keep pace with the changing global emphasis on research. In the Australian context, the fourth year undergraduate research project is relatively unique in that students who excel are propelled directly into a doctoral research program. It is through providing a substantial early experience of research in undergraduate education that confidence in the capacity to carry out research can develop and, equally, potential research talent can be uncovered. Graduates then have the opportunity to 'fast-track' their way at an early age to doctoral research degrees and to higher levels of professional standing within their disciplines.

References

- Batchelor, D., & Di Napoli, R. (2006). The doctoral journey: perspectives. *Educate*, 6 (1), pp. 13-24.
- Kearns, H., Gardiner, M., Marshall, K., & Banytis, F. (2005). *The PhD Experience: What They Didn't Tell You at Induction*. Flinders University Staff Development and Training Unit: Adelaide.
- Miller, N., & Brimicombe, A. (2003). Mapping research journeys across complex terrain with heavy baggage. *Studies in Continuing Education*, 26 (3), pp. 405-417.
- Kiley, M., & Wisker, G. (2009). Threshold concepts in research education and evidence of threshold crossing. *Higher Education Research and Development* 28(4), pp. 431-441.

PAPER PRESENTATION

The motivations, characteristics, and practices of the highly productive research supervisor

Margaret Kiley, CEDAM, Australia

The aim of this research was to identify the various characteristics and practices of those research supervisors who, over their career and at any one time, supervise substantially more PhD candidates than is standard in Australian universities. Furthermore, the research aimed to identify and understand why these academics supervise so many candidates.

The research employed interviews that were subsequently transcribed, returned to the interviewee for confirmation, and then analysed using concept coding and categorisation.

The most common factor reported in the interviews was a love of teaching at the PhD level. Many reported that they enjoyed teaching, but not so much at the undergraduate level which tends to employ lectures and tutorials, but rather the one-to-one relationship developed in a supervisor/candidate relationship. In addition, interviewees reported the excitement they gained from intellectual engagement with candidates who were talented and interested in research, and their desire to imbue early career researchers with their own enthusiasm for research.

An examination of the literature on research supervision in Australia indicates a growing interest in the pedagogy of research supervision and the research reported here contributed to that pedagogical understanding with insights from highly productive supervisors.

Aims

The aim of this research was to identify the various characteristics and practices of those research supervisors who, over their career and at any one time, supervise substantially more PhD candidates than is standard in Australian universities. Furthermore, the research aimed to identify and understand why these academics supervise so many candidates.

Most universities in Australia recommend, and some enforce, that any one doctoral supervisor should have a maximum of four full-time equivalent doctoral candidates at any one time. The Australian doctoral education model involves supervisors in substantial hands-on supervision and even where co-supervisors are involved the bulk of the supervisory load tends to fall on one person. Therefore, the reason generally given for the limit on numbers is that to provide adequate time and attention to candidates and their projects substantial commitment and human resources are required.

In light of this general practice, this project set out to understand why, and how, some supervisors who are considered to be excellent, also manage to supervise anything up to eight or ten candidates at the one time and with considerable success. Methodology

The research employed interviews that were subsequently transcribed, returned to the interviewee for confirmation, and then analysed using concept coding and categorisation.

Deans of Graduate Studies in eight Australian universities (approximately 20% of the Australian total) were asked to nominate supervisors across a range of disciplines and who had a reputation for quality supervision, timely and successful completions and substantially more, in terms of numbers, than average. Interviews with 20 supervisors are reported in this paper.

The interviews addressed a number of issues including:

- Demographic e.g. how many students supervised?
- Motivational e.g. Why do you undertake such a substantial supervisory load?
- Philosophical e.g. How would describe your approach to supervision?
- Practical e.g. How do you manage such a large candidate load?

Findings

The most common factor reported in the interviews was a love of teaching at the PhD level. Many reported that they enjoyed teaching, but not so much at the undergraduate level but rather the one-to-one relationship developed in a supervisor/candidate relationship.

Following on from the 'teaching' theme reported by most of the interviewees was the excitement they gained from intellectual engagement with candidates who were talented and interested in research. A third characteristics related to the supervisors' love of research and the desire to imbue early career researchers with this enthusiasm Theoretical and educational significance of the research.

One critical aspect of doctoral education is the quality of, and candidates' levels of satisfaction with, research supervision. As Golde (2000) suggests one of the main reasons that candidates leave their doctoral program is that they have not been appropriately socialised into the discipline and institution. Lovitts and Nelson (2000, p. 49) further argue from their study that: 'The data suggest that the single most important factor in student decisions to continue or withdraw is the relationship with a faculty adviser.'

Satisfaction with the supervisory relationship is not only critical in candidates' decisions to stay or withdraw but the research suggests that the quality of supervision is a factor in timely completion of the PhD. For example de Valero (2001, p. 346) suggests that the following characteristics are those linked with timely completion: 'financial support, departmental orientation and advising, relationship between coursework and research skills, requiring significant results in the dissertation, student-committee relationship, student-advisor relationship, attitudes towards students, student participation, and peer support.

An examination of the literature on research supervision in Australia indicates a growing interest in the pedagogy of research supervision. 'One important consequence of the increasing scrutiny and intervention into the doctorate over the past decade or so has been the emergence of a set of practices concerned with doctoral education, focusing attention explicitly on the educative work involved in preparing doctoral graduates' (Boud & Lee 2009, p. 1).

The research reported here suggests that some supervisors can take on two or three times as many candidates as generally advised and still produce highly satisfied graduates who have completed successfully and in a timely fashion, the ways and means of this will be reported in detail in the conference presentation and paper.

Boud, D., & Lee, A. (Eds.). (2009). Changing practices of doctoral education. Abbingdon: Routledge.

de Valero, Y. F. (2001). Departmental factors affecting time-to-degree and completion rates of doctoral students at one land-grant research institution. *Journal of Higher Education*, 72(3), 341–367.

Golde, C. (2000). Should I stay or should I go? Student descriptions of the doctoral attrition process. *The Review of Higher Education*, 23(2), 199-227.

Lovitts, B., & Nelson, C. (2000). The hidden crisis in graduate education: Attrition from Ph.D. programs. *Academe*, 86(6), 44-51.

PAPER PRESENTATION

Law teaching: true vocation or tribulation?

Gail Kotze, Tshwane University of Technology, South Africa; S Gravett, University of Johannesburg, South Africa

This paper reports on a study that examined the culture and identity of the legal academic as teacher. The study is based on three law teachers at a South African university. Using an ethnographic design type data was collected through observation during class visits, discussion about teaching in interviews and a review of teaching-related documents. The research revealed that participants' primary professional identity is created around their definition of themselves as teachers and not legal practitioners. Not only do they choose to teach but regard teaching as true vocation. As core of the nature of their teacher identities, participants express a significant emotional dimension shaped by their relationships with students.

This study originated from my need as educational advisor to increase my knowledge and understanding of legal academics and how they teach. It aims to contribute to our knowledge of the academic profession. There is evidence that the need to improve the understanding of the academic profession is shared by others (Becher and Trowler, 2001). Clark (1987:2) emphasises the need to study academics: "Of this we can be sure: the academic profession makes a difference. We can hardly know too much about it".

A literature search revealed that not much research has been conducted in this area. Although some attention has been given to the study of academics it has not focused extensively on legal academics in their teaching role (Taylor, 1999; Henkel, 2000; Becher and Trowler, 2001). In terms of teaching in particular, literature tends to tell academics what to do but what they actually do receives less attention. This while the choices that law teachers make about subjects and how they teach these influence generations of law students.

Until 2004, when Cownie published the first extended study exploring the everyday life of the United Kingdom law school, such studies were rare if not absent (Becher and Trowler, in Cownie, 2004). No evidence exists of any investigation of the culture of the legal academic as teacher within a South African context. Exploring the culture of a small number of South African legal academics as teachers will add a unique perspective to what is currently known and in so doing contribute to what Cownie (2004:47) calls "sustained qualitative examination" of legal academics.

Using an ethnographic design type I studied three purposefully selected legal academics at a South African university.

The study was guided by the following questions:

- What are legal academics' patterns of beliefs, behaviour, norms, attitudes and values about teaching the law?
- What constitute legal academics' identity as teacher?
- What shape/form legal academics as teachers?

Data was collected by three methods associated with qualitative research and an ethnographic design type; namely interviews, class observations and teaching-related documents. The transformation of data comprised three stages; namely description, analysis and interpretation. To realize the descriptive phase I made use of global analysis to search for main features or characteristics of each of the participants without chunking the data into smaller pieces but instead maintaining a holistic view of the data. This was followed by content analysis. Additionally, I conducted discourse analysis in extracts from all data sets. Word portraits were subsequently created around the core teaching characteristic of each of the participants. These main features portray the way in which they understand, experience and conduct themselves as teachers.

The principal findings suggest that participants' primary professional identity is created around their definition of themselves as teachers and not legal practitioners. As occupants of the teaching role participants reveal what Gee (2000:100) refers to as an "institution identity". Since an institution-identity is not given to an individual by nature or accomplished by individuals on their own it can be experienced as either a calling or an imposition. In fact in a world where work is sometimes equated with suffering and where people often do not regard their work as a true vocation (Palmer, 1998) it would be reasonable to argue that academia may be harbouring legal academics that would rather be exclusively practising law. However, in looking at participants' intention in making choices about their career path it is evident that they make a conscious choice to teach and do not regard it second best to being a legal practitioner. In making this choice participants illustrate a strong association with academic culture as opposed to the legal profession which has distinctive values and norms. This finding expands on the work of Cownie (2004) related to cultures and identities of legal academics, who found that law teachers regard academia a preferred career and true vocation.

A second feature of participants' primary identity as teacher is a display of emotion and passion in their teaching. The emotional side of teaching displayed is not unique and undisputed in literature (Hargreaves, 2000; Bellas, 1999). Teaching as emotional labour has been linked to the profession of university professor (Hochschild, 1979). Although Hargreaves (1998) confirms that teachers' relations with their students are often notably emotional in nature and what this study found therefore a mere reaffirmation of what is already known, the finding is significant because it relates to an aspect hardly touched on in studies similar to this one. Although Cownie (2004) in her study of the culture and identity of legal academics in the United Kingdom found that legal academics gain satisfaction from teaching, she did not explore their relationship with students further. As core of the nature of their teacher identities, participants value close contact with their students and embrace a caring notion toward them. The "emotional heart" of their teaching (Woods, 1996) underpins the values that shape them as teachers and as such emphasizes their strong association with teaching as true vocation.

References

- Bellas, M.L. 1999. Emotional labour in academia: the case of professors. *The ANNALS of the American Academy of Political and Social Science*, 561: 96-110.
- Becher, T. & Trowler, P.R. 2001. *Academic tribes and territories: intellectual enquiry and the culture of disciplines*, 2nd ed. Buckingham: SRHE and Open University Press.
- Clark, B.R. 1987. *The academic profession: national, disciplinary, and institutional settings*. Berkeley: University of California Press.
- Cownie, F. 2004. *Legal academics: culture and identities*. Portland: Hart Publishing.
- Gee, J.P. 2000. Identity as an analytic lens for research in education. *Review of research in education*, 25: 99-125.
- Hargreaves, A. 1998. The emotional practice of teaching. *Teaching and Teacher Education*, 14(8): 835-854.
- Hargreaves, A. 2000. Mixed emotions: teachers' perceptions of their interactions with students. *Teaching and Teacher Education*, 16(2000): 811-826.
- Henkel, M. 2000. *Academic identities and policy change in higher education*. London: Jessica Kingsley Publishers.
- Hochschild, A.R. 1979. Emotion work, feeling rules and social structure. *The American Journal of Sociology*, 85(3): 551-575.
- Palmer, P.J. 1998. *The courage to teach: exploring the inner landscape of a teacher's life*. San Francisco: Jossey-Bass Publishers.
- Taylor, P.G. 1999. *Making sense of academic life: academics, universities and change*. Buckingham: SRHE and Open University Press.
- Woods, P. 1996. *Researching the art of teaching: ethnography for educational use*. London: Routledge.

PAPER PRESENTATION

Statistics anxiety: Relation to trait anxiety, learning behavior, and performance

Manuela Paechter, Karl-Franzens-University Graz, Austria; Daniel Macher, Karl-Franzens-University Graz, Austria; Ilona Papousek, Karl-Franzens-University Graz, Austria; Kai Ruggeri, Queen's University, Belfast, United Kingdom

Statistics anxiety can be described as the apprehension that occurs when an individual is exposed to statistics content, problems, instructional situations, or evaluative contexts. Statistics anxiety is situation-specific, inasmuch as the symptoms only emerge at a particular time and in a particular situation. It manifests itself by extensive worry, intrusive thoughts, mental disorganization, tension, and arousal in situations related to statistics. Generally, little is known about the underlying mechanisms of the relationship between statistics anxiety, its antecedents, students' learning behaviors, and their academic performance. Therefore, in the present investigation, the relationship between statistics anxiety, antecedents of statistics anxiety, learning behavior, and academic performance were investigated by means of structural equation modeling.

One-hundred forty-seven students enrolled in a statistics course in psychology filled in a questionnaire on statistics anxiety, trait anxiety, interest in statistics, skills in mathematics, learning strategies, and procrastination. Also, performance in the examination was recorded. Statistics anxiety receives a crucial role in the structural equation model. It is directly related to academic performance. Besides, statistics anxiety is related to inefficient learning behaviors such as procrastination. Statistics anxiety itself was related to antecedents such as skills in mathematics, gender, and trait anxiety. The results of the reported study do not only explain more of the mechanism how anxiety influences performance but are also important for instruction.

Introduction and aims of the research

A large proportion of students identify statistics courses as the most anxiety-inducing courses in their curriculum. Especially in subjects such as psychology, education, or sociology, statistics anxiety is widespread among students (Onwuegbuzie & Wilson, 2003). Statistics anxiety can be described as the apprehension that occurs when an individual is exposed to statistics content, problems, instructional situations, or evaluative contexts. Statistics anxiety is situation-specific, inasmuch as the symptoms only emerge at a particular time and in a particular situation. It manifests itself by extensive worry, intrusive thoughts, mental disorganization, tension, and arousal in situations related to statistics (Zeidner, 1991). The development of statistics anxiety can be influenced by an individual's experiences or skills in subjects such as mathematics, by traits such as anxiety, or by attitudes such as interest in statistics. There is evidence that statistics anxiety is related to general trait anxiety (Zeidner, 1991). Also, female students report higher levels of statistics anxiety than male students. Previous research suggest that students with a high level of statistics anxiety show lower academic achievements (Walsh & Ugumba-Agwonobi, 2002). Presently, it is not clear whether statistics anxiety exerts a direct influence in an examination, e.g., by worry and intrusive thoughts, or whether statistics-anxious students use inadequate learning strategies for achievement and are less prepared. Research points at a relationship between statistics anxiety and specific learning behaviors such as procrastination. Generally, little is known about the underlying mechanisms of the relationship between statistics anxiety, its antecedents, students' learning behaviors, and their academic performance. Therefore, in the present investigation, the relationship between statistics anxiety, antecedents of statistics anxiety, learning behavior, and academic performance are investigated by means of structural equation modeling.

Methodology

Participants were 147 undergraduate students enrolled in an introductory statistics lecture-based course offered for psychology undergraduates. In the study, 112 female students (76.19 %) and 35 male students (23.81 %) took part. The materials for this study include data gathered from questionnaires on statistics anxiety, trait anxiety, interest in statistics, skills in mathematics, the application of learning strategies, academic procrastination, and academic performance in the statistics examination. Questionnaire data were recorded one week prior to the examination. Additionally, the students' examination scores were recorded. FindingsA structural equation model on the relation between statistics anxiety, possible antecedents, learning behaviors, and academic performance was tested. The χ^2 test and descriptive fit indices provided by the software suggest a good fit of the model ($\chi^2 = 42.966$, $df = 30$, $p = .059$; $\chi^2/df = 1.43$; CFI = .97; RMSEA = .05; SRMR = .05). The model shows four antecedents that are related to statistics anxiety: Participants with higher levels of trait anxiety report higher levels of statistics anxiety ($\beta = .42$). Female students report higher levels of statistics anxiety ($\beta = -.32$). Skills in mathematics and interest in statistics are both negatively related to statistics anxiety ($\beta_1 = -.22$, $\beta_2 = -.31$). Both, trait anxiety and statistics anxiety are positively related to procrastination (higher levels of anxiety indicate a higher level of procrastination; $\beta_1 = .24$, $\beta_2 = .27$). Male students showed higher procrastination values than female students ($\beta = .37$). Several variables of the model influence academic performance: Statistics anxiety is negatively related to performance ($\beta = -.30$). Knowledge and skills in mathematics ($\beta = .16$) and interest in statistics ($\beta = .21$) have a positive influence on examination performance. Contrary to initial expectations, no significant relationship between procrastination or deep-level learning strategies and examination performance was found. Of the learning-related behaviors measured, only the frequency of the application of personal resource management strategies contributes positively to performance ($\beta = .16$). In the model, statistics anxiety is directly related to academic performance and is the strongest predictor of performance but it also has an indirect influence on academic performance via its relationship to procrastination.

Theoretical and educational significance

Statistics anxiety receives a crucial role in the structural equation model. It is directly related to performance in the examination. This relationship may be explained by the cognitive anxiety component. Statistics anxiety may lead to an adverse cognitive interference between examination-irrelevant thoughts such as worry and rumination and examination-relevant thoughts. Statistics anxiety is also related to procrastination and thus to less investment of personal resources in learning. Statistics anxious students spend less time for learning, show less concentration and effort, are less prepared for the examination, and consequently achieve less in the examination. The results of the reported study do not only explain more of the mechanism how anxiety influences performance but are also important for instruction. They suggest to support anxious students not only in the examination but also prior to the examination. In the examination, students profit from anxiety-reducing measures such as providing enough time for the examination or using humorous examination tasks (Onwuegbuzie & Wilson, 2003). Prior to the examination, instructors should support students in avoiding procrastination, for instance, by regularly providing opportunities for exercise and reflection of learning content. Instructors are advised to stimulate students' interest in statistics, perhaps by emphasizing the importance of statistics for the students' later vocation and for daily life. By such measures, students will be better prepared for the examination and experience less statistics anxiety.

Literature

- Onwuegbuzie, A., & Wilson, V. (2003). Statistics anxiety: Nature, etiology, antecedents, effects, and treatments – a comprehensive review of the literature. *Teaching in Higher Education*, 8, 195-2009.
- Walsh, J., & Ugumba-Agwunobi, G. (2002). Individual differences in statistics anxiety: The roles of perfectionism, procrastination and trait anxiety. *Personal and Individual Differences*, 33, 239-251.
- Zeidner, M. (1991). Statistics and mathematics anxiety in social science students: Some interesting parallels. *British Journal of Educational Psychology*, 61, 319-328.

PAPER PRESENTATION

Only connect? Being, knowing and communicating in the 21st century university.

Charles Anderson, Edinburgh University, United Kingdom; Velda McCune, University of Glasgow, United Kingdom

Abstract

To address the conference's main theme of 'Education for a Global Networked Society' would seem to require attention to be given to the interrelations between: the goals of education, the nature of our 'global networked society', its forms of communication and its pluralist knowledge practices. An influential characterisation of these interrelationships has been provided by Ron Barnett who has noted how 'Amid supercomplexity, the educational task [of universities] is primarily an ontological task. It is the task of enabling individuals to prosper amid supercomplexity, amid a situation in which there are no stable descriptions of the world' (2004, 252). This presentation examines a number of the challenge that students face in developing the forms of being and the orientations to knowledge associated with an age of supercomplexity. Attention centres on three interconnected areas of analysis. First, there is an examination of the types of commitments that may be required of both students and staff within learning communities in a 'global networked society'. The focus then moves to the question of how to conceptualise the knowledge practices that characterise current learning communities in higher education and the orientations towards knowledge that may be expected of students in an age of supercomplexity. This leads in turn to an examination of the nature of communication and the creation of meaning within learning communities that seeks to problematise the simplistic metaphors and models of communication that often underpin talk of global networking and 'knowledge transfer'.

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Extended Summary

Introduction

This presentation examines a number of the challenge that students face in developing the forms of being and the orientations to knowledge associated with an age of supercomplexity. Attention centres on three interconnected areas of analysis. First, there is an examination of the types of commitments that may be required of both students and staff within learning communities in a 'global networked society'. The focus then moves to the question of how to conceptualise the knowledge practices that characterise current learning communities in higher education and the orientations towards knowledge that may be expected of students in an age of supercomplexity. This leads in turn to an examination of the nature of communication and the creation of meaning within learning communities that seeks to problematise the simplistic metaphors and models of communication that often underpin talk of global networking and 'knowledge transfer'.

The commitments and intentions displayed by students and lecturers

We begin by building on a feature of Wenger's (1998) account, considering how his depiction of learners' 'trajectories' in relation to communities of practice can inform our understanding of the commitments which learners may form as they come to identify with particular communities. A learner's trajectory is their sense of a path of development in relation to a particular community of practice. Where learners come to envisage a trajectory which brings closer identification with a particular community this can have a notably positive impact on their engagement with their studies (McCune, 2009). Thus Wenger's work signals the particular importance of those learning activities which encourage a sense of inbound trajectory among learners. This does, however, leave open the question of how to

support engagement among the many learners who will not intend to become full participants in a particular community but who may come nonetheless to value the practices of that community.

This question of trajectories is then considered in relation to Barnett's recent work (Barnett, 2007; Barnett and Coate, 2005) which can be seen to draw attention to the types of commitments that may be required of both students and staff if a learning community is to be engendered and the forms of being that may be demanded of students in such a community and in future transitions into and between work settings and cultural milieux.

Knowledge practices and orientations to knowledge

Attending to the forms of being demanded of students directs attention towards how meaning is negotiated within its social and cultural contexts (Lea, 2005), and to the knowledge practices that characterise learning communities in higher education and the orientations towards knowledge, (and towards discussions concerning knowledge), that are expected of students. In other words, consideration is given to the epistemological challenges associated with the ontological task identified by Barnett. Here we draw out implications for practice, shedding light on why even experienced learners often struggle with classroom discussion and assessed work as they work to negotiate the practices of particular communities, rather than reapplying generic skills; and introduce cautionary notes concerning the degree to which it is reasonable to expect students to move readily between the knowledge practices of different communities in a 'networked' society.

Communication and the construction of meaning: partial connection

This analysis of knowledge practices leads in turn to an examination of the nature of communication and the creation of meaning within and between learning communities in an age characterised by supercomplexity. Rommetveit's subtle account of how commonality of reference can be achieved to a degree (e.g. Rommetveit, 1992) against the background of 'a world we assume to be multifaceted, only partially shared' (Rommetveit, 1974, 34) offers valuable insights here. According to Rommetveit, a crucial matter for the coordination of attention and intention, is the sufficient sharing of perspectives on the matter that is under discussion (Rommetveit, 1974, 1990; Graumann, 1995). Implications of this emphasis on perspectivity for the fostering of learning communities are drawn out; and issues surrounding the relative power and authority of interactants, including their capacity to set the perspectives under which topics will be viewed, are examined. Building on this consideration of Rommetveit's work, a concluding section explores how Law's (2004, 62) advocacy of an ontology of the 'in-between', of partial connection, may be an appropriate way in which to frame our understanding of the challenges that university lecturers face in fostering communities of learners for a global, networked society.

References

- Barnett, R. (2004) Learning for an unknown future. *Higher Education Research and Development*, 23, 3, 247-260.
- Barnett, R. (2007) *A Will to Learn: Being a Student in an Age of Uncertainty*. Maidenhead: The Society for Research into Higher Education and Open University Press.
- Barnett, R. and Coate, K. (2005) *Engaging the curriculum in higher education*. Buckingham: The Society for Research into Higher Education and Open University Press.
- Graumann, C. F. (1995) Commonality, mutuality, reciprocity: a conceptual introduction. In I. Markova, C. Graumann and K. Foppa (eds.) *Mutualities in Dialogue*. Cambridge: Cambridge University Press.
- Law, J. (2004) *After Method: mess in social science research*. Abingdon: Routledge.
- Lea, M. (2005). Communities of practice in higher education: useful heuristic or educational model? In D. Barton and K. Tusting (eds.) *Beyond communities of practice: language, power and social context*. Cambridge: Cambridge University Press, pp. 180-197.
- McCune, V. (2009). Final year biosciences students' willingness to engage: teaching-learning environments, authentic learning experiences and identities. *Studies in Higher Education*, 34(3), 347-361.
- Rommetveit, R. (1974) *On Message Structure: A framework for the study of language and communication*. London: John Wiley and Sons.
- Rommetveit, R. (1990) On axiomatic features of a dialogical approach to language and mind. In I. Markova and K. Foppa (eds.) *The Dynamics of Dialogue*. New York/London: Harvester Wheatsheaf.
- Rommetveit, R. (1992) Outlines of a dialogically based social-cognitive approach to human cognition and communication. In A. H. Wold (ed.) *The Dialogical Alternative: Towards a Theory of Language and Mind*. Oslo: Scandinavian University Press.
- Wenger, E. (1998) *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.

Models of scientific thinking and connections to guidance and students' learning in university.

Hanna-Maija Liitos, University of Jyväskylä, Finland; Eeva Kallio, University of Jyväskylä, Finland

This paper investigates the complex nature of acquiring scientific thinking from three theoretical perspectives in students' learning in university context. Scientific thinking is defined to compose of thought operations, which include critical and logical thinking and judgment making skills based on evidence and awareness of one's epistemic assumptions. Students in this study represent two different faculties of sciences. Their models of thinking are studied in the beginning and in the middle phase of their studies and the relation to study guidance is explored. Research questions are following: 1) what kind of models of scientific thinking can be detected from students' thinking and 2) how these differences are related to students' experience of studies, including guidance of studies? Analysis of students' entrance examination essays, questionnaire and in-depth interviews were used to explore these questions. Preliminary results show that in the already beginning of their university studies relativism, i.e. ability to understand multiply perspectives on knowledge is present on student's thoughts. This form of thought is also present in the middle phase of studies, although some forms of integrative and evaluative thinking are emerging. Students present ambivalent thoughts on study guidance, part of them present positive attitudes and regard guidance as self-regulative tool, others have not used it, but instead formed independent plans for conducting their studies.

Theoretical framework

The purpose is to explore scientific thinking skills during university studies through three theoretical perspectives: dialectical thinking by Basseches (1984, 2005), Kuhn's (2002) model of epistemic understanding and Baxter Magolda's (2001) model of self-authorship. Three perspectives are used to understand the complex nature of acquiring scientific thinking skills. Scientific thinking is defined to comprise of thought operations, which include critical and logical thinking and judgment making skills based on evidence and awareness of one's epistemic assumptions. (Hofer & Pintrich, 2002; Kuhn, 2002; Commons & Pekker, 2004).

According to Perry (1968), students' patterns of reasoning develop through absolutistic/dualistic assumptions of knowing to relativism, and further to evaluative and integrative forms of knowing. In this study Basseches' model is used as a framework for adult thinking as continuous evolving process and movement to more evaluative and integrative forms of thought as organized on called 'schematic framework'. Secondly, Kuhn's model on development of epistemic understanding, reasoning and beliefs on knowledge was used, and also Baxter Magolda's model, which concentrates on building self-authorship in decision making. Models focus and emphasize different dimensions of scientific thinking. Guidance is defined according to social-constructive learning theory and is seen as horizon for action, where individuals choices are linked in cultural and social factors (Hodkinson & Sparks, 1997).

Mentioned models of scientific thinking are explored in different phases of study processes. Student's levels of thinking, learning experiences and experiences of guidance have been studied in the beginning and in the middle phase of their studies.

Major research questions are:

1. What kind of models of scientific thinking can be detected from student's thinking in the beginning and in the middle phase of university studies?
2. How these differences in the levels of thinking are related to student's significant learning experiences and experience of study guidance?

Methodology

60 student's entrance examination essays were analyzed using dialectical thinking schemata in the year 2006. Students' experiences of their study processes and thinking skills and guidance of studies were examined by study questionnaire in 2008. Questionnaire is based on integrative pedagogy and -thinking theories (Tynjälä & Kallio, 2010; Kallio, 2010) included questions about self-evaluation of thinking, of study processes, experiences of received guidance, personal study planning and amount and quality of guidance received during the studies.

In-depth interviews were conducted for a subgroup of students (N=27) in 2009-2010. Interviews included epistemic problem solving task called 'Livia war problem', Kuhn, *ibid.*), and semi-structured questions of students' own decision making and learning (Baxter Magolda, *ibid.*) during university studies. Interviews were tape recorded. To analyse the data both quantitative and qualitative methods were used.

Findings

Preliminary results indicate that dialectical thinking of the students in the beginning of their studies focus mainly on basic argumentation skills. This includes the understanding of relativistic nature of knowledge. Least present were

evaluation and integration of different perspectives. Preliminary results of epistemic understanding study show that students' thinking is predominantly on relativistic level in the middle phase of studies, although evaluativist levels are also present. From analysis of Baxter Magolda's model, student's present mainly relativistic and independent patterns of knowing.

Students' thoughts on guidance of studies and especially attitudes towards personal study plans were inquired in study questionnaire. Students were overall content with their study processes in university. The need for guidance differs during study processes, as student's needs for guidance is individual, although guidance is also needed in the middle phase of studies. Continuity and presence of guidance seem to be important issues for students. Question on personal study planning raised contradictory result: part of students (N=23) experiences personal study planning very important for success of their study processes, while same amount experiences that study planning has not influenced to their study processes; and last ones (N=17) had not formed opinion on matter. Students, who regarded personal study plan positively, used it for understanding and conversations and tool for planning of their studies. For those, who regarded it negatively, had not used personal study planning as a tool for their studies or had developed individual study plans.

Theoretical and educational significance

In sum, preliminary results indicate that university students show relativistic thinking forms already in the beginning of their university studies. This result is based on Basseches' model of dialectical thinking and it goes against to most of empirical results before: it has been claimed that in the beginning of their studies, students show absolutistic thinking, and relativistic thinking in the midst phase of their studies (see Perry, *ibid.*). However, because these are still preliminary results, no further conclusions can be made and final results have to be waited. The second main study question of the interconnections between development of thinking and learning-environment are under way and results of these interconnections will be discussed in the presentation.

References

- Basseches, M. (1984). *Dialectical Thinking and Adult Development*. NJ: Ablex.
- Basseches, M. (2005). The development of dialectical thinking as an approach to integration. *Integral review* 1. http://7integral-review.org/back_issues/index.asp
- Baxter Magolda, M. (2001). *Making Their Own Way. Narratives for Transforming Higher Education to Promote Self-Development*. Virginia: Sterling.
- Commons, L.M. & Pekker, A. (2004). *Hierarchical Complexity: A Formal Theory*.
- Hodkinson, P. & Sparks, A. C. (1997). *Careership: a sociological theory of career decision making*. *British Journal of Sociology of Education*. Vol. 18, No. 1, 29 - 44.
- Hofer, B. & Pintrich, P. (2002). *Personal Epistemology. The psychology of beliefs about knowledge and knowing*. New Jersey: Lawrence Erlbaum.
- Kallio, E. (2011). Integrative thinking is a key. An evaluation of current research into the development of thinking in adults. In press (*Theory & Psychology*).
- Kuhn, D., & Weinstock, M. (2002) What is epistemological thinking and why does it matter? In B. K. Hofer & P.R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 121-144) Mahwah, NJ: Erlbaum. .
- Perry, W. (1970). *Forms of Intellectual and Ethical development in the college years*. New York: Holt.
- Tynjälä, P & Kallio, E. (2011). *Integrative Pedagogy for Developing Professional Expertise in Higher Education*. Submitted Manuscript.

PAPER PRESENTATION

Moving beyond academic procrastination by investigating procrastination in different life domains

Katrin Birte Jorke, Bielefeld University, Germany; Laura Meike Thau, Bielefeld University, Germany

The results of a variety of studies suggest that academic procrastination (chronic postponement of study related tasks) is detrimental to academic success. More and more universities offer counselling services for students suffering from academic procrastination. However, in order to support students effectively counsellors need to understand whether their clients' procrastination is solely an academic phenomenon or whether it occurs in other life domains as well. Hence, we need to move beyond the investigation of academic procrastination in order to understand procrastination comprehensively. In the present study on 203 students (mean age = 23.8) six different life domains (academic, daily duties, health, leisure, family, social contacts) were compared in regard to their occurrence and frequency of procrastination and in regard to the correlations of procrastination with other constructs (self-efficacy, stress, and life-

satisfaction). Results show that procrastination occurs in all domains investigated, that procrastination differs in frequency from one life domain to the other and that procrastination's correlations with self-efficacy, stress, and life-satisfaction vary in strength between domains. Interestingly, the academic domain was the domain displaying the highest procrastination frequency, while procrastination in the social contacts domain was correlated the highest of all domains with self-efficacy, stress, and life-satisfaction. The results deliver first hints for domain specificity of procrastination and will support the development of an instrument assessing the individual procrastination pattern across domains which, in turn, will support student counsellors in configuring their interventions for academic procrastination.

Theoretical Background and Aims

The results of a variety of studies suggest that academic procrastination (chronic postponement of study related tasks) is detrimental to academic success. More and more universities offer counselling services for students suffering from academic procrastination. However, in order to support students effectively counsellors need to understand whether their clients' procrastination is solely an academic phenomenon or whether it occurs in other life domains as well. Hence, we need to move beyond the investigation of academic procrastination in order to understand procrastination comprehensively. While previous procrastination research has focused on academic procrastination we adopt a holistic approach by examining procrastination in different domains. The purpose of the present study was to understand whether procrastination does occur in other domains but the academic, and if yes, whether procrastination differs in its characteristics (i.e. correlations with other constructs) between domains. We compared six different domains in regard to the occurrence and frequency of procrastination and in regard to the correlations of procrastination with other constructs. The domains (derived from a literature research and a qualitative study concerning commonly applied classifications of life domains) were: academic, daily duties, health, leisure, family, and social contacts. The constructs represent commonly assessed correlates of procrastination in procrastination research: self-efficacy, stress, and life-satisfaction.

Methods

Sample: Participants were 203 university students (mean age = 23.8, SD = 3.5), 83.7% of which were female. Participants were enrolled in different fields of study and had been studying for five semesters on average (M = 5.8, SD = 3.7). Participants were recruited via an online link on different social network websites. **Procedure:** The study was implemented via an online survey. Each domain's content was explained briefly before participants proceeded to fill out the survey which contained instruments for assessing the occurrence of procrastination in each domain (4-point scale, 1 item), the frequency of procrastination in each domain (adapted version of the Procrastination Scale for Students; Glöckner-Rist, Engberding, Hßcker & Rist, 2009; 6-point scale, 6 items each, .93 (family domain)

Results

First, for the grant majority of participants procrastination did occur in all domains (academic: n = 191, daily duties: n = 196, health: n = 195, leisure: n = 177, family: n = 180, social contact: n = 181). Secondly, results of multiple t-Tests (with Bonferroni correction) showed that all but two differences in procrastination frequency were significant (daily duties – health, family – social contacts). The domain displaying the highest frequency was the academic domain (M = 3.32; SD = .92). The domain displaying the lowest frequency was the leisure domain (M = 2.34; SD = .81). Correlations between procrastination frequency in different domains ranged from .39 (p p r = -.37 (p r = -.18 (p r = .32, p r = .19, p r = -.38 (p r = -.19 (p r = -.21, p r = .26, p r = -.24, p

Discussion

Results show that procrastination occurs in all domains investigated, that procrastination differs in frequency from one life domain to the other, and that procrastination's correlations with self-efficacy, stress, and life-satisfaction differ in strength between domains. Interestingly, procrastination in the social contacts domain seems to have the highest influence on stress and life-satisfaction, while procrastination in the academic domain, although being the domain displaying the highest procrastination frequency, is not as highly correlated with self-efficacy, stress, and life-satisfaction as one might have expected based on the general notion of academic procrastination as an impediment to academic success and subjective well-being. The results prove the approach taken in this study to be worthwhile in that it helps to understand procrastination more comprehensively. The differences in procrastination's character between domains can be seen as first hints for domain specificity of procrastination. The results support the demand for the development of an instrument assessing the individual procrastination pattern across domains. Such an instrument will support student counsellors in understanding their clients' academic procrastination in the broader context of procrastination in different domains which, in turn, will help to tailor interventions accordingly. Future studies should extend on these results by exploring the reasons for and consequences of procrastination in each domain on a more detailed level.

PAPER PRESENTATION

Promoting self-regulated learning in university education

Hideko Itoh, National Institute of Multimedia Education, Japan

Methods of promoting self-regulated learning in university education were investigated based on the quantitative and qualitative analyses of learning self-efficacy, self-evaluation of learning, and goal setting, as well as the usefulness of the learning and instructional activities. Participants were Japanese graduate students ($N = 36$) who alternatively took the role of instructor or learner. Participants completed the Learning Self-Efficacy and Self-Evaluation of Learning scales, which consisted of the following items: 1. Concentrate on the lecture, 2. Understand the lecture, 3. Identify key ideas, 4. Memorize the contents, 5. Acquire deep and wide knowledge, 6. Think by oneself, 7. Do one's best to solve problems, 8. Actively participate in collaborative work, 9. Actively participate in discussions, and 10. Ask questions. The correlation between the mean scores on the Self-Evaluation of Learning and Learning Self-Efficacy scales for a subsequent course indicated that higher levels of performance were correlated with higher self-efficacy ratings for subsequent learning. All the item scores on the Learning Self-Efficacy scale significantly increased after taking the course. These results are consistent with Bandura's theory of self-efficacy, which postulates that mastery experience is the most effective source of self-efficacy information. Learners also made proper efforts to achieve their goals. Furthermore, the mean degree of usefulness for lectures by students was high, suggesting that the goal of the course, active participation by students, was successfully attained. Reasons for the usefulness of lectures by students suggested the effects of multiple modeling. These findings indicate that self-regulated learning can improve university education.

Recent psychological and educational studies have focused on the self-directed functions of human nature, including the following:

Self-regulation and self-efficacy.

According to social cognitive theory, humans possess self-directive abilities that enable them to exercise control over their thoughts, feelings, and actions, based on the consequences of their actions. Therefore, psychological functioning is regulated by interaction between self-generated and external sources of influences (Bandura, 1986). Perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to achieve goals.

Self-regulated learning.

The theory and practice of self-regulated learning focus on active aspects of learning, including self-efficacy, self-evaluation, and goal setting (Schunk and Zimmerman, 1998; Zimmerman and Schunk, 2001).

Modeling and multiple modeling.

Modeling or observational learning is defined as learning through observing others (Bandura, 1965; 1986). Multiple models displaying diverse patterns of behavior allows observers to exhibit novel responses representing amalgams of elements from the different models (Bandura et al., 1963).

Learning and instructional sciences. Itoh (2005) proposed the new field of "Learning and instructional sciences (LIS)" emphasizing the significance of self-investigation, which is a general term for finding out about the self. LIS can clarify learning and instructional phenomena and apply the outcome to human problem solving. A series of studies revealed that self-investigation can facilitate improvement in university education (Itoh, 2006; 2009).

The present study aimed to identify effective methods of promoting self-regulated learning in university education, based on the quantitative and qualitative analyses of learning self-efficacy, self-evaluation of learning, and goal setting, as well as the usefulness of the learning and instructional activities.

Method

Participants. Participants were 36 Japanese graduate students who were enrolled in courses given by the author from 2004 to 2008.

Course design. (a) Lecture by teacher: During approximately half of the sessions in each course, the teacher gave lectures. (b) Lecture by students: During the rest of the sessions, students took turns in the instructor's role and gave two lectures about their research topics, while the other students and the teacher took the role of learners.

Measures.

The Learning Self-Efficacy and Self-Evaluation of Learning scales consisted of the following items: 1. Concentrate on the lecture, 2. Understand the lecture, 3. Identify key ideas, 4. Memorize the contents, 5. Acquire deep and wide knowledge, 6. Think by oneself, 7. Do one's best to solve problems, 8. Actively participate in collaborative work, 9. Actively participate in discussions, and 10. Ask questions.

Procedures.

(a) Learning Self-Efficacy before the course: At the end of the orientation session, participants indicated their degree of confidence in their learning activities for the course on a scale of 0 to 10. After October 2006, participants also chose 5 items as progress goals from the 10 items. (b) Summative survey: In the final session of the course, participants completed a survey including the Evaluation of Teacher's Instruction by students and teacher, Self-Evaluation of Learning, Usefulness of Learning and Instructional Activities for Learning, Learning Self-Efficacy for a subsequent course, and free descriptions about the course. Except for the Self-Efficacy scale, participants' responses were given on a scale of 1 to 4.

Results and Discussion

After removing the effects of Learning Self-Efficacy before the course, a significant partial correlation coefficient was observed between the scores on Self-Evaluation of Learning and Learning Self-Efficacy for a subsequent course ($r = .634$, $p < .001$). This indicates that higher performance was correlated with higher self-efficacy ratings for subsequent learning. This finding is consistent with Bandura's theory of self-efficacy, which postulates that mastery experience is the most effective source of self-efficacy information. The correlation between the scores on Learning Self-Efficacy before the course and Learning Self-Efficacy for a subsequent course was significant ($r = .663$, $p < .001$). Higher self-efficacy was maintained in the ratings for subsequent learning activities.

Changes in Learning Self-Efficacy scores by item before and after the course analyzed with a 10×2 (Efficacy \times Periods) ANOVA showed significant interaction between Efficacy and Periods ($F(9, 297) = 2.72$, $p < .001$). Main effects were observed for Efficacy ($F(1, 297) = 9.95$, $p < .001$) and Periods ($F(1, 33) = 58.54$, $p < .001$). Post hoc analysis was conducted using Bonferroni's test. For Self-Efficacy before the course, the mean score for item 7 was higher than for items 2-6, 8, 9, and those for items 1, 5-9 were higher than for item 4. Whereas for Self-Efficacy after the course, mean scores for items 1-3, 5-10 were significantly higher than for item 4. A t test revealed significant changes in Learning Self-Efficacy scores on all the items. These findings suggest that achievement of the learning activities during the course effectively increased self-efficacy.

For progress goal items, significant correlations were observed between Self-Evaluation of Learning and Learning Self-Efficacy for a subsequent course ($r = .653$, $p < .001$). Learning Self-Efficacy before the course and Learning Self-Efficacy for a subsequent course ($r = .726$, $p < .001$, $N = 12$).

The most frequent items chosen as progress goals were items 5 ($n = 10$) and 6 ($n = 10$). The most frequent efforts for making progress were "Referring the related research materials" ($n = 6$) for item 5, while "Thinking by oneself to understand" ($n = 7$) for item 6, suggesting learners' proper efforts to achieve their goals.

The mean degree of Usefulness of Learning and Instructional Activities for Learning analyzed by ANOVA showed a significant effect for Activities ($F(6, 180) = 3.65$, $p < .001$). Post hoc analysis using Bonferroni's test revealed that lectures by students were rated higher than teacher's talks, a term paper, problem solving, and surveys on instruction. This suggests that the course successfully encouraged students' active participation.

Reasons for the usefulness of lectures by students included "Learned various research fields" ($n = 26$) and "Learned various instructional methods" ($n = 10$), suggesting the effects of multiple modeling both on contents and methods.

Conclusion

Self-efficacy, self-evaluation, goal setting, and multiple modeling during students' lectures effectively promote self-regulated learning in university education.

PAPER PRESENTATION

Elementary school students regulation of motivation and cognition in challenging learning situations

Jonna Malmberg, University of Oulu, Finland; Sanna Jarvela, University of Oulu, Finland; Hanna Jarvenoja, University of Oulu, Finland

At the school context, the students seldom recognize a need or opportunities to self-regulate their learning. When the task conditions become demanding and call for self-regulated learning, the students may give up since they don't know how to adapt their study techniques. However self-regulated learning is not a general process or trait that operates in a same fashion across learning situations. Rather, self-regulated learning is depended on the different features of current learning situation, such as context, task and various aspects of self that affects for the learning activities students choose to perform. The aim of this study is to examine how elementary school student use control strategies and maintain learning in challenging learning situations. In this study the elementary school students (N=19) aged 9 to 10 years participated in a science project for two months. The pedagogical structure aimed to promote self-regulated learning and included working with gStudy learning environment that prompted study technique use of the students. The students were divided in high and low achievers based on their learning result. The students' use of control strategies was coded from the interview data. Finally, the log file traces from the gStudy were divided in two categories, namely challenging and other gStudy sessions. The results suggest that successful use of control strategies enables the use of information processing strategies. However, when facing challenges, the high achievers did not change their prominent study technique. The low achievers instead switched into surface level strategies.

Summary

At the school context, the students seldom recognize a need or opportunities to self-regulate their learning. When the task conditions become demanding and call for self-regulated learning, the students may give up since they don't know or they don't want to adapt their study techniques (Winne & Hadwin, 2008). However, self-regulated learning is not a general process or trait that operates in a same fashion across learning situations. Rather, self-regulated learning activities are depended on the different features of current learning situation, such as context, task and various aspects of self (Wolters, 1998). That is why it is important to examine how elementary school students use control strategies and maintain learning in varying situations.

The aim of this study is to examine (a) How do the elementary school students use control strategies in challenging learning situations? (b) How the high and low achieving students' learning patterns are composed during the challenging and other learning situations?

Participants and methods

The elementary school students (N=19) aged 9 to 10 years participated in a science project for two months. The pedagogical structure aimed to promote self-regulated learning and included working with gStudy learning environment (Winne et al., 2006). The gStudy is multimedia learning environment that promotes use of study techniques with the assistance of cognitive tools. GStudy also records log file traces of students' use of these tools.

When the students logged in gStudy learning environment (f=172) they were prompted to fill in the "Motivation Scaffold sheet" where they explicate if they felt the learning situation challenging. The challenges were identified and categorized (Cohen's kappa .80) and the challenging gStudy sessions (f=46) were located from log file traces.

The students were asked to construct mind maps (F=28) about the topics before- and after the science project. The students' learning result was measured by analyzing these mind maps (Novak, 1998) by two independent researchers. After the last lesson the students were interviewed. The students were asked to describe the challenges they encountered and following control strategies. The control strategies (f=77) the students described using per challenge were identified from the interview data. The reliability analysis for the coding was conducted by an independent researcher (Cohen's kappa .72).

Analysis and results

K-means cluster analysis was used to establish two groups, namely high (n=7) and low achievers (n=12) based on the students learning result. This categorization was used as a basis for further analysis.

In respect of the first research question, the students reported using zero to three control strategies per challenge. Also, the high achievers reported using more control strategies, when confronting challenges (see Picture 1).

In respect of the second research question, the high and low achievers learning patterns in challenging and other gStudy sessions between the high and low achievers were investigated (see Table 1). Learning patterns refers to sequences about how cognitive tools are typically used in challenging and other gStudy sessions.

Table 1.

From the other gStudy sessions only one learning pattern emerged from the high and low achievers learning activity. Both groups pattern was similar and focused on making notes. From the high achievers challenging gStudy the same learning pattern emerged again. However, from the low achievers challenging gStudy sessions learning patterns ($F=88$) occurred (See table 1). These emerging learning patterns were composed of different types of highlights, notes and concept mapping.

Conclusions

The results of this study show that elementary school students are aware of using control strategies in challenging learning situations, but there are differences about how these control strategies are used. The students, who achieved the best learning result, reported having more choices of control strategies when confronting challenges, whereas the low achieving students gave up more easily.

These study suggest, that successful use of control strategies enables the use of information processing strategies (see also Rozendaal, Minnaerts & Boekaerts, 2001). Based on the theoretical models on self-regulated learning, challenges should lead to change or adaptation of study techniques (Winne & Hadwin, 2008). Yet, in this study the high achieving students maintain the same use of study techniques in challenging learning situations as they were engaged to use in other kind of learning situations.

The low achievers' study technique use, instead, become vague and experimental in challenging learning situations. This might indicate that the effort of carrying out a deeper learning strategy was too much for them, or they didn't recognize appropriate study technique. This study shows that even though the students are prompted to use different study techniques, they do not necessary change their prominent learning strategy. The study results suggest, that there should also be embedded prompts or hints for the students about the situations that call for changing the study technique, but also about the purposes that different study techniques can serve.

Novak, J.D. (1998). Learning, creating and using knowledge: concept maps as facilitative tools in schools and corporations. New Jersey: Mahwah.

Pintrich, P. (2000). Role of goal orientation in self regulated learning. In M. Boekarts, P.R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation (pp.452-494). San Diego: Academic Press.

Rozendaal, J.S., Minnaert, A, & Boekaerts., M (2001). Motivation and self-regulated learning in secondary vocational education: information-processing type and gender differences. Learning and Individual Differences (13)4, 273-289.

Winne, P.H., & Hadwin, A.F. (2008). The weave of motivation in self-regulated learning. In D.H. Schunk & B.J. Zimmerman (Eds.), Motivation and self-regulated learning. Theory, research and applications (pp. 297-314). New York: Lawrence Erlbaum Associates.

Winne, P.H., Nesbit, J.C., Kumar, V., Hadwin, A.F., Lajoie, S.P., Azewedo, R., & Perry, N.E. (2006). Supporting self-regulated learning with gStudy software: The LearningKit project. Cognition & Instruction, 3, 103-113.

Wolters, C.A. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. Instructional Science(26)1-2, 27-47.

PAPER PRESENTATION

Self-regulation of motivation: Evaluation of a strategy knowledge test on motivation regulation

Hubertina Thillmann, Ruhr-University Bochum, Germany; Joachim Wirth, Ruhr-University Bochum, Germany

The purpose of this study was to evaluate a newly developed test for assessing students' strategy knowledge about motivation regulation during self-regulated learning (Wolters, 1998, 2003). 109 university students took part in a correlational study. Before reading a subjectively uninteresting text students were instructed to motivate themselves. Their motivation to read the text was assessed prior to and after the self-motivation phase. Students' conceptual knowledge about the respective text content was assessed by a multiple-choice test. Furthermore, students' strategy knowledge on motivation regulation was assessed by the newly developed strategy knowledge test on motivation regulation. The test has a specific format (cf. Artelt, Schiefele & Schneider, 2001) that presents sketches of learning situations with a specific motivational problem. Each situation is followed by a list of action alternatives that describe more or less useful motivation strategies. Students' task is to rate the usefulness of the action alternatives for each situation. A strategy knowledge score is calculated as the degree of correspondence between the individual's rating and a respective expert's rating. Results show acceptable reliability of the test as well as hints of validity. For example, positive correlations between students' strategy knowledge and their motivation after the self-motivation phase,

between students' motivation after the self-motivation phase and their learning outcome, and between students' strategy knowledge and their learning outcome suggest the expected mediation pattern. In sum, these first results are promising with respect to test quality.

Aims of the study:

Models of self-regulated learning assume that learners have to regulate their cognition as well as their motivation by appropriate strategies (e.g. Wolters, 1998). Furthermore, these models assume that learners' knowledge about strategies can be regarded as a prerequisite for their strategy use (e.g. Winne & Perry, 2000). Accordingly, Veenman, van Hout-Wolters and Afflerbach (2006) point out that for empirical research it is important to assess both, learners' strategy knowledge and their strategy use in order to be able to diagnose whether problems in self-regulated learning are due to a mediation deficiency, i.e. that learners have no strategy knowledge available, or to a production deficiency, i.e. that learners have strategy knowledge available but don't use it.

Empirical research on self-regulated learning has focused for a long time on the cognitive aspects of self-regulated learning (cf. Wolters, 2003) and the use of cognitive strategies (cf. Winne & Perry, 2000). Consequently, there exist various tests assessing cognitive strategy use. However, there is to our knowledge only one test available assessing strategy knowledge (Schlagmüller & Schneider, 2007). Furthermore, this test is restricted to knowledge about cognitive strategies.

Turning to the regulation of motivation within self-regulated learning, research has shown that learners report using motivation strategies, ranging from volitional strategies to extrinsic and intrinsic regulation strategies and that their use of motivation strategies seems to depend on the specific motivational problem, ranging from difficult tasks to unimportant or uninteresting tasks (Wolters, 1998). However, until now learners' knowledge about strategies for regulation of motivation has not been assessed. Against this background, the aim of this study was to develop and evaluate a new test that assesses learners' knowledge about strategies for regulating their motivation.

Methods:

Sample. 109 university students with a mean age of $M=24.1$ years ($SD=3.3$) and 74.3% female participated in this study.

Materials.

We developed two parallel versions of a strategy knowledge test on motivation regulation. The test included twelve situation sketches (each test version included six sketches). Each sketch was accompanied by four to six action alternatives. According to Wolters (1998), the situation sketches dealt with different motivational problems, namely uninteresting, difficult, or plenty learning material or an attractive distraction, and the action alternatives described different volitional and information processing strategies as well as extrinsic and intrinsic regulation strategies. Two science texts, two multiple-choice tests on conceptual knowledge and motivation ratings were taken from a training study run by Leutner, Barthel and Schreiber (2001).

Procedure.

The study was run with groups of about 15 persons per session, with each session taking about 60 minutes. First, students filled in the A version of the strategy knowledge test on motivation regulation (10 min.). Afterwards, students were instructed to read the abstracts of two different science texts and to rate their motivation to read the respective full text (10 min.). Then, they were given the text they previously rated as less interesting and were instructed to motivate themselves to read the text (3 min.). Subsequently, they wrote down how they had motivated themselves and rated again their motivation to read the text (5 min.). After reading the respective text (12 min.) students filled in a multiple-choice test on conceptual knowledge about the text content (8 min.). Finally, students filled in the B version of the strategy knowledge test on motivation regulation (10 min.).

Results:

The two versions of the strategy knowledge test on motivation regulation showed both medium difficulties and acceptable reliabilities in terms of internal consistency (version A: $M=.63$; $SD=.11$; $\alpha=.86$; version B: $M=.69$; $SD=.08$; $\alpha=.77$), and parallel-test-reliability ($r=.654$).

Furthermore, results revealed hints of validity of the strategy knowledge test on motivation regulation: First, we found a positive correlation between strategy knowledge (version A), and motivation after the self-motivation phase ($r=.198$;
p

Second, we found a significant difference between students' strategy knowledge on motivation regulation before the self-motivation phase (version A) compared to afterwards (version B) ($t(108)=7.51$; p

Discussion and Outlook:

In sum, results speak for a good test quality in terms of reliability and first hints of validity.

In order to further replicate and extend the results we are currently evaluating a test version for secondary school students. Results of this study will also be presented.

For future research we propose to assess learners' strategy knowledge and their actual strategy use of motivation regulation strategies in order to get a deeper insight into the mechanisms of motivation regulation and to be able to design adequate support for learners' regulation of motivation.

References:

- Artelt, C., Schiefele, U. & Schneider, W. (2001). Predictors of reading literacy. *European Journal of Psychology of Education*, 16, 363-383.
- Leutner, D., Barthel, & Schreiber, B. (2001). Studierende können lernen, sich selbst zum Lernen zu motivieren: Ein Trainingsexperiment [Students can learn to motivate themselves: A training experiment]. *Zeitschrift für Pädagogische Psychologie*, 15, 155-167.
- Schlagmüller, M. & Schneider, W. (2007). Wuerzburger Lesestrategie-Wissenstest fuer die Klassen 7-12 [Wuerzburger reading strategy knowledge test for classes 7-12]. Goettingen: Hogrefe.
- Veenman, M.V.J., van Hout-Wolters, B.H.A.M., & Afflerbach, P. (2006). Metacognition and learning: conceptual and methodological considerations. *Metacognition and Learning*, 1, 3-14.
- Winne, P.H., & Perry, N.E. (2000). Measuring self-regulated learning. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Handbook on self-regulation* (p. 531-566). San Diego, CA: Academic Press.
- Wolters, C.A. (1998). Self-regulated learning and college students' regulation of motivation. *Journal of Educational Psychology*, 90, 224-235.
- Wolters, C.A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist*, 38, 189-205.

PAPER PRESENTATION

Readers' ability attributions in dealing with scientific Internet information

Dorothe Kienhues, Institute of Psychology, Germany; Rainer Bromme, Universitat Muenster, Germany

The Internet has become an important source for laypeople searching for (scientific) information. During Internet search, they easily come across conflicting or preliminary information. We assume that being confronted with such information evokes a need to explain why conflicts occur, and that people may (partly) attribute the problem of making sense of conflicting information to their own limits to understand the information and to deal with it properly. This study investigates readers' ability attributions in dealing with conflicting and consistent Internet information. Different variables were considered: situational ability reasoning, a global competence self-concept measure, decisional conflict, satisfaction with the decision made, and knowledge gained during Internet search. Sixty-four participants were asked to search the Internet for information on cholesterol to support a fictitious friend in making a treatment decision. Participants were either provided with 15 preselected conflicting websites (conflict group, $n = 30$) or 15 preselected consistent websites (consistency group, $n = 34$). Results show that dealing with conflicting or consistent information did not differentially influence participants' situational ability reasoning, decisional conflict, satisfaction with the decision made or knowledge gained during Internet search. However, regression results revealed that in dealing with conflicting information, questioning one's ability was a reaction to the problems encountered and did not derive from the general competence self-concept. Dependent on features of the information, participants either referred to a trait-like concept of own competencies in their situational ability reasoning or not.

The Internet has become an important source for laypeople searching for (scientific) information. While searching the Internet, they easily come across conflicting or preliminary information provided by experts of all kinds. When confronted with conflicting information on the Internet, it might be unclear for laypersons whether there is a 'real' contradiction or whether their lack of understanding causes the impression of a conflict. In latter case, a reader would assume that more knowledge on his/her side could resolve the conflict or at least make it possible to find out which view is right or wrong (we will call this an ability attribution). We assume that people may (partly) attribute the problem of making sense of conflicting information to their own limits to understand the information and to deal with

it properly (even though they usually do not lack self-confidence). This study investigates ability attributions in dealing with conflicting and consistent Internet information. Precisely, we wished to investigate whether participants show different ability attributions depending on the kind of information dealt with.

We hypothesized that participants dealing with conflicting information would question their ability to deal with the task at hand more than participants dealing with consistent information. To explore ability attributions in further detail, we additionally took into account participants' general self-concept of own competencies. We assumed that the global self-concept measure should only be a reliable predictor for participants' task-specific ability reasoning in the case of consistent information, but that the predictive power of the general variable should be lessened in the case of conflicting information, due to the specific influence of this kind of information. Furthermore, we considered potential differences in decisional conflict and satisfaction with decision, assuming that participants dealing with conflicting information would experience more conflict and would be less satisfied with their decision than participants dealing with consistent information. In our study ($N = 64$), participants searched the Internet for cholesterol information to advise a fictitious friend about treatment. Participants were randomly assigned to two conditions: a group provided with 15 preselected websites with conflicting contents (conflict group, $n = 30$) and a group provided with 15 preselected websites with consistent contents (consistency group, $n = 34$). We applied a scale of a global competence self-concept measure (FKK) before the Internet search. After the Internet search, we applied a scale retrospectively assessing participants' ability reasoning during Internet search, e.g. in how far participants had thoughts of insufficiency concerning their knowledge for dealing with the specific task. Participants furthermore answered the Decisional Conflict Scale, the Satisfaction with Decision Scale and a post-search knowledge test on cholesterol to control for learning effects (no significant difference between the groups, $t[62] = -.46$, $p > .20$). Results indicate that the two groups did not differ significantly in the scores gained on the ability reasoning scale, $t[62] = -.95$, $p > .20$. Contrary to our suggestions, all participants equally estimated their situational ability as "mediocre". We then conducted a hierarchical moderated regression analysis. Dependent variable was ability reasoning. Predictor variables were general competence self-concept (as measured with the FKK; the two groups did not differ significantly in this measure, $t[62] = 1.31$, $p = .19$), the kind of information dealt with (conflicting information vs. consistent information), and the interaction of the FKK and kind of information dealt with.

Results reveal that a model including the interaction term accounted for 52% of the variance and contributed to an increment of explained variance over the variance contributed by a model without the interaction term, $R^3 = .52$, $F(1, 61) = 7.26$, $p < .09$. A moderating effect was identified by a significant beta weight for the interaction term ($b = -.26$; $p > .10$; consistency condition: $b = .73$; $p < .05$, $t[62] = .59$, $p > .20$, nor in satisfaction with decision, $t[62] = .09$, $p > .20$). Correlation analyses reveal that participants who believe more in their abilities during online search were more certain in their decision and vice versa, $r = .58$, $p < .05$, $r = .62$, $p < .05$, $r = .14$, ns. Our results underline the role of ability aspects in dealing with conflicting scientific (Internet) information. Regression results reveal that participants attribute the problem of making sense of conflicting information to their own limits to understand the information and to deal with it properly, even though they usually do not lack self-confidence. These results suggest that questioning one's own competence to deal with conflicting information is an interpretative answer to the difficulties encountered when it comes to making sense of such information. In general, dealing with information on the Internet seems to require an optimistic and self-confident view of one's own abilities to deal with the information accessed. This subjective assessment seems to determine more how people react in the specific situation than an objective measure of ability, e.g. a knowledge measure. Therefore, it is important to encourage consumers' information literacy. The role of laypeople's beliefs about their abilities for dealing with scientific information, on the Internet and in general, will be further highlighted in the full paper.

PAPER PRESENTATION

Toward a dynamic approach to the study of self-efficacy: the impact of its evolution on motivation

nadia leroy, UNIVERSITE DE GRENOBLE LSE, France; Gwenaëlle Joet, Université Pierre Mendès France, France; Pascal Bressoux, Université Pierre Mendès-France, France

The influence of students' self-efficacy on their academic motivation has largely been documented. However, studies having addressed the effects of self-efficacy fluctuations over time on motivation remain relatively absent from international literature.

A longitudinal approach was used to examine growth trajectory in self-efficacy during the first year of middle school as well as the impact of its changes on academic.

A total of 915 students completed a questionnaire at four occasions during their 6th grade year. Using the multilevel model for change technique (Singer & Willett, 2003)

The results revealed that student's self-efficacy gradually declines over the school year.

Having proposed a model for intra individual changes we then wanted to examine the relationship between self-efficacy growth patterns and academic motivation. Growth parameters extracted from the intra individual model were introduced as covariates in a regression model aiming at explaining interindividual differences in academic motivation.

Concerning the relationship between self-efficacy changes and academic motivation they indicated that fluctuations in self-efficacy impact student motivation.

Theoretical implications of such a dynamic approach with regard to academic motivation will be discussed

Theoretical framework

The first year of middle high school is a transitional period that puts students in face of new demands that force them to adapt to a variety of situations. With a larger responsibility left to them, the way in which they feel able to cope with these many challenges seems to play a key role for their school adaptation.

Another factor that plays a particularly important role with regard to school achievement is academic motivation (for review, see Gottfried et al., 2009) especially among students who demonstrate self-determined forms of motivation.

Studies conducted by Albert Bandura (1977, 1982, 1997) have shown that evaluations that students formulate about their capacities to achieve a given task (i.e., their self efficacy beliefs) can be considered as powerful motivational resources.

According to the socio-cognitive theory, self-efficacy determine the level of effort and perseverance that individual deploy when confronted with difficulties (Bandura, 1989 ; Bandura & Cervone, 1983). As a consequence, self-efficacy can be considered as a factor that indirectly affects school performance (e.g., Bandura, 1997; Pajares, 1996; Schunk, 1995) via academic motivation.

However if these theoretical contributions seem to indicate that self-efficacy play a central role in the cognitive regulation of motivational processes few studies had effectively been conducted to empirically analyze their relationships.

In addition another issue that needs to be considered in empirical studies concerns the evolutionary nature of self-efficacy.

Theoretically admitted as a dynamic variable that tend to decrease over the school years, self efficacy and its effect on motivation are in fact systematically apprehended in a static way. Little is known about its pattern of change across time and even less about the effects of self-efficacy fluctuations on academic motivation.

Objective and hypothesis

The aim of the present research is precisely to examine the relationship between self-efficacy and academic motivation according to a dynamic approach by analyzing how self efficacy changes impact on academic motivation.

In terms of the direction of self efficacy change trajectory, we had a priori hypothesis for a decrease over time. Concerning the impact of self-efficacy changes on academic motivation we hypothesized that academic motivation would be positively influenced by the beliefs student develop about their capacities to achieve a given task and that the fluctuations of these beliefs can account for a significant part of motivation variance.

Method

Participants

Students registered in French middle high schools in the Grenoble area participated in the present study. The original sample consisted of 1082 students (boys, n=543; girls, n = 538) from 47 classes of 15 schools in a large French city.

The data collection took place for 4 consecutive times. The students were sampled few weeks after the beginning of the year and then at the end of each quarter. Thus, in total four measures were taken. 915 students completed the questionnaires on all occasions.

Measures

Academic motivation

We used the academic self regulation questionnaire, developed by Ryan and Connell (1989), to evaluate why students do various school related behaviors. This questionnaire assesses the reasons why students do various school related behaviors in a Likert scale format from 1 (strongly disagree) to 5 (strongly agree).

Self efficacy beliefs

The scale aiming at measuring this variable was inspired by a scale extracted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich and De Groot (1990).

Analysis technique

To model self-efficacy growth trajectory and to test this impact of its evolution on academic motivation we used the multilevel model for change technique (Singer & Willett, 2003) and fitted longitudinal models using SAS PROC MIXED with Full Maximum Likelihood parameters estimation method to handle the presence of any missing data

Results

The analysis had two parts.

The first part examined the growth trajectory of self-efficacy beliefs. The second part aimed to ascertain whether self-efficacy beliefs fluctuations could account for the variation in academic motivation.

Firstly, to identify fluctuations occurring in each student self efficacy pattern, a simple longitudinal model equation has been fitted.

Results indicate that this simple longitudinal model equation describes negative self-efficacy development over the first year of middle high school with a mean decrease of 0.07 point in self-efficacy score from one measurement occasion to another.

In this second part of the analysis that consist on analyzing the impact of self-efficacy changes we introduced in a multilevel of academic motivation the growth parameters factor reflecting self-efficacy intraindividual fluctuations. In other words, academic motivation score was regressed on growth parameters extracted from the self-efficacy growth trajectory just fitted above

The results summarize a number of important findings with respect to the predictive capabilities of self efficacy dynamic on academic motivation.

First, initial mean level of self-efficacy significantly predicted academic motivation score at the end of the school year beyond the influence of initial level of performance and motivation, indicating that, on average, student who had higher scores on academic motivation score had significantly higher initial values on self-efficacy scores.

Second, self efficacy rate of change over the school year also significantly predicted the level of academic motivation at the end of the year after controlling self-efficacy mean level at the beginning of the year .

This result indicates that, on average, children whose self-efficacy rate of change is the faster have significantly higher values of academic motivation.

To briefly conclude we can say that ths study present the advantage to clarify our understanding about the effects of self-efficacy dynamics on academic motivation during the first year of middle high school insofar as they reveal that the impact of self efficacy on motivation is not limited to the value taken by this variable at a given point in time but that it also extends at its rate of change throughout the school year. By better understanding the relationship between these two key processes it would be possible to improve the predictive power of models of motivation and as a consequence to better apprehend the processes involved in school achievement differences

PAPER PRESENTATION

Teachers' Source Evaluation Self-Efficacy Predicts Their Use of Relevant Web Source Features

Ivar Braten, University of Oslo, Norway; Rune Andreassen, Ostfold University College, Norway

The study investigates the relationship between teachers' beliefs about their capability to evaluate the trustworthiness of sources and their reliance on relevant source features when searching the Internet to learn about special educational needs (SEN). To answer the research questions about this relationship 263 in-service teachers from 40 elementary schools responded to a 30-items digital questionnaire including questions about domain knowledge, experience in searching for information and participants' beliefs about their capability to evaluate the trustworthiness of Web-based information on SEN. Two hierarchical multiple regression analyses were performed, one with emphasis on source features related to the product of a Web site as DV, and the other with emphasis on source features related to the producers of a Web site as DV. The analyses showed that teachers' source evaluation self-efficacy beliefs predicted their use of both source feature dimensions independent of other individual difference variables. This study contributes to the literature of source evaluation within both reading and information literacy by exploring the role of teachers' self-related belief.

Aim

The main aim of this study was to investigate the relationship between teachers' beliefs about their capability to evaluate the trustworthiness of sources and their reliance on relevant source features when searching the Internet to learn about special educational needs (SEN).

Theoretical framework

Learners' demanding, yet necessary source evaluation, presents not only students but also professionals and seasoned learners great challenges. Thus far, few studies have investigated in-service teachers' use of source features to evaluate Web-based information. However, Williams and Coles (2007) found that many teachers recognized the need to make quality judgments about research evidence but did not feel confident that they were able to do so.

Bråten et al. (2009) and Rouet et al. (1996) demonstrate that domain knowledge plays a role in source evaluation. Also, learners' experience in searching for and evaluating information is likely to contribute to their sourcing skills (Rouet et al., 1997). Another relevant but less researched individual difference variable in this context concerns learners' self-efficacy beliefs (Bandura, 1997), specifically their beliefs in their capability to evaluate the trustworthiness of Internet sources. In the present study, we therefore created a new measure to assess teachers' source evaluation self-efficacy and used the scores on this measure to predict their use of relevant source features when evaluating source trustworthiness. Specifically, we hypothesized that teachers' source evaluation self-efficacy would uniquely predict their reliance on relevant source features when judging the trustworthiness of Web-based sources on SEN after variance related to gender, age, domain knowledge, and experience in relevant Internet use had been accounted for.

Method

263 in-service teachers from 40 elementary schools responded to a 30-items digital questionnaire.

Predictors.

A mix of Likert scale and multiple choice questions were asking for participants' gender, age, domain knowledge related to SEN, and experience in using the Internet in search for SEN information during the current school year. They were also asked to indicate which SEN topics they had most frequently been in search of. To assess participants' beliefs about their capability to evaluate the trustworthiness of Web-based information on special education, we developed the Source Evaluation Self-Efficacy Scale (SESES) by combining questions.

Dependent variables.

The outcome variables were based on participants' responses to five 5-point Likert scale items concerning to what extent they emphasized the source features of layout, Web-address, author, content, and date of publication, respectively, when judging the trustworthiness of Web sites on SEN. Principal component analysis of the five items yielded two factors with high loadings and no overlap for any item. Because the first factor seemed to be concerned with the product of a Web site (its content and the layout and timeliness of this content), we labeled this factor Emphasis on Product. Because the second factor seemed to be more concerned with the producer of a Web site (Web-address and author), we labeled that factor Emphasis on Producer.

Results

Two hierarchical multiple regression analyses were performed, one with emphasis on product as DV, and the other with emphasis on producer as DV. In each analysis, gender and age were entered into the equation in step one, and

indicators of domain knowledge and experience in searching the Internet for SEN information were entered in step two. In the third step, we included scores on the measure of SESES.

First analysis.

In step one, both gender and age were statistically significant predictors, indicating that female teachers were more likely than male teachers and younger teachers more likely than older to emphasize the product when evaluating source trustworthiness. In step two, experience in searching the Internet were a statistically significant predictor in addition to age. Finally, in step three, the SESES was the only statistically significant predictor in addition to gender, indicating that the higher confidence the teachers had in their ability to evaluate the trustworthiness of sources, the more they emphasized product features of the site.

Second analysis.

In step one and two, no significant increment in the explained variance was observed. However, when participants' SESES scores were entered in step three, this resulted in a statistically significant increment in the explained variance. In this step, the SESES was a strong positive predictor of Emphasis on Producer.

Conclusions

This study contributes to the burgeoning literature on source evaluation within both reading and information literacy in several ways. First, few other studies have explored the role of teachers' self-efficacy beliefs for educational use of information technology (Hoy & Davis, 2006). Second, this study developed a new measure of self-efficacy beliefs specifically addressing beliefs about source evaluation when using the Internet in a particular domain and provided preliminary reliability and validity information about this measure. Third, the study provided the first empirical evidence about the underlying structure of learners' use of source features when evaluating sources, indicating that emphasis on product and emphasis on producer may form separate dimensions. Fourth, the study showed that teachers' source evaluation self-efficacy beliefs predicted their use of both source feature dimensions independent of other individual difference variables, suggesting that teachers' critical evaluation of Web-based resources is not only a matter of domain knowledge and technological skills but also of self-related beliefs.

References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
- Bråten, I., Strömsö, H.I., & Britt, A. (2009). Trust matters: Examining the role of source evaluation in students' construction of meaning within and across multiple texts. *Reading Research Quarterly*, 44, 6-28.
- Hoy, A., & Davis, H.A. (2006). Teacher self-efficacy and its influence on the achievement of adolescents. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents*. Greenwich, CT: Information Age Publishing.
- Rouet, J.F., Britt, M.A., Mason, R.A., & Perfetti, C.A. (1996). Using multiple sources of evidence to reason about history. *Journal of Educational Psychology*, 88, 478-493.
- Rouet, J.F., Favart, M., Britt, M.A., & Perfetti, C.A. (1997). Studying and using multiple documents in history: Effects of discipline expertise. *Cognition and Instruction*, 15, 85-106.
- Williams, D., & Coles, L. (2007). Teachers' approaches to finding and using research evidence: An information literacy perspective. *Educational Research*, 49, 185-206.

PAPER PRESENTATION

Domestic and international students: readiness, course experiences and achievement

Ellen Jansen, University of Groningen, Netherlands; Cor Suhre, University of Groningen, Netherlands

Higher education institutions all over the world have received international students with open arms. A case study in Economics and Business at a Dutch research university shows that international students need less time-to-degree, have higher marks and need less re-sits compared to domestic students. Data from the REQ (Readiness and Expectations Questionnaire) and CEQ (Course Experience Questionnaire) point at differences between the different groups of students. In the study we discerned domestic students, European students and Asian students. It seems that international students have another approach to the study and another study experience than Dutch students.

Introduction

International degree programmes attract a lot of students from different regions. These students represent a heterogeneous group. Regions that are best represented in the Netherlands are Asia and European countries with German as the medium. To be able to enhance foreign students' chances of graduating and to offer them a

satisfactory study experience the management needs specific information on students' readiness, expectations and study performance.

In particular we draw attention to differences between students in their study aspirations, their study skills, the course experiences and study progress. This information can be used to provide prospective students with accurate information on study skills required to succeed and to offer students from different regions any additional support they need the most.

Research Questions

There are three questions we wish to address in our presentation:

1. Which differences in study preparation and course experiences exist between students from different regions in the world in a typical degree programme at a Dutch university?
2. Which differences in achievement profiles exist between students from different regions in the world in a typical degree programme at a Dutch university?
3. Does the participation in international degree programmes have advantages for domestic students?

Theoretical background

Research on study success departs from a student-centred theory of college completion (see for example Stage & Hossler, 2000). They start their model from student background, via school experiences, intentions and engagement, college entry through completion or drop out. In an adapted form for our programme the model can schematically designed as:

Student Background experience	School	Higher experiences	Degree education	completion
SES	learning	choice	persistence	
GPA	experience	motivation	drop out	
Gender		involvement	skills acquisition	

The model shows that outcome not only depends on the higher education experience, but it is also influenced by student background characteristics, experiences in secondary education and experiences, motivation and involvement in higher education. Bandura and Locke (2003) showed that perceived self efficacy and personal goals enhance motivation and performance attainment. This is based on social cognitive theory which indicates that people regulate themselves in an anticipative, purposive and evaluating manner. Efficacy beliefs contribute to the level of motivation and performance. If students belief that their self efficacy is high, they will use more efficient problem solving strategies and achieve higher intellectual performance (Bouffard-Bouchard, 1990 in : Bandura 2003, p.88). Academic self-efficacy is also related to students' approaches to learning and their use of study and learning strategies (Simmons, 1996).

As an elaboration on Tinto's interactionalist theory with the central concepts of academic and social integration (Tinto, 1975, 1993) Kuh and Love (2000) added the cultural perspective and this can be seen as one of the main problems first-year students encounter commencing in higher education. Drop-out in the first year of higher education is a global theme (Krause, 2005; McInnis & James, 2004; Yorke, 1999) and reasons to drop out can according to Yorke and Longden (2004) be classified in four groups among others unsatisfactory experience at university and difficulties in coping with the programme demands. It seems that first-year students are not clear about what is expected of them in terms of more generic foundation skills, and that they have unclear expectations about what is going to happen starting their study (Pitkethly & Prosser, 2001).

Research design

Two cohorts of students from Dutch as well as international degree programmes in Economics and Business at a Dutch university are followed during their first year.

At the very begin of their study they filled out the Readiness and Expectations Questionnaire (Jansen & van der Meer, 2007; Van der Meer & Jansen, 2008; Jansen & van der Meer, forthcoming) and midway their first year an adapted version of the Course Experience Questionnaire (McInnis et al, 2001; Ramsden, 1991; Wilson et al, 1997). The results of these questionnaires are merged with data on student characteristics and student progress/ success data. For triangulation purposes interviews with students and focus groups were organised.

Results

The results from cohort 2009 show that students from different nationality groups do differ in their expectations and preparedness for university. Students from Asia were to a higher extent unsure if they were well-prepared for university. They scored lower on their self-perceived command of English and on the preparedness scales on time-management, information processing, writing and working in small groups. On the other hand Asian students expect to a higher extent than the other nationality groups to be involved in research activities in the first year and to be inducted in the new programme. European students (German, Bulgarian, Romanian) have the highest expectation that they will need time-management skills and overall they scored highest on the readiness scales.

Also the course experiences differ for the different groups. The European international students were the most satisfied with the degree programme, but the teaching quality was the least appreciated. They identified the workload in the programme as appropriate.

We had students rate their study behaviour against two standard 30 hours time per week and more than 75 % tutorial attendance on a five point scale. The average score are given in the next table. This table shows that the study behaviour of the three groups differ strongly. Most European and Asian students easily comply with these standards, while many Dutch students don't.

A LISREL analysis indicated the importance of the expectations on degree programme satisfaction, which leads to a better study behaviour and actually to higher study success.

Also the perceived readiness in information processing affects the course experience and via the course experience affects the degree programme satisfaction.

PAPER PRESENTATION

Reciprocal Effects of Spelling and Reading Comprehension

Olaf Koeller, Leibniz Institute for Science and Mathematics Education, Germany

A repeated measurement study was carried out to analyze reciprocal effects of reading comprehension and spelling. Recent training studies have suggested that transfer effects across skills can be observed. To test whether these effects can be found in a school setting, we analyzed two-wave data ($n = 1.143$, 49,7% female) from junior high schools. The first measurement point (T1) was at the beginning of grade 5, the second at the beginning of grade 7 (T2). Students worked on spelling and reading tests. Multi-level analyses supported a reciprocal effects model. The effect of T1-reading on T2-spelling ($b = .216$, $p < .001$), however, was stronger than from T1-Spelling on T2-reading ($b = .060$, $p < .05$). These effects were stable even after controlling for psychometric intelligence and type of secondary school. Educational implications are discussed.

Background and Aims of the Study

Reading and Spelling skills are very important for a successful school and vocational career. Therefore, educators put much emphasis on teaching both skills in primary and in secondary education and much research has been carried out identifying antecedents of successful spelling and reading. In the field of educational research, several studies have been conducted investigating the relationship between reading and spelling skills in early years of primary school (Ehri, 2005). Here, major findings support a reciprocal effects model, meaning that early reading skills (fluency when reading single words) promote spelling and vice versa. Authors like Ehri (2005) have argued, that this relationship is based on common cognitive processes during reading and writing. In older ages, however, the relationship between reading and spelling is less clear. Stanovich and Cunningham (1992) analyzed data from a sample of university students and found a correlation of $r = .57$ between reading comprehension and spelling. Such a strong association may be understood in terms of individual differences in the underlying verbal ability. However, reading and spelling may also be causally interconnected in their development.

Based on this research we were interested in the relationship between reading comprehension and spelling in early high school years. We thus carried out a repeated-measurement study with time points at the beginning of high school (grade 5) and two years later (beginning of grade 7). We predicted stronger effects from reading on spelling than vice versa. Since the German high school system is highly selected, meaning that bright students attend high-achieving schools preparing for university (in German: Gymnasium) while the rest of the students attend schools

preparing for vocational education, we were also interested in whether school-type contributes to change in spelling and reading skills.

Materials and Method

A repeated measurement study with data collections at the beginning of grade 5 (T1) and the beginning of grade 7 (T2) was carried out. A total of $n = 1.143$ German high school students (49,7 % female; 31% non-German students) worked on spelling and reading comprehension tests at both measurement points. Students came from two different types of junior high schools, i.e., 27 percent attended Gymnasium, while the remaining 77 percent attended schools preparing students for vocational education.

Reading comprehension was measured with tests that have been developed in the context of large-scale studies. Items mainly focus on students' skills to form a broad and general understanding of the texts and to retrieve information from the texts. Means of test linking using an anchor item design were applied to obtain a common scale for T1 and T2. Using IRT methods weighted likelihood estimates (WLE) were computed as students' reading scores. The WLE-reliabilities of the reading tests were sufficient ($> .80$ at T1 and T2).

Spelling was measured at both time points by means of a text consisting of 307 words, of which 31 were written incorrectly. Students were instructed to mark the incorrect words. The test score was defined by computing the squared number of identified mistakes divided by the total number of words marked by the student. Reliability was also quite high at both time points ($> .80$).

Validity of both the reading and the spelling test was investigated by linking test results to school marks (in German as the first language) in the last report card. The correlation coefficients were $r = .39$ ($p < .001$, T1) and $r = .43$ ($p < .001$, T2) for spelling and $r = .38$ ($p < .001$, T1 and T2) for reading, indicating a sufficient degree of validity.

Due to the hierarchical character of the data (students nested within classes) multi-level analyses using HLM 6.0 were conducted. To ease interpretations of the HLM-output, all measures were standardized at T1 ($M = 0$, $SD = 1$). T2 measures were standardized with respect to T1 means and standard deviations, so that differences in all measures could be interpreted as change over time.

Results

Longitudinal multi-level path analyses were conducted to test the reciprocal effects model of spelling and reading comprehension. The findings provide evidence for a substantial effect of T1-reading on change in spelling ($b = .22$), while the corresponding effect from T1-spelling on T2-reading was substantially smaller ($b = .06$) but still significant. Furthermore change in both constructs was significantly affected by school-type, i.e., students at Gymnasium outperformed all other students, and intelligence. Note that more than 70 percent of the variance in T2-spelling and T2-reading was explained by T1-measures.

Discussion and Educational Implications

The major hypothesis predicting a stronger effect of reading on change in spelling than from spelling on change in reading was supported. This finding highlights the important role reading experiences play for the development of spelling skills. Reading activities do not only enhance reading comprehension but also increase the lexical and orthographic memory of students. Accurate spelling is thus strongly based on specific word knowledge that students receive from reading.

With respect to school-type, the results provide evidence for the important role learning environments play. Curricula on spelling vary among schools and particularly the German Gymnasium has a strong tradition promoting students' spelling skills. This tradition was clearly reflected by the findings.

Concerning educational practice the findings strongly suggest that teachers providing learning opportunities in reading will also improve spelling skills of their students. Our findings should also motivate parents to foster their children's reading activities at home.

References:

- Burt, J. S., & Fury, M. B. (2000). Spelling in adults: The role of reading skills and experience. *Reading and Writing: An Interdisciplinary Journal*, 13, 1 – 30.
- Ehri, L. C. (2005). Learning to read words: Theories, findings, and issues. *Scientific Studies of Reading*, 9, 167 – 188.
- Landerl, K. & Wimmer, H. (2008). Development of word reading fluency and spelling in a consistent orthography: An 8-year follow-up. *Journal of Educational Psychology*, 100, 150 – 161.

Stanovich, K. E., & Cunningham, A. E. (1992). Studying the consequences of literacy within a literate society: The cognitive correlates of print exposure. *Memory and Cognition*, 20, 51 – 68.

PAPER PRESENTATION

Literacy skills and psychosocial competence in Primary school children

Asimina Ralli, University of Athens, Greece; Electra Andaraki, University of Athens, Greece

Literacy skills and psychosocial competence are very important parameters for children in the school setting. Most of the relevant studies have focused only on the relationship between reading difficulties and externalizing behavior problems, without considering other aspects of literacy, such as writing skills, as well as other aspects of psychosocial competence such as school competence.

The aim of the present study is to explore the possible associations between literacy skills (reading and writing) and psychosocial competence (school, social and emotional competence as well as behavior problems) in the Greek mainstream classroom. The sample consisted of 90 primary school children, aged 9-12 years. Children were individually assessed in their literacy skills and data were also collected regarding their psychosocial competence. According to the results, performance in both reading and writing were related with children's social and school competence. Furthermore significant correlations were found between writing skills and school competence as well as between restitution of unstructured text and emotional competence. The findings are discussed in relation to other relevant evidence. Finally, strengths and limitations of the current study are described, and implications for interventions are suggested.

Theoretical background:

The link between reading performance and psychosocial competence has been well documented in the literature. Most of the studies have mainly focused on reading difficulties and behavioral, social and emotional problems in childhood (Pearl, 2002; Wehby et al., 2003).

Reading difficulties have been linked with a range of specific social, emotional, and psychosocial problems, including low self-esteem, depression, anxiety, loneliness, and aggression (Gorman, 2001; Grigorenko, 2001; Snowling 2002; Carroll et al., 2005; Nowicki, 2003).

Impulsivity, hyperactivity, and attention problems have also consistently been associated with reading difficulties (Fleming et al., 2004), with scores on reading achievement tests in elementary school predictive of these behavioral symptoms. Teachers have been found to tend rating students with reading difficulties as having lower social competence and more psychosocial problems than their peers (Pearl, 2002; Nowicki, 2003).

The relationship between reading difficulties and behavior problems increases as students progress through school (Roeser & Eccles, 2000; Morrison et al., 2001; Fleming et al., 2004; Nelson et al., 2004). Also, both reading difficulties and psychosocial problems are strongly predictive of difficulties in adolescence (Hinshaw, 1992; Maughan, 1995).

Adolescents with reading difficulties display higher school drop-out rates, higher levels of inattention, and more delinquent behaviors (including violence and substance abuse) in comparison to controls (Wehby, et al., 2003; Arnold et al., 2005).

Although a great deal of research has demonstrated an association between reading difficulties and psychosocial problems, little is known about the early development, underlying causal mechanisms, or the causal direction of this link (Hughes et. al. Dunn, 2000). Which came first? Do problems in academics lead to problems in behavior? Do problems in behavior lead to problems in academics?

There are two pathways to the above question: According to the social behavior deficit model, social skills problems may lead to academic problems (Dishion et.al. 1995; Wehby et. al. 2003). On the other hand, according to the academic skills deficit model, academic problems may lead to behavior problems (Lee et al., 1999; Roberts et al.2001). Mackintosh's study (2008) demonstrated that deficits in either area were independent risk factors which support the idea for both pathways. Alternatively, the spoken and written language impairment may have a shared underlying etiology with the behavior problems.

In contrast to the voluminous literature on the relation between externalizing behavior problems and reading difficulties, little has been written about:

- a. possible associations between different levels of literacy skills and psychosocial competence (social, emotional, school competence and behavior problems) in the mainstream classroom which may include both typically developing children and children with learning difficulties.
- b. possible associations between literacy skills and internalizing behavior problems.
- c. possible associations between writing skills and psycho-social competence.
- d. data in other languages and cultures than English. Such data could offer a further insight along this line of research.

Previous studies have mostly used curriculum-based measurements of oral reading fluency and children's school attainments in reading. The present study attempts to address the above issues using recently devised psychometric tools which cover more than one aspect of reading performance including apart from fluency- as most of the studies do-, decoding, syntax, morphology and reading comprehension. The present study also includes assessments of children's writing skills. Furthermore, while other studies have used office discipline referrals (ODRs), children's self-reports and rating scales for assessing children's psycho-social competence, the present study uses a test for psychosocial competence completed by the teachers.

Aims:

The aim of the current correlational study is to explore the relationships between literacy skills (reading and writing) and psycho-social competence using cross-sectional data from primary school children in Greece by applying psychometric assessments recently standardized in the Greek population. The above tests measure not only reading fluency as most of the previous studies but also decoding, syntax and comprehension. Also writing measures which have not been included in previous studies will be employed in the present study. Regarding children's psychosocial competence new variables will be measured such as school competence apart from social and emotional competence and behavior problems.

Methodology:

Ninety primary school children from three age groups (10, 11, and 12 years old) took part in the study. Children's reading performance was assessed with the tool Test-A for reading (Panteliadou and Antoniou, 2008). The above test examines decoding, reading fluency, syntax and comprehension. The writing skills were assessed with the test of writing difficulties (Porpodas et. al. 2008). The particular test assesses spelling accuracy, text structure, as well as restitution of unstructured sentence and text. Children were assessed individually during those two assessments. Children's psychosocial competence was assessed with the test for psychosocial competence (Ηatzichristou et. al. 2008) which was completed by the teachers. The above test includes questions for social competence, school competence, emotional competence and behavior problems.

Findings:

In general, developmental patterns were found in children's performance both in literacy skills and psychosocial competence. Particularly, children's reading performance varied by age range mainly in reading fluency and comprehension. Children's writing performance varied also by age mainly for spelling accuracy as well as for restitution of unstructured sentence and text. Regarding psychosocial competence, older children performed better in social and emotional competence than their younger counterparts.

Children's performance in both reading and writing was found to be related with their social and school competence. Particularly, children with high performance in reading decoding and fluency, morphology-syntax and comprehension had also scored in high levels for school and social competence. Furthermore, significant correlations were found between writing skills and school competence as well as between restitution of unstructured text and emotional competence.

Theoretical and Educational significance:

The present research demonstrates that competence in literacy skills is a foundation for psycho-social competence. Thus, is very important, children with poor literacy skills who are therefore at risk for psychosocial problems to be identified efficiently during the first grades of the primary school. Interventions should be also devised for promoting literacy skills, or both literacy skills and psychosocial competence. Future studies could also focus on the particular factors underlying this complex link between literacy skills and psychosocial competence in children.

PAPER PRESENTATION

Development and validation of COAT: measuring linguistic performance across children groups

Michalis Michaelides, University of Cyprus, Cyprus; Maria Kambanaros, University of Cyprus, Cyprus; Kleanthes Grohmann, University of Cyprus, Cyprus

The aims of this paper are to describe the development of a language-specific scale to measure object and action word retrieval for use with Greek-Cypriot children and present validity evidence for the measurements derived from this scale using data collected from various children groups. The adapted scale was originally administered to typically developed first-graders, and subsequently to younger children, monolingual and bilingual groups with specific language impairment, as well as typically developed bilingual children. Results confirm the difference in favour of nouns compared to verbs across the various samples, as well as the positive relationships of linguistic performance with a battery of scales administered to some of the participants. Group differences are also examined. Beyond the practical usefulness of developing an original, language-specific instrument with validity documentation in a language that has not been studied, this research is important for improving theoretical understanding of language acquisition in Greek-Cypriots, as well as for clinical purposes to identify special populations.

THEORETICAL BACKGROUND – PURPOSE

The study of language acquisition and linguistic development in a globalised society is becoming quite important in recent years. One aspect of this developmental process that has received little attention is lexical access of nouns and verbs, despite an increasing appreciation for the role of the lexicon in language development (Tomblin & Zhang, 2006), the acquisition of literacy skills (Messer, Dockrell & Murphy, 2004), and for communication and psycho-social well-being (Tomblin, 2008). Linguistic development in special populations such as children with specific language impairment (SLI), or dyslexia, and the increasing numbers of bilingual students in European schools pose additional challenges for the field.

Research suggests that verbs appear to be a more problematic category compared to nouns in various languages and across different groups of language users, including normal elderly adults and young bilingual adults (e.g., Bogka et al., 2003). Similar findings emerge for special populations, such as children with word-finding difficulties and/or SLI (Dockrell, Messer & George, 2001; authors, 2010) as well as for monolingual and/or bilingual adults with acquired language disorders.

The purpose of this paper is to (a) describe the development of a language-specific scale to measure object (noun) and action (verb) word retrieval for use with Greek-Cypriot children; (b) present validity evidence for the measurements derived from this scale across typically developing children and children with specific language impairment, whether monolingual or bilingual; and (c) report comparative results on verb and noun access from these groups. Beyond the practical usefulness of developing a unique language-specific instrument in a language that has not been studied, this research is important for improving theoretical understanding of language acquisition in Greek-Cypriots, as well as for clinical purposes to identify special populations.

METHODOLOGY

Cypriot Greek is a dialect of Modern Greek. The COAT (Cypriot Object and Action Test) was adapted for use with young children from the Greek Object and Action Test (author, 2003) which is used to assess verb and noun retrieval in Greek. Children are asked to name picture stimuli; answers are scored, noting the types of errors made by the children. Thirty typically developing (TD) monolingual first-grade children, between 6;0 and 6;11 years of age were tested with the COAT. They were recruited randomly from three urban public schools. Subsequent testing was conducted with 14 monolingual children with SLI (aged between 5;5 – 9;9 years), and 10 TD children of younger age (between 3;05-5;2 years of age). Two smaller groups were also included: 4 bilingual children with SLI, 6 TD bilingual children.

For the adaptation of the test, word frequency, syllable length as well as adult ratings were taken for each test item regarding the age of acquisition, picture complexity and picture imageability. A test battery was administered in addition to the COAT, which included measurements of nonverbal performance with the Raven's Coloured Progressive Matrices, linguistic abilities with the Developmental Language IQ Test, receptive vocabulary with the Greek version of the Peabody Picture Vocabulary Test, and the Picture Naming Test.

FINDINGS

The GOAT consists of 42 nouns and 42 verbs. Based on the adult ratings on the age of acquisition, a number of words with estimated mean age of acquisition above 6 years of age were deleted from the test. The adapted version of the

COAT consists of pictures of 35 nouns and 39 verbs. The object and action words did not differ significantly on word frequency ($z=-0.569$, $p=0.569$), syllable length ($z=-0.404$, $p=0.687$) or age of acquisition ($z=-0.401$, $p=0.688$). Nouns were however rated as more imageable ($z=-4.047$, $p<0.001$) and more easily recognizable ($z=-2.644$, $p<0.01$) than verbs. Multiple linear regression models revealed that mean age of acquisition of a word was the most significant predictor of correct lexical access, both for nouns and verbs.

Correlation coefficients between performance on the COAT (both on the verb and the noun subtests) and the rest of the measures administered in the test battery were positive in almost all cases and in all children groups, as expected; small sample sizes however did not allow many significant correlations to emerge (detailed results will be presented in the full paper).

MANOVA tests were employed to compare performance on the verb and noun components of the COAT for the three largest groups. Monolingual TD children performed significantly better than the other groups on both noun and verb accuracy, and the monolingual SLI performed better than the younger TD children only on nouns.

Children in all groups did better on nouns than on verbs. Wilcoxon signed rank tests within each group showed that this difference was significant for the TD ($z=-3.55$, $p<0.001$) and the monolingual SLI children ($z=-2.42$, $p=0.016$).

RESEARCH SIGNIFICANCE

Measures appropriate for use with particular groups and documented validity evidence are necessary for the assessment of language development in typical as well as special populations. The current research describes the development of such an instrument in Cyprus where similar measures have not yet been developed. The clinical relevance of the COAT for identifying children with developmental difficulties is obvious. Further data collection will lead to the establishment of norms for various special groups, such as children with SLI and bilinguals. This will enable more accurate evaluation and design of timely interventions. Moreover, the study findings contribute to the theoretical discussion on language development, and the linguistic differences between special populations.

REFERENCES

- Bogka, N., et al. (2003). Object and action picture naming in English and Greek. *European Journal of Cognitive Psychology*, 15, 371-403.
- Dockrell, J.E., Messer, D., & George, R. (2001). Patterns of naming objects and actions in children with word finding difficulties. *Language and Cognitive Processes*, 16, 261-286.
- Messer, D., Dockrell, J., & Murphy, N. (2004). The relationship between naming and literacy in children with word finding difficulties. *Journal of Educational Psychology*, 96, 462-470.
- Tomblin, J.B. (2008). Adolescent outcomes of SLI. In C.Norbury, J.B.Tomblin, & D.V.M. Bishop (eds.), *Developmental language impairment* (pp.93–114). London: Psychology Press.
- Tomblin, J.B., & Zhang, X. (2006). The dimensionality of language ability in school-age children. *Journal of Speech, Language, and Hearing Research*, 49, 1193-1208.

PAPER PRESENTATION

The Testing Effect: Applied to Primary School Children Learning Vocabulary

Nicole Goossens, Erasmus University Rotterdam, Netherlands; Gino Camp, Erasmus University Rotterdam, Netherlands; Rolf Zwaan, Erasmus University Rotterdam, Netherlands

Vocabulary learning is an important factor in primary school education. Lack of vocabulary has a negative impact on subjects like reading comprehension, geography and math. The current study investigated whether vocabulary learning can be stimulated by using a cognitive memory principle, such as the testing effect. The testing effect refers to the phenomenon that tests enhance long term retention more than additional study of course material (Roediger & Karpicke, 2006). The testing effect has been investigated primarily in adults, using word pairs, texts, pictures, and foreign words as study materials. This study is the first to investigate the testing effect in children learning new vocabulary. In the current study, the value of the testing effect for learning 16 new words was examined in grade 3. After an initial study phase, children were presented with extra study trials, test trials, or a combination of extra study and test trials. After five minutes, all children made a final test. This test was repeated after a retention interval of one week. The children showed a testing effect in learning new words. The children who had received extra study trials forgot significantly more of the words than the children who received test trials or a combination of extra study and test trials. These results show that testing may be a powerful means of improving word learning for children.

Extending the vocabulary of primary school children is important, because a small vocabulary has a negative impact on subjects like reading comprehension, geography and even math (Vermeer, 1998). Children with small vocabulary sizes even have more difficulties in extending their vocabulary than children with big vocabulary sizes (Stanovich, 1986). There is a high need for instructional designs that are optimal for remembering new words and their meaning for the long term. The current study investigated whether providing children with test trials after initial learning can help children to learn new words. This instructional guideline is based on the testing effect. This phenomenon, stemming from cognitive psychology, refers to the finding that tests enhance long term retention more than additional study (Roediger & Karpicke, 2006). Research on the testing effect has used texts and pictures, but most experiments on the testing effect have been conducted in verbal learning using independent word lists as study material (e.g. Tulving, 1967; Wheeler, Ewers, & Buonanno, 2003). Also, the testing effect has primarily been investigated in adults. Only Gates (1917) and Spitzer (1939) have investigated the testing effect with primary school children.

The current study is the first to use new vocabulary as study material in the testing effect procedure and is also one of the first to investigate the testing effect in children. The value of the testing effect for learning 16 new words was examined in grade 3. The hypothesis was that children would forget more of the new words after one week in the restudy condition than in the testing condition. We expected that even less forgetting would occur in the condition that consisted of a combination of restudy and test trials, because the children could restudy what they did not know during the test trials. We also investigated whether vocabulary size influences the size of the forgetting effect.

Method

Subjects Eighty-two children (44 boys, 38 girls), aged 8-10 (grade 3) participated individually in this study.

Materials & Design

The children read a story from a grammar book of grade 5 with 16 new difficult words to learn. The words to learn were presented by E-Prime 2.0 on a laptop computer. A 3 x 2 mixed design was used. Subjects learned 16 words under one of three conditions (S = study, T = test): repeated study (SSSS), repeated test (STTT), or a combination of studying and testing (STST). All the subjects were given an immediate test (after a retention interval of 5 minutes) and a delayed test (after 1 week).

Procedure

The children's vocabulary size was assessed prior to the experiment (Verhoeven & Vermeer, 1996). All the children learned the words individually, together with the experimenter. In the initial study phase, all children listened to the story twice and were then told the meaning of the new words. The children also had to read the words aloud twice. After a short break, the children either restudied the words (SSSS), were tested on the words (STTT), or were given a combination of restudy and test trials (STST). The children were given a final test after five minutes. This test was repeated after a retention interval of one week.

Results

The mean percentages of words recalled by the subjects on the final test after 5 minutes and on the final test after 1 week are presented in Table 1. The mean differences in recall between the two tests are also presented. Table 1 Mean recall percentage of studied words (with standard deviations in parentheses) on the final test after a 5-min and a 1-week retention interval as a function of learning condition (SSSS, STTT, STST).

Final Test Condition

	Immediate (5 minutes)	Delayed (1 week)	Differences
SSSS (N = 27)	55.32 (16.87)	43.29 (17.50)	12.04 (13.86)
STTT (N = 27)	50.93 (18.81)	46.30 (20.53)	4.63 (8.05)
STST (N = 28)	53.35 (16.09)	49.33 (17.71)	4.02 (8.71)

Before we analyzed the results we examined if there was a relationship between the vocabulary size and the difference in recall between the two tests. Vocabulary size did not correlate significantly with difference in recall between the two tests ($r = -.19$, $p = .089$). Therefore, we did not include vocabulary size as factor in our analysis. There was a significant interaction between condition and final test moment ($F(2,79) = 4.91$, $p = .010$, $\eta^2 = .11$). Thus, the children displayed a testing effect. The children in the SSSS condition displayed a larger forgetting effect between the immediate test and the delayed test than the children in the STTT or STST condition. Post hoc analyses confirmed these observations. Children in the SSSS condition forgot significantly more of the words after one week compared to the children in the STTT condition ($p = .034$) and compared to the children in the STST condition ($p = .018$). There was no difference in forgetting between the STST condition and the STTT condition ($p = 1.00$).

Conclusion

The current study is the first one to investigate the value of the testing effect procedure in learning new vocabulary in primary school children. The children showed a testing effect in learning new words independent of their vocabulary size. Children who had received extra study trials forgot significantly more of the words than the children who had received test trials or a combination of extra study and test trials after one week. A combination of extra study and test trials does not reduce forgetting more than only extra test trials. These results show that testing may be a powerful means of reducing forgetting in word learning for children.

In conclusion, the procedure of testing can successfully be applied to an educational setting with educationally relevant materials for vocabulary learning in children. If children make tests while learning vocabulary, they will forget fewer words on the long term retention than if they restudy the words.

References

- Gates, A.I. (1917). Recitation as a factor in memorizing. *Archives of Psychology*, 6 (40).
- Roediger, H.L. & Karpicke, J.D. (2006). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181- 210.
- Spitzer, H.F. (1939). Studies in retention. *Journal of Educational Psychology*, 30, 641- 656.
- Stanovich, Keith E. (1986). Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly*, 21, 360-407.
- Tulving, E. (1967). The effects of presentation and recall of material in free-recall learning. *Journal of Verbal Learning and Verbal Behavior*, 6, 175-185.
- Verhoeven, L. & Vermeer, A. (1996). *Taalvaardigheid in de bovenbouw*. Tilburg: Tilburg University Press.
- Vermeer, A.(1998). Tekstdekking in groep 5. Woordkennis als oorzaak van het Mattheÿseffect in het basisonderwijs. *Toegepaste Taalwetenschap in Artikelen*, 60, 9-18.
- Wheeler, M. A., Ewers, M., & Buonanno, J. F. (2003). Different rates of forgetting following study versus test trials. *Memory*, 11, 571–580.

PAPER PRESENTATION

Peer-Feedback and Feed-Forward in academic writing: Effects on revision performance

Susanne Narciss, Technische Universitat Dresden, Germany; Jan-Willem Strijbos, Ludwig-Maximilians-Universitat, Germany

Peer-feedback content is a core component of peer assessment, but the impact of various contents of feedback is hardly studied. Participants in this study were 140 graduate students who were assigned to six experimental and a control group. Experimental groups received a scenario with feed-forward (FF) or without feed-forward (no-FF) in combination with concise general (CGF) or elaborated specific (ESF) feedback or no feedback (no-FB). The study consisted of a pretest-treatment-posttest design. We used the same material as in the study by Strijbos et al. (2010). In each phase participants were asked to revise a text containing various errors in view of text comprehension criteria (i.e., simplicity, structure, conciseness, stimulating). Students were asked to first detect and label these errors (error-detection; ED) and subsequently suggest corrections for them (error-correction; EC). We computed a revision performance score by adding the z-score ED and z-score of the EC-measure and divided the resulting revision score by time-on-task. There were no significant differences during the pretest. An ANOVA for the treatment phase revealed a significant interaction for feedback and feed-forward. No significant effects were found for the posttest. These findings reveal that less treatment is sometimes more. Students with feed-forward achieved lower levels of revision performance if they were also provided with ESF. If students are not provided with feedback, feed-forward was beneficial for their performance. There was no difference in performance for students with CGF.

The shift towards student-centered learning emphasises that students assume responsibility for their learning. In the context of peer assessment the role of feedback is stressed but the evidence for peer feedback effects are scarce. A recent study by Strijbos, Narciss and Dÿnnebier (2010) investigated the impact of peer-feedback content (concise general (CGF) vs. elaborated specific (ESF) and of sender's competence level (low vs. high) on peer-feedback perceptions and revision performance. Concerning revision performance, the groups receiving feedback did not outperform the control group. Strijbos et al. (2010) hypothesised that the lack of differences might be due to the scenarios providing a type of feed-forward (FF) to all groups, because they included the text comprehension criteria on which the students could rely during the revision of the treatment and posttest text. Based on feedback models stressing the role of internal feedback loops (e.g., Butler & Winne, 1995; Narciss, 2008) the question can be raised whether students in the control group achieved the same level of performance as the feedback groups due to the feed-forward information.

Purpose and research questions

This study aims at clarifying if the feed-forward provided by the peer-feedback scenarios accounts for the lack of missing differences between the feedback groups and the no-feedback group. To meet this aim we conducted a follow-up experimental study in which the effects of (a) contents of peer-feedback (CGF vs. ESF vs. no-FB) and (b) the availability of feed-forward (FF vs. no-FF) on error-detection (ED) and error-correction (EC) performance were investigated.

Method

Participants. The participants were 140 teacher education students at Dresden University of which 38 were male and 102 female. Their age ranged between 20 and 39 years (mean = 24.6). Most of the participants were in the third or fourth year of their studies (75%).

Design, materials and procedure.

A three feedback (CGF vs. ESF vs. no-FB) by two feed-forward (FF vs. no-FF) pretest-treatment-posttest design was conducted. Students were randomly assigned to the six experimental conditions. A seventh condition (ESF with no-FF) containing the same information as the FF, served to investigate the mere impact of the FF information. We used the same material as in the study by Strijbos et al. (2010). During each phase (pretest, treatment, posttest) participants were asked to revise a text containing various errors in view of text comprehension criteria (i.e., simplicity, structure, conciseness, stimulating): pretest 13, treatment 24 and posttest 29 errors. In the treatment phase students studied a scenario consisting of a text revised by a fictional student and the feedback that this fictional student received by the fictional peer. Participants in the FF scenarios were provided with a description of the text comprehension criteria. In CGF-scenarios the peer-feedback consisted of short and general comments (e.g. "The text is complex and hard to understand"). The peer-feedback in ESF-scenarios consisted of knowledge of mistakes (location and error-type) and implicit knowledge on how to proceed (e.g., "An introduction is missing"). The experiment lasted ninety minutes (30 min. per phase) and was embedded in the context of 'academic writing'.

Measures:

Error-detection (ED), error-correction (EC) and time-on-task. During each phase students had to revise a text containing typical errors with regard to text comprehension criteria. Students were asked to first detect and label these errors and subsequently suggest corrections for them. Rooted in signal detection theory, ED was operationalised by the difference of the standardized number of hits and false alarms. EC was measured by the number of correct correction suggestions. In each phase students manually recorded when they started and stopped on a revision task: time-on-task (in min.).

Results

Preliminary analyses revealed that the elaborated feedback group receiving the same information as the feed-forward information spent significantly less time-on-task in all phases than the other groups. Hence, it was excluded in further analyses. Correlational analyses revealed significant correlations for time-on-task and EC, as well as for ED and EC measures in each phase. Therefore, we computed a revision performance score by adding the z-score ED and z-score of the EC-measure and divided the resulting revision score by time-on-task. Table 1 shows the Mean and SE's for time-on-task and the revision performance by time-on-task for the six experimental conditions.

Table 1. Mean and standard errors of time-on-task, and revision performance by time-on-task for the 6 experimental conditions by phase.

A preliminary ANOVA for the pretest-score of the revision performance by time-on-task revealed that there were no significant differences among the experimental conditions. Furthermore, a correlational analysis showed no significant correlation between treatment and posttest revision performance, but a significant correlation between pretest and posttest revision performance ($r = .24$, $p = .005$). Thus, we first conducted an ANOVA for the treatment revision performance by time-on-task score. This ANOVA revealed no significant main effects but a significant interaction for feedback and feed-forward $F(2, 117) = 4.03$, $p = .02$, $\eta^2 = .06$.

As shown in Figure 1 the no-FB group achieved a significant better revision performance with FF, than without FF, whereas for the ESF-group it was the reverse. There is no difference for the CGF-group.

Figure 1: Interaction between feedback content and feedforward for treatment revision performance.

We subsequently conducted an ANOVA for the posttest revision performance by time-on-task. This reveals neither significant main effects for the feedback or feed-forward conditions nor a significant interaction.

Significance of the study

This study investigated the effects of combining feedback and feed-forward in a peer-feedback scenario in the context of an academic writing revision task. The findings reveal that less treatment is sometimes more. Students receiving feed-forward achieved lower levels of revision performance if they were also provided with ESF. If students were not provided with feedback, feed-forward was beneficial for their performance. There was no difference in performance for students with CGF.

References

- Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65, 245-281.
- Narciss, S. (2008). Feedback strategies for interactive learning tasks. In J. J. G. van Merriënboer, J. M. Spector, M. D. Merrill, & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed., pp. 125-144). New York: Lawrence Erlbaum Associates.
- Strijbos, J. W., Narciss, S., & Dýnnebie, K. (2010). Peer feedback content and sender's competence level in academic writing revision tasks: Are they critical for feedback perceptions and efficiency? *Learning and Instruction*, 20, 291-303.

PAPER PRESENTATION

Collaborative Revision: An Investigation Into How L2 Language Learners Collaboratively Revise

Elke VanSteendam, HUB (University College Brussels), Belgium; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Huub Van den Bergh, University of Utrecht, Netherlands

A large majority of the studies on L2 collaborative revision are empirical studies which study the effect of students commenting on and revising each others' writing (peer response e.g. De Guerrero & Villamil, 1994; Liu & Hansen, 2002). Studies on the collaborative revision process of two students revising an L2 text which neither of them has written are scarce (Van Steendam, Rijlaarsdam, Sercu, & Van den Bergh, 2010). In this study we analyse the collaborative revision process of dyads revising other students' writing both with and without instruction. To that end, 90 Belgian undergraduates, university students of English as a second language, were randomly assigned to two conditions in which they had to collaboratively revise L2 essays. In a first condition, prior to the dyadic revision session, students watched two models illustrate two different approaches to L2 revision: a global approach in which a reviser improved structure and content of L2 writing and a local approach in which a second reviser edited a text in a linear manner. In a second condition dyads revised collaboratively without any instruction. Both product and process data were collected and the data were analysed using a triangular approach. Analyses of the product data (revision quality) confirm results of previous studies on modelling and cognitive strategy instruction: dyads in the modelling condition revised more global problems than dyads in the control condition (Van Steendam et al., 2010). To completely understand why some dyads revised more and better than other dyadic groups, the quantitative product results were completed with qualitative analyses of revision processes and interaction in the dyads.

Studies on revision in a second language (L2) are relatively scarce (Chenoweth & Hayes, 2001; Hall, 1990; Lindgren & Sullivan, 2006; Stevenson, Schoonen, & De Glopper, 2006, Sullivan, Lindgren, & Spelman Miller, 2008). The majority of these studies compare the L2 revision process to L1 revision. Relatively few studies on L2 revision investigate collaborative revision. A large majority of the studies on collaborative revision are empirical studies which investigate the effect of students commenting on and revising each others' writing (peer response e.g. De Guerrero & Villamil, 1994; Liu & Hansen, 2002). Studies on the collaborative revision process of two students revising an L2 text which neither of them has written are scarce (Van Steendam, Rijlaarsdam, Sercu, & Van den Bergh, 2010). The objective of the present study is twofold.

A first aim is to analyse the collaborative revision process of dyads revising other students' writing both with and without support and/or instruction. The instructional method under review is strategy instruction through modelling, which according to a number of empirical studies is one of the more effective instructional methods for both individual and dyadic revision (Graham & Perin, 2007; Van Steendam et al., 2010). Our second objective is to study the relationship between the collaborative revision process and its resulting revision product. To that end, 90 Belgian undergraduates, university students of English as a second language enrolled in an English composition course, were randomly assigned to a dyad to collaboratively revise an essay. The essays the 1-year university students had to revise were selected from a corpus of 1-year university L2 writing and were thus a good representation of participants' typical problem areas in writing in English. To counter the criticism that students would be at a loss to revise the essays without any additional instruction or training (Liu & Hanssen, 2002; Min, 2006; Zhu, 1995), we had half of the

students watch two models of text revision prior to the collaborative revision session. The students in this randomly formed condition thus observed a first model demonstrate a global revision strategy and a second model illustrate a local revision approach. The design, inspired by both Wallace & Hayes (1996) and by Rijlaarsdam et al. (2008), enabled us to both study authentic collaborative revision processes (control condition) and dyadic revision after instruction (strategy modelling condition).

Both product data (revision tests) and process data (collaborative revision process and interaction) were collected. Process data were collected with both screen capture software and audio software. Multilevel results of product data in previous studies on modelling collaborative revision (Van Steendam et al., 2010) showed that dyads in a modelling condition outperformed dyads in so-called practising conditions without a model for revision quality. Multilevel analyses of the product data in this study confirm these findings. Dyads in the modelling condition revised more global text problems than dyads in the control condition. However, to completely understand why some dyads revised more and better than other dyadic groups, the quantitative product results should be completed with qualitative analyses of revision processes and interaction in the dyads (data triangulation). Studies on modelling (e.g. Braaksma, Rijlaarsdam, Van den Bergh, & Hout-Wolters, 2004) show that observation has a significant impact on students' writing processes: students engage in more metacognitive activities and meta-analytic activities such as rereading and analysing text compared to writers in a practising-only condition.

A preliminary analysis of the process data in the study under review confirm that modelling a revision strategy has a significant impact on the orchestration of writing processes, in this particular case the dyadic revision process. The results are interpreted in the broader theoretical framework of revision in both L1 and L2 on the one hand and on observational learning and cognitive strategy instruction in revision on the one hand.

References

- Braaksma, M., Rijlaarsdam, G., Van den Bergh, H., & Hout-Wolters, B. A. M. (2004). Observational learning and its effects on the orchestration of the writing process. *Cognition and Instruction*, 22(1), 1-36.
- Chenoweth, N. A., & Hayes, J. R. (2001). Fluency in Writing. Generating Text in L1 and L2. *Written Communication*, 18(1), 80-98.
- De Guerrero, M. C. M., & Villamil, O. (1994). Social-cognitive dimensions of interaction in L2 peer revision. *The Modern Language Journal*, 78, 484-496.
- Graham, S., & Perin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology*, 99(3), 445-476.
- Hall, C. (1990). Managing the complexity of revising across languages. *TESOL Quarterly*, 24(1), 43-60.
- Lindgren, E., & Sullivan, K. P. H. (2006). Analysing on-line revision. In G. Rijlaarsdam (Series Ed.) & K. P. H. Sullivan, & E. Lindgren (Vol. Eds.), *Studies in writing: Vol. 18. Computer keystroke-logging and writing: Methods and applications* (pp. 157-188). Amsterdam: Elsevier.
- Liu, J., & Hansen, J. (2002). *Peer response in second language writing classrooms*. Ann Arbor: University of Michigan Press.
- Min, H. T. (2006). The effects of trained peer review on EFL students' revision types and writing quality. *Journal of Second Language Writing*, 15, 118-141.
- Rijlaarsdam, G., Braaksma, M., Couzijn, M., Janssen, T., Raedts, M., Van Steendam, E., et al. (2008). Observation of peers in learning to write, Practice and research. *Journal of Writing Research*, 1(1), 53-83.
- Stevenson, M., Schoonen, R., & De Glopper, K. (2006). Revising in two languages: A multi-dimensional comparison of online writing revision in L1 and FL. *Journal of Second Language Writing*, 15, 210-222.
- Sullivan, K., Lindgren, E., & Miller, K. S. (2008). Development of fluency and revision in L1 and L2 writing in Swedish high school Years 8 and 9. *ITL-International Journal of Applied Linguistics*, 156, 133-152.
- Van Steendam, E., Rijlaarsdam, G., Sercu, L., & Van den Bergh, H. (2010). The effect of instruction type and dyadic or individual emulation on the quality of higher-order peer feedback in EFL. *Learning and Instruction*, 20(4), 316-327.
- Wallace, D. L., Hayes, J., Hatch, J., Miller, W., Moser, G., & Silk, C. (1996). Better revision in eight minutes? Prompting first-year college writers to revise globally. *Journal of Educational Psychology*, 88(4), 682-688.
- Zhu, W. (1995). Effects of training for peer response on students' comments and interaction. *Written Communication*, 12(4), 492-528.

PAPER PRESENTATION

Individual and school-level predictors of progress in writing

Kane Meissel, University of Auckland, New Zealand; Judy M. Parr, University of Auckland, Faculty of Education, New Zealand

Student achievement profiles of many countries in the OECD exhibit considerable disparity based on socio-economic and ethnic groupings (OECD, 2001; 2005). The investigations detailed in this paper draw on longitudinal data collected from a large national project aimed at raising achievement and decreasing disparities in literacy among students in Years 4-8; gains were substantial. The current paper aims to examine various predictors of student writing progress within this intervention. Since the intervention has been demonstrably successful using typical Educational measures, further analyses provide an interesting profile of where the shift occurs and for whom. Possible predictors were investigated using multiple linear regression, with progress as the dependent variable. Baseline achievement was the best predictor of growth (both in terms of significance and magnitude), with lower starting points predicting greater progress, suggesting that the intervention was more effective with lower achieving students. Factors related to socio-economic status, gender and ethnicity were also important, with students in typically disadvantaged groups progressing more slowly, after taking into account the variance predicted by starting point.

The student achievement profiles of most countries in the OECD exhibit considerable disparity based on socio-economic and ethnic groupings (OECD, 2001; 2005). Efforts to reduce these disparities have increasingly focused on school reforms, including (re-)educating and developing teachers, since teachers have the most impact on student achievement at the system-level (Alton-Lee, 2003; Nye, Konstantopoulos & Hedges, 2004).

The investigations detailed in this paper draw on longitudinal data collected from a large national project aimed at raising achievement in literacy. The project involved expert facilitators working with school leaders and teachers and had a large effect on student achievement, with an average Cohen's effect size of .38 above expected maturational progress for each of the two years of the project (almost three times the usual rate of progress). The gain was markedly higher among lower achieving groups, with average effect sizes of 1.0 above expectation each year. The large gains in achievement are credited to coherence within and between the multiple levels of the schooling and administration systems developing educational partnerships, alongside a focus on evidence-informed inquiry into effectiveness at each level of the system (Author, 2007; 2010).

The current paper examines various predictors of student progress within this intervention using multiple linear regression. Since it has been demonstrably successful using typical Educational measures, further analyses provide an interesting profile of where the shift occurs and for whom.

Two cohorts of students in Years 4-8 are included in the regression model ($n=6,801$); the first started the intervention at the beginning of 2006, while the second began at the start of 2008. Each cohort was involved in the project for two years. The dependent variable was progress over the two years as measured by aSTTle writing, a standardised assessment tool (technical data available at http://www.tki.org.nz/r/asttle/user-manual_e.php).

Factors investigated included baseline achievement, gender, ethnicity, decile (a measure of the average socio-economic standing within a school's zone), school size, school type (full primary, contributing or intermediate), and year level. Gender, ethnicity and school type were entered as either dichotomous or polytomous dummy variables. This process is outlined and justified in a number of publications (e.g. Brambor, Clark & Golder, 2006; Fox, 2008). Various interactions were also considered to investigate moderating effects.

Stepwise regression and incremental sums of squares methodologies were used to investigate the relevance of individual factors and their higher order interactions. Stepwise regression is sometimes criticised as being analogous to data dredging due to the possibility of over-fitting of a model, meaning that the apparent relationships may only be valid within the specific data set, and have little generalisability (Rencher & Pun, 1980; Copas, 1983). However, due to the large number of students, as well as the inclusion of two cohorts within the model, this issue is largely circumvented since any findings are based on generalisation across two large cohorts (Tabachnik & Fidell, 2001).

Interestingly, the most parsimonious model was the best in terms of predictive validity, very low levels of multicollinearity and interpretability. Although the initial stepwise model suggested some evidence of interaction effects, subsequent models, testing these against models with only lower order factors using incremental sums of squares, showed no loss of predictive validity as a result of their exclusion. The initial model with all variables predicted around 37% of the variance in progress, as did the final, parsimonious model where only significant lower order variables were included. A Kolmogorov-Smirnov test for normality confirmed that the residuals were normally distributed.

By far the best predictor of growth (both in terms of significance and magnitude) was initial achievement, with lower starting points predicting greater progress. Decile was also important, with students in lower deciles progressing less than those in higher decile schools, after taking into account the variance predicted by starting point. In other words,

students with similar starting points were more likely to have greater progress if they were in a school drawing on a higher socio-economic area. Female students and students in intermediate schools also tended to have higher levels of progress than other students, while Maori and Pasifika students typically progressed more slowly than other students (largely NZ European and Asian students) with similar starting points.

The regression model provides important insight into the deeper structure of shift among students within a successful intervention. The project aimed to enhance teacher content knowledge of writing and to transfer this learning to practice. The finding that starting point is the major predictor suggests that teachers were more successful in accelerating the performance of lower achieving students; that the knowledge they built of writing and writing practice was best suited to the nature of learning and instruction effective with such students. Perhaps, also the complexity of the act of writing means that a high level of knowledge is needed to assist those higher achievers to progress. Of concern are findings regarding the influence of socio-economic factors and of ethnicity; while the intervention had been demonstrably successful for all, these analyses show it to be most successful for underachievers from groups that are traditionally advantaged.

References

- Alton-Lee, A. (2003). *The best evidence synthesis: Teaching for diversity*. Wellington: New Zealand Ministry of Education
- Author (2007, 2010).
- Brambor, T., Clark, W., & Golder, M. (2006). Understanding interaction models: Improving empirical analyses. *Political Analysis* 14: 63-82
- Copas, J.B. (1983). Regression, prediction and shrinkage. *Journal of the Royal Statistical Society, Series B*. 45. 311-354.
- Fox, J. (2008). *Applied Regression, Generalized Linear Models, and Related Methods*, Second Edition. Sage Publications
- Nye, B., Konstantopoulos, S. & Hedges, L. (2004). How large are teacher effects? *Education Evaluation and Policy Analysis*, 26, 237-257.
- OECD (2001). *Knowledge and Skills for Life: First results from the OECD Programme for International Student Assessment (PISA) 2000*. Paris: OECD Publications
- OECD (2005). *PISA 2003 Technical Report*. Paris: OECD Publications.
- Rencher, A. & Pun, F. (1980). Inflation of R^2 in best subset regression. *Technometrics*. 22, 49-54.
- Tabachnick, B. & Fidell, L. (2001). *Using Multivariate Statistics*, Fourth Edition. Needham Heights, MA: Allyn & Bacon.

PAPER PRESENTATION

Didactic Instruction or Cognitive Conflict in preschool children's invented spelling?

Tiago Almeida, ISPA, Portugal; Ana Cristina Conceicao Silva, ISPA, Portugal

The goal of this work was understand the differences between didactic instruction and cognitive conflict in the development of invented spelling. The participants were 60 preschool children (5-to-6) divided in two experimental groups (n=20) and a control group (n=20). All children were pre-syllabics, equivalent in intelligence level, phonological awareness and they were capable of naming the same letters. In Experimental Group 1 we used a didactic instruction of the sound of the letters; in Experimental Group 2 we used a constructivist approach inducing the children to think about and try to discover the sound of the letters using metalinguistics strategies of reflection. All children of experimental groups faced a pre test, an intervention and a post-test. In the pre and pos test we asked children to write a set of 40 words to evaluate the number of correct phonetizations. The results show that the participants of experimental group 2 (discovery of the sound) had better results in the pos-test than the participants of experimental group 1 (didactic instruction). Participants of both experimental groups evolve more that the control group. These results indicate that when children are induced to reflect about the phonological structure of words they generalize more to other situations than when they are instructed to do so.

Recent studies (Sporer, Brunsteim & Kieschke, 2009; Nie & Lau, 2010) retake the discussion concerning the highest or lowest efficiency of constructivist strategies of instruction – adult-child interaction inductive of cognitive conflict – comparatively with didactic instruction – adult-child interaction centred in adult knowledge transmission – at cognitive, academic and motivational achievements of children. These studies (2009, 2010) show that the constructivist strategies were more efficient e produced more lasting results that didactic instruction. Ferreiro and Teberosky (1979) introduced constructivist principles in the study of written language early acquisition. Currently the Psychogenetic Perspective (op. cit. 1979) has a main role on the analyses of children early conceptualizations and ideas about written language. The work of Ferreiro and Teberosky (1979) was continuously developed and improve for

the authors (Ferreiro, 2004) and by other works with European Portuguese (Alves Martins, 1994; Silva, 2003; Alves Martins & Silva, 2006). Alves Martins and Silva (2006) demonstrated how the specific interaction adult-child could facilitate the discovery of written language and alphabetic principle. The results show that it's the nature of adult-child interaction – facilitator of cognitive conflict – and the children needs of solve the problem alone that promote the conceptual evolution of children think and knowledge about written language.

Even so, some authors (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1991) argue that is more efficient the utilization of explicit methodologies with systematic and direct instructions. However, concerning the early acquisition of written language and the evolve of invented spelling, the lack of studies and data comparing these two methodologies of intervention program (one based in constructivist approach and other based in a more directive and didactic instruction) lead us to the following problem: is more efficient use a didactic instruction or a constructivist instruction to evolve preschool children invented spelling and to promote a better appropriation of the alphabetic principle? Thus our goal was to analyze what intervention methodology (didactic instruction versus. constructivist interaction) is more facilitator of metalinguistics reflection strategies and more effective to infantile evolution of phonetized writings.

Methodology:

Participants selection: the participants were selected previously concerning the conceptions on the writing (pre-syllabic), number of letters known, level of intelligence, phonological awareness and pedagogical practice of the educator. Phases of pre and pos test: the participants were requested to write 40 real words initiated for consonants b, d, p, t, v, f, m, n (4 of each letter) and r (8) to analyze if exist generalizations for letters not worked. The protocols were analyzed considering the conceptual level of the writings and the number of letters correctly phonetized.

Programs of writing:

The writing programs had the duration of 6 sessions. The studies of Alves Martins and Silva (2006) show that this number of sessions is enough for the evolution of children invented spelling to a more evolved conceptual level. Still in accordance with the works of the authors (op. cit.) these sessions will be destined to take children to use conventional letters to represent the initial consonant of the words. The used words in the programs will be always different of the used in pre and pos test. In the two experimental groups, in each session, participants were asked who to write a word, as he or she knows. After that, the same word, written for a hypothetical child of another school, was used correct letters to represent the syllables. The confrontation writings will appear with a structure CV, CC in alternating. In each session were used 10 words all initiated with the consonants P or T (1? and 2? sessions, words initiated with consonant P; 3? and 4? sessions, words initiated with consonant T; 5? and 6? session, half of the words initiated with consonant P and the other half with consonant T).

Experimental Group 1: The methodology of this group implies that the intervention sessions will be carried through individually. The instruction was given in a didactic way after children write the words. The confrontation writing will be carried through by the experimenter and in accordance with the experimental condition the instruction will be guided for sound of the letter. Thus, in experimental condition 1 the following instruction will be given: "The sound of the first letter is P?", "You ear two bits (stand for syllables), so you write two letters"

Experimental Group 2: The sessions will be carried through individually and the changeable instruction was given to help children think and discover the sound of the first letter. It was asked for after his writings he compares the writings of the other child with their one and that try to think which were the best form to write and why. In experimental conditions 2 was requested to children that in the analysis of the words, attempt against to the sound of the first letter, being given the following instruction to them: "You are capable to say which is the sound of the first letter in the word that you find it is better written?", "Why do you think it is better written?", "What is the first sound you eared?", "How many bits (stand for syllables) do you eared?", "How many bits the other boy wrote?", "Witch one do you think is more correct? You or the other boy? Why?"

Control Group:

The participants of control group were doing draws while the participants of experimental groups were in individual sessions.

Results:

Our results show that when children are induced to think about the words they are able to generalized more efficiently to other words. In experimental group two all children evolve to syllabic or syllabic-alphabetic writes while in experimental group one just half of the children evolve to more advanced levels of conceptualization. Concerning to the number of phonetizations, experimental group 2 had a significant higher number of corrects letters mobilized that

experimental group 1 ($p < 0,01$). Both groups performed better than the control group in the number of correct phonetizations and conceptual evolution.

Discussion:

Probably these results appear because the kind of cognitive strategies utilized in the interventions programs. While in experimental group 1 the main strategy utilized by children when learning by didactic instruction in experimental group 2 children develop a more appropriate knowledge about the alphabetic principle because they are conducted to think and reflect about the relation between written words and oral language (Silva, 2003). Other conclusion that we can retreat is that some kind of written language initiation is better than none. This kind of studies can help us to understand how to initiate children in written language before the formal learning, improving the success of future readers and writers.

PAPER PRESENTATION

Organizing teachers' knowledge about networked learning in concept-maps

Celeste Meijs, Open University, Netherlands; Maarten de Laat, Open University, Netherlands; Bieke Schreurs, Ruud de Moor Centrum Open Universiteit, Netherlands

Networked learning is an important form of professional development of teachers that complies with the rapidly changing culture, technology and complexity of the profession of the teacher. However, the formation of teacher networks is a often difficult process. In the current presentation, an instrument that can be used to support the formation of the networks by the teachers is described: the construction of a concept-map that constitutes of the knowledge, skills, beliefs and values of teachers regarding networked learning. This map gives insights in the position of the teachers regarding networked learning, which in turn should give them support in acting accordingly in the formation of the networks.

Background:

Professional development of teachers has traditionally been organised in static courses or seminars (Lieberman & Wood, 2002a). Since the emergence of sophisticated internet tools for online connections between people and the rapid demographical and socioeconomic changes, networks to support learning arose (Goodyear, Banks, Hodgson, & McConnel, 2004; Harasim, Hiltz, Teles, & Turoff, 1995; Lieberman & Wood, 2002a). Additionally, recent studies indicate that learning from other teachers is a powerful way to enhance professional development (Dresner, Worley, & E., 2006; Lieberman & Wood, 2002a, 2002b) and that teacher networks provide large opportunities for professional development (de Bruijn, 2008; Gellert, 2003; Lieberman & Wood, 2002b). Therefore, it would be a missed opportunity not to stimulate the formation of teacher networks.

Aims:

The formation of teacher networks is a difficult process because, amongst other things, it needs a switch in thinking about teacher professional development programs (Meijs & De Laat, in prep). Networked learning stimulates a personal driven informal perspective on professional development, starting with a critical, reflective and active attitude from the teacher. An aid to help teachers in the formation of teacher networks is giving teachers insight in their skills, knowledge, beliefs, and values regarding networked learning. With this metacognitive knowledge, teachers should be able to establish their own position regarding networked learning, which in turn, should lead to more support during the formation of teacher networks. We establish this insight by constructing concept-maps, which have previously been described as a useful manner to organise and structure knowledge (Amer, 1994; Zanting, Verloop, & Vermunt, 2003).

Methods participants:

We developed an interview framework that included the formation of a concept-map about the skills/knowledge/beliefs/values of the teacher regarding networked learning. The interview was administered by 12 teachers of primary and secondary schools.

Methods procedure:

The interview took about 1,5 hour. These conversations formed the base for the construction of a concept-map, in which the teachers connected the core concepts mentioned during the interview.

Methods instrument:

The rationale behind the formation of concept-maps was founded by the epistemic frameworks theory described by Shaffer et al. (2009). However, in a different context, the method of structuring knowledge is applicable for other topics as well. Shaffer et al. describe five levels of information of which we make use of the levels skills, knowledge, beliefs and values. The core elements of the interview framework were: (a) The core concepts of networked learning according to the teachers, (b) previous experiences and contacts related to networked learning, (c) skills needed for networked learning and estimation of their own skills, (d) characteristics of a good teacher network and estimation of their own network, and (e) to make associations between the concepts mentioned during the interview by means of connecting the concepts in the concept-map.

Methods statistics:

Several measures were calculated for the quantitative data-analyses including social network analysis measurements (Hawe & Ghali, 2008; Wang & Li, 2007), which were applied to the concept-map, to analyse the overall density of the concept map, followed by measurements to detect which key topics were closely connected, and if there were clusters and isolates. The content of the concepts was used for qualitative analyses. Also

Results:

The density of the concept-map, which is the percentage of connections made / all possible connections is a useful measure for comparison between subjects. On average, the teachers connected 14.3% of all possible connections (sd = 9.2; range 6.2 – 37.9). Mean number of connections per concept is 2.3 (sd = 9.1; range 1.3 – 4). Future studies should explore whether these measures correlate with other factors such as experience with networked learning or overall position regarding networked learning based on the results of the network-learning quiz (Meijs & De Laat, in prep).

The concept-maps reveal, per teacher or overall, what he or she finds the most important value, what the most important actions or skills are to reach the aim and what they need to know about this. For instance, overall, the maps show that the teachers aim to learn from and with each other, that they need to work together and need to give and take in order to reach this aim and that this requires an open attitude.

Discussion:

The concept-maps show that the teachers are aware of how they want that their professional development regarding to networked learning is designed, what they need to do and what their attitude regarding networked learning is. This should give them support in acting accordingly.

Subjectively, the participating teachers mentioned that they felt enlightened about their vision on networked learning after the completion of the interview framework and the concept-map, because the most important concepts according to them (and mostly had the highest number of connections) stood out of the map.

Theoretical implications:

There is a lot of research on the effects of social networks, to some extent as well within professional development. However current research lacks insight about the strategies people develop and apply when engaged in these activities. What makes a good networker/networked learner? This study is an attempt to uncover the behavioural aspects of networked learning to build further theory to frame social learning in networked environments by means of the construction of concept-maps.

Practical implications:

The interview framework with the formation of the concept-map is a useful instrument for the support of teachers in the formation of teacher networks.

PAPER PRESENTATION

Theoretically and empirically developed test-instruments for teachers' professional knowledge

Melanie Juttner, University of Munich (LMU), Germany; Birgit Neuhaus, University of Munich (LMU), Germany

Due to the fact, that students' learning outcome was not as high as expected in international studies like PISA or TIMSS, research on teachers' professional knowledge and the role of teachers concerning teaching effectiveness increased (Johnson, Kahle & Fargo, 2007). In spite of everything, research on teachers' professional knowledge and the relationship between this knowledge and their students' learning outcome is still at the beginning (Baumert et al., 2010). The here presented part of the project, ProwiN (professional knowledge in science education), is a first step towards closing this gap for science education. In the study the pedagogical content knowledge, the content

knowledge and the pedagogical knowledge of science teachers' is evaluated by using paper-and-pencil tests as well as videotaping lessons combined with students' achievement tests. These data will be used for the calculation of correlations between teachers' professional knowledge and students' learning outcome. This project is realized by a co-operation of the Universities of Munich, Duisburg-Essen and Bochum. In the presentation, the theoretically and empirically based developed PCK- and CK-items for biology as well as the results of the pilot phase will be demonstrated.

1. Theory

The effectiveness of instruction is defined in many ways with different focal points (Seidel & Shavelson, 2007). All in all the theoretical models indirectly postulate that the professional knowledge of the teacher influences the effectiveness of instruction and therefore the students' outcome (Johnson, Kahle & Fargo, 2007). But research on this relation is just at the beginning and only several studies like COACTIV (Cognitive Activation in the Classroom; Baumert et al., 2010) analyzed it by combining mathematical teachers' knowledge tests to students' results of PISA. Research on other subjects than maths – like science – is still rare (Abell, 2007). The here presented project is a first step to close this gap concerning biology.

Research on professional knowledge exists since decades (Abell, 2007). The original definition of professional knowledge was given by Shulman (1987). All current empirical studies and theories on professional knowledge have different foci and interpret teachers' professional knowledge in different ways, but often based on Shulman's idea. Currently, there are three major categories used in most of the studies: content knowledge (CK), pedagogical content knowledge (PCK) and pedagogical knowledge (PK) (Baumert et al., 2010).

PCK is an important category not only for teachers, but also for science educators, so it will be pointed out in this paper. According to Shulman (1987), ProwiN (professional knowledge of science education; Borowski et al., in press) - and therefore the here presented part of this project - defines the PCK as knowledge of structuring the content and preparing the subject matter, making it comprehensible for students (Borowski et al., sub.).

The model of the PCK-test has three dimensions: knowledge (declarative, procedural and conditional), facets (models, experiments and students cognition) and topics (neurobiology, plants and vertebrates) (Tepner et al., in progress). According to the professional knowledge and especially to the PCK, the following objectives of the research project reported here are:

- (1) development of a reliable and valid assessment test to measure biology teachers' PCK,
- (2) analysis of the correlations between the three types of knowledge and
- (3) to scrutinize the influence of different types of knowledge for teachers of different school types: secondary school and secondary modern school.

2. Study design

The PCK-items, all in all 27 open-ended items, were developed based on the theoretical model. Some of these PCK-items were based on an empirical pilot-study that was conducted to learn more about students' errors (Jýttner & Neuhaus, 2010).

In the pilot phase, the PCK-questionnaire was first of all given to 24 biology teachers (58% female; 42% male) of different secondary school types. First results concerning quality criteria will be presented: For calculating the reliability the standardized cronbach's alpha was taken, because of different variances of the items (Field, 2009). The ICC (IntraClassCorrelation) was used to analyze the objectivity. For this calculation, the two-way mixed model and the absolute agreement was taken (Shrout & Fleiss, 1979). The validity of the test was computed by the t-test.

3. Findings

The 27 PCK-items were uniformly distributed over the theoretical model. For all facets the reliability is computed and presented in table 1 (see appendix). The inter-rater reliability of two independent raters is ICC (3,2) = .87 (F 503,503 = 15.43; p

The t-test of the mean test score of biology teachers working in secondary school versus other school types is not significant for the PCK-test (T = - 1.24; p = .30; N = 24).

4. Discussion and contribution to teaching of science

Nearly all quality criteria of tests are achieved: The reliability, measured through the standardized cronbach's alpha for each subscale is satisfying (Field, 2009). The objectivity, measured by the singled measure ICC, demonstrates another

satisfying result (Garson, 2010). In future the validity of the test should be analyzed again and optimized. Therefore the pilot phase is still going on for becoming a bigger sample size ($N = 60$).

In a nutshell, the PCK-items for biology teachers seem to be useful, reliable and objective items. Additionally, both instruments, the PCK-test for teachers and the students' achievement tests, could be combined to collect data on the relationship of both. This could be seen as a first step forwards in the research on teaching effectiveness.

Until summer 2011 the results of the main study with a sample size of $N = 300$ biology teachers and the final version of the test-items will be presented.

5. References

- Abell, S. K. (2007). Research on Science. Teacher Knowledge. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of Research on Science Education*. Routledge.
- Baumert, J. et al. (2010). Teachers' Mathematical Knowledge, Cognitive Activation in the Classroom, and Student Progress. *American Educational Research Journal*, 47 (1), 133-180.
- Borowski, A. et al. (in press.). ProwiN: Das Professionswissen von Lehrkräften in den Naturwissenschaften. *Zeitschrift für Didaktik der Naturwissenschaften*.
- Field, A. P. (2009). *Discovering Statistics Using SPSS (Third Edition)*. London: Sage.
- Jýttner, M. & Neuhaus, B. (2010). Using empirically analyzed pupils' errors to develop a PCK Test. In M.F. Tasar & G. Çakmakç? (Eds.), *Contemporary science education research: preservice and inservice teacher education* (pp. 331-340). Ankara, Turkey: Pegem Akademi.
- Johnson, C. C., Kahle, J. B. & Fargo, J. D. (2007). Effective Teaching Results in Increased Science Achievement for All Students. *Science Education*, 91, 371-383.
- Seidel, T. & Shavelson, R. J. (2007). Teaching Effectiveness Research in the Past Decade: The Role of Theory and Research Design in Disentangling Meta-Analysis Results. *Review of Educational Research*, 77 (4), 454-499.
- Shulman, L. (1987). Knowledge and Teaching: Foundations of the New Reform. *Harvard Educational Review*, 57, 1-22.
- Shrout, P. E. & Fleiss, J. L. (1979). Intraclass correlation: Uses in assessing rater reliability. *Psychological Bulletin*, 86, 420-428.
- Tepner, O. et al. (in progress). Modell zur Entwicklung von Testitems zur Erfassung des Professionswissens von Lehrkräften in den Naturwissenschaften., *Zeitschrift der Naturwissenschaften*.

PAPER PRESENTATION

What can novice teachers learn from experienced teachers – and vice versa? A collaboration scenario

Kati Makitalo-Siegl, University of Jyväskylä, Germany; Anna-Maria Mekota, University of Munich, Germany; Joachim Kahlert, University of Munich, Germany; Frank Fischer, Universität München, Germany

There is a notion about the importance of collegial support and pedagogical discussions in teacher's profession. However, only few studies have been investigating learning among teachers directly in their workplace, although this setting would be the most natural place for learning, because collegial expertise is available. So far we know that in order to collaborate successfully, a certain degree of support is necessary.

This study aims to investigate how to structure teacher groups in order to optimise teacher collaboration and how to support teachers to bring their expertise into the group. Twelve novice and experienced teachers from primary- and secondary school levels participated in this study and their intergenerational collaboration was guided by a collaboration script. Both quantitative and qualitative approaches were utilised in the analysis of the interviews and the log diaries.

The results show that the teacher-pairs utilised the given collaboration script in their meetings and found it to be useful regardless of the school level. Novice teachers received advices and support from experienced teachers and experienced teachers got new perspectives and the opportunity to share their knowledge. Both novice and experienced teachers self-reported more about changes in their knowledge as well as beliefs and emotions than changes in teaching practices. The possibilities and the challenges of the collaboration scenario and also the role of technology will be further discussed.

PAPER PRESENTATION

Does the Lesson Study Work? A Systematic Review on the Effects of Lesson Study and Learning Study

Wai Ming CHEUNG, University of Hong Kong, Hong Kong

Purpose:

There has been a rapid proliferation of lesson study and learning study all over the world. Do they really work in teachers' professional development and student learning? This paper reviewed studies from 2000 to 2010 on lesson study and learning study with a view to unraveling their benefits on teachers and students.

Methods:

A total of 74 articles were extracted from relevant electronic databases and 9 articles were screened in the systematic review to examine the effect of lesson study and learning study.

Results:

8 studies reported that lesson study or learning study was beneficial to teachers while only 6 stated beneficial to students. This supported the benefits of both as a powerful tool to help teachers examine their practices and enhance student learning.

Conclusion:

All nine reviewed studies showed that they work with positive effects on teaching, learning or both. However the outcome measures and study designs with varied a lot which made comparison of results difficult. We recommend that more well-controlled studies with validated outcome measures be conducted in the future to address the short and long-term effects of lesson study approach on students, teachers and school level.

Significance:

This review is the first of its kind which unveils the positive effects on teaching and learning which shed light on the linkage between teachers' professional development and student learning. Future directions of lesson study and learning study are recommended.

Since 1999, Stigler and Hiebert commended the use of lesson study (Fernandez & Chokshi, 2002; Lewis & Tsuchida, 1998) as a teacher professional development approach to improve teaching and student learning, the movement for classroom-based research has become prominent among teachers and educators for the past decade. A related basic approach called "learning study" was developed from the ideas about lesson study by Marton (Marton & Morris, 2002; Marton & Pang, 2003; Marton & Tsui, 2004). Lesson study and learning study which share the basic elements are used worldwide nowadays in the United States, Sweden, Australia, the United Kingdom, Hong Kong, Japan, and Singapore to improve teachers' teaching and quality of student learning. Both approaches combine collaboration, reflection, and professional development into a structured experience that allow them to construe new meanings about instructional practices.

There has been however a lack of systematic review that focuses on its effectiveness available in the literature. Our point of departure is to answer the question "Does the lesson study work", "How it works?" and "What kind of evidences we find". This paper aimed to respond to this question with present findings on this aspect based on a systematic review of relevant studies from 2000 to 2010. This systematic review covered literature from 2000 because there was lack of studies about lesson study and learning study before 2000. Although lesson study has widely been used in Japan, most lesson studies were not yet well-documented, fidelity and spread standards were problematic. The evidence we reported here are the evidences that are the best we can find.

A comprehensive literature search was performed for the period from January 2000 to March 2010, on computerized electronic databases. Studies were further filtered by visual examination to avoid duplication of articles across different databases. A study was included if: (i) the theme was mainly on identifying the effectiveness of "lesson study" or "learning study"; (ii) it was an empirical study; and (iii) the targeted subjects were teachers or students. The study was excluded if it was a review. A total of 74 articles (21 from ProQuest, 27 from JSTOR, 24 from Springer-Link, 2 from Sage Journals) were extracted from the electronic databases. According to the inclusion criteria, 20 articles in full texts were selected for a detailed review. After screening, 9 articles were included in the systematic review.

All of the reviewed studies (N=9) reported positive effects on either students or teachers, or both. Six studies reported that lesson study or learning study had positive effects on students (Cheung, 2009; Lo et al., 2006; Marton & Pang, 2006; Matoba et al., 2007; Pang, 2009; Pang & Marton, 2003). Among them, three studies reported that the positive effects on students were statistically significant (Cheung, 2009; Marton & Pang, 2006; Pang, 2009). Two studies found that learning study outperformed lesson study on enhancing students' learning outcomes (Pang, 2009; Pang & Marton, 2003). Eight studies reported that lesson study or learning study had positive effects on teachers or teaching (Cheung, 2009; Lo et al., 2006; Marton & Pang, 2006; Pang & Marton, 2003; Marble, 2007; Matoba et al., 2007; Perry

& Lewis, 2009; Stewart & Brendefur, 2005). Among these lesson studies, one study reported positive effects on both teachers and students (Matoba et al., 2007). Four learning studies reported positive effects on both students and teachers. The positive effects on teaching from learning study were the light shed by the comparative analysis of what happened in the classrooms that related differences in the students' capabilities in handling the object of learning to differences in how the object of learning was handled in the classrooms.

As the main aim of lesson study is to enhance teacher's professional development to improve students achievement (Matoba et al., 2007) and learning study is to enhance the learning outcomes of students (Kullberg, 2010), so it is more beneficial if the linkage between teaching and learning is made clear to the audiences (Kennedy, 1999). What has been missing is a theory that could explain the effects of teachers' actions on student learning in a useful way though there have been many attempts to explain teaching-learning relationships (Nuthall, 2004). In the reviewed learning studies, teaching and student learning is explored by means of a framework called variation theory (Marton & Booth, 1997; Marton & Tsui, 2004; Marton & Pang, 2006). The framework makes it possible to analyze teaching and learning in commensurable terms, which implies that "what the teacher intends the students to learn", "what is made possible to learn in a lesson" and "what the students learn" are connected and describe in similar ways. The reviewed studies (Cheung, 2009; Lo et al., 2006; Marton & Pang, 2006; Pang & Marton, 2003) showed the use of variation theory to explain differences in students' possibilities to learn with reference to the differences in handling how the object of learning was handled in the classroom. In this sense, learning studies will be transferable or may be replicable to other teachers and students if the new teachers tried to help the students to discern the critical features of the object of learning. It would be valuable to education if more research could also highlight the significant effects of lesson study and learning study on teaching and student learning.

Our review identified some positive evidence supporting the educational benefits of lesson study and learning study. There is however still a lack of high-quality and well controlled studies in this field. The majority of the existing trials have small sample size. Further trials should be conducted with more representative samples to confirm the effectiveness of lesson study and learning study. Proper randomization techniques need to be used, clearly described, and fully reported. This review did not intend to make a conclusive remark on the effect of lesson study and learning study. On the other hand, we attempted to summarize findings of respective research in the past decade so as to shed light on the direction of future research on this modality.

PAPER PRESENTATION

Is teacher expertise reflected in talking about classroom situations?

Katharina Rosenberger, University College of Teacher Education Vienna/Krems, Austria

The conference paper aims to present the reconstruction of pedagogical knowledge through picture und text vignettes. The vignettes have been used to show teacher students' – and in comparison expert teachers' – way of seeing and interpreting a given classroom situation. The central aim is to investigate the changes in the students' pedagogically directed perception, in their skills of interpretation and their knowledge of action at the beginning and at the end of their studies.

The sample comprises 273 teacher students. In addition to these two data sets, 60 experienced teachers also took part as a comparison group. Using the vignettes we analyse and assess the texts written in their response mainly with qualitative research techniques: How do the respondents comment on the pedagogical situation described in the text vignette or shown in the picture? What do they articulate and how do they articulate it?

At the conference the results of the expert-novice-comparison will be presented. A comparison of the students' answers with those of experienced teachers illustrates to a certain extent differences – for instance the 'teacher's eye' of the expert teachers as a symptom of professional identity or the 'student's heart' by focusing on how pupils feel. The analysis also reveals the range of interpretative perspectives of any particular situation and indicates in which way initial teacher training could address this issue.

The debate about teacher expertise is highly related to the question of professional knowledge and its acquisition in formal and informal ways. To cope with pedagogical-practical challenges requires on one hand conceptualized knowledge (acquired through formal training) and on the other hand embodied practical knowledge (acquired by doing). (cf. Polanyi 1958 and Neuweg 2004) Professional knowledge has to manifest itself in successful practise. Teacher education institutions are therefore facing various challenges. Their curriculum and actual training serves

primarily as a structure for the direction of teaching, but it cannot determine it. Thus, these institutions need to find effective ways how it is possible to support the acquisition of practical knowledge.

A key approach in initial teacher training in various European countries is observation, analysis and (verbal) reflection of teaching – either one's own practice or others persons teaching, which became especially popular with Schoen's distinction between reflection-in-action and reflection-on-action. While the first is integrated in action serves the second as a form of retrospective deliberation on action. "Through reflection, he [the practitioner] can surface and criticize the 'taken-for-granted assumptions' that have grown up around the repetitive experiences of a specialized practice, and can make new sense of the situations of uncertainty or uniqueness which may allow himself to experience." (Schoen 1983, 61) Although Schoen does not follow the classical Cartesian model of rational subject, he doesn't reflect the concept of reflection. On the contrary he recognises the reflection of concrete situations as a form of creating or refining professional wisdom.

The conference paper aims to present the reconstruction of pedagogical knowledge through picture und text vignettes. The vignettes have been used to show teacher students' – and in comparison expert teachers' – way of seeing and interpreting a given classroom situation. Both vignettes are embedded in a broader multi-method research design of the perennial research project "Competency development of students in teaching degrees, using the example of the ability to differentiate as one of the prerequisites for handling heterogeneous student groups competently" that is carried on from 2009-2012 at a University College of Teacher Training in Vienna. The project follows two basic tracks of research: on one hand the description of actions taken in the classroom by students in teaching degrees (through reconstructive methodologies) and on the other hand an explorative study and an analysis of professional concepts that generate such interpretations. A central aim of the project is to investigate the changes in the students' pedagogically directed perception, in their skills of interpretation and their knowledge of action at the beginning and at the end of their studies.

The sample comprises 273 Austrian teacher students. At the very beginning of their training in 2008 they were asked to take part at the vignette study and they will be asked again shortly before the completion of their course in 2011. In addition to these two data sets, 60 experienced teachers also took part as a comparison group. Using the vignettes we analyse and assess the texts written in their response: How do the respondents comment on the pedagogical situation described in the text vignette or shown in the picture? What do they articulate and how do they articulate it?

The codifying system consists of inductive as well as deductive codes – mainly with descriptive and structural categories. In the process of analysing the material we mainly used qualitative research techniques (criteria-related text analysis). Additionally, some quantitative calculations were also done to allow a comparative analysis in order to find special types and correlations. These types were interpreted in case studies and linked with other empirical methods in the research project.

At the conference the results of the expert-novice-comparison will be presented. A comparison of the students' answers with those of experienced teachers illustrates to a certain extent differences – for instance the 'teacher's eye' of the expert teachers as a symptom of professional identity or the 'student's heart' by focusing on how pupils feel. The analysis also reveals the range of interpretative perspectives of any particular situation and indicates in which way initial teacher training could address this issue. The distinction between experts and students is much smaller than was assumed by teacher trainers interviewed for the study. Therefore we might have to rethink our assumptions about the role that verbal reflections on teaching play in teacher training and find innovative ways how reflecting can be used in order to improve the students' repertoire of strategies.

Literature:

- Neuweg, G.H.: Figuren der Relationierung von Lehrerwissen und Lehrerbinnen. In: Hackl, B./Neuweg, G.H. (Eds.): Zur Professionalisierung pädagogischen Handelns. Vienna 2004, p.1-26
Polanyi, M.: Personal knowledge. Towards a Post-Critical Philosophy. London 1958
Schoen, D.: The reflective practitioner. San Francisco 1983

PAPER PRESENTATION

Extending understandings: Teacher expectations across time

Christine Rubie-Davies, University of Auckland, New Zealand; Rhona Weinstein, University of California at Berkeley, United States; Phil Cowan, University of California at Berkeley, United States; Carolyn Cowan, University of California at Berkeley, United States

This study sought to empirically examine long-term teacher expectation effects in relation to student outcomes. Many studies have investigated what we defined as contemporary effects (teacher expectation effects that occur across one year) but few have studied longer-term effects. We examined enduring effects (distal effects of one teacher across more than one year) which have occasionally been reported and compounded effects (the additive effects of different teacher expectations across several years) which to our knowledge have not previously been reported. The participants (110 students) were tracked from pre-school through Grade 4. Teacher expectations were measured in Fall and student achievement in Spring. Relationships were found between teacher expectations and student achievement across one year (contemporary effects) and more distally across two or more years. Compounded teacher expectation effects were examined in two ways, firstly by using structural equation modelling to predict student achievement and secondly, by examining long-term outcomes when students had successive teachers with correspondingly high or low expectations for their achievement. Data from the path model showed that by end of Grade 4 the longer term expectancy effect advantage translated to a score of 61.5% correct on a test versus a score of 39.5% - a substantial difference. There was a direct linear relationship by end of Grade 4 between numbers of teachers a student had with high (or low) expectations and student achievement. The study advances understandings of longer-term relationships between teacher expectations and student outcomes, particularly by including the compounded effect of expectations across time.

Despite the voluminous teacher expectation research, little is known about relationships beyond one year between teacher expectations and student outcomes. There is clear evidence of teacher expectation effects in naturalistic settings across one year (defined as contemporary effects). Further, a few researchers have considered the enduring effect of teacher expectations (i.e. whether teacher expectation effects of an original perceiver are sustained across several years). For example, Alviderez and Weinstein (1999) showed that Kindergarten teachers' over- and under-estimates of intelligence relative to IQ predicted grade-point average 14 years later. Despite using different expectation measures, various studies have reported that controlling for initial achievement, earlier teacher expectations have a durable effect on later outcomes as diverse as achievement, courses taken and test-taking for college admission. However, the role of an initial and then subsequent perceivers and additive effects across a number of years should also be considered. We define the separate but cumulative effects of multiple teachers across time as compounded effects of teacher expectations. Brophy (1983) suggested that even if effects of within-year expectations were small, the effects could increase substantially as they accrued across several years. To our knowledge, this has not been investigated previously.

Research aims

Our aims were to a) examine contemporary effects of teachers' expectations on student achievement across one year, b) investigate enduring effects of a single teacher's individual expectations on students' achievement beyond the year students were with the original perceiver, c) consider the compounding of each succeeding teacher expectancy effect from Kindergarten through fourth grade and d) explore effects on fourth-grade achievement of multiple years of having a teacher with high versus low expectations.

Method

The participants were 110 students tracked from pre-K to Grade 4. This study used data from the Schoolchildren and their Families Project (Cowan, Cowan, Ablow, Johnson, & Measelle, 2005) to examine teacher expectation effects across time (at Kindergarten, Grade 1 and Grade 4). The 'intelligence' subscale of the Child Adaptive Behavior Inventory (CABI) (Cowan, Cowan, Heming, & Miller, 1995) was used as a measure of teachers' expectations. In Fall, at Kindergarten, Grade 1 and Grade 4, teachers provided expectation data for the target and other students in their classes. Standardized measures of verbal ability and achievement were obtained at pre-school using the Peabody Picture Vocabulary Test (PPVT) and then the Peabody Individual Achievement Test (PIAT) in Spring.

Results

At the three grade levels across a one-year period, controlling for the most proximal end of year achievement, three hierarchical regressions were performed to predict end of year achievement at Kindergarten, Grade 1 and Grade 4. At each grade level, teacher expectations predicted student achievement.

We examined enduring effects of teacher expectations, after controlling for PPVT scores, and found significant and sustained effects of early teacher expectations past one year. Beyond the Kindergarten year, we found evidence of rising teacher expectation effects in the following year and diminishing effects four years later. With regard to the predictive role of Grade 1 teacher expectations, there was evidence of an increased effect of expectations on Grade 4 achievement three years later compared to the within-year effect which was smaller.

The question of the compounding of teacher expectancy effects was explored in two ways. First, we examined the additive effects of successive teacher expectancy effects in predicting fourth-grade achievement by using a path model. The compounded result of the teacher expectancy effect at Kindergarten, Grade 1 and Grade 4 was almost a quarter of a standard deviation or the difference between scoring 61.5% and 39.5% on a test. The combined effect across four years of previous and current teacher expectations was more substantial than the within-grade effects or the enduring effects across more than one year. Second, we used a median split at each grade level to assign students to high or low teacher expectation groups. Controlling for achievement, the more teachers students had with high expectations, the greater their mean achievement at Grade 4 and conversely, the more teachers students had with low expectations, the lower was their mean achievement. Numbers of high (or low) expectation teachers significantly predicted achievement at Grade 4.

Discussion

The current study conceptualized three different long-term teacher expectancy effects: contemporary, enduring and compounded. The contemporary teacher expectancy effects confirmed results of other studies (e.g., Kuklinski and Weinstein, 2001). While the effects were small, early teacher expectations had an independent relationship with student outcomes at the end of the current year, above what might be anticipated based on prior achievement, and beginning in the Kindergarten year. Evidence of the enduring effects of teacher expectations on student achievement also confirmed previous work (e.g., de Boer, Bosker, & Van der Werf, 2010). The remarkably consistent evidence for the enduring relationship between earlier teacher expectations and later student achievement is an important finding in its own right, since it indicates an extension of teacher expectancy effects beyond the year in which the expectations were formed. Our findings of compounded effects across multiple years, occurring at both positive and negative poles of expectations, underscores the increased and cumulative effects that Brophy (1983) hypothesized – small effects can become sizeable over time.

This study shifts the debate from single teachers whose expectations endure to compounding effects across multiple teachers over time. The interesting question, however, is not whether long term effects of teacher expectations exist but rather what the conditions are in relation to teachers and students whereby expectancy effects are intensified and accrue more or less across a child's schooling. Further, given consistent findings about teacher qualities or practices that moderate teacher expectancy effects, it is critical to pursue the role of teacher differences in studying longitudinal effects. We know relatively little about teacher qualities, beliefs, and school environments that moderate beliefs about what teachers can expect of students and how they actualize these beliefs in practice. Developing a more holistic view of students within the schooling context offers many opportunities to advance knowledge about expectancy processes and positively contribute to enhanced and equitable outcomes for all students.

PAPER PRESENTATION

Beliefs about teaching: persistent or malleable?

Erika Lofstrom, University of Helsinki, Finland; Katrin Poom-Valickis, Tallinn University, Estonia

The paper describes a follow-up study focusing on change in Estonian university students' beliefs about the teacher role. The beliefs were investigated through metaphors, and analysed applying the dimensions of the teacher identity model developed by Beijaard, Verloop and Vermunt (2000). The method of analysis was thus deductive, theory-driven content analysis. The number of students was 68, resulting in 136 metaphors collected two years apart. A third of the students changed the type of metaphor between the two sets of data collection. The finding indicated that beliefs about teaching are fairly persistent. However, when there were changes, the views expressed were broader including additional elements reflecting a more developed and expanded view. The finding supports the notion that it is important to provide university students opportunities to reflect on their experiences of the university teaching–learning environment as this may allow the students to broaden their conceptions. This is particularly vital in programmes that follow a consecutive (3+2) teacher education model and in contexts in which there is a lack of prospective teachers in certain subject areas. Now that we have an understanding of the positive nature of the changes, the next step is to look into factors facilitating change in the beliefs.

Introduction

This paper describes a follow-up study focusing on change in Estonian university students' beliefs about the teacher role. The beliefs were investigated through metaphors about the teacher role. Beliefs are often unconscious, yet they serve as a filter through which the student responds to teacher education. Prospective teachers enter the university with existing conceptions and beliefs about teachers and teaching (Calderhead 1996). Preconceptions have demonstrated resistance to change (Joram & Gabriele 1998). However, beliefs can change as a result of reflection on

classroom experiences, and the changes can be expressed through metaphors (Alger 2009). Metaphors can serve as a tool in making implicit beliefs explicit (Leavy & al. 2007) helping the student to connect personal beliefs and educational theories.

The Interpretative Framework

We have analysed metaphors using the dimensions of the teacher identity model by Beijaard, Verloop and Vermunt (2000) identifying different knowledge bases that characterise teacher identities. According to Beijaard & al., teacher expertise can be based on subject matter expertise, pedagogical knowledge, and didactics expertise. The knowledge base that the teacher primarily relies on has implications for the teaching. In addition to the subject area knowledge teachers need an understanding of how to teach the content to enhance learning, i.e. knowledge of didactics, and it is discipline- and subject specific in nature. Focus is on the creation of learning environments that support the learning processes. Further, the understanding of human learning, behaviour, and communication are essential elements and form the pedagogical knowledge with an emphasis on relationship, values, and the moral and emotional aspects of development.

Method

The research questions were: How stable are students' beliefs about teacher role? Can changes be identified, and if so, how have the beliefs changed? The number of students was 68, resulting in 136 metaphors collected two years apart; in the first and the third study year. The students were asked to provide a metaphor characterising the teacher role. They were prompted by the statement "A teacher is like...", which they were to finish, and provide a brief explanation. The metaphors together with the explanations formed the units of analysis. The metaphors were categorised through deductive, theory-driven content analysis according to the dimensions in the Beijaard et al. model. The agreement for the categorisations between two independent raters on 85% of the metaphors was high with an agreement rate of 97%.

Findings

The pedagogical metaphors were generally related to mother or leader, or other living entity. By contrast, the subject metaphors were mostly related to static, non-living objects, typically book. The didactical metaphors typically expressed something active, strong or powerful, e.g. brick oven, ice-breaking ship, steam engine, a snowflake starting an avalanche. The metaphors expressing teacher/work characteristics represented both static objects and living entities, but the explanations described work environment or personal characteristics.

In the first data set, 19 metaphors were categorised as expressing a belief about the teacher as a pedagogue, 7 expressing subject expertise, and 9 expressing didactics expertise. Twenty-one metaphors were hybrids of these categories, and 12 did not fall into these categories expressing teacher characteristics or characteristics of the teacher's work rather than its knowledge base. In the second data set, 27 metaphors were grouped into the Pedagogue, 13 in the Subject expert, and 7 in the Didactics expert category. Thirteen metaphors were hybrids, and 8 expressed teacher/teacher work characteristics. The metaphors changed in twenty-four cases (32%). In twenty cases (29%) some element was added to the initial idea expressing an expanded view of the teacher role.

The relevance of the research

The data showed that metaphors tended to be more persistent than malleable. However, when there was change, the metaphors expressed a broader view of the teacher role indicating development of beliefs. The expanded perspectives may be related to own experiences in the university teaching-learning environment, which emphasises the importance of offering the students opportunities to reflect on their learning experiences. The next step is to look into students' experiences of their study environments to find out the factors that are related to change in the beliefs. Our interest in prospective teachers arises from the fact that a large number of students who have a foundation degree in a subject choose careers other than teaching. School teaching staff in Estonia is growing older and there is a lack of school teachers in certain subject areas (Riigikontrolli...2004). Research (Rots & al. 2007) indicates that non-integrated teacher education, which also Estonian subject teachers follow, is a negative predictor of graduates' entrance into the teaching profession. At the point at which the Estonian university students are to choose entry into subject teacher studies at the Master's level, their likelihood of entering teacher education is at the lowest point (Lõfström & al. 2010). By investigating the students' beliefs about teaching and the changes in those beliefs during their Bachelor's degree studies (i.e. prior to entering teacher education) we can better understand the possibilities teacher educators have in identifying and working with teacher potential already during the Bachelor's studies.

REFERENCES

Alger, C. L. (2009). Secondary teachers' conceptual metaphors of teaching and learning: Changes over the career span. *Teaching and Teacher Education*, 25(5), 743–751.

Beijaard, D., Verloop, N., and Vermunt, J.D. 2000. Teachers' perceptions of professional identity: an exploratory study from a personal knowledge perspective. *Teaching and Teacher Education* 16; 749-754.

Calderhead, J. (1996). Teachers: Beliefs and Knowledge. In Berliner, D. C., & Calfee, R. C. (Eds.) *Handbook of Educational Psychology*. New York, NY: McMillan, 709–725.

Joram, E., & Gabriele, A. J. (1998). Preservice Teachers' Prior Beliefs: Transforming Obstacles into Opportunities. *Teaching and Teacher Education*, 14 (2), 175–191.

Leavy, A.M.; McSorley, F.A. & Bote, L.A. (2007). An Examination of what metaphor construction reveals about the evolution of preservice teachers' beliefs about teaching and learning. *Teaching and Teacher Education*, 23, 1217-1233.

Lßfstrßm, E., Poom-Valickis, K., Hannula, M.S. & Mathews, S. (2010) Supporting emerging teacher identities: can we identify teacher potential among students? *European Journal of Teacher Education*, 33(2), 167-184.

Riigikontrolli aruanne (Report of the National Audit Office). 2004. "Lack of teachers in comprehensive schools". Nr. 2-5/04/14.

Rots, I., Aelterman, A., Vlerick, P. and Vermeulen, K. 2007. Teacher education, graduates' teaching commitment and entrance into the teaching profession. *Teaching and Teacher Education* 23: 543-556.

PAPER PRESENTATION

A meta-analysis on teacher judgment accuracy

Anna Suedkamp, University of Kiel, Germany; Johanna Kaiser, University of Kiel, Germany; Jens Moller, University of Kiel, Germany

This meta-analysis summarizes empirical results on the correspondence between teachers' judgments of students' academic achievement and students' actual performance. Drawing on a heuristic model of teacher-based judgments on students' academic performance, we further investigated theoretically and methodologically relevant moderators of the correlation between the two measures. Overall, 75 studies reporting correlational data on the relationship between teachers' judgments of students' academic ability and students' test performance were analyzed, including studies focusing on different school types, grade levels, and subject areas. The overall mean effect size was found to be .61. The effect sizes were moderated by use of direct versus indirect teacher judgments, with use of direct judgments leading to a higher correspondence between teachers' judgments and students' academic achievement.

Introduction

The ability to accurately assess students' achievement is considered to be an important professional skill of teachers. Often, teacher judgments are the primary source of information on students' academic achievement. Indeed, teacher judgments can have consequences for their instructional practice (Alvidrez & Weinstein, 1999; Clark & Peterson, 1986; Hoge, 1983, Hoge & Coladarci, 1989), the further evaluation of students' performances (Begeny, Eckert, Montarello, and Storie, 2008; Feinberg & Shapiro, 2003), and placement decisions—and can crucially influence individual students' academic careers and self-concepts (Mßller, Pohlmann, Kßller, & Marsh, 2009).

A review of literature by Hoge & Coladarci (1989) summarized the results of 16 studies presenting data on the relationship between teachers' judgments of students' achievement and the students' actual performance on an independent criterion of achievement. Hoge and Coladarci reported a range of correlations from .28 to .92 and a median correlation of .66. Additionally, they examined how different methodological study characteristics were related to the correspondence between teachers' judgments and students' achievement. They also sought to identify moderator variables influencing the size of the correlation between the two measures. Because only 16 studies were included in the review, the sample sizes for studying the different effects were small. As such, only descriptive analyses could be presented.

Since the publication of the Hoge and Coladarci review in 1989, numerous further studies have reported data on teachers' judgment accuracy. In order to overcome the limitations of their narrative review and to draw a clear picture of current findings on teacher judgment accuracy, we therefore present a comprehensive meta-analysis. Beyond the statistical synthesis of study results, the meta-analysis evaluates whether potential moderators influence the size of the correlation between teacher judgments and students' actual academic performance.

Method

We identified relevant studies by applying a multimodal search strategy involving both electronic and manual searches.

For this meta-analysis, we coded not only study outcomes, but also several study characteristics as variables with the potential to explain differences in study outcomes (e.g., the students' grade level, the use of direct or indirect teacher judgments).

To account for the hierarchical structure of the meta-analytic data (subjects within studies at the first level, and studies at the second level), we applied a multilevel approach (Hox, 2002; Kalaian & Kassim, 2008). The analyses were performed with HLM6 (Raudenbush, Byrk, Cheong, & Congdon, 2004) using the HLM2 option, in which restricted maximum likelihood estimation is applied.

Results

Overall, $k = 75$ studies were included in the analysis of effect sizes. In a first step, we applied an unconditional multilevel model to the data to estimate the overall mean effect size and to examine heterogeneity in the primary study effects. The overall mean effect size was .61 ($SE = .03$) and significantly different from zero. A large and highly significant chi-square test ($\chi^2 = 827.09$, $df = 74$) indicated that the effect sizes are heterogeneous, indicating that there is a need to include explanatory variables in the model to explain the variance in the effect sizes. The Fisher's Z-transformed correlations ranged between -.03 and 1.18.

Next, we computed several conditional multilevel models in which the explanatory predictor variables were entered separately. For each model, only those studies reporting data on the predictor variable of interest were included in the analysis; all others were excluded. Therefore, the sample size varied across the models. In this summary, an excerpt of the most relevant and significant findings is presented.

First, most studies asked teachers to judge students' performance indirectly (90%); only 10% effect sizes related to direct judgments. We found a significant negative effect ($-.25^{**}[1]$) of direct vs. indirect teacher judgments on teacher judgment accuracy, indicating higher correlations between students' academic achievement and direct teacher judgments (mean effect size = .86) than indirect teacher judgments (.61).

Second, most studies addressed the domain of language arts (59.4% of effect sizes), followed by mathematics (34.9%), music (2.8%), science (0.9%), social sciences (0.9%), and sports (0.9%). In comparison to language arts (reference category), the only statistically significant effects to emerge were those for sports (.40*[2]) and music (-.26*). The mean effect size for the study focusing on sports was 1.033, significantly higher than for studies focusing on language arts (.63). The effect size for music was .33, significantly lower than the mean effect for studies addressing language arts.

Third, according to our coding procedure, the domain specificity of the achievement test and the teacher rating was congruent for 64.9% of the effect sizes reported in this analysis and incongruent for 35.1%. We found a significant negative effect on teacher judgment accuracy (-.11*). As expected, larger effect sizes were observed for studies in which the domain specificity of the achievement test and the rating task was congruent (.66) than for studies in which it was not (0.56).

Discussion

On the basis of a heuristic model of teacher judgment accuracy, we statistically summarized empirical research findings in a meta-analysis. In addition, we examined the role played by theoretically and methodologically relevant moderators in explaining the variation in findings across studies.

The results of our meta-analysis indicate that teachers' judgment accuracy—defined as the correlation between teachers' judgments of students' performance and students' actual test performance—is positive and fairly high (.61). Nevertheless, this result shows that teacher judgments are far from perfect, and that there is plenty of room for improvement.

Our meta-analysis revealed substantial variation in effect sizes across studies. Three important moderators of teacher judgment accuracy were identified: one judgment characteristic, one test characteristics, and one characteristic based on the interaction between judgment and test characteristics.

In summary, this meta-analysis has important theoretical and methodological implications for research on teacher judgment accuracy. It highlights the various methodological aspects that need to be considered when conducting studies on teacher judgment accuracy. The differentiation between teacher characteristics, student characteristics, judgment characteristics, and test characteristics was fruitful in this analysis, as these factors proved to constitute judgment accuracy.

SYMPOSIUM

SIG FUTURE & VISION

Jean-Luc Patry, Universitat Salzburg, Austria; Dimitris Pnevmatikos, University of Western Macedonia, Greece; Anna Tapola, Linnaeus University, Sweden; Wiel Veugelers, University of Amsterdam, Netherlands; Kirsi Tirri, University of Helsinki, Finland; Lena Fritzen, Vaxjo university, Sweden

Within SIG 13, two international projects performed by several institutions across Europe are among the main activities. The aims and future activities of these two projects are presented and discussed.

The first project, the Linnaeus International Project on Integrative Approaches within Teacher Education (TLP), was initiated 2009 by Linnaeus University, Sweden, and has seven partners. TLP aims to analyse the preconditions for integrative approaches in teacher education, where morality and democratic aspects, and subject matter, are integrated into new entreties. The topics to be addressed in teacher education deal with various contemporary challenges related to threats against humanity and human living conditions. The aim includes a broad distinction of the concept of democracy, i.e., studies within TLP aim to study the preconditions for practicing democracy on a daily basis, as fostered though teacher education.

The project has now been running for two years, and in this session we report on our progress, common research, and future plans. The second project is a network called "Education for Democratic Intercultural Citizenship" (EDIC) with eight partners. The main focus is to establish a platform for educators and researchers from different parts of Europe to work and learn together. Creating networks of educational professionals that are the same time flexible (bridging) and give a sense of community (bonding) is very important for future educational change. Educating a new generation of young educational researchers that is linked to elder generations is important for education, for universities and for the young scholars own career and well-being.

Within SIG 13, two international projects performed by several institutions across Europe are among the main activities. The aims and future activities of these two projects are presented and discussed. The first project, The Linnaeus International Project on Integrative Approaches within Teacher Education (TLP), was initiated 2009 by Linnaeus University, Sweden. The invitation to join the project was met with considerable interest from the SIG 13 community.

TLP aims to analyse the preconditions for integrative approaches in teacher education, where morality and democratic aspects, and subject matter, are integrated into new entreties. The topics to be addressed in teacher education deal with various contemporary challenges related to threats against humanity and human living conditions. The aim includes a broad distinction of the concept of democracy, i.e., studies within TLP aim to study the preconditions for practicing democracy on a daily basis.

Various contemporary challenges related to threats against humanity and human living conditions, constitute the targets addressed within TLP. For example, a common research object is called Food Security (including issues related to lack of clean fresh water, and polluted agricultural land, etcetera). Another research object concerns risks related to modern genetics and gene technology (including issues related to human nature, human dignity, and threats against genetic diversity among people etcetera). Within TLP it is assumed that some ways out of the challenges may be found within education, especially in terms of Education for a Global Networked Society. However, since contemporary global challenges most likely need to be addressed in political arenas, and not least through human behaviour and human action, it is not sufficient to merely rely on various types of subject matter education. Therefore, we are interested in examining what potentials that might exist in integrative approaches where subject matter education, and moral and democratic education, are integrated. In addition, since all formal education in schools ought to involve professional teachers, TLP focuses on preconditions for integrative approaches within teacher education where moral and/or democratic aspects and subject matter are integrated into new entreties.

Within the TLP network we address such demanding research objects by creating an international research milieu that: (i) is permeated by interdisciplinarity; (ii) offers an arena that provides opportunities to explore, scrutinise, analyse, and evaluate the potentials that may be inherent in the integration of subject matter, and moral and political aspects; (iii) enables and supports extensive research collaboration between different groups of scholars; (iv) facilitates comparative studies between different countries; (v) includes a variety of research traditions (e.g. emanating from educational science, psychology, science, philosophy, etcetera), which supplement each other in order to shed light on common research objects; and, (vi) provides an international critical mass.

The project has now been running for two years, and in this session we report on our progress, common research, and future plans.

The second project to be presented and discussed is a network called "Education for Democratic Intercultural Citizenship" (EDIC). The main focus is to establish a platform for educators and researchers from different parts of Europe to work and learn together. The participating universities are Barcelona, Brighton, Helsinki, Prague, Thessaloniki, Fribourg, Kibbutzim College Tel Aviv, and Humanistics Utrecht.

Modern societies need citizens who can cope with differences and together constitute a democracy. More than ever democracy can be seen as what Dewey called 'a way of life'. It deals with how to live with cultural differences, to develop a common moral foundation, to get everyone involved, to live with change and uncertainties, and to develop new joint initiatives. Living in a modern democratic and intercultural society requires people, and in particular young people, who are reflective, moral, dialogical and social competent and are willing to behave in these ways. Education, both in formal and informal institutions, has an important role in most societies in creating this kind of citizens. Creating networks of educational professionals that are the same time flexible (bridging) and give a sense of community (bonding) is very important for future educational change. Educating a new generation of young educational researchers that is linked to elder generations is important for education, for universities and for the young scholars own career and well-being.

After several joint research seminars the network now created an annual intensive programme for young and senior researchers to enter in a dialogue with each other about research, concepts and practices and to collaborate.

SYMPOSIUM

SIG FUTURE & VISION

Wim Van Dooren, K.U. Leuven, Belgium; Michael Schneider, ETH Zurich, Switzerland; Xenia Vamvakoussi, , Greece

Conceptual change has influential in cognitive psychology and educational research for more than 20 years. Throughout its lifespan, the SIG on Conceptual Change has been under continuous development, in terms of theoretical assumptions, methodology, and content-domains. Input of pre-appointed discussants will trigger a discussion on several topics that are of interest to the SIG.

A first topic is how conceptual change is viewed nowadays the field. This topic can stimulate discussion on the various theoretical approaches used to studying conceptual change, their similarities and differences, and the potential impact of taking various stances.

A second issue relates to the curricular domains in which conceptual change research is conducted. Besides research in the past in the domains of physics, biology and history, focus is now also on other domains, such as mathematics. What does the field gain by these extensions? Is conceptual change similar across domains?

Third, there is interest in the role of motivation, emotions, and personal epistemologies in learning. This topic is of particular interest, since it can stimulate fruitful exchange between members of different SIGs within the EARLI community.

A fourth element are the methodological tools that are being used in our field. These are also under continuous development, and include besides questionnaires, task-based interviews, and a variety of qualitative approaches and intervention studies, also eye-movement technology, reactiontime measurements and phenomenographic methods. Finally, there are the instructional implications derived from conceptual change research. What do nowadays' conceptual change approaches to learning have to offer in relation to instruction, and what empirical evidence is there available?

Conceptual change has been an influential topic in cognitive psychology and educational research for more than 20 years. Throughout its lifespan, the Special Interest Group on Conceptual Change has been under continuous development, in terms of theoretical assumptions, methodology, and content domains. Given this continuous development, it seems useful to close the EARLI Conference with an open discussion, where all SIG members and interested non-members can discuss a variety of new developments, and the impact they have, should have, or could have on our Special Interest Group.

The Future and Vision session will start with some input of pre-appointed discussants who will briefly share their experiences and insights on what they saw and heard during the conference that might be of interest to the SIG members. Afterwards, the audience will be invited to participate in the exchange. There are four potential topics on which the Future and Vision session could focus.

A first topic is how conceptual change is viewed nowadays by researchers in the field, which can stimulate discussion on the various theoretical approaches that are used to studying conceptual change. Indeed, under the common denominator of the conceptual change approach to learning, several distinct theoretical assumptions have served as a source of hypotheses and have guided rich and fruitful research agendas. One can think of the potential impact of taking a sociocultural stance towards conceptual change, a 'knowledge in pieces view', a phenomenographic approach, or a framework theory approach. The discussion might focus on the differences and commonalities of these various approaches, and their impact on the field of conceptual change. To what extent are they compatible? How can each of the approaches enrich the research field?

A second issue that deserves attention relates to the curricular domains in which conceptual change research is conducted. In the past decades, research on conceptual change has provided detailed descriptions and explanations of students' difficulties in diverse areas, such as physics, biology and history. Since some years, the scope is being expanded towards new curricular domains such as mathematics and economy, and towards societal topics that can be considered "controversial" (e.g. global warming, evolution theory). Topics for discussion could be what the field of conceptual change gains by its extension to new curricular domains, and whether (and why) this extension needs our explicit attention. Reflections could also be made on whether conceptual change is similar in these different curricular domains, or whether (and why) the processes involved are actually different.

A third element for discussion is the methodological tools that are being used in our field. These tools are also under continuous development, and the toolkit available to nowadays' conceptual change researchers is extensive. Besides questionnaires, task-based interviews, and a variety of qualitative approaches and intervention studies, research has made use of eye movement technology, reaction time measurements and phenomenographic computer tools. Reflections could be made on each of these methods' usefulness in conceptual change research, on their validity, and on the need for new or improved methods to study the phenomena that we are interested in.

Fourth, there is a considerable interest among researchers in the Special Interest Group in the role that motivation, emotions, and personal epistemology play in the way processes of conceptual change take place. The discussion could therefore focus on the impact of this "warming trend", on the progress being made in this direction and on the future directions of it.

Finally, an ever-present interest of the Special Interest Group is the instructional implications that derive from research on conceptual change. Cognitive conflict has been –and possibly, still is – typically recognized as a conceptual change teaching practice. Effective as cognitive conflict may be in certain contexts, it became subject to severe criticism as its limitations emerged and were pointed out. It is an urging question however, what nowadays' conceptual change approaches to learning have to offer in relation to instruction, and what empirical evidence there is available for these instructional implications.

PAPER PRESENTATION

Seeking relevance: an evaluation of student learning and assessment in postgraduate accountancy

Jane Hughes, Open University, United Kingdom

Does assessment help students develop an appropriate 'form of competence' (Wenger 1998: 53) for a 'professional life', beyond higher education?

Taking a sociocultural perspective (Lave and Wenger 1991), this study explored the influence of assessment (accountancy examination) on postgraduate accountancy students' learning trajectories, the transformational journey of a learner, as they became a member of a higher education accountancy practice. The learning trajectory and associated identity development of seven case study students were explained using 'modes of belonging': engagement, imagination and alignment, (Wenger 1998: 174). The explanation considered students' prior experiences, as well as their future expectations, in relation to their accountancy studies.

While student success relied on having appropriate accountancy-related study-strategies, the most successful students, in terms of pass marks, were those who were able to combine appropriate accountancy-related study-

strategies with a sense of imagination of how they might use accountancy in the future and were aligned with accountancy, which they could relate to a 'professional life'. The findings suggest that, when designing assessment, higher education accountancy practitioners could consider how to encourage students to see the 'use value' (Lave and Wenger 1998: 112) of their accountancy studies, with the aim of moving students away from a narrower focus on accountancy-related study strategies.

This research took place in the business school department of a post-1992 UK university. The research subjects (postgraduate students) studied accountancy as a core (mandatory) module, Accounting for Managers (AFM), on a generic postgraduate business studies degree. Quantitative analysis showed that for students who entered postgraduate studies with higher-level prior qualifications, the pass rate was 87.5 %, compared to a pass rate of 68.46% for those with lower-level prior qualifications, (n = 345). Log-linear analysis indicated that the prior level of qualification had a stronger effect on pass rates than other factors: seminar attendance, prior knowledge of accountancy ($\chi^2 = 15.963$, df 1, p

This research aimed to explore the relationship between AFM student prior experiences and AFM student outcomes (pass rates). From a sociocultural perspective, the learning trajectory provides evidence of the transformation, or a change in identity, as students become members of an HE accountancy practice; identity is a 'form of competence' (Wenger 1998: 53). This study explored the learning trajectories, undertaken by the AFM students, using the 'community of practice' model of Wenger (1998). While difficulties arise in establishing a 'community of practice' in institutionalised education (for example, Roth and Lee 2006: 33), the concept of identity is useful in exploring learning development (Sfard and Prusak 2005: 18). Tobell et al. (2010: 277) see investigating identity as a way to analyse educational transition in an HE 'practice'.

Assessment, in particular, signals what is valued in the 'practice'. Differences arising between teachers' perceptions and students' perceptions of assessment, and the subsequent response from students, seen in students' use of study strategies, have been explored in HE (for example, Entwistle and Wilson 1977). Reconciling the requirement of a 'professional practice' with an HE 'academic practice' in accountancy is problematic, both for assessment and for curricula (Lin et al. 2004). Boud and Falchikov (2006) highlight the drawbacks of HE assessment for preparation for life beyond university; HE assessment, inevitably, takes place in an institution that mimics a 'professional life' experience. This study used the sociocultural perspective of Wenger (1998) to explore the question:

How do students' perceptions of their assessment (accountancy examination) affect their learning and outcomes (pass marks) as they engage in the AFM practice?

A sociocultural, or situated, view of learning contrasts the 'use value' of what is learnt, whereby learning contributes to becoming a 'knowledgeable person' in a practice, with the 'exchange value' of what is learnt, whereby learning is exchanged for a 'reward', such as, examination success (Lave and Wenger 1991: 112).

Methodology and methods

This research took a case study approach (Yin 2003). Student case studies (seven students), with a range of prior HE qualifications and study experiences, were the main analytical focus. In-depth semi-structured interviews with students, before and after the examination, provided 'narrative' data, following Sfard and Prusak (2005). 'Practice' data, following Wenger (1998), came from students' examination answers, revision and class notes. Pass mark data provided evidence of examination outcomes. 'Narrative' and 'practice' data were analysed using the 'modes of belonging' (ways of learning): engagement in practice, imagination and alignment (Wenger 1998: 174)

Findings

These case study students perceived the HE accountancy practice, in which they were engaged, to be an 'examination practice'; having appropriate, accountancy-related study strategies was the key to accountancy examination success. Students who were conscious of the need to develop appropriate study strategies, had better outcomes (higher pass marks) than those who were not so aware.

The most successful students, in terms of pass marks, were those who were able to combine appropriate accountancy-related study-strategies with a sense of imagination of how they might use accountancy in the future and were aligned with accountancy, which they could relate to a 'professional life'. The latter students saw the 'use value' (Lave and Wenger 1991: 112) of their studies, and drew on their prior experiences and future ambitions to do so. While the use of appropriate accountancy-related study-strategies appeared necessary for success in this 'examination practice', the use of study strategies (engagement in practice) was only part of the story of student success. This research suggests that imagination and alignment have a role to play in student learning.

The findings suggest that, when designing assessment, HE accountancy practitioners could consider how to encourage students to see the 'use value' of their accountancy studies, with the aim of moving students away from a narrower focus on accountancy-related study strategies. Harnessing students' prior experiences and future expectations in order to develop ways to help students see the relevance of their accountancy studies for their future ('professional life') may improve students' experience and performance. The limitations of this study arise from the small sample, albeit an approach which offered the opportunity for fine-grained analysis. Further research using the 'modes of belonging' (Wenger 1998: 174) to explore student experiences and outcomes in other business school disciplines is ongoing.

- Boud, D. and Falchikov, N. (2006) 'Aligning assessment with long-term learning' *Assessment and Evaluation in Higher Education*, 31 (4), 399-413
- Entwistle, N. J. and Wilson, J. D (1977) *Degrees of Excellence: The Academic Achievement Game*, London, Hodder and Stoughton Ltd
- Lave, J. and Wenger, E. (1991) *Situated learning: Legitimate peripheral participation*, Cambridge, Cambridge University Press
- Lin M. T., Fowler M.B. and Hawkes, L. (2004) 'Management accounting curricula: striking a balance between the views of educators and practitioners' *Accounting Education*, 13 (1), 51 -67
- Roth, M-W and Lee, Y-J. (2006) 'Contradictions in theorising and implementing communities in education', *Educational Research Review*, 1, 27 - 40
- Sfard, A. and Prusak, A. (2005) 'Telling Identities: in search of an Analytical Tool for Investigating Learning as a Culturally Shaped Activity', *Educational Researcher*, 34 (4), 14 - 223
- Tobbell, J., O'Donnell, V. and Zammit, M. (2010) Exploring transition to postgraduate study: shifting identities in interaction with communities, practice and participation, *British Educational Research Journal*, 36 (2), 261- 278
- Wenger, E. (1998) *Communities of practice: Learning, meaning and identity*, Cambridge, Cambridge University Press
- Yin, R. K. (2003) *Case study research: design and methods*, London, Sage Publications Ltd

PAPER PRESENTATION

The quality and importance of thesis 'contribution'

Sid Bourke, University of Newcastle, Australia; Allyson Holbrook, SORTI, The University of Newcastle, Australia

One of the key components of examiner comment on the theses they examine is the contribution the thesis makes to the discipline and its literature. Universities normally request specific comment from examiners on the significance and 'contribution' of the thesis. We asked PhD and research masters degree examiners to rate the thesis they had just examined on 12 quality criteria, including three thesis contribution indicators, and indicators covering the literature review, thesis approach/method, analysis/ results and presentation. The criteria were developed from an archive of examiner reports. We also asked how important each criterion was. Although the means for contribution quality items were between Moderate/high and High, they were lower than those for the other quality indicators, indicating the examiners considered thesis contribution was of lower quality than the other indicators. This was particularly so for examiners of masters theses. However, the contribution indicators had among the highest correlations with the overall normative measure of thesis quality, emphasising their importance. Research candidate enrolments and outputs are vital to national advancement, and involve a considerable financial investment, both nationally and individually. Universities must articulate clear standards within and between research degrees. There is clear benefit for all stakeholders – candidates, universities, employers and research funding agencies – nationally and internationally.

Aims

One of the key components of examiner comment concerns the contribution the thesis makes to the discipline and its literature. Although advice to examiners differs considerably between universities, one common component is a request to indicate the significance and 'contribution' of the thesis. The main aims of this paper are to: Identify the relative and absolute importance and quality of three indicators of thesis 'contribution' Identify any differences between PhD and masters theses in examiner judgments about importance and quality of thesis 'contribution' Establish the relative importance and quality of 'contribution' compared with the other nine indicators of thesis quality for both PhD and masters theses. Brief review Concerns about thesis outcomes range from the nature of skills development through to where the bar is set in doctoral work, and how this differs between doctoral and masters theses (Scott et al. 2004). Researchers have noted the need for, but a lack of consensus about, doctoral standards and evince doubts about consistency, clarity and rigour in thesis assessment and the criteria applied (see, eg, Denicolo 2003, Morley et al. 2002, Powell & McCauley 2003). Interviews, surveys, observed examination proceedings, and collection of examiner reports, have elicited what examiners look for in a thesis (eg, Pitkethly & Prosser 1995, Delamont et al. 1997, Mullins & Kiley 2002, Winter et al. 2000, Trafford 2003). Many are single institution studies, but

the most extensive study focusing purely on examination was that of Tinkler and Jackson (2004) which spanned 20 institutions. In a study of 8 institutions' PhD examinations across all disciplines, the authors found that examiners utilise a common framework of criteria in PhD examination (Bourke et al. 2004) and are, on the whole, consistent in their application (Holbrook et al. 2005). The focus in this new study is one major aspect of the criteria they use – the contribution of the thesis.

Methodology

We have expanded our research into PhD thesis assessment to include masters degrees. Archived examiner reports were accessed to identify links between what examiners wrote and their recommendations. We developed a set of 12 criteria, across five areas, that captured the essence of what examiners were doing when assessing thesis quality and deciding their recommendation. This was an iterative process, involving regular return to the examiner reports to confirm or alter the criteria identified. The five areas within which these 12 criteria nested were Contribution, Literature review, Approach/methods, Analysis/results and Presentation. Three of these area are entirely consistent with the components of a dissertation identified by Lovitts (2007, pp.53-58). For Stage 2 we collected a new sample of 621 PhD thesis examiners, and an initial sample of 170 masters examiners. The research protocol requested the examiners to perform two additional tasks: rate the overall quality of the thesis, and subsequently complete a questionnaire. At the time of examination, examiners rated the thesis on a 5-point normative scale. The questionnaire Shortly after the examination, the examiners completed a questionnaire, first asking them to rate the quality of the thesis on each of the 12 identified criteria. A 6-point scale was used with categories ranging from Exceptional quality to Fundamentally flawed. Examiners were also asked how important each of the 12 criteria was for thesis quality generally (not for the thesis just examined), with response categories from Exceptionally important to Not at all important. The results now summarised in this paper focus on the three indicators of thesis contribution identified: Originality of the contribution, Substantive contribution to the discipline, and Advance(s) in new knowledge/ theory/ skills.

Findings

Importance

Originality was considered more important by examiners of both PhD and masters theses than the other two contribution indicators, Substantive nature was second and advancement of knowledge third. The means of the three contribution indicators were 6th, 8th and 9th among the 12 criteria used for PhDs and 7th, 8th and 11th for masters theses. It was notable that the importance of approach/methods and analysis/results were rated above contribution at both degree levels.

Quality

A similar pattern was evident for thesis quality at both degree levels, in that originality was of higher quality than substantive nature and advancement of knowledge. The means for quality across all PhD examiners were between moderately high and high quality for all contribution measures. As might be expected, the means for thesis contribution were lower for masters' examiners. When compared with the other nine indicators, the three contribution ranks were 8th, 11th and 12th for PhD theses and 10th, 11th and 12th for masters theses. Although still in the moderate/high to high range, clearly examiners were least satisfied with contribution quality. When the assessment of the 12 individual indicators was related to the overall PhD thesis quality measure, the contribution indicators had, along with literature review use, the highest correlations (all between 0.70 and 0.74). However, as might be expected, these indicators had lower correlations with overall masters thesis quality (between 0.56 and 0.64), while literature coverage (0.68) and analysis/results being appropriate (0.66) had higher correlations.

Theoretical and educational significance

Research candidate outcomes are vital to national advancement, and involve considerable national and individual financial investments. Research, particularly PhD projects, requires a highly complex and integrated set of outcomes, however, currently the measurement of outcomes is primarily limited to degree completions, because the criteria by which theses are judged and standards are applied do not translate easily into an assessment scale. It is very important that the universities articulate clear standards within and between research degrees. There is clear benefit for all stakeholders – candidates, universities, employers and research funding agencies – to have a clear idea of the quality of research and how it is assessed. The empirical research necessary to identify 'quality' and differentiate between theses is still in its infancy. This is a yawning gap at a time when sustained attention is focussed, internationally, on the quality of research.

PAPER PRESENTATION

The pattern and style of formative feedback presented by PhD examiners in their reports

Allyson Holbrook, SORTI, The University of Newcastle, Australia; Sid Bourke, University of Newcastle, Australia

Drawing on a mixed methods approach this paper will report on the pattern and style of formative comment employed by examiners of PhD theses and will look at these qualities in conjunction with examiner recommendations and specific ratings of quality. The problems facing weaker students are highlighted. There is strong evidence of examiners wanting to assist the student to complete the task, but even more pronounced attention to encouraging the student to dig deeper intellectually and embed their work more firmly in the scholarly literature. Such motivations are closely aligned with development of scholarly identity, disciplinary immersion and innovation.

Aims

There is still a great deal to learn about assessment in higher education, from the approaches used through to effectiveness. The researchers have drawn on PhD examiner reports to investigate the standards in play and the criteria used to determine different levels of doctoral quality. This paper will report on the pattern and style of formative feedback employed by examiners and will look at these qualities in conjunction with examiner recommendations and specific ratings of quality. PhD examination has often been compared to peer review. In the normal course of manuscript peer review reviewers tend to identify features of a manuscript that show deeper flaws that may lead to rejection. Another function of peer review is to provide feedback that can assist in the development of the writer and move the manuscript toward higher quality. These functions also exist in doctoral examination. Each examiner report addresses a range of content. What examiners focus on tells a great deal about what they are seeking from a thesis. Questions addressed in this paper explore how examiners address the weaknesses they perceive that cannot be corrected in a simple and straightforward manner. In our previous study the latter are identified as prescriptive instruction where an examiner tells the candidate exactly what they need to do. In formative comment the examiners identify the problem, engage with it and offer direction. This process lends itself to further learning by the candidate. Bearing in mind that formative feedback in this context has already been coded by this definition and includes all three characteristics, questions that move the analysis forward are: What is the distribution of content emphasis in formative instructive comment? How is this distribution related to examiner recommendation and a thesis quality measure? Does the nature and tone of the comment vary for: content areas, field of study, and recommendation? A further and final question pertains to developments in recent literature. Pryor and Croussard (2010) identify three different levels of engagement evident in formative feedback to doctoral students during candidature: concrete/procedural; reflective discursive and discursive existential. This framework captures some of the complexity connected to learning, especially at doctoral level where new knowledge production and disciplinary immersion are transformative both intellectually and personally. This prompts the further question: 4. Are there different levels of assessor or peer engagement communicated in the formative comments in doctoral thesis reports?

Method

The approach used is a mixed methods sequential design with an equal emphasis on qualitative and quantitative elements applied in two separate studies at different points in time. A total of 2121 examination reports from study 1 and another 600 from study two were collected from a total of 9 Australian universities (representative of the sector in Australia and all fields of study) in de-identified format. These were scanned, transferred into a standard template and then coded and entered into QSR N6. They were coded at 29 categories that identified dialogic elements, content area and evaluation types (e.g. summative, formative, prescriptive instructive, instructive commentary and other evaluative) (Lovat et al., 2008). These categories represent the core codes. Since establishing and testing those categories, the team have been systematically exploring substantive sections of text in depth. This paper reports on an analysis of what is, on average, the largest section of evaluative text. Two-thirds of all reports have some formative comment. The analysis involves using the intersect function in N6 to identify the proportions of formative comment associated with each broad category of thesis content (e.g., contribution, analysis, literature review coverage, etc.). We have the full data set at present only for study 1 and those results are presented in this abstract, but will be combined with a further 600 reports from study 2 in the final paper. After coding, the data are transferred into SPSS to examine relationships with recommendation, a separate quality rating, and field of study.

Findings

Findings are interim at this stage and are limited to questions 1 and 2. The landscape of formative comment as a sub-section differs from the core landscape of examiner report text. The category 'analysis and reporting' is dominant in both, but the emphasis on coverage and use of literature becomes much more pronounced when only formative comment is examined. 'Communicative competence' has a slightly higher profile, whereas significance and contribution less so. Most of the formative comment is about analysis and reporting (more than 40%) and the literature (about 30%) compared to 37 and 9 percent of the total text units. Examiner recommendations were divided into four levels from highest to lowest. The lower groups had consistently more intersected text than the higher groups, and the differences were significant. For only one area (coverage of the literature) were all groups discrete, but in other cases the two lower groups had significantly more intersected text than the two higher groups.

SignificanceThe most interesting questions (3 and 4) have yet to be addressed and further coding will be required but, to this point, it is clear examiners focus on two areas of the thesis or subsequent publication that would benefit from closer attention and extended comment. There is strong evidence of examiners wanting to assist the student to complete the task, but an even more pronounced attention to encouraging the student to dig deeper intellectually and embed their work more firmly in the scholarly literature. Such motivations are closely aligned with development of scholarly identity, disciplinary immersion and innovation (Crossouard & Pryor, 2009). Formative feedback in higher education, the way peer assessors reach decisions on quality (Lamont, 2009), and a great many aspects about doing and completing doctoral degrees (Lee and Boud, 2009) are now substantial areas of study in the higher education literature. When completed, this work will contribute not only to a deeper understanding of the nature of assessment at doctoral level, but will reveal how the act of formative assessment is directed at multiple and integrated facets of learning to address the needs, and perpetuate the activity, of knowledge creation.

PAPER PRESENTATION

Evaluation of a Theoretical Structure of Model Competence using Multiple-Choice Items

Eva Terzer, Humboldt-Universität zu Berlin, Germany; Annette Upmeyer zu Belzen, Humboldt-Universität, Germany

Model competence functions as a "door-opener" for an elaborated understanding of the nature of science and leads to advanced qualities of scientific thinking and problem solving (Leisner, 2005). Therefore, it is a profound part of scientific literacy (Driver et al., 1996; Gilbert & Boulter, 2000). Yet, various studies (e. g. Grosslight et al., 1991; Treagust et al., 2002) have identified that students are not aware of the role of models in an epistemological process and focus on descriptive aspects of models, perceiving them as depicting miniatures of real-life objects.

On the basis of the view of models in philosophy of science (e. g. Giere, 2004; Mahr, 2008), Upmeyer zu Belzen and Krueger (2010) used various studies evaluating students' and teachers' comprehension of models and modelling (e. g. Grosslight et al., 1991; Justi & Gilbert, 2003; Crawford & Cullin, 2005) to develop a theoretical structure of model competence. However, it still has to be tested empirically. In this study, 45 multiple-choice items are used to evaluate the theoretical structure of model competence (Upmeyer zu Belzen & Krueger, 2010) empirically (N ≈ 2000) by structural equation models, by variance analyses and by Rasch models. The results of a pilot study (66 items, N = 270) suggest a unidimensional structure of model competence. They indicate that level 1 can be separated from level 2 (.002**) and 3 (.008**). The latter cannot yet be split up empirically.

Relevance

Going along with a stronger focus on the outcomes of the German educational system, educational objectives are operationalized in terms of competence (Klieme et al., 2008). The implemented German educational standards and curricula defining learning outcome for 16 years olds particularly include model competence (KMK, 2005). Model competence functions as a "door-opener" for an elaborated understanding of the nature of science (Leisner, 2005). Therefore, it is a profound part of scientific literacy (Driver et al., 1996; Gilbert & Boulter, 2000). Yet, various studies have identified that students are not aware of the role of models in an epistemological process and focus on descriptive aspects of models (e. g. Grosslight et al., 1991; Treagust et al., 2002).

The precondition for the diagnosis of model competence in biology education is the development of a diagnostic instrument based on an empirically tested theoretical structure of model competence suited to this domain (cp. Schecker & Parchmann, 2006) – a gap that needs to be filled. Upmeyer zu Belzen and Krueger (2010) used various studies dealing with students' and teachers' comprehension of models and modelling (e. g. Grosslight et al., 1991; Justi & Gilbert, 2003; Crawford & Cullin, 2005) to develop a theoretical structure of model competence that identifies two cognitive dimensions of model competence differentiated into three levels with increasing degrees of reflection. This structure still has to be validated empirically.

Theoretical Background

In our research, model competence relates to Weinert's (2001) general definition of competence as a specialized, domain-specific competence referring to cognitive, motivational and volitional prerequisites to coping with a specific range of situations. In this project, only the cognitive dimensions will be examined (cp. Hartig & Klieme, 2006).

Aims and Research questions

The aims of this study are the operationalization and the empirical evaluation of the theoretical structure of model competence (Upmeyer zu Belzen & Krueger, 2010).

The main resulting research questions associated with the operationalization are:

- Do the items have suitable psychometric properties?
- Are these items content valid?

A further research question is linked with the empirical validity of the theoretical structure:

- Does the data support the theoretical structure?
- In which way is model competence related to other theoretical constructs?

In addition to the information gained on the validity of the theoretical structure, students' answers will allow a cross-sectional description of their model competence.

- Are there differences in model competence between different grades (grade 7 to 10) and different school types (Sekundarschule and Gymnasium)?

Further studies in our research group examine whether the theoretical structure of model competence provides a basis for a differentiated facilitation of students' model competence.

Methods

In the first step, the theoretical structure is operationalized in multiple-choice items with a standardized question for each combination of aspect and level. Students' conceptions of models and modelling and their impact on model competence (Trier & Upmeyer zu Belzen, 2009) serve as background information for the construction of the items. These items are calibrated and validated in pre-tests. In a second step, a selection of content validated items will be used in a main study with the aim to evaluate the theoretical structure empirically.

Experienced teachers develop items with reference to actual school practice. The response options are generated on the basis of students' answers to an open-response version of the items to allow the use of a wording close to students' one and to construct valid items.

The item pool is distributed in overlapping test-booklets (multi-matrix-design), reduced and calibrated by theoretical criteria (e. g. grade of difficulty, selectivity, contents and contexts). Each item will be answered by \approx 50 students per group (grade 7-10, Sekundarschule and Gymnasium), totalling \approx 2000 students in the main study.

A first study with 66 items was conducted with 60-70 students per item ($N = 270$ students). The internal validity is evaluated using IRT (Rasch) models (ConQuest; Wu et al., 1997) in order to test if the theoretical structure consists of discrete dimensions and categories (s. a.; Hartig, 2008). Variance analyses provide information about the relations between components and the levels of model competence, with the dependant variable representing the difficulty of the items. Analysing the data of the main study, we will additionally use confirmatory factor analyses (Mplus, Muthén & Muthén, 2007) to evaluate the theoretical structure. The model-fit of competing psychometric operationalizations will be tested (Carroll, 1993).

The main study is designed as a cross-sectional cohort study (grade 7 to grade 10, Realschule and Gymnasium, \approx 2000 students). In addition to analyses concerning the internal validity, the influence of the control variables subject matter knowledge and intelligence as well as a comparison to open-ended tasks (Gruenkorn et al., 2009) are considered.

Findings

According to the results of the first study (66 items, $N = 270$), the operationalization led to 22 items with adequate psychometric properties. These data suggest a unidimensional structure of model competence. They indicate that level 1 can be separated from level 2 (.002**) and 3 (.008**). The latter cannot yet be split up empirically. A second pretest (22 selected items of the first study, 28 new items, $N = 396$) is currently analyzed. A selection of 45 items tested in these studies will form the item pool of the subsequent main study. Final findings regarding the empirical validity will be available in spring 2011.

PAPER PRESENTATION

Measuring change when there is a changing criterion: the case of digital literacy

John Ainley, Australian Council for Educational Research, Australia; Julian Fraillon, ACER, Australia; Christopher Freeman, ACER, Australia; Wolfram Schulz, ACER, Australia

It has been a long-standing principle in the measurement of change not to change the measure. However, it is now accepted that changes are necessary for assessments to remain relevant. This is especially the case when studying the

digital literacy of students. This paper is based on computer-based assessments of digital literacy in Australia conducted in 2005 and 2008. It reports the methods used for equating those assessments and measuring change over that three-year period. The assessments involved large nationally representative samples in primary and secondary schools and included the creation of digital products. The assessment tool was based on sets of thematic modules in a rotated design with some modules used to link the two assessments. There was a significant increase between 2005 and 2008 in the mean digital literacy score for Grade 6 students, and shift in the distribution, but that no significant increase for Grade 10.

Introduction

It has been a long-standing principle for the measurement of change to not change the measure. However, it is now accepted that changes in methods and content are necessary for assessments to remain relevant (von Davier & Mazzeo 2009). This is especially the case when studying changes in the digital literacy of students (called ICT literacy in Australia and Computer and Information Literacy by the IEA). This paper reports a computer-based assessment of digital Literacy in Australia conducted in 2005 and 2008, methods for equating those assessments and the measurement of change over that three-year period (MCEETYA, 2007). Digital Literacy is seen as a set of generalisable and transferable knowledge, skills and understandings concerned with the use of computer technology to investigate, create and communicate information in a variety of contexts (Catts & Lau, 2007; ETS, 2002, European Commission, 2006)).

Assessment design

The assessment of digital literacy in Australia was computer-based and combined the performance of specific software functions with the creation of digital products in a rotated set of thematic modules. It made use of purpose-designed software that included simulated and live applications. Some tasks were automatically scored and others were captured for marking by assessors. Tasks involved collecting and appraising, synthesising and reframing information. A number of thematically-linked modules were used in a rotated design to ensure that the instrument assessed what was common to ICT Literacy across a range of contexts.

In 2005 each student completed three of the seven modules generating more than 200 score points. In 2008 the appearance of material was identical and the method of response was the same as in 2005. The 2008 assessment included three modules from 2005 plus four new modules. Each student completed two of the trend modules and two of the new modules. The 2008 tasks included new software contexts but relied on the same fundamental ICT receptive, productive and evaluative processes as the 2005 tasks. In both 2005 and 2008 students completed a questionnaire about their use of ICT at school and at home. For the 2008 cycle some innovations in delivery methods were introduced without altering the assessment experience.

Data

The assessments of digital literacy in Australia were conducted in Grades 6 and 10 with large nationally representative samples. The 2008 sample included almost 11,000 students from 591 schools and the 2005 sample consisted of 7,400 students from 517 schools. The samples were selected by cluster sampling methods from a stratified sampling frame to ensure that the results accurately represented the Australian population of Year 6 and Year 10 students. Trained test administrators supervised the assessment in schools.

Analysis

IRT methods (Rasch scaling) were used to analyse the student responses and generate a scale for locating items from each module and reporting student achievement. For each cycle these methods were used to analyse the student responses and generate a scale for locating items from each module and reporting student achievement. The scale was one-dimensional and reliable (0.93). The logit scale was transformed to a reporting scale which was set to a mean score of 400 and a standard deviation 100 for Grade 6 students in 2005. The scale was characterised by descriptions of proficiency levels based on item difficulties. A proficient standard for each Grade was established by a panel of ICT education experts.

Thirty-seven items were used to compare the relative performance of the Grade 6 and Grade 10 students and 39 items from the trend modules were used to link the 2008 results to those from 2005. The comparisons of achievement over time in such a rapidly developing field were made possible through instruments that reflect relevant technological changes and maintain integrity to the core processes of the ICT Literacy construct.

Results and conclusions

An important conclusion, consistent with the argument of Kolen (1999), was that it was possible to introduce change in the assessment but still provide measures of change in the underlying construct with a core set of common items. There was a statistically significant increase between 2005 and 2008 in the mean score for Grade 6 students from 400 to 419 scale points. For Grade 10 the increase from 551 to 560 scale points was not statistically significant. The difference between Grade 6 and Grade 10 did not change significantly being 141 points in 2008 and 151 points in 2005. In 2005 49% of Year 6 and 61 % of Year 10 students attained the relevant proficient standard, in 2008 this increased to 57% of Year 6 and 66% of Year 10 students. The associations with student characteristics were the same in 2008 as in 2005. There were significant differences in digital literacy associated with socioeconomic background, Indigenous status and remote geographic locations. Frequency of computer use (especially school utilities) was also associated with digital literacy in each cycle and there had been an increase in computer use at home and school between the two cycles.

References

- Catts, R. and J. Lau (2008). Towards Information Literacy Indicators. Paris, UNESCO.
- European Commission (2006). Key Competences for Lifelong Learning. Official Journal of the European Union. Brussels, Author.
- Kolen, M. (1999). Equating of tests. In G. Masters and J. Keeves (eds.) *Advances in Measurement in Educational Research and Assessment*. New York: Pergamon, pp. 164-175.
- Ministerial Council for Education, Employment, Training and Youth Affairs (MCEETYA) (2007). National Assessment Program - ICT Literacy Years 6 & 10 Report, Carlton: Curriculum Corporation.
- von Davier, M., & Mazzeo, J. (2009). Review of PISA Test Design: Recommendations for Fostering Stability in Assessment Results. Paper presented at the PISA Research Conference, Kiel, Germany.

PAPER PRESENTATION

Two strategies to measure Cognitive Load

Melina Pichler, Ulm University, Germany; Tina Seufert, Ulm University, Germany

Despite the extensive use of concepts from Cognitive Load Theory, the problem of how to assess cognitive load, especially the intrinsic, extraneous and germane load aspects remains still unsolved. We developed two strategies to measure cognitive load: (1) First, we trained a group of learners in differentiating the three concepts before rating (informed rating). (2) Second, we developed a questionnaire with different items for each type of cognitive load (differential rating). The question was how valid, reliable and how comparable the two instruments are. In an experimental study (n=51) with 21 tasks each varying in one aspect of cognitive load learners of both groups had to rate the three types of load and additionally the overall amount of load. To analyse the reliability of the two instruments we calculated the overall internal consistency and for the differential rating additionally the internal consistency per load type. The validity was analyzed by comparing the ratings of the learners with the theoretically expected outcomes. Both instruments turned out to be valid, except the germane load scale of the differential rating. The overall internal consistency of the informed rating was weak, indicating that may be better for differential than overall load ratings. The overall and specific reliability of the differential rating instrument was good. In many tasks we found differences between the two instruments due to more distinct values of the informed rating group. Overall, especially the informed rating seems to be a promising strategy to assess different aspects of cognitive load.

Introduction and Theoretical Background One of the most powerful and most criticized research frameworks in educational research of the last decades is the Cognitive Load Theory (CLT; Chandler & Sweller, 1991). Powerful because the concept is extensively used for evaluating learning environments or interpreting empirical results. Criticized, because there is at least one main problem that is still not solved adequately: how to measure cognitive load (Moreno, 2010). Almost all studies on multimedia learning assess cognitive load by using one item for rating the perceived invested mental effort (Paas, 1992). Some other studies used objective techniques like dual task measures or physiological parameters. However, there is no appropriate instrument to measure the three conceptual parts of CLT, the intrinsic, extraneous and germane cognitive load. In the present study we investigated two different strategies for assessing these different parts of cognitive load: (1) First, we trained a group of learners in differentiating the three concepts before rating (informed rating). (2) Second, we developed a questionnaire with different items for each type of cognitive load (differential rating). The question was whether the two instruments were reliable and valid and whether they lead to comparable ratings of cognitive load when the same tasks had to be evaluated.

Method

In the experimental study 51 students took part and were randomly assigned to one of the two experimental groups. The informed rating group got a short introduction into cognitive load, especially the three different types of cognitive

load, whereas the differential rating group didn't get any instruction. Then every learner had to evaluate 21 tasks where the three types of cognitive load had been varied based on theoretical assumptions and empirical findings: (a) For intrinsic cognitive load (ICL) the element-interactivity of a task had been varied, e.g. "the day after tomorrow will be Saturday. Which day was yesterday" versus "Three days after yesterday was Friday. Which day will be five days before tomorrow?" (b) For extraneous load (ECL) we showed learning environments with an integrated format of text and picture versus a separated format etc. (c) For germane load (GCL) we asked to rate different instructional settings which should either induce germane load, like "every 20 minute a teacher gives you time to think of examples you can find for the topic" versus tasks without such an activation. We created pairs or groups of tasks with the same content type, only varying in the amount of ICL, ECL or GCL. Students had to rate the three types of load in a questionnaire. The informed rating group had to answer one item per load type, the differential rating group got 2 respective 3 items for each load type: For ICL we asked for example how complex the task was. For ECL learners should rate whether it was exhausting to find the relevant information. For GCL we asked learners to rate whether this task animates to think intensively about the given topic. In both questionnaires learners additionally had to rate the overall amount of perceived cognitive load on a 7-point-likert-scale from very low to very high mental effort, which was adapted from Paas (1992). To analyse the reliability of the two instruments we calculated the overall internal consistency for each task. For the differential rating test with more than one item per load type we also analyzed the internal consistency per task for each type of cognitive load. The validity was analyzed by comparing the ratings of the learners with the theoretically expected outcomes, i.e. the theoretically defined oppositional tasks should be rated significantly different in the respective type of load.

Results

The reliability of the informed rating test was highly varying for the different tasks: for almost half of the tasks the internal consistency was not sufficient. The differential rating test on the other hand had good to excellent values of an overall from .67 to .96. For the different load types the internal consistency was also good (with the exception of 1 to 2 tasks) with a values about .80. The validity test revealed significantly different ratings for the oppositional groups of tasks (extraneous load: $F(1,7) = 68.89$, $p=.00$, $\eta^2=.92$, germane load: $F(1,20) = 20.31$, $p=.00$, $\eta^2=.62$, intrinsic load: $F(1,19) = 131.74$, $p=.00$, $\eta^2=.88$). The differential rating test also differentiated very good for differences in extraneous load ($F(1,9) = 21.87$, $p=.00$, $\eta^2=.73$) and intrinsic load ($F(1,17) = 106.19$, $p=.00$, $\eta^2=.87$), but not that good for differences in germane load ($F(1,21) = 0.27$, $p=.61$, $\eta^2=.01$). Moreover we analyzed whether there are differences between the ratings of the two groups. For ECL the two instruments were comparable for 62% of the tasks, for ICL only for 52% and for GCL the ratings were comparable only for 33% of the tasks. However, in all those cases where there are differences between the two groups, the informed rating group rated the load type of the task more distinct, e.g. for a low germane load task the germane load rating is much lower than in the differential rating group.

Summary and Discussion

The informed rating turned out to be a valid measure for the three types of cognitive load. However, the overall reliability was not sufficient, indicating that it is much better to make differential ratings instead of calculating an overall amount of cognitive load. Nevertheless, other reliability measures like retests should be considered. The differential rating instrument also was valid for ECL and ICL, but for GCL the items should be revised. The great differences between the two questionnaires are due to the more distinct ratings of the informed rating group. Overall, especially the informed rating seems to be a promising strategy to assess different aspects of cognitive load.

References

- Chandler, P., & Sweller, J. (1991). Cognitive Load Theory and the Format of Instruction. *Cognition and Instruction*, 8, 293-332.
- Paas, F. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology*, 84, 429-434.
- Moreno, R. (2010). Cognitive load theory: more food for thought. *Instructional Science*, 38, 135-141.

PAPER PRESENTATION

A Framework for validation of Competence Assessment Programs

Saskia Wools, Cito, Netherlands; Theo Eggen, Cito / Twente University, Netherlands

One of the current trends in education is the shift towards more competence-based education. An implication of this change in educational emphasis is an increased use of competence assessments such as performance assessments, situational judgement tests, portfolio assessments. These competence assessments are often combined into a competence assessment program (CAP) that is aligned with the competence-based curriculum (Baartman, et al., 2007). Within a context of competence-based education CAPs are used for high stake decisions on students. It is

therefore important that the quality of these CAPs is ensured. An important aspect of the quality of assessments is validity. But while validity is a very important quality criterion for any form of assessment, it has thus far been operationalized mainly around the use of standardized tests. Nevertheless, validity is just as important for competence assessments and CAPs. This paper exemplifies the use of the Argument-based Approach (Kane, 1992) to validity for a single competence-based performance assessment. Furthermore, the Argument-based Approach to validity is extended for the validation of competence assessment programs (CAPs) where separate tests or assessments contribute to one decision.

Introduction

One of the current trends in education is the shift towards more competence-based education (Baartman, Bastiaens, Kirschner & Van der Vleuten, 2007). In the Netherlands, for example, the ministry of education decided that all vocational education institutes must formulate their curriculum according to principles of competence-based education which has led to concomitant changes in learning outcomes. One of the implications of this change in educational emphasis is an increased use of competence assessments such as performance assessments, situational judgement tests, and portfolio assessments (Baartman, Bastiaens, Kirschner & Van der Vleuten, 2006). These competence assessments are often combined into a competence assessment program (CAP) that is aligned with the competence-based curriculum. Within a context of competence-based education CAPs are used for high stake decisions on students. It is therefore important that the quality of these CAPs is ensured. An important aspect of the quality of assessments is validity. But while validity is a very important quality criterion for any form of assessment, it has thus far been operationalized mainly around the use of standardized tests. Nevertheless, validity is just as important for competence assessments (Messick, 1994). Recently, Wools, Eggen, and Sanders (2010) presented criteria that can be used for the evaluation of validity of competence assessments. These new criteria are developed for use alongside the Argument-based Approach to validity as described by Kane (2004; 2006). The proposed paper exemplifies the use of the Argument-based Approach to validity for a competence-based performance assessment. Furthermore, the Argument-based Approach to validity is extended for the validation of CAPs where separate tests or assessments contribute to a single decision.

Argument-based Approach to validity

Validity is basically about the interpretations assigned to test scores rather than the scores themselves (Kane, 1992). Interpreting a test score concerns explaining the meaning of a score and making the implications of the scores explicit. The process of evaluating the appropriateness of these interpretations is called validation. Validating an interpretation or use of test scores concerns a critical evaluation of the claims being made. This requires a clear description of the claims that accompany the proposed interpretation and uses. Also, this critical evaluation requires a somewhat objective attitude from the researcher involved. However, as Kane (2006) comments, 'most validation research is conducted by tests developers and tends to have a confirmationist bias.' (p. 22). In consideration of this tendency Kane (1992) suggests the Argument-Based Approach (ABA) to validation which provides guidance in the validation process.

This guidance is provided by a framework for gathering evidence to support intended interpretations and uses of test scores (Llosa, 2008). The argument-based approach (Kane, 1992; 2004; 2006) consists of two phases: the development stage in which an assessment is developed and an appraisal stage in which the claims being made in the development stage are critically evaluated. During the development stage, inferences and assumptions inherent to the proposed interpretation of assessment results are specified within an interpretive argument. When the assessment is fully developed and the interpretive argument is specified, a critical evaluation of the claims being made within the interpretive argument should be made. This critical evaluation takes place in the appraisal stage during which the assumptions stated in the development stage are validated in a validity argument that includes both analytical and empirical evidence. Validation of a competence-based performance assessmentIn the proposed paper both the interpretive argument as the validity argument are presented for a competence-based performance assessment. The validation of this assessment serves as illustration of the Argument-based Approach to validity for competence assessments. It is demonstrated which assumptions and inferences are made for this assessment and furthermore, validity evidence is structured into a validity argument to complete the validation. Validation of a competence assessment program (CAP)In the second part of the paper the Argument-based Approach is extended to the validate a combination of multiple tests that lead to one decision, specifically a CAP. It is demonstrated how the inferences and assumptions underlying different tests can be combined into one interpretive argument. Furthermore, it is demonstrated what validity evidence should be gathered to form a validity argument that supports the interpretive argument.

To summarize, the proposed paper will present the use of the Argument-based Approach to validity for the validation of a single competence assessment. Furthermore, the approach will be extended for the validation of a combination of multiple assessments in a CAP.

References

- Baartman, L. K. , Bastiaens, T. J. , Kirschner, P. A. , & Van der Vleuten, C. P. (2006). The wheel of competency assessment: presenting quality criteria for competency assessment programs. *Studies in educational evaluation*, 32, 153-170.
- Baartman, L. K., Bastiaens, T. J., Kirschner, P. A., & van der Vleuten, C. P. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review*, 114 – 129.
- Kane, M. T. (1992) An argument-based approach to validity. *Psychological Bulletin*, 112, 527-535.
- Kane, M. T. (2004). Certification Testing as an Illustration of Argument-Based Validation. *Measurement*, 2, 135-170.
- Kane, M. T. (2006). Validation. In R. L. Brennan (ed.), *Educational Measurement* 4th edition. (pp. 17-64). Westport: American Council on Education and Praeger Publishers.
- Llosa, L. (2008). Building and supporting a validity argument for a standards-based classroom assessment of English proficiency based on teacher judgments. *Educational Measurement: Issues and Practice*, 27 (3), 32-42.
- Messick, S. (1994). The interplay of evidence and consequences in the validation of performance assessments. *Educational Researcher*. 23, 13-23.
- Wools, S., Eggen, T., & Sanders, P. (2010). Evaluation of validity and validation by means of the argument-based approach. *CADMO*, 8, 63-82.

PAPER PRESENTATION

Assessment of fraction competencies on the basis of a two-dimensional competency-model

Lenka Schnaubert, TU Dresden, Germany; Susanne Narciss, Technische Universität Dresden, Germany

The assessment of competencies is a strongly discussed issue in educational psychology. Criterion-oriented testing requires an appropriate theoretical basis. Therefore Eichelmann, Narciss, Faulhaber and Melis (2008) created a two-dimensional competency-model for the domain of fractions. Based on Anderson and Krathwohl's revision of Bloom's taxonomy of educational objectives (Anderson et al., 2001), it contains a cognitive process-dimension while differentiating conceptual and procedural fraction knowledge. On the basis of this two-dimensional view on fraction competencies, two sets of fraction tasks (A and B) were created – each containing 35 items – and given to 293 6th and 7th graders, who each worked on one of the sets for 30 min. 237 pupils were re-tested after one week where they worked on the other set. Data-analysis showed that the item difficulties (integrating both sets and assessment times) ranged from .03 to .88 (.01 to .91 if only considering results without pre-testing) – with the conceptual items being slightly more difficult than the procedural items. The difficulties were normally distributed for each set with a mean of .45 (A) or .41 (B). For each set the mean discriminatory index was .31 (ranging from -.25 to .61) – considering the two-dimensional basis, this was appropriate. A closer look at each item revealed that some tasks were rather difficult, did only correlate negligibly with other test-items and therefore had no (or even negative) discriminatory power. Reliability-analysis showed a Cronbach's α of .73 for version A and .80 for version B.

Introduction and purpose

The domain of fractions is said to be one of the most difficult mathematical domains for students. Many authors stress the importance of this domain for educational and everyday purposes, especially when considering the amount of errors students make when handling fractions (e.g. Brown & Quinn, 2006) and the conceptual deficits students have regarding fractions (e.g. Chan, Leu & Chen, 2007). Although these problems are well-known to teachers and researchers around the globe, a valid diagnostic instrument providing information about the level of competence of students as well as information vital to treatment adaption is overdue.

The assessment of competencies is a strongly discussed issue in educational psychology. As criterion-oriented testing requires an appropriate theoretical basis, national and international comparative studies like PISA use theoretical frameworks to create tasks for assessment purposes. The critique is that these frameworks lack the precision to deduce guidelines for the generation of adequate assessment tasks and tools (Eichelmann, Narciss, Faulhaber, & Melis, 2008).

Therefore, Eichelmann et al. (2008) developed a competency-model for the domain of fractions which represents competencies as pairs of knowledge and a cognitive process. This two-dimensional representation of competencies is rooted in Anderson and Krathwohl's revision of Bloom's taxonomy of educational objectives (Anderson et al., 2001). The cognitive process dimension of this two-dimensional competency-model includes the processes Remember, Represent, Compare, Compute, Communicate, Model and Meta-cognition, the knowledge dimension includes

conceptual knowledge ("knowing what") and procedural knowledge ("knowing how"). It was explicitly developed to be used as a rationale for developing fraction tasks, which address competencies in the fraction curriculum (Eichmann et al., 2008). The present study aims at developing and evaluating such tasks.

Methodology

Based on Eichmann and colleagues' (2008) two-dimensional view on mathematics and the spadework of Berger (2009), two sets of fraction tasks (version A and version B) were created – each containing 35 items. Each set covered all of the suggested processes and knowledge types and their combinations (except for the combination of Metacognition and conceptual knowledge).

To allow economic assessment but still to address the full range of competencies described, the sets contained multiple-choice items as well as other answering formats (e.g. calculating was required as well as sketching, see figure 1). To allow a detailed look on students' performance in dealing with fractions, tasks were created to account for typical errors in the fraction domain as well (see figure 2).

The two sets of fraction tasks were given to 293 6th and 7th graders including the full range of traditional German school types. The students were randomly assigned to one of the two different sets and worked on it for 30 minutes. 237 pupils were re-tested after one week where they again worked 30 minutes but on the other set.

Results

Data-analysis showed that the item difficulties (integrating both sets and assessment times) ranged from .03 to .88 (.01 to .91 if only considering results without pre-testing) – with the conceptual items being slightly more difficult than the procedural items, although this difference was not significant. The difficulties were normally distributed for each set with a mean of .45 (version A) or .41 (version B). For each set of tasks the mean discriminatory index was .31 (ranging from -.25 to .61). Considering the two-dimensional basis, this can be regarded as appropriate, even if items with a significant negative item-test-correlation should be reconsidered. A closer look at each item revealed that some tasks were rather difficult, did only correlate negligible with other test items and therefore had no (or in one case for each version even significant negative) discriminatory power. Reliability-analysis showed a Cronbach's α of .73 for set A and .80 for set B, containing only results of pupils who worked on every task. Due to the restricted time frame, this was only true for NA = 64 or NB = 56.

Theoretical and educational significance

As mentioned above, fraction learning is a difficult subject for students. To effectively support learners, interventions (instructional designs, feedback, learning and teaching methods) have to be adapted to the learners' level of competence. Therefore we need to get a detailed look on how students perform, what kind of errors they make and we need instruments that enable us to draw conclusions regarding the students' competencies. Given the opportunity provided by computer-supported learning, such an instrument would allow the implementation of adaptive feedback and adaptive instructional designs to support students according to their competencies. The presented generation and first evaluation of two theoretically designed fraction tests provide a basis for future work. Even if further evaluations, revisions and the implementation of a computer-based version are still to be done, this work shows how criterion-based fraction tasks and tests can be designed and what can be accomplished by using specific competency-models as a theoretical basis for constructing diagnostic instruments.

References

- Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Rath, J., & Wittrock, M.C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.
- Berger, S. (2009). *Lernen auf fremden Fehlern beim Bruchrechnen – eine Vergleichsstudie zwischen tasks with typical errors und herkömmlichen Rechenaufgaben*. Unveröffentlichte Diplomarbeit, Technische Universität Dresden, Dresden.
- Brown, G., & Quinn, R.J. (2006). Algebra students' difficulty with fractions: an error analysis. *amt*, 64(2), 28-40.
- Chan, W.-H., Leu, Y.-C., & Chen, C.-M. (2007). Exploring group-wise conceptual deficiencies of fractions for fifth and sixth graders in Taiwan. *The Journal of Experimental Education*, 76(1), 26-57.
- Eichmann, A., Narciss, S., Faulhaber, A., & Melis, E. (2008). Analyzing computer-based fraction tasks on the basis of a two-dimensional view of mathematics competencies. In J. Zumbach, N. Schwartz, T. Seufert, & L. Kester (Eds.), *Beyond knowledge: The legacy of competence. Meaningful computer-based learning environments* (pp. 125-134). Dordrecht: Springer.

PAPER PRESENTATION

Different Identities as Tools in Social Science Learning

Karin Ehrlen, Sodertorn University, Sweden

The aim of this study is to investigate how knowledge is constructed in dialogue. The focus is on a dialogue in the form of a discussion between two young adult students about an international political conflict. The discussion is video recorded, transcribed and analyzed. The immigrant experiences in the families of the discussing persons contribute to the construction of knowledge by making it possible for the participants to move among a variety of perspectives related to different identities. This helps them in their efforts to understand the conflict. This indicates the usefulness to study cultural diverse settings at school from a dialogical perspective. The educational significance of the study is the importance for teachers to realise the use that can be made of different identities as new perspectives on subjects at school.

Aims

According to Bakhtin (1984), seeking knowledge in dialogue is the opposite of finding truth in authoritative monologism. The knowledge in dialogue is the opposite of a ready-made truth, which is possible to possess. In dialogue, the knowledge is to be found between people. The aim of this study is to investigate how knowledge is constructed in dialogue. Theoretical framework and research questions
The prerequisite for a dialogue is that there is more than one voice (Bakhtin, 1981). That an utterance is directed toward a listener means that it is directed toward the specific conceptual system of the listener. Voice is understood as perspective on topics. This means that one person may express several voices and many individuals can express the same voice. One way for speakers in a dialogue to express personal will is in the choice of speech genre (Bakhtin, 1986). Speech genres acknowledge the tradition of how we speak about certain subjects. In addition to the connection to typical themes, speech genres depend on the situation in which they are used, the social position of the speaker, and the relations between the speakers in the dialogue. In this study the focus is on a dialogue in the form of a discussion between two young adult students about an international political conflict. The research questions are: What voices are heard? From what national, ethnic or religious position do the participants speak? What times, places and conflicts are actualized in the utterances?

Methodology

A first course in social sciences at upper secondary for adults in Sweden is object of the research. The first part of the course concerns the Swedish parliamentary system. Here a group of five students is followed. The last part of the course is about international relations. Here two girls in their early 20s, who had been followed during the first part of the course, volunteer to go on letting their work being recorded for research purpose. A task given by the teacher, in this part of the course, is to choose an international conflict and, after working on the subject, present an essay. The two participants would present a common essay. One of them has immigrated to Sweden, and the other girl's parents have immigrated to Sweden. The conflict the girls choose to work on is the Israeli – Palestinian conflict. They are video recorded on four occasions, while they are working. This, however, is not all of the work that the girls put into the project. The researcher interviews them about their work and is told that they also discuss the subject over the telephone and read and write about it when they are not together. About four hours of video-recorded work is transcribed. The character of the content is to a big deal work with facts. The students collect data about for example the history of the region and about economics. The final essay is mainly based on this kind of material. There is also content that can be described as procedural questions about how to write the essay. Other material has no connection to the task given by the teacher. The data that is selected for further analysis is material, where the discussions concern the girls' efforts to understand the Israeli - Palestinian conflict. Utterances are analyzed as actions and interactions. This is because when we consider utterances as actions, we take notice of intentions and this means that we study the individual and the historical, cultural, and institutional environment of the actions and of the individual together (Halldén et al. 2007; Wertsch, 1991).

Findings

Not only the students take part in the discussions. Other voices enter the discussions from TV programs and material from the Internet. The girls find themselves forced to enter a dialogue with these voices from "outside" and to take religious and ethnic positions vis-à-vis these voices from "outside". The immigrant experiences in the families of the discussing persons contribute to the construction of knowledge by making it possible for the participants to move among a variety of perspectives related to different identities as well as between times and places. Other factors contributing to the knowledge construction are that the girls have common experiences (they are from immigrant families) and different experiences (they are of different ethnicities and have knowledge of different geographical areas). These conditions make it possible for the students to move between voices of non-migrants and migrants, between voices of Swedes and voices of Arabs or Pakistanis. In time, the dialogue alternates between old religious

history, the Second World War, and present time. Conflicts that are actualized in the dialogue are between Israel and Palestine, Hitler and Jews, non-migrants and immigrants, the Swedish speaking minority in Finland and immigrants in Sweden, Pakistan and India. In the enterprise of understanding the conflict, the students appear to favour a human rights speech genre over a genre with explanations from political history or religious history. This means that the students describe the conflict from the perspective of an individual human being rather than from the perspective of larger political structures. Although the participants choose to understand the conflict in the same speech genre (a human rights genre), they express two different voices in this genre. One student is of the opinion that how long you have been living in a country is grounds for your right to remain, while the other girl appears to give ethnicity or culture priority or at least can understand it as reasonable. Conclusion The students' capacity to position themselves in different identities helps them in their efforts to understand the conflict that is the theme of the essay.

Theoretical and educational significance

Theoretically this study indicates the usefulness to study cultural diverse settings at school from a dialogical perspective. The educational significance of the study is the importance for teachers to realise the use that can be made of different identities as new perspectives on subjects at school.

PAPER PRESENTATION

Emerging intercultural interactions at university: Agency and identities within and across contexts

Simone Volet, Murdoch University, Australia; Farida Fozdar, Murdoch University, Australia

The paucity of intercultural interactions among students from diverse cultural backgrounds on university campuses is well documented. Recent research has revealed troubling patterns in students' attitudes towards learning and interacting in culturally diverse groups, and evidence that culturally homogeneous groups are firmly established within the first year of study, with limited change in later years. In light of tangible educational, social and economic benefits expected from intercultural learning during university study, it is argued that early establishment of systemic in-group favouritism needs to be avoided. The study reported in this paper tries to capture first year students' initial expectations and evolving experiences of intercultural interactions by exploring the mediating role of individual and situational dimensions within and across contexts of study. This research departs from prior research by focusing on positive intercultural experiences and exploring the emerging nature of interactions in situated contexts. Data consists of two questionnaires from 321 students and two interviews with a sub-sample of 34 students during their first seven months at university. Preliminary findings, analysed from a combination of cognitive-situative perspective, identity theory and multiple contexts as activity systems perspective, provide evidence of institutional and instructional influences but also stress the criticality of agency, personal identities and interdependency within and across contexts.

Introduction and Aims

The challenges of cultural diversity in higher education have been extensively researched in countries hosting large numbers of international students, most of them also having a diverse domestic student population (e.g. Harrison & Peacock, 2009; Groeppel-Klein, Germelmann, & Glaum, 2010; Levin, Van Laar & Foote, 2006; Sakurai, McCall-Wolf, & Kashima, 2010; Summers & Volet, 2008). This research has documented the societal, situational and personal variables that can inhibit the emergence and maintenance of productive interactions between students from diverse cultural backgrounds in learning and social university contexts.

What have received less attention, however, are the nature, origin and development of intercultural experiences and interactions taking place through learning activities, and which lead to positive outcomes. Adopting a positive psychology lens (Linley, Joseph, Harrington & Wood, 2006) to examine this phenomenon is viewed as imperative to identify the process by which intercultural interactions and confidence emerge and intercultural learning takes place, thus the educational conditions and practices that should be considered when designing learning activities. The study presented in this paper aimed to address this gap.

The aim of the paper is a) to present and interpret first year students' initial expectations and evolving experiences of intercultural interactions with peers, in relation to personal and contextual dimensions, and b) to examine the mediating role of individual and situational aspects on interactions that have lead to positive outcomes in the context of learning activities.

The research, framed in combined cognitive-situative (McCaslin, 2008; Volet 2001) and activity (Engestrom, 1993; Nardi, 1997) theory perspectives, targets students' expectations, metacognitive reflection and personal interpretations of actual experiences taking place in learning contexts that are conceptualised as dynamic social systems made of interdependent participants. The conceptual lens of identity theory is added with a view to capture

the significance on emerging intercultural peer interactions of multiple, endorsed, assigned and negotiated personal, social, ethnic or cultural identities (e.g. Sidanius, Levine, Sears & Van Laar, 2008).

Methodology

Consistent with the multiple theoretical grounding, a multi-method approach is adopted for the study. It combines questionnaires from a large sample of first year students (n=331) with in-depth interviews with a sub-sample (n=34). The questionnaire data (beginning and end of first semester) provides data on a range of evolving individual and perceived situational dimensions within distinct contexts of study. They include measures of intercultural disposition, motivation to mix, social goals, expectations of intercultural interactions, prior, current and anticipated experiences, as well as open-ended questions about self-identified ethnicity(ies).

The two sets of interview data (4-5 months apart) explore students' cultural, linguistic and educational backgrounds, expectations, and emerging experiences of positive intercultural interactions in learning activities and broader social contexts, alongside reflections on the importance and impact of personal ethnic and/or cultural identity(ies). Using original process-based stimulus materials (construction of personal and situational identity maps), the second interview teases out the significance of identity(ies), agency and situated opportunities and constraints in students' cognitive and affective interpretations of actual experiences of positive intercultural interactions.

Questionnaire data analysis reported in this paper includes both a variable-oriented approach (e.g. multiple analyses of variance with repeated measures, regressions) as well as a person-oriented approach (e.g. cluster analysis), in an attempt to identify patterns of individual and situational variables and their relationships, as well as entry profiles of groups of students based on selected dimensions, and the evolution over one semester at university of target variables not used in the cluster groupings.

The interview data selected for presentation is from the second interview. The process-based stimulus materials used for data collection will be presented alongside the method of analysis (still being refined).

Findings

Preliminary findings reveal interaction effects for course of study by time in students' ratings of their behaviours and (meta)cognitions related to intercultural interactions and experiences, a pattern which parallels interaction effects for course of study by time in perceptions of teacher practices that capitalize on cultural diversity – the patterns in both instances highlighting evidence of less positive cognitions and practices after one semester, with some differences across courses. These findings can partly be related to differences in perceptions of the importance of cultural understanding in the respective course of study and future profession as well as the diversity student profile of each course. The significance of self-assigned identities and bi/multi-lingualism on students' intercultural dispositions and perceptions of the importance of fostering intercultural interactions at university is also highlighted. The interview analyses suggest some ambivalence among students regarding intercultural interactions, which includes a general positivity towards the idea but at the same time some reticence to make a personal effort to take up the opportunities, even when learning activities are structured such as group work. The analyses of positive intercultural interactions, using the identity maps and an activity theory perspective, provide illustrations of 'reluctant agency' and peers interdependency, alongside the significance of personal multiple, but also assigned and negotiated identities on emerging intercultural interactions. The implications of these findings for the design of learning activities and instructional practices that foster intercultural learning as an integral part of university education are discussed.

PAPER PRESENTATION

Do All-Day Schools offer better participatory opportunities for parents with migration background?

Christine Steiner, German Youth Institute, Germany; Bettina Arnoldt, Deutsches Jugendinstitut, Germany

High and far-reaching expectations have been placed on the German all-day schools: One of them is the inclusion of the subject of migration in the schools, and the integration within the school of the children and youth with a migration background. Therefore, one step is to improve the cooperation between school and parents, especially parents with migration background or a lower social status. All-day schools are able to provide more possibilities for parental participation.

The willingness of parents to commit oneself for school interests is seen as an essential factor for improving school quality. Several studies verified a strong connection between parental participation and personality development of students. The lecture will answer the question, whether all-day schools succeed in including parents that are in general under-represented on participation. The empirical basis of the presentation is the nationwide "Study of the

Development of All-day Schools" (StEG) for which those who teach in all-day schools, as well as pupils and their parents were interviewed three times. The results show that parents with migration background participate significantly more in extra-curricular activities than parents without migration background. Moreover, the analysis shows, that the probability for parental participation increases if parental collaboration is established in the school concept. This is an important result, because in this point head masters and teachers have opportunity for action.

For a long time Germany has been a country in which school typically ended around noon. This has only begun to change in the last few years, during which time more and more schools, especially grade schools, have become all-day schools. Just between 2002 and 2006 the numbers doubled. Despite this dramatic growth, at the moment only one third of all schools offer all-day places. High and far-reaching expectations have been placed on the all-day schools: The diverse educational, free-time and care offerings that run through the day and are linked with the educational plan are meant to achieve a clear improvement in the educational quality, as well as offering the parents a chance to balance work and family. In addition, by opening the school to those in the region who have no direct connection to schools, the school can be placed in the context of the pupils' lives, and offer not only a better, but a different way to learn. This applies as well to the inclusion of the subject of migration in the schools, and the integration within the school of the children and youth with a migration background.

The goals of improving integration and reducing social inequality in educational attainment are strongly connected with all-day schools. Therefore, one step is to improve the cooperation between school and parents, especially parents with migration background or a lower social status. All-day schools are able to provide more possibilities for parental participation. Besides participating in conventional committees for parents, they can support the additional learning time, for example to foster homework, give support at lunchtime or offer extra-curricular activities.

The willingness of parents to commit oneself for school interests is seen as an essential factor for improving school quality. Several studies verified a strong connection between parental participation and personality development of students. This result can be explained by a number of reasons: parental commitment functions as an example for their children, parents get more information from school and at the same time, they have the chance to influence school decisions. However, it is known that in general it is parents with higher income and higher education, who look after their interests.

The lecture will answer the question, whether all-day schools succeed in including parents that are in general under-represented on participation, because of their wider possibilities of participation and because of their focus on (social) integration. The empirical basis of the presentation is the nationwide "Study of the Development of All-day Schools" (StEG) for which those who teach in all-day schools, as well as pupils and their parents were interviewed three times. The third survey took place in 2009 in 357 primary and secondary schools. The longitudinal approach from StEG allows to understand better how schools establish a new learning culture, because changes across time could be investigated. The study is conducted jointly by three institutes: German Institute for International Educational Research (DIPF), German Youth Institute (DJI) and Institute for School Development Research (IFS).

The question was examined by analyzing the data with regression analysis. Because of the fact, that the new possibilities of participating in all-day schools are yet not wide spread, the calculations were checked with a rare-event-regression. Firstly, the results show that also in all-day schools parents with a lower social status, lower education or migration background participate less in parental committees. Secondly, parental involvement in extra-curricular activities in general is at a low level. Thirdly, parents with migration background participate significantly more in extra-curricular activities than parents without migration background. Moreover, the analysis shows, that the probability for parental participation increases if their children are users of extra-curricular activities. Another crucial factor is that parental collaboration is established in the school concept. This is an important result, because not only individual factors influence parental participation, but school characteristics. In this point head masters and teachers have opportunity for action.

PAPER PRESENTATION

"Doing science" through multimodal interactions in the early childhood classroom

Charles Max, University of Luxembourg, Luxembourg; Chris Siry, University of Luxembourg, Luxembourg

In this paper we will share findings as evidence of the spontaneous ways children describe, explain, interconnect and reason about phenomena related to the natural, physical and chemical properties of water. Drawing from a longitudinal corpus of classroom interactions (200 h), this research is part of a larger three-year study (2008 - 2011)

conducted in five pre-school and elementary schools. The data were collected in the academic year 2009-2010 via participatory observation, video and document analysis, interviews with teachers and pupils.

The aim of this research is to explore the nature of 4 to 8 year-old children's science learning as a social phenomenon that is interactively achieved, discursively bound and contextually mediated. A particular concern in this multicultural context are the multiple resources, which young learners bring from socio-cultural, institutional and historical contexts and, which they use within interactive practices and multimodal talk-in-interaction to co-create make meaning about water phenomena.

The multi-dimensional framework of the study combines cultural-historical, sociocultural, interactional and micro-ethnographic perspectives in order to frame „doing science" as a cultural enactment in collaborative inquiry activities. The outcomes stress changes in children's knowing related to water phenomena as a mutual redistribution between individual resources as regards thinking and speaking on the one hand and external means of inquiring on the other hand (intentionally introduced or jointly created within the learning activity). This presentation provides insights in this dialectical process of scientific learning and meaning making.

Subject/ Problem

In order to shed light on the learning processes of young children as they accomplish joint activities in elementary science, this study emphasises the interactive practices of children when "doing science" around the exploration of water in early childhood classrooms with a complex multilingual background. More specifically, the present paper analyses the mutual accomplishment of the particular inquiry context through children's joint acting with material equipment and their multimodal interactions about the natural, physical and chemical properties of water.

The mutual dynamics between processes of personal scientific inquiry and collective knowledge creation (Paavola and Hakkarainen, 2005) are central to "doing science" as deployed in the present research. Specifically, we conceive science learning as an interactional achievement, one that encompasses the enactment of elementary science as culture and as a cultural accomplishment. This enactment unfolds through a dynamic, non-linear and creative combination of culturally given tools and the children's specific linguistic repertoires and discourse formats that they develop across multiple contexts.

Rationale

The rationale behind this research is to explore the nature of young children's science learning as a social phenomenon that is interactively achieved, discursively bound and contextually mediated. A further issue of this study concerns the multiple resources of young learners, which they use to make meaning about water phenomena through interactive practices and multimodal talk-in-interaction. To that end, the following questions are guiding the research work:

- How do 4 to 6 year-old children display their understanding about water phenomena?
- How does the multimodal nature of children's ways of doing, arguing, reasoning, imagining, re-presenting and talking about water phenomena allow to construct a collaborative framework for exploring the specific science phenomena?
- How does the context-sensitive organization of talk and multimodal interactions of the children shape promising opportunities for science learning in an early education class?

Multi-method framework

As we explore what young children value in science activities, we elaborate on the empirically tangible and systematically analyzed ways in which they construct science as their gradually emergent accomplishment, which - at first sight - might not be considered (relevant) 'canonical Science'. However, children's discursive practices are framed as enactments of elaborate science, demonstrating representations of science concepts but also the conditions of such science accomplishments. A specific emphasis concerns the available multimodal resources and the diversified multilingual practices brought into the situated science classroom setting.

The study is framed by a multi-dimensional approach based on a thorough combination of different research perspectives. In particular, these perspectives include cultural historical frameworks of human activity (Daniels et al., 2010), sociocultural approaches on learning as cultural enactment (Goodwin, 2007), conversational analytic perspectives on learning as an interactional achievement (Melander & Sahlström, 2009) and micro-ethnographical discourse analyses to conceptualizing "doing science" as a cultural accomplishment (e.g., Schlieben-Lange, 1983).

Within these perspectives, we acknowledge that learning science is both individual as well as collective, as participants construct science in interaction with others (Fleer & Robbins, 2003). Issues of learning, participation and change within open science workshops can be addressed from a micro-sequential approach to interaction, which we see as layering well with sociocultural approaches (Robbins 2005). Whereas the sociocultural understandings of participation

tend to deal with long-term processes occurring within specific communities, a CA approach understands participation as "a micro phenomenon, accomplished in the complex, situated moment-by-moment constitution of human sociality ... participation is in constant flux, and what is of interest to CA is the organization of this flexible phenomenon" (Sahlström 2009, p.108).

Research design/context

Drawing from a longitudinal corpus of classroom interactions (age 4-8), this excerpt is part of a larger three-year study (2008 - 2011) conducted in five pre-school and elementary schools. By working in collaboration with early childhood classroom teachers, this project systematically documents the emergence of practices through which children co-construct science as a discursive accomplishment, while simultaneously supporting teachers in implementing science activities and expanding inquiry-based approaches. Classroom interactions were audio and video recorded by children and researchers. Researchers intervened as participant observers as children investigated a variety of water-related concepts. Children acted as co-researchers and recorded prominent moments of their inquiries via handheld devices during and after the classroom sessions. The recorded core moments of the inquiry process in form of pictures, drawings, audio or video recordings mediated the subsequent teacher-initiated talk and interactions between the children as well. All the recordings (200 hours) have been organised within a searchable database using Transana, an open-source software (Woods, 2007). They serve as the main data source for the current analytic work. Key episodes are being transcribed in relation to the core research questions. The transcripts serve to analyse the dynamics of speech while children interact (1) in small groups during inquiry activities, and (2) during classroom talk, teacher initiated.

Findings / Analysis

The project has generated tangible outcomes about the multimodal and discursive ways of young children when enacting knowledge and reasoning as regards elementary science topics. In considering the ways in which children develop shared meanings, the research draws attention to a genuine feature of knowledge building through participating in emerging multimodal and multilingual discourses. In our case, multilingual children develop their multimodal frameworks (understood as enrichment or reorganization processes) while participating in spontaneous scientific discourse – featuring both specific conceptual content and scientific inquiring – through discourse competencies that are enacted during multilayered interaction.

In this presentation we will share findings as evidence of the spontaneous ways children describe, explain, interconnect and reason about phenomena related to the natural, physical and chemical characteristics of water. By tracking changes in children's knowing as a mutual redistribution between individual resources as regards thinking and speaking on the one hand and external means of inquiring on the other hand (intentionally introduced or jointly created within the learning activity) the project provided insights on the dialectical process of scientific meaning making.

PAPER PRESENTATION

Progressive reflection – fostering conceptual understanding in chemistry

Sascha Schanze, Leibniz Universität Hannover, Germany; Thomas Gruess-Niehaus, Leibniz Universität Hannover, Germany; Sarah Hundertmark, Leibniz Universität Hannover, Germany

Research results report difficulties in teaching chemical concepts like the solution concept because students often have resistant alternative conceptions of the processes, formed in everyday life experiences. It is assumed that the process of externalising concepts, reflecting on the externalizations progressively and also communicating them in a group can support the awareness of misconceptions and also to overcome them. In a study 297 13 to 15 year old students, learning chemistry in a context based curriculum, use computer based concept mapping or a monitoring worksheet method as progressive reflecting tools. Additionally the condition reflecting in pairs or alone is altered. Results show an advantage of the mapping method for students reflecting alone. No differences between the methods were found when reflecting in pairs.

Introduction

Modern chemistry curricula are learner-oriented and provide opportunities for meaningful inquiry. But they also put demands on the student because of complex and sometimes open-ended environments and on the teacher to monitor and scaffold students' individual learning progress. Land & Zembal-Saul (2003) describe tools and perspectives to progressively deepen and refine meaning as fruitful and supportive. Our research focuses on supporting students' understanding chemistry concepts, by using tools that foster students to first externalize their ideas in their own language and then to continually reflect on their understanding (progressive reflection), on their artefacts. The study compared computer-based concept mapping and a monitoring worksheet as two progressive

reflections methods. We also compare individual learning with collaborative learning settings where students discuss in pairs about their individual artefacts (peer interaction).

Theoretical background

Progressive Reflection: We understand progressive reflection comparable to Liu (2002) as a process of ongoing revision, meaning that revision takes place in an isochronous way. Students need methods or tools that foster them to make their thinking visible (Linn, 2000) and to build up a coherent knowledge structure. These self constructed external representations are partly snap-shots of their understanding or idea of the relating concept. To reflect on theses artefacts after a new learning period give the students the chance to identify inconsistencies or add new ideas. In this study we compare two methods, a monitoring worksheet method and computer-based concept mapping. Because of its absent linear structure a concept map can easily be augmented or refined; creating new or deleting incorrect propositions does not entail as many problems as correcting a text. So we assume concept mapping to be more supportive for understanding the underlying chemical concept.

Peer interaction: In order to stimulate the procedure of reassessing one's initial explanation, peer interaction can be one means that students actually recognise the reason for rethinking and reassessing their prior understanding (e.g. Havu-Nuutinen, 2005). So, we assume, that if students reflect on their concepts progressively and collaboratively, comprehension of the addressed concept can be fostered in a wider and deeper way.

Research question

- To what extend does students' understanding of a basic concept depend on the used reflection method and the social setting?

Based on the presented theoretical background, we hypothesise that

- the concept mapping method outclasses the monitoring worksheet method with regard to foster student's understanding of the respective concept.
- students reflecting collaboratively will gain a better understanding of the addressed concept than those students reflecting alone.

Methodology

Participants: 297 13 to 15 years old students (51% female, seventh grade, 10 classes, three German schools). The variable "social arrangement" was altered between the classes whereas the variable "reflection method" was altered within the classes. The participants were assigned to the four experimental groups (fig. 1) with regard to gender as well as verbal and spatial intelligence. During the teaching unit (20 lessons), the dissolution concept was developed by investigating chocolate and its ingredients whereas brewing and sweetening tea was the context of three reflection phases. In order to measure learning progress and long term effects about the content of the teaching unit, the German version of the solution concept test (SCT, Uzuntiryaki & Geban, 2005) was used (pre-, post-, and follow-up-test; 14 items). Gender, domain specific self-concept and verbal and spatial intelligence were surveyed.

see appendix

Figure 1: 2x2 design of the study

Analysis and results

The raw data as well as z-values of the SCT's overall scale are displayed in figure 2.

see appendix

Figure 2: Raw data and z-values of the SCT

Figure 2 indicates the fact, that at the beginning of the teaching unit the knowledge base of the 4 experimental groups cannot be characterised as comparable; the pair working classes showed greater previous knowledge than the single working classes (difference: $M = 1.08$, $t(244) = -3.805$, $p = .000$). As a consequence, the previous knowledge is considered as a covariate while analysing the learning progress of the 4 experimental groups. A repeated measures analysis of variance (ANOVA) shows a significant difference which can be traced back to the extreme enhancement of the single working concept mapping group ($F(2,444) = 2.171$, $p = .046$, partial $\eta^2 = .029$; weak effect, following (Cohen 1988)). Looking at the pair working groups no difference could be found between the two methods (more detailed results will be presented).

Discussion

The different learning outcomes of the single working classes can be traced back to the fact, that in a concept map the individual understanding of the respective learner becomes immediately obvious whilst a text rather is unclear and

confusing. In order to understand the content of a concept map, the students have (a) to recognise and (b) to find suitable association to every single concept and relation. If the goal is to understand a text there is a right chance to lose sight of inadequate concepts - such faulty terms and ideas are not noticed as frequently as in the case of a concept map. The findings of the peer interaction groups go along with a meta-analysis of collaborative concept mapping activities, conducted by Gao et al. (2007). One reason which is possibly essential for the effectiveness of peer interaction can be seen in different cognitive preferences of the group members. Furthermore the students might learn predominantly by discussing with their partners and not by collaboratively revising their externalizations so that no dependence of the applied method can be detected. These findings implicate extra scaffolds in the peer interaction period that foster the revision of the externalizations. For this reason, we currently analyse the video-typed conversation.

Bibliografie

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale: Erlbaum.
- Gao, H., Shen, E., Losh, S., & Turner, J. (2007). A review of studies on collaborative concept mapping: what have we learned about the technique and what is next? *Journal of Interactive Learning Research*, 18(4), 479-492.
- Havu-Nuutinen, S. (2005). Examining young children's conceptual change process in floating and sinking from a social constructivist perspective. *IJSE*, 27(3), 259-279.
- Land, S., & Zembal-Saul, C. (2003). Scaffolding reflection and articulation of scientific explanations in a data-rich, project-based learning environment: An investigation of progress portfolio. *Educational Technology Research and Development*, 51(4), 65-84.
- Linn, M. C. (2000). Designing the knowledge integration environment. *IJSE*, 22(8), 781-796.
- Liu, X. (2002). Using concept mapping for assessing and promoting relational conceptual change in science. *Science Education*, 88(3), 373-396.
- Uzuntiryaki, E., & Geban, O. (2005). Effect of conceptual change approach accompanied with concept mapping on understanding of solution concepts. *Instructional Science*, 33(4), 311-339.

PAPER PRESENTATION

Using non-integrated and/or integrated instruction to develop understanding of the nature of science

Rena Heap, The University of Auckland, New Zealand

The importance of an understanding of the nature of science (NOS) as one of the crucial educational components of scientific literacy is well argued in literature (e.g. Lederman, 2007) and is clearly reflected globally in science education documents and reform initiatives, including our New Zealand curriculum document. Young people need to see science as relevant to the identities they are building or wish to build for their future selves and they need to develop this insight against an international backdrop of global issues and concerns. Hodson (2009) argues for a curriculum aimed at far reaching social change through critical considerations of socio-scientific issues. It is of critical importance to research effective ways for pre-service teachers to develop their own understanding of NOS in order to plan to teach NOS in a transformed school science programme which engages and retains students' interest in science. This study examines the effectiveness of the use of structured reflection and generic science-content-free activities to develop understandings about the nature of science (NOS). The research participants were pre-service primary teachers (n=38) enrolled in the Graduate Diploma (Primary) University degree programme. Data was collected using open-ended questionnaires, selected items from the Views on Science-Technology-Society (VOSTS) questionnaire (Aikenhead & Ryan, 1992) and the preservice teachers' regular reflective journal writing. Analysis of the data obtained showed a considerable shift in students' NOS views and showed a relationship between these shifts and the use of the structured reflection and generic science-content-free activities.

Aim

Improving nature of science (NOS) understandings is complex and requires an approach that addresses conceptual change. Therefore, the research design for this study incorporated an explicit reflective approach and consistently provided opportunities for reflection and reflective writing. The generic science-content-free activities were strategically embedded throughout the course so that the pre-service teachers could approach them as decontextualised NOS activities (a non-integrated approach) or could relate the generic NOS activity to the science content being covered at the time, as contextualised activities, if they made those connections (an integrated approach). The research aim was to identify the existing NOS understandings and to map shifts in these understandings over the duration of a science course.

Two factors were examined in facilitating shifts in NOS understandings;

- 1) The use of structured reflection
- 2) The use of both an integrated and a non-integrated approach, utilising generic science-content-free NOS activities.

Methodology

Within this research study the researcher was both the instructor of the course and the researcher. The research was embedded in critical social science methodology as underpinning both critical social science and the educational goal of scientific literacy and NOS is the emphasis they place on transformation, emancipation and change. The research participants were students (n=38) enrolled in the Graduate Diploma (Primary) University degree programme. The design of this research study provided the opportunity for both integrated and non-integrated instruction. Data was collected using; 1) open-ended questionnaires, 2) selected items from the Views on Science-Technology-Society (VOSTS) questionnaire (Aikenhead & Ryan, 1992) and 3) the students' regular reflective journal writing. Data was analysed both qualitatively and quantitatively using a content analysis of all the sets of data collected. A NOS framework was developed to further analyse data gathered. Findings Only one small section of quantitative data, from the students' reflective journals, will be introduced in this preview. A comprehensive data analysis, both qualitative and quantitative, is presented in the final presentation and paper. All entries in the students' regular reflective journal writing were coded for the articulation of NOS tenets. Table 1 shows the quantitative results of this analysis. This table shows the number of students who expressed a NOS tenet in their reflective journal writing for that topic or NOS activity. Columns A and B are a chronological overview of the course. Column C shows the number of students who, based on activities of the topic or in the generic NOS activity, expressed at least one NOS tenet in their journal writing. Columns D-H identify which NOS tenets were explicitly articulated in the students' journals. Multiple references to the same NOS tenet by each student will only score as one since the analysis is to show how many students articulated each tenet, not how many times the tenet was expressed. The total number of comments in each topic or generic activity will usually exceed the number of students who expressed NOS tenet/s as the students may have articulated more than one tenet. The shading of the cells (columns D-H) indicates the tenets which were explicitly covered during the topic or activity. Within any of the topics covered, it would have been possible to see each of the NOS tenets, but those shaded were specifically addressed.

Significance

Quantitative data analysis shows a shift in NOS understanding. Qualitative analysis of the data shows that the students moved backwards and forwards between approaching the generic activities as stand-alone activities to deepen their NOS understanding (non-integrated) or relating the activity to the science content being covered (integrated approach). This was considered to be of critical importance in structuring a course to develop NOS understanding. The full presentation will examine this data and approach in depth, with regard to the theories of conceptual change and cognitive load. It is of critical importance to research effective ways for pre-service teachers to develop NOS understanding in order to teach NOS in a transformed school science programme which engages and retains students' interests in science. If teachers translate into classroom practice such contemporary understandings, this could be a critical factor in the development of the scientific literacy required by our students in order for them to fully realise the benefits of and participate in an increasingly scientific society. References Aikenhead, G. S., & Ryan, A. (1992). The development of a new instrument: "Views on science-technology-society" (VOSTS). *Science Education*, 76(5), 477–491. Hodson, D. (2009). Teaching and learning about science. Language, theories, methods, history, traditions and values. Rotterdam: Sense. Lederman, N. G. (2007). Nature of science: Past, present and future. In S.K. Abel & N. G. Lederman (Eds.) *Handbook of Research in Science Education*, (831-880). New Jersey: Lawrence Erlbaum Associates. Lederman, N.G., & Abd-EL-Khalick, F. (1998). Avoiding de-natured science: Activities that promote understandings of the nature of science. In W.F. McComas (Ed.), *The nature of science and science education: Rationales and strategies* (pp. 83-126). Dordrecht, The Netherlands: Kluwer Academic Publishers.

PAPER PRESENTATION

Using self-generated analogies in teaching of thermodynamics

Fredrik Jeppsson, FontD, Sweden; Jesper Haglund, Linköping University, Sweden, Sweden

Using self-generated analogies has been proposed as a method for students to learn about a new subject, by use of what they previously know. We report on a group exercise on using self-generated analogies to make sense of two thermodynamic processes, reversible adiabatic expansion and free expansion of an ideal gas, particularly regarding the entropy concept. The participants (N = 8) were physics teacher students at the fourth year of the teacher education program. In all, the students brought up 27 analogies, all of which used microscopic models, and during the group exercises a number of challenges were encountered, which provided a ground for discussions. In the present study, we show that the use of self-generated analogies is a possible way to make students assume ownership of their learning, by engagement in group work. Due to this ownership, self-generated analogies tend to be elaborated into a greater structural depth than teacher-generated analogies.

Introduction

Many concepts in thermodynamics are considered to be abstract and difficult for novices to grasp and this is particularly the case for the concept of entropy. One common approach to introduce abstract concepts in science education is to use analogies. Gentner's Structure Mapping Theory (1983) has been used extensively in science education research to account for the nature of analogical reasoning. The purpose of teaching with analogies is that the students are going to learn about a new domain by comparison with another, more familiar domain. Conclusions are made with regards to the familiar context and transferred to the taught context. However, it is not always clear that the more familiar domain is familiar to all listeners and therefore students may draw wrong conclusions. The failure to recognise structural relations in taught analogies may seem as a paradox since individuals frequently use spontaneous analogical reasoning in daily life. Blanchette and Dunbar (2000) explain this discrepancy by contrasting a reception paradigm with a production paradigm. In the reception paradigm, learners are supposed to receive an already existing analogy and interpret and use it in an intended way. This brings along two challenges: firstly, that the subjects are supposed to have in depth knowledge of the source domain, and secondly; that they have to identify the similarity of the domains. In the production paradigm, on the other hand, the learner him- or herself creates or generates analogies in order to organise what is known about a studied phenomenon. By default, the source domain and how it is linked to the target is grasped by the learner, otherwise it would not be considered as useful. In this study we regard spontaneous analogy as the use of analogy when exploring a new area spontaneously, without being cued by a teacher or researcher. Self-generated analogy is the generation of a new analogy, by request from a teacher or researcher. Aim In the present study, we aim to: Explore how the use of self-generated analogies may be used to express and develop the understanding of thermal phenomena. Describe different challenges, which were identified from group work on the generation of own analogies for two thermodynamic processes

Methodology

The participants were eight teacher students ($N = 8$), specialising in mathematics and physics teaching at upper secondary school, at the fourth year of the teacher education program at a Swedish university. The participants were given a short introduction by the researchers on the use of analogies in teaching and on two thermal processes: reversible, adiabatic expansion of an ideal gas, and; free, adiabatic expansion of an ideal gas. The participants were divided in two groups of four in each and asked to generate own analogies for the two processes. The audio records were transcribed and the coding and analysis was managed by using the MAXQDA software. We followed the approach of Blanchette and Dunbar (2000) in analysing the following dimensions of the generated analogies:

Degree of similarity · Structural depth ·

The explicitness In addition, we analysed the challenges that the groups encountered during the exercises. Findings Overall, the discussions in the two groups went on well and the teacher students came up with many analogies for the two processes, out of which 27 were analysed. In spite of the primarily macroscopic approach of a thermodynamics course the teacher students had just participated in, all analogies used microscopic models, comparing particles to for example people or angry bees. A majority of the analogies were originated by the groups themselves, but 10 of them were taken from previous teaching. Interestingly, however, the groups elaborated the new, own analogies more than the previously known analogies, as seen in Table 1 in the larger amount of concepts covered, the qualitatively deeper structural level and the considerably larger amount of statements.

As hypothesised, it was challenging for the teacher students to account for the constant entropy during reversible, adiabatic expansion, since their conception of microstates was limited to spatial configuration, ignoring the energy contribution. In addition, it was challenging to grasp the constant temperature in free, adiabatic expansion, partly by influence from known reversible processes. However, by the end of the exercise, the students had managed to come to terms with the challenges and make sense of the processes.

Educational significance

We show that the use of self-generated analogies is a possible way to make students assume ownership of their learning, by engagement in group work (Enghag, Gustafsson, & Jonsson, 2009). Specifically, self-generated analogies tend to be elaborated into a greater structural depth than teacher-generated analogies. As opposed to Blanchette and Dunbar (2000), however, we claim that this is not due to the student teachers not realising the structural relations of the teacher-generated analogies, but on the assumption that these analogies are unproblematic. Self-generated analogies, on the other hand, have to be explicitly elaborated and scrutinized in order to see where they break down. In this respect, we adhere to the view of Heywood and Parker (1997) that richness of the discussions is one of the main objectives of the exercise, rather than finding the analogy with the perfect match between the source and target domains.

As a conclusion, student-generated analogies may provide both a useful instructional tactic for encouraging students to 'talk physics' and as a research tool for identification of conceptions. A particularly promising result of the exercise was that the groups by themselves and with brief input from the researchers managed to make sense of and resolve most of the encountered challenges.

Reference

- Blanchette, I., & Dunbar, K. (2000). How analogies are generated: The roles of structural and superficial similarity. *Memory & Cognition*, 28(1), 108-124.
- Enghag, M., Gustafsson, P., & Jonsson, G. (2009). Talking physics during small-group work with content-rich problems - analysed from an ownership perspective. *International Journal of Science and Mathematics Education*, 7(3), 455-472.
- Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science*, 7, 155-170.
- Heywood, D., & Parker, J. (1997). Confronting the analogy: primary teachers exploring the usefulness in the teaching and learning of electricity. *International Journal of Science Education*, 19(8), 869-885.

PAPER PRESENTATION

Mediating disciplinary practice to understand a complex aquatic ecosystem

Cognitive Development, Computer supported Learning Environments, Science Education; Catherine Eberbach, Rutgers University, United States; Cindy Hmelo-Silver, Rutgers University, United States; Rebecca Jordan, Rutgers University, United States; Julia Svoboda, Georgia Institute of Technology, United States

This study explored how computer, teacher, and student use of questions mediated middle school student understanding of a complex aquatic ecosystem. Adopting a case study approach, we closely examined three groups of middle school students in a U.S. school as they interacted with computer tools. More specifically, we focused on questions as a critical mechanism for supporting complex observational reasoning. Our findings suggest ways in which questioning may support learning about complex systems in technology rich learning environments.

Introduction

Learning about complex systems is challenging when even experts find systems difficult to understand and predict. Understanding complex systems necessitates reasoning about multiple, interdependent levels, non-linear causality, and emergence. Yet, novices tend to focus on observable structures and simple linear relationships without perceiving systemic and dynamic patterns (e.g., Ben-Zvi Assaraf & Orion, 2010; Hmelo-Silver, et al., 2007). That is, students focus on easily perceptible structures and behaviors without associating these with their functions or micro-level structures and processes. The ability to observe scientifically meaningful patterns is critical to generating new knowledge. Much more than simply sensing phenomena, observation is a complex scientific practice that requires the coordination of disciplinary knowledge, theory, and habits of attention (Eberbach & Crowley, 2009). Computer tools can support the development of such perceptions.

This study focuses on the use of questions as a critical aspect of scientific observation and how asking questions mediates student observations and understanding of an aquatic ecosystem. Asking what, how, and why questions is a powerful heuristic of expert observational practice. Doing so filters complexity and stimulates iterative cycles of noticing recurring patterns and asking new questions (Smith & Reiser, 2005). Research suggests why and how questions are associated with deeper levels of reasoning and what questions with more superficial reasoning (e.g., Graesser & Person, 1994). However, Hmelo-Silver and Barrows (2006) found that so-called superficial what questions could serve important functions, such as focusing and orienting students towards important aspects of a task and helping them to develop appropriate problem representations.

Methods and analysis

Working from a framework in which knowledge is socially constructed (De Jong & Joolingen, 1998; Palincsar, 1998), this case study examines how teacher and peer interventions mediated middle school students' observations of an aquatic ecosystem. This research is situated in a technologically rich learning environment where instruction was organized around facilitating student understanding of structures (what), behaviors (how) and functions (why). Collaborative student groups accessed hypermedia organized around these questions and used simulation models to explore the system's macro- and micro-levels. One challenging task involved identifying what the simulation objects represented and discerning their behavior. Finally, students generated a structure-behavior-function model using the Aquarium Construction Toolkit (Goel et al., 2010).

Data sources consist of video-recordings and student-generated models. We used an iterative deductive and inductive approach in which we initially viewed the video with certain expectations but were open to unanticipated

phenomena and interactions. We examined student and teacher discourse, with a particular interest in the role of questions.

Findings

The findings demonstrate the importance of questions in mediating students' developing understanding of complex systems. But the nature of those questions was unexpected: asking "what is it" questions productively cultivated iterative observations of the same phenomena—a key practice of scientists that is difficult to motivate students to do. Asking questions about structure eventually led to noticing and documenting relations between the system's structures and behaviors. In particular, when the students or the teacher asked "what is it" questions in reference to abstract representations, it led to iterative close observation of the representation's behavior, which in turn, afforded new opportunities to notice and incorporate information from data outputs and graphs to interpret and identify the object.

Throughout, students generated field notes, discussed what the simulation's structures represented, and often hypothesized what the functions and behaviors of these structures were. For instance, when working with one computer simulation that included only abstract representations, students were able to notice and to coordinate a range of evidence to reason about the identity of each structure based upon its behaviors. However, when asked to create a model after interacting with these simulations, these ideas did not appear in the student-generated models. Instead, students used their models to document their understanding rather than as a tool for reasoning. Finally, by asking focused questions that explicitly considered timing, behavior of the representation, and relations between different phenomenon, the teacher played a key role in facilitating the development of students' observational practices.

Theoretical and educational significance

In this study, we expected that asking questions would be an important strategy for mediating productive observations and learning about complex systems. Our analysis suggested that asking simple what questions were scientifically valuable and initiated a line of inquiry that supported complex observational reasoning. We noted how asking "what is it" questions led students to iteratively observe phenomena, to purposefully notice recurring behavioral patterns, and to reason about complex and dynamic relationships across the system's macro and micro levels. We suspect that certain design features (e.g., abstract forms used in the simulations) necessitated that students closely observe their behavior in conjunction with the graphs in order to identify the structures.

Although research suggests that use of how and why questions that emphasize behavior and function are more scientifically valuable than simple what questions that emphasize identification of structural components, in this case, the use of what questions also appeared to effectively stimulate productive observations and complex reasoning. It was probably critical that the teacher balanced identification questions with more conceptual questions. Pursuing explanations about why the fish are dying seemed necessary for observing complex relationships, and finding connections between the different levels of systems. Finally, the kinds of questions used by the teacher played a key role in the kinds of questions students also asked and their ability to observe phenomena in ways that begin to distinguish scientific from everyday practice. Thus, in sum, this paper adds to our understanding of how systems understanding develops, and how instruction can support it.

PAPER PRESENTATION

Analyzing students' learning pathways to better understand processes of mental model development

Sibylle Reinfried, University of Teacher Education Central Switzerland Lucerne, Switzerland; Sebastian Tempelmann, University of Teacher Education Central Switzerland Lucerne, Switzerland

An analysis of 13-year old middle school students' learning pathways concerning their mental model development of the greenhouse effect and global warming was conducted to better understand mental model construction processes in learners and the difficulties related to them. An explanatory in-depth investigation based on the case study method was employed. An instructional sequence embedded in a pre-posttest design provided quantitative and qualitative data. The instruction used a constructivist learning environment that focused on model evolution and conceptual change and included worksheets, a model experiment, phases of co-construction and one-on-one tutoring interviews. The transcripts of the videotaped student-student and student-teacher co-constructions, students' annotated drawings, their answers to the questions in the questionnaire and the tutoring interviews served as the database. The learning and teaching processes as revealed in this database were depicted in diagrammatic representations that allowed the analysis of the interaction patterns used by the learners to build successive intermediate mental models within the model evolution process. The diagrams demonstrate that during their conceptual change process the

students used prior knowledge as well as sources of ideas based on individual experience, contributions from the learning material and from the tutor. These findings give evidence that mental model evolution can be seen as an interactionist way of learning. Because teachers play a key role in the mental model development process these results are of great importance for teacher education and their professional development.

Background

Prior research has indicated that students of all ages show little understanding of the greenhouse effect and global warming. Detailed inquiry of students' understanding of the greenhouse effect revealed specific alternative conceptions that have proven to be largely resistant to instruction (Reinfried, 2010). Many attempts that have been made to teach the complex concepts of the greenhouse effect and to change learners' pre-instructional ideas were not satisfactory (Kirkeby Hansen, 2010). Based on the principles of constructivist learning theory (e.g. Vosniadou, 2008) and conceptual change theory (e.g. Posner et al., 1992) we developed a constructivist learning environment aimed at inducing a lasting conceptual change. In a quantitative longitudinal study including 289 middle school students, this learning environment caused a relatively persistent knowledge gain in comparison to conventional instruction and proved to lead to a better understanding of the greenhouse effect (Reinfried, 2010).

To better understand (1) how students construct their knowledge and (2) what their difficulties are in understanding the complex greenhouse effect concept, we subsequently conducted a learning process study in which we explored students' learning pathways when studying our constructivist learning environment. We embedded this learning environment into an approach of mental model co-construction, which is, according to Clement & Rea-Ramirez (2008), central to understand how students construct meaning in science. This approach, called 'model evolution approach', includes student-teacher co-construction that builds on students-generated as well as teacher-generated model elements and can be described as functioning within a cycle of model generation, evaluation, and revision.

Research questions

The following research questions were addressed:

- What processes are involved in the construction of mental models concerning the greenhouse effect and global warming?
- What kind of intermediate mental models are constructed?
- What are teachers' and students' contributions to the co-construction process?

Methods

The learning pathways of fourteen students of the 7th grade (Mage = 13 years, 8 boys, 6 girls from a Swiss suburban middle school) were explored in an explanatory in-depth investigation. The case study employed an instructional sequence embedded in a pre-posttest design, providing quantitative and qualitative data. The students' knowledge and mental models of the greenhouse effect before and after the instruction were explored using a questionnaire that included 24 knowledge questions and a request to draw an annotated sketch of how they understood the greenhouse effect. During an instructional session, which took 60 minutes, two students, working in pairs, were guided through the learning process by a tutor. The students worked with worksheets and a model experiment. The instructional techniques included analogies and observations, phases of student-student and student-teacher co-construction and a one-on-one tutoring interview with each learner after the research session. The entire session was videotaped. The transcripts of the videotaped student-student and student-teacher co-constructions, students' annotated drawings, their answers to the questions in the questionnaires and the tutoring interviews served as database. Following the different steps of qualitative content analysis (Mayring, 2008), the video transcripts and students' drawings were interpreted and systematically categorized.

Results

The categorized transcripts and drawings allowed the identification of model evolution phases, discrepant events and the use of analogies, and thereby the observation of each student's model evolution process. The learning and teaching processes involved were depicted in diagrammatic representations. These convey each individual's model construction process and illustrate how a student-teacher co-construction process leads to a model that could explain why carbon dioxide is responsible for the natural greenhouse effect and why increasing carbon dioxide emissions must lead to global warming. As a result of the co-construction process, the students made progress towards scientific ideas but not by replacing or removing their pre-instructional conceptions. They did however integrate new knowledge, construct simple relationships between physical processes relevant to the greenhouse effect and successively add variables to their models, which resulted in evolved and enriched mental models compared with what they had expressed at the outset of the learning process. The diagrams of the learning process provide a view on the interaction patterns that were used to build successive intermediate models within the model evolution process. The diagrams reveal that during their conceptual change process the students used prior knowledge as well as sources

of ideas based on individual experience, contributions from the learning material and from the instructor. Based on these results and in accordance with Clement & Rea-Ramirez (2008) we state that mental model evolution is to be seen as an interactionist way of learning that is an empirically constrained, creative process requiring scaffolding students' reasoning via teacher-student co-construction.

Implications

The results of this study are of great significance for pre- and in-service teacher education. Teachers play a key role during the teacher-student co-construction process by constantly diagnosing students' ideas and encouraging the students to disconfirm, recombine, restructure or tune their ideas and to generate successive intermediate mental models. As a consequence, teaching for deep understanding involves (1) analyzing students' alternative conceptions developed both before and during instruction and (2) finding and coordinating sequences of analogies and dissonance producing events that take these alternative conceptions into account (Clement & Rea-Ramirez, 2008). If teachers learn how to make use of mental model evolution strategies, their teaching for meaningful conceptual change will be more effective.

Bibliography

- Clement, J. J. & Rea-Ramirez, M. A. (2008). Model based learning and instruction in science. Berlin: Springer.
- Kirkeby Hansen, P. J. (2010). Knowledge about the greenhouse effect and the effect of the ozone layer among Norwegian pupils finishing compulsory education in 1989, 1993, and 2005 - What now? *International Journal of Science Education*, 32(3), 397-419.
- Mayring, P. (2008). *Qualitative Inhaltsanalyse*. Weinheim: Beltz Pädagogik.
- Posner, G., Strike, K., Hewson, P., & Gertzog, W. (1982). Conceptual change and science teaching. *European Journal of Science Education*, 4(3), 231-240.
- Reinfried, S. (Ed.) (2010). *Schýlervorstellungen und geographisches Lernen*. Berlin: Logos.
- Vosniadou, S. (Ed.) (2008). *International Handbook of Research on Conceptual*. New York: Routledge.

PAPER PRESENTATION

Number sense in infancy: Individual differences in number discrimination

Annelies Ceulemans, Ghent University, Belgium; Annemie Desoete, Ghent University, Belgium; Sofie Rousseau, Catholic University of Louvain, Belgium; Cecile Guerin, Catholic University of Louvain, Belgium

Number discrimination is considered to be a basic form of number sense. Therefore, number discrimination performances in infants at age 8-11 months and 24 months are explored to detect early differentiation between children. A number discrimination task with different number sets was used. Both group and individual performances as well as the relation between the different performances were of interest.

First, infants completed a habituation task (1 versus 3, 1 versus 4, or 4 versus 8): children saw a number of dots until they were habituated after which the same and a new number were shown in alternation in the test phase. Stimuli were controlled for continuous variables (e.g., total occupied area; individual dot size) and an eye-tracker recorded the children's eye-gazes. Second, a manual search task was given at 24 months, with the same number set as in the habituation task. A researcher hid balls in a opaque box. Children were allowed to retrieve the balls, but in a second trial some balls were surreptitious taken away. Respectively, longer looking and searching at the new number indicates successful discrimination.

The group results of the first moment show that infants discriminate small numbers as well as a small from a large number, but not large numbers. Furthermore, poor performers for each set support the existence of individual differences on number discrimination performances in infancy. Data from the second moment will be available at the conference. Implications and future challenges will be outlined.

Background: Individual differences in number sense are considered to differentiate with respect to mathematical achievement. Although number sense is mostly investigated in preschoolers it is assumed to be present earlier in the form of number discrimination. Individual differences may thus occur from infancy on. Because studies on number discrimination, however, mainly focus on group results, research needs to explore individual differences. This study explored performances of children at the age of respectively 8-11 months and 24 months on number discrimination tasks. Possible number sets were drawn from previous research to cover the full range of possibilities. As such a number set with only small numbers (1 versus 3), one with a small and a large number (1 versus 4) and one with only large numbers (4 versus 8) were selected for this research. The number discrimination tasks were age-appropriate for both research moments. Group performance as well individual performances on the number discrimination tasks were of interest. Furthermore, it was questioned whether a relation exists between the performances at the different

ages. It is hypothesized that poor performers at the age of 8-11 months are still performing poor at the age of 24 months.

Method:

At the age of 8-11-month-olds infants completed one of the three number discrimination tasks according to the habituation paradigm (1 versus 3: $N = 48$; 1 versus 4: $N = 37$; 4 versus 8: $N = 51$). Children saw a number of dots until they were habituated to it. Afterwards, in the test phase they saw in alternating order the same (three trials) and a new number (three trials). This resulted in three test trial pairs including the old and a new number of dots. Longer looking at the novel number is considered to be an indication of a successful discrimination between the presented numbers of stimuli. Stimuli were controlled for continuous variables (e.g., total occupied area; individual dot size). Habit X 1.0 generated the task and an eye-tracking system, Tobii T60, recorded the children's eye-gazes. At the age of 24 months infants received the same number set as they did on the previous research moment. This time a researcher hid balls in a opaque box according to the manual search paradigm. First, children were allowed to retrieve the balls. In a second trial some balls were surreptitiously taken away. A longer searching time after these kind of trials (compared with the first trials) indicates differentiation between the two numbers. The manual search tasks was adjusted to each specific number set.

Results:

Data from the first research moment show a successful discrimination (at group level) for the number sets 1 versus 3 ($F(1,45.669) = 5.182, p = .028$) and 1 versus 4 ($F(1,36) = 1.940, p = .002$) but not for the number set 4 versus 8 ($F(1,50) = 0.107, p = 0.745$) during the habituation paradigm. These findings indicate that infants in this study can discriminate small numbers from each other as well as a small from a large number, but not large numbers. Poor performers (being the children who looked longer at the old number during all test pairs) can be identified for all sets. Data from the second research moment are currently being collected and will be available at the conference.

Conclusions: The identification of poor performers clearly supports the existence of individual differences on number discrimination performances in infancy. Since these individual differences thus occur from infancy on and number discrimination is considered as a basic form of number sense it will be interesting for future research to explore the relationship between these individual performances and later performances on components of number sense which have already been found to be predictive to further mathematical outcome. More specifically, these differences in number sense may be related to individual mathematical differences between children later on. Furthermore, the group results show the importance of exploring the whole possible number range. For each number range poor performers are identified besides non-poor performances indicating that infants do vary in their ability to discriminate each number set.

PAPER PRESENTATION

English elementary school children's beliefs about knowledge

Ruth Kershner, University of Cambridge, United Kingdom; Linda Hargreaves, University of Cambridge, United Kingdom; Sue Bingham, University of Cambridge, England, United Kingdom; Rocio Garcia, University of Barcelona, Spain

This paper presents evidence from a small-scale study of children's epistemic beliefs across the English primary (elementary) school age range (5-11 years). The study aimed to gain a better understanding of developmental change in children's personal epistemology; to pilot and refine a productive dialogic methodology; and to test the application of relevant conceptual frameworks to young children's epistemic beliefs. The premise is that effective, inclusive learning and teaching in school depends on the types of knowledge created and valued in school, home and community. The study draws on existing frameworks of personal epistemology including Schommer-Aikins's (2004) multidimensional belief system. Semi-structured interviews were conducted with groups of 3-5 children from each of seven classes (UK: Reception to Year 6). Data were recorded, analysed and coded inductively. Emerging categories were then compared to existing conceptual frameworks. Preliminary analysis suggests that the 5-11 year old children in this study do identify different forms and sources of knowledge in the school, home, community and beyond. There is evidence of age-related change between year groups. The study has theoretical significance for the extension of existing conceptual frameworks to accommodate children's references to the functions, purposes and values of knowledge, and to different ways to learn. In educational terms, it raises key points concerning the relevance of family and community contexts, and teachers' awareness of their own and their pupils' epistemic beliefs.

Aims and background

This paper presents evidence from a small-scale study of children's epistemic beliefs across the English primary (elementary) school age range (5-11 years). The study aimed to gain a better understanding of developmental change

in children's personal epistemology; to pilot and refine a productive dialogic methodology; and to test the application of relevant conceptual frameworks to young children's epistemic beliefs. The premise is that effective, inclusive learning and teaching in school depends on the types of knowledge created and valued in school, home and community. Children's sources of knowledge beyond the school may be either incorporated or dismissed in formal education, with associated implications for educational achievement. Research on personal epistemology has highlighted the educational relevance of students' beliefs about knowledge and knowing (Bendixen and Feucht, 2010). Our theoretical analysis of English children's epistemic beliefs draws on three conceptual frameworks: Schommer-Aikins's (2004) multidimensional belief system; Hofer and Pintrich's (1997) epistemological theories (noted to have potential connections to conceptual change learning); and Hammer and Elby's (2002) epistemological resources in specific subject domains and contexts.

Methodology

Exploratory research question: How far do children aged 5-11 years in an English primary school identify, describe and value different forms of knowledge in the school, home, community and beyond?

Design and procedure:

The study was carried out in one rural primary school in Eastern England. Written parental consent was gained for the children's participation, within a wider ethical framework (BERA, 2004). A group interview approach was used, drawing on a general sociocultural understanding of how knowledge and epistemic beliefs are created and incorporating elements of Bronfenbrenner's ecological systems theory.

Small groups of 3-5 children from each of seven classes (UK: Reception to Year 6) participated the following: group discussion focusing on 'what children know' in different contexts. The children's ideas were recorded collectively. Further group discussion of knowledge and knowing prompted by a semi-structured interview schedule. Individual activity in which children used a personal systems diagram to record their own ideas about their knowledge in different contexts and how important they think this knowledge is.

The data consisted of taped group discussions and the children's individual and group work (i.e. their writing and drawing). These data were first coded inductively with attention to age-related changes and individual differences within the seven year groups. Emerging categories were then compared to the three conceptual frameworks outlined above for further theoretical consideration.

Findings

Preliminary analysis suggests that the 5-11 year old children in this study do identify different forms of knowledge in the school, home, community and beyond. They express a wide range of epistemic beliefs relating to different types of human experience, domains and contexts, and affective aspects. There is evidence of age-related change between year groups, notably relating to distinctions made between stable 'facts' and more abstract or questioning beliefs about the nature of knowledge in different contexts.

With regard to the theoretical conceptualisation of personal epistemology, we found that the children's statements and conversation called up elements of each model mentioned above and, in turn, potentially extended them. For instance, Schommer-Aikins' framework can be used to map many of the children's espoused beliefs. However her specific belief dimensions of stability of knowledge, source of knowledge, speed of learning and ability to learn were more strongly represented in all the children's talk than was knowledge structure. Hofer and Pintrich's framework similarly applied in relation to the children's ideas about the certainty and the internal/external sources of knowledge, with some evidence of age-related change. Yet little was said about the dimension of simplicity of knowledge and only occasional reference was made to the justification procedures of knowledge (e.g. how knowledge is demonstrated and proved). Both of these frameworks may usefully be extended by the children's references to the functions, purposes and values of knowledge, and to different ways to learn. However further research is needed to gather systematic evidence across all these dimensions, including developmental change.

With regard to Hammer and Elby's framework, the current study was not solely or directly focused on learning specific subjects. Yet the children did offer relevant epistemological activities (such as the value of play) and forms (e.g. information versus knowledge), within their wider discussions of the nature and sources of knowledge in different contexts. Explicit epistemological stances, such as acceptance, puzzlement, and so on, were less evident, although most of the children exhibited a wondering interest in talking about knowledge and knowing in this way. Knowledge resources in different contexts were clearly evident in comparing school and home.

Conclusions

This study provides substantive findings about young children's epistemological beliefs, together with certain methodological and theoretical insights. In particular, it has theoretical significance for the further elaboration of

existing conceptual frameworks. In educational terms, it raises key points concerning the relevance of family and community contexts, and teachers' awareness of their own and their pupils' epistemic beliefs.

PAPER PRESENTATION

Application of Skill Theory to compare scientific reasoning of young children in different tasks

Heidi Meindertsma, Rijksuniversiteit Groningen, Netherlands; Marijn van Dijk, Rijksuniversiteit Groningen, Netherlands; Paul van Geert, Rijksuniversiteit Groningen, Netherlands

In order to study the development of scientific reasoning in children, it is necessary and also challenging to compare performance of children over different tasks and/or situations. In the present study, Skill Theory (Fischer, 1980) is used as a framework for comparative description of the reasoning of children during and between different scientific tasks in a guided interaction with an adult. Fifteen 4- and 5-years old children performed four different tasks (floating/sinking, linked syringes, marble track, balance scale) with four different adults. Two variables were used to record the performance of the children: the correctness of the predictions and the cognitive complexity levels of the given explanations. Results indicate that children show high variability in cognitive complexity level between tasks but also within a task. Although the older children were not significantly better in making predictions, complexity levels were higher in 5 year olds than in 4 year olds. Only in the floating/sinking task, a meaningful relationship was found between prediction and complexity level. Our results demonstrate the importance of the dynamics of the interaction between child, adult and task. Coding the explanations of the children using skill theory can be seen as a good first step in unraveling these dynamics.

Introduction:

In recent years, there has been an increased interest in science education in preschoolers. In order to study the development of scientific reasoning and the effects of science education, the researcher faces the difficult task of comparing performance of children in different tasks and situations. In the present study, Skill Theory is used as a framework of comparative description of young children's scientific reasoning in scientific tasks with an adult. Already in 1930, Piaget described the conceptions of children about physical causality and many other science related concepts. Since then, much attention has been given to the approaches and strategies children use in solving or explaining scientific tasks. For example, Siegler and Chen (1998) and later Jansen and Van der Maas (2002) focused on rule learning in children solving balance scale problems. Tytler and Peterson (2004) characterized the approaches children use in explorative situations by several dimensions, such as nature of exploration and depth of processing. However, these systems are rather specific and thus not always suitable to compare across tasks and conditions. Skill Theory (Fischer, 1980) promises to be a good general framework to classify the explanations of the children (Rappolt-Schlichtmann, Tenenbaum, Koepke, & Fischer, 2007), and thus enables comparison of the competence level of children across tasks and children (Fischer, 1980).

The complexity level is divided into three different tiers: sensory-motor, representations and abstractions (Fischer & Bidell, 2006). Each tier consists of three different levels: single, mapping and system. The highest tier, abstractions, has an additional level called principles. The highest levels will not be reached until early adulthood. As part of its dynamic approach to scientific reasoning, Skill Theory emphasizes the importance of context on the performance level. Also, the performance of children is assumed to be highly fluctuating, leading to high inter- and intra-individual variability in competence (Van Geert & Van Dijk, 2002). In the Netherlands, the educational project 'Curious minds' claims that children in the age of three to six years of age have natural talents in the Science, Technology and Mathematics (STEM)- disciplines: they ask questions, are creative, explore and want to know how something works. The project aims at describing and stimulating the talents of young children in the STEM-disciplines. The importance of context is emphasized by stating that talent can be seen as a process that emerges during real time interactions between child, task and adult, but only if the situation is sufficiently talent-eliciting, open and supportive ((Steenbeek & Uittenbogaard, 2009, p.45). In a previous study, we have argued that the task protocol (specifically, the way this is 'open' or rather 'strict') possibly influences the level of the scientific reasoning.

The present study aims at contributing to unraveling this dynamics by answering the following questions:-

How can the reasoning of children during and between different scientific tasks be characterized?

- What complexity level do 4- and 5-year old children reach in their explanations?
- o How good are the predictions made by these children? o Are there differences in age for complexity level and percentage of correct predictions?
- o How does the complexity level relate to percentage of correct predictions? - How variable is the performance of these children?
- o How variable is the performance between children?
- o How variable is the performance between tasks and conditions?

- o How variable is the performance within sessions?

Method:

Fifteen 4- and 5-years old children performed four different tasks (floating/sinking, linked syringes, marble track, balance scale) in four different conditions; varying from a very strict (test) protocol to no specific instructions (Meindertsma, Van Dijk, & Van Geert, 2010). Two variables were used to record the performance of the children: the correctness of the predictions and the complexity levels of the given explanations. All explanation will be coded as level 3 (sensimotor system). When the child explains one element of the explanatory principles of the task, this is coded as representational/single. Two or more given principles are coded as representational/mapping and a complete explanation is coded as representational/system. The third tier, abstractions, is only reached when a statement about a general rule is made.

Results:

In our study, fourteen children explained at least once at single representational level, although six of them never came higher than this level. Five of them gave an explanation at the level of representational mapping whereas three children reached the first level at the abstraction tier in the floating/sinking task in combination with the strictest protocol. Only one child never made it to the second (representational) tier. Variability was high between and within tasks. Nine children differed more than one level in maximum complexity level between tasks. Only one child reached the same maximal level in all four tasks. Also within a task there was a high fluctuation of performance. The percentage of correct predictions showed the same pattern as complexity level: there was a high variability between children as well as between and within tasks. Although the older children were not significantly better in making predictions, complexity levels were higher in 5 year olds than in 4 year olds ($t = 2.312$, $p = 0.04$). There seems to be clear differences between the conditions/tasks: most children used explanations of higher complexity in the strictest condition (the floating/sinking task) and only here a significant correlation was found between correct percentage predictions and complexity level ($r = 0.707$, $p = .003$).

Conclusion:

These results support the notion of high intra- and inter-variability as predicted by skill theory (Fischer & Bidell, 2006; Van Geert & Van Dijk, 2002). The influence of the context – adult and task – could account for this variability. Many children used explanations of different complexity level, indicating that children do not only proceed through skill levels with age, but can also show short-term progressions within a task, as Fischer and co-workers have claimed (Fischer and Bidell, 2006). Our future efforts will focus on the dynamics of this interaction. Coding the explanations of the children using Skill Theory can be seen as a good first step in unraveling these dynamics.

PAPER PRESENTATION

Different perspectives on the effectiveness of private tutoring in Germany

Karin Guill, TU Dortmund University, Germany; Wilfried Bos, TU Dortmund University, Germany

Parallel to the mainstream education system many students make use of private tutoring to improve their academic achievement. However, evidence about the effectiveness of private tutoring to do so is rare and contradictory. Effects of private tutoring seem, at least partly, to depend on the understanding of academic success. As private tutoring focuses on success in the mainstream education system, positive effects on marks are expected. Positive effects on the broader achievement tests are less likely. These hypotheses are tested in the presented analyses. The data originates from the German longitudinal study KESS ("Competencies and Attitudes of Students") at the beginning of grade 7 and at the end of grade 8. The effect of private tutoring is evaluated on multiple criteria: The majority of the parents ($N = 447$) as well as of the students ($N = 618$) states that private tutoring improved the students' mathematics achievement. In contrast, there is neither a significant improvement of maths marks of tutored compared to non-tutored students (ANOVA with repeated measures, $N = 4701$) nor an improvement in maths achievement test results due to private tutoring when controlling for prior knowledge and school level effects (HLM, $N = 4701$). Effects of private tutoring on the different criteria will be compared and related to the main activities during the tutoring lessons.

Research aim

Parallel to the mainstream education system many students make use of private tutoring. Private tutoring is defined as tutoring in academic subjects in addition to the provision by mainstream schooling (Bray, 1999). While there is growing research about the extension and use of private tutoring there are few empirical findings about the effectiveness of private tutoring to improve academic achievement. In addition, results are contradictory. In a German context, parents and students mostly state their satisfaction with the effects of private tutoring (Abele & Liebau,

1998). Results from a quasi-experimental design are indicating an improvement of marks in school due to private tutoring (Mischo & Haag, 2002). In contrast, regression analyses show that private tutoring has a small but negative effect on the results of a mathematics achievement test (Guill & Bensen, 2010). Internationally, there is evidence for positive (Ireson & Rushforth, 2005; Kulpoo, 1998) as well as for negative (Cheo & Quah, 2005) or even for contradictory effects of private tutoring within the same study (Kenny & Faunce, 2004). The aim of this paper is to clarify the mixed results from earlier studies and to answer the following research question: Does the effectiveness of private tutoring depend on the operationalization of academic success? Do effective and non-effective tutoring lessons differ regarding the main activities during the tutoring lessons? As private tutoring focuses on success in the mainstream education system, positive effects on marks are expected. Positive effects on the broader achievement tests are less likely.

Methodology

The analysed data originates from the Hamburg panel study KESS ("Competencies and Attitudes of Pupils") at the beginning of grade 7 and at the end of grade 8. Missing values are partly imputed. Students stated whether they currently were taking part in private tutoring in mathematics; 13.2 % were doing so at the end of grade 8. Parents stated whether their child had taken part in tutoring during the past two years, which additionally 11.4 % did. Students described how often they did different activities like doing homework or practicing study techniques during the tutoring lessons.

The effectiveness of private tutoring is evaluated based on four criteria:

- 1) the parents' statement about its effectiveness
- 2) the students' statement about its effectiveness
- 3) improvement of maths marks at the end of grade 8
- 4) better results of tutored compared to non-tutored students in the KESS 8 mathematics achievement test.

Findings

76.7 % of the parents agree that private tutoring improved their child's performance in mathematics, 23.3 % disagree (N = 447). Students with effective and non-effective private tutoring report no significant differences regarding the main activities during the private tutoring lessons (N = 296 to 317, t test). 80.4 % of the students agree that private tutoring improved their performance in mathematics, 19.6 % disagree (N = 618). Students with effective private tutoring report repetition of earlier lessons, preparing tests and debriefing previous tests, and checking of their homework during the private tutoring lessons significantly more often than students with non-effective private tutoring (N = 386 to 416, t test, *p). Improvement in math marks due to private tutoring are analysed by group comparisons between students with and without private tutoring. In a two-way ANOVA with repeated measures (within subject: Term 1 vs. term 2 in grade 8; between subject: tutoring vs. no tutoring) the interaction term *tutoring is not significant (p = .058) when controlling for motivational covariates as interest, self concept, and anxiety (N = 4701). 18.6 % of the tutored students improved their mark, 81.4 % did not improve their mark (N = 618). Students with effective and non-effective private tutoring report no significant differences regarding the main activities during the private tutoring lessons (N = 386 to 416, t test). When analyzing effects of private tutoring on achievement test results, controlling for prior knowledge, socioeconomic status, gender, and especially for school level characteristics is important as tutored and non-tutored students differ systematically in these characteristics and are unequally allotted between different school tracks. Therefore, hierarchical regression analysis (HLM) are used. Even then, the main effect of private tutoring is negative (N = 4701). Further analyses are in preparation.

Theoretical and educational significance

Students' and parents' satisfaction with the effects of private tutoring stands in obvious contrast to the absent effects of private tutoring on the more objective criteria marks and especially test results. There are two possible explanations: Firstly, activities such as checking the students' homework and debriefing previous tests might give the students an illusion of competence without a real improvement in situations without the tutor's assistance. Secondly, general achievement tests as well as marks might be too vague a measure to capture small improvements in achievement by private tutoring. For further analyses, more detailed information about teaching and learning processes during the tutoring lessons should be taken into account, for example by analysing teacher-student dialogues. A more detailed diagnosis of the students' achievement development is desirable. For educational practice, these findings indicate that private tutoring often not succeeds in solving school achievement problems. Parents and students opting for private tutoring should be advised to evaluate its success critical, if possible on objective criteria, instead of relying on a general impression that it seems to help.

References

- Abele, A., & Liebau, E. (1998). Nachhilfeunterricht. Eine empirische Studie an bayrischen Gymnasien [Private tutoring. An empirical study at Bavarian grammar schools]. *Die Deutsche Schule*, 90, 37-49.
- Bray, M. (1999). The shadow education system: private tutoring and its implications for planners (Vol. 61). Paris: UNESCO: International Institute for Educational Planning.
- Cheo, R., & Quah, E. (2005). Mothers, maids and tutors: an empirical evaluation of their effect on children's academic grades in Singapore. *Education Economics*, 13(3), 269-285.
- Guill, K., & Bonsen, M. (2010). Die Effektivität von Nachhilfeunterricht in Mathematik am Beginn der Sekundarstufe I [Effectiveness of private tutoring in Math at the beginning of secondary schooling]. *Unterrichtswissenschaft*, 38 (2), 117-133
- Ireson, J., & Rushforth, K. (2005). Mapping and evaluating shadow education (ESRC Research Project RES-000-23-017 - End of Award Report): Institute of Education, University of London.
- Kenny, D. T., & Faunce, G. (2004). Effects of academic coaching on elementary and secondary school students. *Journal of Educational Research*, 98, 115-126.
- Kulpoo, D. (1998). The quality of education: some policy suggestions based on a survey of schools in Mauritius. Paris: UNESCO/IIEP.
- Mischo, C., & Haag, L. (2002). Expansion and effectiveness of private tutoring. *European Journal of Psychology of Education*, 18(3), 263-273.

PAPER PRESENTATION

School Curriculum Development to Improve Students' Strategy Use: Focusing on Diagrams Use in Math

Emmanuel Manalo, Waseda University, Japan; Maiko Takahashi, The University of Tokyo, Japan; Ryuji Mine, Hitachi, Ltd., Japan; Atsushi Maki, Hitachi, Ltd., Japan; Yuri Uesaka, The University of Tokyo, Japan

Although many studies have indicated that using diagrams is a powerful strategy for problem solving, research and educational practices have revealed that students do not use this strategy spontaneously despite frequently receiving instructions with the use of diagrams in class. This lack of spontaneity means that many students do not obtain the benefits of diagrams use that have been demonstrated in previous research. There are studies that have proposed teaching methods to address this problem, but these methods are not fully integrated within the school curriculum. This paper reports on the development of an instruction and support program to promote students' spontaneous use of diagrams as part of a school curriculum. The program (2 days, 2 x 50mins in each day) was provided to first grade students of a public junior high school (n=34) in Japan as a part of math course. Teaching approaches that previous studies have found as effective in promoting spontaneous diagrams use were employed in the program. Other students in the same grade (n=72) took other equivalent instructional programs dealing with other skills. To evaluate the effect of the program, pre-tests and post-tests were conducted 3 months before and after the program respectively. The results showed that improvement in spontaneity of diagrams use was significantly higher among students in the first group compared to the other groups. This finding indicates that teaching approaches to promote spontaneity in students' strategy use, that have been developed through experimental studies, can successfully be implemented in ecologically valid contexts.

Introduction

Many previous studies have demonstrated that diagrams are powerful strategies for problem solving (e.g., Cheng, 2002; Larkin & Simon, 1987; Mayer, 2003). However, studies relating to educational practices have suggested that students do not use diagrams effectively as teachers and researchers do. One of the main problems is lack of spontaneity: many students try to solve problems in their head and do not construct diagrams spontaneously, despite the fact that they frequently receive instructions with the use of diagrams in class. Recent studies examining students' behaviors when solving math word problems (e.g., Uesaka, Manalo, & Ichikawa, 2007; Uesaka, Kiyokawa, & Ichikawa, 2010) have confirmed this tendency, suggesting that many students do not obtain the benefits of diagrams use that have been demonstrated in previous research. To address this problem, some studies have examined factors influencing, and teaching approaches for promoting, students' use of diagrams. For example, Uesaka et al. (2007) found that students tend not to use diagrams because they perceive diagrams as "tools for teachers' instruction" rather than "their own tools for problem solving". In addition, Uesaka, Manalo, and Ichikawa (2010) demonstrated that a combination of teacher explicit instruction about the efficacy of diagrams use, and practice in constructing diagrams, promoted students' spontaneous use of diagrams because these manipulations enhanced perceptions about the usefulness of diagrams as their own tools, and diagram construction skills, respectively. Uesaka and Manalo (2007, 2008) provided another perspective: that setting a learning circumstance, where students collaboratively communicate with diagrams and experience peer teaching in a small group, increases the subsequent spontaneous use of diagrams. As most of the studies described above have been undertaken in the context of psychology or diagrams research, these have had little influence on real day-to-day instructional practices in schools. However,

incorporating the effective approaches that previous studies have revealed into the school curriculum would seem desirable as that would likely result in benefits to student development of learning skills. The present study, therefore, attempted to develop a program to improve students' spontaneous use of diagrams in a school setting.

Method

The program was provided to first grade students of a public junior high school ($n=34$) in Japan as a part of math course. The program consisted of 2 days, with 2 x 50-minute lessons in each day. Other students ($n=72$) in the same grade of this school took equivalent instructional programs dealing with other skills. The authors developed the instructions provided on the basis of findings from previous studies. For example, based on the findings by Uesaka et al. (2010), teaching approaches that enhance perceptions of the efficacy of diagrams use and diagram construction skills were both included. Moreover, based on the findings of Uesaka and Manalo (2007, 2008), the classes provided ample opportunities for students to experience peer teaching with diagrams in small groups. The two days proceeded as follows. The first day focused mainly on enhancing students' views about the efficacy that results from incorporating diagrams as tools within their own personal repertoire of learning strategies. The instructor demonstrated the efficacy of diagram use in solving a math word problem. To promote deeper understanding of this efficacy, the instructor provided other problems for the students to solve with and without using diagrams. Finally, working in small groups, the students were provided three other math word problems and asked to find the most effective diagrams for solving them. Diagrams proposed within the groups were shared in the class. On the second day, the purpose was to develop diagram drawing skills as well as to continue enhancing perceptions of the efficacy of diagrams use. Horizontal bar charts were focused on as these are popularly used in Asian countries for solving algebraic problems (e.g., Koedinger & Terao, 2002) but many students find them difficult to use. Firstly, the instructor demonstrated how to draw and use horizontal bar charts when solving algebraic problems. Secondly, the students were asked to solve similar problems in small groups. Finally, the instructor provided a task, in which the students were asked to make a new math problem which can be solved with the use of a horizontal bar chart. Pre- and post-instruction assessments were administered 3 months before and after the program. In these assessments, the participants were asked to solve math word problems. As one of the main objectives of the assessments was to gauge students' spontaneity in using diagrams, the teacher did not say anything that could influence the approaches that they used in attempting to solve the problems.

Results and Discussion

The students' responses to each of the problems given during the pre- and post-instruction assessments were coded. Firstly, they were coded according to whether a "diagram was used (1)" or "no diagram was used (0)". Secondly, the quality of the diagrams the students produced were coded according to a rubric whether appropriate diagrams to use in solving each of the problems were used. To examine differences between the programs provided to the students, a covariant analysis of variance (ANCOVA) (with the numbers of problems in which diagrams were used at pre-instruction as the covariant) was carried out on the numbers of problems in which students used diagrams at post-instruction. The results showed that the improvement in spontaneous use of diagrams among the students who took the diagrams-related program was significantly higher than other students ($F(1, 104) = 3.96$, $p = 0.048$, $p = 0.002$). These findings indicate that teaching approaches which have been revealed as effective in promoting spontaneity in students' strategy use through experimental studies can successfully be implemented in ecologically valid contexts.

PAPER PRESENTATION

Effects of instructions on economics students' critical thinking

Anita Heijltjes, Avans Hogeschool, University of applied sciences, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Fred Paas, Institute of Psychology, Erasmus University Rotterdam, The Netherlands, Netherlands

Although critical thinking (CT) is considered to be a central goal in economics education, it is rarely explicitly taught and educators are often unsure how to foster CT throughout the curriculum. An experimental study will be presented investigating the impact of CT instructions on economics students' CT development. CT development was operationalized as gains in inductive and deductive reasoning skills. Participants ($N=183$) were exposed to one of four conditions: CT instruction, CT instruction combined with self-explanation prompts, CT instruction combined with activation prompts and a control condition (irrelevant instruction). Results show that participants exposed to the CT instructions gained more from the pre-test to the immediate post-test than participants in the control condition. This effect lasted on the delayed posttest with inductive reasoning skills but not with deductive reasoning skills. There were also differences between the experimental conditions: Participants in the self-explanation condition significantly outperformed participants in the CT instruction condition on inductive reasoning on the immediate test, although this effect disappeared on the delayed test. CT dispositions, especially actively open-minded thinking, correlated positively with all tests scores, and with CT development in inductive reasoning skills.

Introduction

Against the background of complex and rapidly changing business environments, economics students are expected to become critical thinkers (Chonko, 1993; Klebba & Hamilton, 2007; Smith, 2003). Critical thinking (CT) enables students to make sound logical and unbiased decisions and often leads to better learning and transfer outcomes (e.g. Facione, 2009; Halpern, 1998; Helsdingen, Van Gog, & Van Merriënboer, in press). It is therefore surprising that CT is rarely explicitly taught (Jones, 2007). The existing CT literature is predominantly descriptive and pays limited attention to the effectiveness of CT instructions (Abrami, et al., 2008; Wolcott, et al., 2002). Hence the present study aims to empirically examine the effects of CT instructions on economics students' CT.

During reasoning, two thinking systems, referred to as system 1 and system 2, can be at work (Evans, 2003; Stanovich, 2009). System 1 has a rapid, automatic nature and requires little reflection, while system 2 is slow in nature and requires the exclusion of attention to other matters. Using system 1 reasoning might result in thinking errors, unless system 2 overrules these automatic responses by explicit reasoning efforts like CT. These reasoning efforts are presumably affected by dispositions (West, Toplak, & Stanovich, 2008), and may have to be explicitly taught (Abrami, et al., 2008). The teaching method used here consists of CT instructions and subsequent application of these instructions to domain content, either with or without prompts. We hypothesized that 1) CT instruction with prompts (either self-explanation or activation prompts) would foster acquisition of CT skills compared to CT instruction without prompts, which would be better than no CT instruction at all, and that 2) participants with higher scores on dispositions (actively open-minded thinking and need for cognition) would score better on CT development than participants with lower scores on these dispositions. CT development was operationalized as pre-test to posttest learning gains on inductive reasoning skills and deductive reasoning skills.

Method

Students (N=183), from an economics department within a Dutch University of Applied Sciences, were randomly assigned to 4 conditions: control (n= 40), instruction (n=46), instruction plus self-explanation prompts (n=47), instruction plus activation prompts (n=50). CT was measured by a pre-test, an immediate post-test and a delayed post-test. All tests consisted of deductive and inductive reasoning tasks selected for their heuristic tendency (adapted from e.g. Tversky, A., & Kahneman, D.; West, et al., 2008). After the pre-test participants completed a dispositions test consisting of a Dutch translation of the Actively Open-Minded Thinking Scale (Stanovich & West, 2007) and the Need for Cognition Scale (Cacioppo, et al., 1996). Thereafter participants in the experimental conditions were exposed to a 15 minutes CT instruction, while the control group watched a short film unrelated to CT. Then all participants worked on a business case that allowed them to practise some of the instructed heuristic reasoning skills; participants in the prompting conditions were asked to self-explain how they arrived at the answer, or their memory of the instructions was activated by hints about relevant task aspects. Subsequently participants performed a post-test comparable to the pre-test. After three weeks they completed a similar delayed post-test (n=76). CT learning gains were measured by subtracting pre-tests scores on inductive and deductive reasoning skills from the immediate and delayed post-test scores.

Findings

In line with our first hypothesis, on the inductive reasoning skills, an ANOVA showed an effect for instructional interventions on learning gains in both post-tests (immediate post-test $F(3,179) = 20.52$, $p = .000$, delayed post-test $F(3,72) = 5.03$, $p = .003$). Post-hoc tests showed that participants exposed to the instruction significantly outperformed the control group on both post-tests. Moreover, participants in the 'instruction plus self-explanation prompts' condition outperformed participants in the instruction only condition on gains in inductive skills on the immediate test. This effect was extinguished on the delayed test however. On deductive skills, learning gains were also significantly higher for all instructional conditions compared to the control group on the immediate post-test ($F(3,179) = 6.81$, $p = .000$). However, this effect was not found on the delayed post-test ($F(3,72) = 1.75$, $p = .164$). Moreover, we did not find any effects of prompting on deductive reasoning skills.

In line with our second hypothesis participants with lower (+1 SD) scores on actively open-minded thinking differed significantly on learning gains on the immediate post-test ($T(84) = -.220$, $p = .031$) and the delayed post-test ($T(19) = -2.46$, $p = .024$), in favour of the higher achievers. Dispositions, especially the actively open-minded thinking scores, significantly correlated with the CT pre-test scores and post-test scores (pre-test $r = .31$, immediate post-test $r = .40$ and delayed post-test $r = .33$).

Additional analyses showed that instructed and practised skills led to significantly better results than instructed but not practised skills, in inductive and deductive reasoning on both post-tests (note that not all skills were practised on the business case).

Discussion

Although participants in all instruction conditions benefited from the CT instructions, these only had a lasting (i.e., > 3 weeks) impact on inductive skill development, not on deductive skill development. Possibly, the business case allowed for practicing inductive skills more than deductive skills. Adding self-explanation prompts to the instruction only yielded better inductive reasoning results, and only on short term. Because the prompts were given during the business case, this might also be a consequence of the case, which probably allowed more for practicing inductive rather than deductive skills. The lack of longer-term effects may be due to the short exposure to the prompts. Adding activation prompts which focused attention on task relevant factors and inhibited attention to irrelevant factors did not show additional benefits on gains compared to CT instruction only, which is rather surprising. Participants' dispositions, especially actively open-minded thinking were correlated positively with CT and gains in CT. Also brief explicit CT instructions on heuristic inductive and deductive reasoning have positive effects. Future research might unravel why effects of CT instruction differ on inductive and deductive (heuristic) reasoning tasks, to what extent additional practise might be necessary, and whether dispositions as actively open-minded thinking could be affected by instructions, especially for students scoring lower on these dispositions.

PAPER PRESENTATION

The Development of Inductive Reasoning Skills from Grade 1 to Grade 11

Gyongyver Molnar, University of Szeged, Hungary; Beno Csapo, University of Szeged, Hungary

In educational assessment growing attention has been paid to the developmental perspective of cognitive abilities, however, most of the measurements still focus on single measurement points. Inductive reasoning is such ability. In the past years, we carried out several cross sectional assessments to study the development of inductive reasoning. This paper synthesizes the results of these assessments and outlines the developmental tendencies and student level differences of inductive reasoning. Altogether, nine age groups from grade 1 to 11 were assessed by means of several inductive reasoning tests containing a large number of common anchor items that allows the transfer of all results to the same scale. Rasch-model was used for scaling the data. Large differences were found at individual and cohort level as well, while the developmental speed is relatively slow, at about one quarter standard deviation per year. The fitted logistic curves indicated a rapid change around grade 7; then the speed of development got slower. The differences at student level in the same grade are getting larger when older age-groups are considered. At the end of compulsory schooling the difference is more than threefold of what is computed at school entrance. Findings support the views that there exist differences equivalent with several years of development within the same age groups in the field of a general cognitive ability.

Theoretical framework

In new educational assessment models and projects growing attention has been paid to the assessment of cognitive skills and competencies and to the comparison of different aged students' achievement by bringing their results to a common scale (sees Lazer, Mazzeo, D. Way, S. Twing, Camara, and Sweeney, 2010). A broad age range can only be covered with different tests, containing a number of common anchor items. IRT models offer the possibility to express all test results on the same scale.

Inductive reasoning is one of the basic components of thinking (Csapo, 1997). Several studies have focused on inductive reasoning from different perspectives, with different techniques, with different contexts (Tomic, & Kingma, 1998), but usually in laboratory conditions and not in developmental perspective regarding a wider age range.

Aims

The crucial questions that arise when we look at the assessment of inductive reasoning include how students' inductive reasoning develop over time during compulsory schooling and what kind of developmental differences occur between students in the same cohort.

In this paper we

- (1) synthesize the results of the cross-sectional studies carried out on a nationally representative sample;
- (2) place the scaling into a developmental context, by expressing the achievements of the different age groups on the same scale;
- (3) express the competency level differences between students in the same cohort in developmental years.

Methodology

This paper synthesizes studies aiming at different cohorts regarding inductive reasoning. Every sample involved in these analyses is representative for the school population of Hungary. The sample for the studies was drawn from 1st and 4-to-11 grade students (age 6 to age 17). The total number of participants is about 75 000.

The instruments of the studies were pencil and paper tests that varied by grade. The different tests were connected by common anchor items. Test for first graders was developed directly for young learners; i. e. special attention was paid to the non-verbal character of the test. The tests for higher graders are comprised of letter series, number analogies, verbal analogies and number series tasks altogether. Regarding the item types, each test comprised both open-ended and multiple-choice items, altogether 109 items.

The Rasch-model was used for scaling the data and plausible values (PV) and weighted likelihood estimation (WLE) were computed to compare the achievements of the age groups and to obtain individual level point estimates. Besides the Item Response Theory, several means of Classical Test Theory were computed and logistic curve estimation was made to predict the point of inflection and the growth rate.

Educational and scientific importance

Most of the researches on inductive reasoning focused on one measurement point; however, skills and competencies can be studied from a developmental perspective as well. Therefore, we decided to develop a test battery for a broader age-range, from age 6 to 17, that is applicable in educational context. Data allows the construction of inductive reasoning competency scales for a broad age range that describes students' development during the years of compulsory schooling and indicates student level differences in the same grade.

Analysis and results

The reliability indexes (Cronbach- α) for the inductive reasoning tests are between .86 and .94. The item difficulty parameters vary from -2.30 to 3.78, while the mean person parameters are between -1.16 (sd=1.19 for grade 1) and 1.37 (sd=1.17 for grade 11). The difficulty level of the items fit most students' ability level. This item bank is appropriate and valid to measure student's inductive reasoning level from grade 1 to grade 11 in an educational context.

Across all grades, development of inductive reasoning is obvious; however, the developmental speed is relatively slow, at about one quarter standard deviation per year and changing between different grades (see Figure 1). The slowest development (.12) is noticeable from grade 9 to 10 (age 16). The fastest development (both .5) happens from grade 6 to 7 and 9 to 10; it is more than twofold of what is computed in average from school entrance to school leaving. According to the fitted logistic curves the point of inflexion is at the age of 12.9, meaning that a significant change in growing occurs in grade 7, the accelerating growing slows down in this competence field.

The differences at student level in the same grade are getting larger when older age-groups are considered, at the end of compulsory schooling there are more than threefold differences of what is computed at school entrance. Students with the highest ability level differences are 10th graders, where the average difference between the 10% of the lowest and the highest achiever is 7.74 logit. If we assume that 2.53 logit development happens within the analysed period of 10 years in average, this difference corresponds to 30 year developmental log between the highest and the lowest achievers in this age group.

There are first grade students with inductive reasoning ability level of higher achiever 11 graders and on the other way round, there are 11 graders with reasoning skill level of a lower achiever first grader. The difference between students with the lowest ability level (-5.55) and the highest ability level (6.70) in the sample is more than four times higher than the differences between the mean achievers in grade 1 and grade 11. The standard deviations regarding different age groups do not change over time.

Findings of the present paper do support the views that claim that there exist differences measurable in several years within the same age groups in the field of a general cognitive ability and the development is expressible and comparable on the same developmental scale.

References

- Csapo, B. (1997). The Development of Inductive Reasoning: Cross-sectional Assessments in an Educational Context. *International Journal of Behavioral Development*, 20(4), 609 – 626.
- Tomic, W. and Kingma, J. (1998). Accelerating Intelligence Development through Inductive Reasoning Training. *Cognition and Educational Practice*, 5. 291-305.
- Lazer, S., Mazzeo, J., D. Way, W., S. Twing, J., Camara, W., and Sweeney, K. (2010): Thoughts on Linking and Comparing Assessments of Common Core Standards. ETS. http://www.ets.org/Media/Home/pdf/14518_RTTA_WP_WEB.pdf.

PAPER PRESENTATION

Reading and reasoning about uncertain science issue: An eye-movement analysis

Fang-Ying Yang, National Taiwan Normal University, Taiwan, Province of China; Meng-Lung Lai, National Chiayi University, Taiwan, Province of China; Meng-Jung Tsai, National Taiwan University of Science & Technology, Taiwan, Province of China

The objective of the study is to explore the reading and reasoning behaviors of university students when they encounter a news report concerning the issue of earthquake prediction. We employ the eye tracking method to record subjects' visual attentions on different parts of a news report which show the components of scientific argumentation including claim, warrant, data and theory (Tulmin, 1958). By comparing the visual attentions with subsequent reasoning modes, we hope to obtain a more in-depth picture about how the online cognitive processes and text comprehensions may interfere the practice of argument skills. The study is still in progress. Currently, 14 eye-movement samples have been collected. More eye movement data and reasoning analysis will be presented in the conference. Some preliminary findings are summarized as follows. First, the data of average fixation durations show that participants distributed much of their reading time to statements regarding Data (mean=0.35s). Warrant, Backing and Rebuttal (0.27s) received less time. Statements regarding Claim (0.21s) did not gain too much attention. Second, according to Table 1, LBK students seemed to pay more attention on the data and rebuttal statements. Third, the saccade durations (i.e. total time not fixed) of LBK students were significantly higher, which suggested that LBK subjects were more likely to be disoriented when reading unfamiliar texts. Moreover, it was found that those who changed their positions after reading the news report showed significantly higher fixation durations on Data. The average fixation duration on Rebuttal was higher too.

Objective

The objective of the study is to explore the reading and reasoning behaviors of university students when they encounter a news report concerning the issue of earthquake prediction.

Background rationale

The improvement of argument skills is a central goal of science education (Duschl & Osborne, 2002). Studies investigating students' argument skills have reported that the practice of argument skills is mediated by domain-specific background knowledge and personal epistemological beliefs (e.g. Duschl & Osborne, 2002; Kuhn et al., 2008; Yang & Tsai, 2010; Zimman, 2000). According to the problem-solving paradigm, background knowledge affects the construction of the problem representation (Newell & Simon, 1972). Therefore, to study peoples' argument skills, it is necessary to disclose how they perceive the problem/issue to be argued.

As far as representing the encountered problem is concerned, it has a lot to do with individual's reading and comprehension when the problem and associated information are written in texts. As Gee (2000) pointed out, readers construct mental representations of texts in accordance with the surface structure of the text, readers' prior knowledge, and the concurrent experiences in the sociocultural context. Different problem representations will lead to different problem solving outcomes. In literature related to the reading of science texts, most studies focus on discussing text structures (e.g., Broek & Kendeou, 2008; Kendeou & Broek, 2007), the effects of psychological factors (e.g., Quian & Alvermann, 1995; Lehman et al., 2007) and associations with academic performance (e.g., Reilly & McNammar, 2007). Nevertheless, no study probed how different ways of text reading and comprehension would affect reasoning when people encounter problems or issues in newspapers, magazines or on-line resources.

Thus, in the study, an attempt is made to explore the interaction between reading and reasoning behaviors displayed by university students when they encounter an uncertain science issue in newspapers. We employ the eye tracking method to record subjects' visual attentions on different parts of a news report which show the components of scientific argumentation, including claim, warrant, data and theory (Toulmin, 1958). By comparing the visual attentions with subsequent reasoning modes, we hope to obtain a more in-depth picture about how the online cognitive processes and text comprehensions may interfere the practice of argument skills.

Methodology

Subject

Participants of the study are 25 university students who are in science related majors. About half of them in earth science major are assigned to High Background Knowledge (HBK) group because the target issue is earthquake prediction. The rest belong to the Low Background Knowledge (LBK) group.

Instrument

This study employs FaceLAB 4 eye tracking system developed by Seeing Machines Company, Australia. This apparatus is a non-intrusive and fully automated eye and head tracking instrument. The data rate is 60Hz.

Reading material

A news report concerning whether earthquakes are predictable was selected from the data base of a renowned news media in Taiwan, Chinatimes, as the reading material. The report contains two contrary viewpoints held by different expert groups. One group of experts claimed that some certain kind of fish can predict earthquakes, while the other group argued that the predication is impossible even in next 20 or even 30 years. Both groups provide data and explanations to their arguments. To facilitate reading, the whole issue is divided into 5 on-screen pages. Each page consists of no more than 230 Chinese characters. For the purpose of examining readers' attentions on different parts of text, the reading material is divided into several 'Lookzones' (i.e. areas of interest) that indicate 'Claim,' 'Data,' 'Warrant,' 'Backing,' and 'Rebuttle.' Two coders deciphered the reading material and the inter-coder agreement is over 0.9. The remained difference was solved through discussions.

Interview

To probe students' reasoning modes, participants receive interviews before and after the eye-movement investigation. They are asked to take sides between two different expert groups and provide reasons for their choice.

Data analysis

The eye-movement data are analyzed by the GazeTracker software also provided by Seeing Machines. The outputs of the GazeTracker analysis include number of fixations, total reading time, average fixation duration, saccade duration (time spent during two adjacent fixations), fixation positions and durations in a LookZone, etc. Figure 1 shows two examples of eye movement paths. In the figure, the black circles indicate fixation positions and the rectangle areas are the Lookzones.

Students' interview responses are analyzed through the content analysis. The ability of coordinating theory and evidence as well as reflective reasoning are the main coding targets.

Procedure

The study is carried out mainly by the FaceLAB system. Participants are asked to read the material displayed on the computer screen according to their own pace. The FaceLAB records concurrently eye movements during reading. Before and after reading the issue, students are interviewed to probe their thoughts about the target issue.

Result and discussion

The study is still in progress. Currently, 14 eye-movement samples have been collected. The average fixation duration for HBK was 0.27sec while LBK 0.30. The average numbers of fixation count for HBK and LBK were 139.75 and 130.5 respectively. The average fixation duration for HBK students was 0.28 second and 0.30 for LBK subjects. Some preliminary findings are summarized as follows. First, the data of average fixation durations show that participants distributed much of their reading time to statements regarding Data (mean=0.35s). Warrant, Backing and Rebuttal (0.27s) received less time. Statements regarding Claim (0.21s) did not gain too much attention. Second, according to Table 1, LBK students seemed to pay more attention on the data and rebuttal statements. Third, the saccade durations (i.e. total time not fixed) of LBK students were significantly higher, which suggested that LBK subjects were more likely to be disoriented when reading unfamiliar texts. Moreover, it was found that those who changed their positions after reading the news report showed significantly higher fixation durations on Data. The average fixation duration on Rebuttal was higher too.

Conclusion

According to the eye-movement collected at this far, university students showed different cognitive approaches to process the uncertain science information. The approaches were apparently related to their knowledge background. The study is in progress. More eye-movement data and the analysis on students' reasoning modes and will be presented in the conference.

Note: Complete references will be included in the full paper.

PAPER PRESENTATION

Taking a Reader's Perspective Improves Argumentation in Students' Writing

Kristin Schmidt, University of Freiburg, Germany; Matthias Nuckles, University of Freiburg, Germany

The aim of this study was to investigate how writing can facilitate critical thinking. Following Kuhn (1992), we defined critical thinking as "internal argumentation". As people tend to exhibit a "my-side" bias and avoid considering different points of view, we asked participants to imagine specific audiences during writing in order to distance themselves from their own point of view and to consider an alternative position. Using this instruction, we expected to help students reach a higher quality of argumentation. We asked 80 participants to write an argumentative text either to

(1) themselves, (2) pupils, (3) peers, or (4) experts and to take the perspective of their assumed readers. Thus, we varied the expertise-level of the fictional audience. Participants received detailed instructions on how to write an argumentative text. Results showed that writing for different audiences had an effect on the quality and quantity of arguments and their integration into an evidence-based final conclusion. Differences between a writer's and the imagined reader's level of knowledge facilitated the generation of different arguments. A high expertise of the imagined audience promoted the integration of different arguments and counterarguments into a final conclusion. This study showed that a rather minimal instructional aid, that is, the task of imagining a specific audience during writing, improved the quality of a written argumentation.

Theoretical background

The ability to think critically is important for an active participation in a pluralistic and rapidly changing society wherein people have to deal with conflicting information. Critical thinking involves the illumination of conflicting information with the help of argumentative support and contradiction. Thus, the essence of critical thinking is argumentation. Unfortunately, even adults rarely achieve the normative ideal of argumentation (Nussbaum & Schraw, 2007). They tend to interpret all information in a way that fits their preexisting beliefs and expectations (Nickerson, 1998), a phenomenon that is called "my-side bias". Instructions which are designed to support the generation of alternative arguments and counterarguments, for example diagrams, have a small effect on argumentation skills. These instructions rather provide memorization aids for important elements of argumentation than help to distance from preexisting beliefs. By contrast, taking a specific perspective seems to be a process that invites people to distance themselves from their existing mental models and to modify them. The exploration of a topic from another point of view may help people acknowledge previously neglected facets of an issue. Hence perspective-taking can reduce "my-side bias" and thereby improve argumentation. Accordingly, new ideas could become part of the writer's mental model. In our study, we investigated the effect of an imagined reader's level of expertise during writing and its effect on the facilitation of argumentative writing.

We hypothesized that

- (1) perspective-taking is more effective for written argumentation when the writer and the imagined reader are dissimilar because a different point of view is more likely to stimulate the construction of more varied arguments.
- (2) the greater the knowledge level of the imagined audience, the more complex the integration of arguments and counterarguments will be, since integration is an indicator for expertise. As the expertise level of the writer is stable, the expertise level of the reader is suspected to have an influence.

Methodology

Eighty preservice teachers with an average age of 23.1 years ($SD = 2.82$) were assigned to one of four conditions: writing an argumentative text either to (1) themselves, (2) pupils, (3) peers, or (4) experts. As the audience was fictional, the students had to imagine the potential readers and their attributes based on their prior knowledge and personal experiences. The task was to write about possible causes for conduct disorders. The students first received written instructions on how to write an argumentative text. They were encouraged to develop arguments and counterarguments in order to explore the issue and to develop a final conclusion. In each condition they had one hour to plan and develop their texts.

The data analysis was based on the argumentative texts. All texts were rated by two independent raters ($ICC = .92$). The expressed argumentation skills of the students were the dependent variables in the study. The number of primary claims (opinions on the main issue), arguments (claims supported with evidence) and counterarguments (arguments that refute others) and the integration of the different arguments into a final conclusion were analyzed. The final conclusion is a result of weighing different arguments. It was rated on a 5-point Likert-Scale based on Kuhn's epistemological theory (Kuhn, 1991). The lowest score indicates that alternative arguments were assimilated in an absolutist way suggesting that only one detectable, correct answer exists. The highest score indicates an evaluative stance with multiple alternative arguments judged reflectively by consideration of situational aspects.

Results

Participants were motivated to engage in the topic. All of them produced some ideas as to what aspects can cause conduct disorder. The average text length was 3686 signs ($SD = 1407$). Text length was a statistically significant predictor of the number of primary claims, $F(1, 75) = 15.85$, $p F(1, 75) = 22.18$, p

To test the first hypothesis, namely the positive effect of an imagined, dissimilar reader, on the construction of different arguments, we conducted a contrast analysis (Rosenthal & Rosnow, 1985) with number of signs as a covariate. The contrast weights of the experimental conditions were assigned as follows: self: -1; pupils: 1; peers: -1; experts 1 (with positive values indicating a higher degree of dissimilarity between writer and imagined reader). The tests proved to be statistically significant for primary claims, $F(1, 75) = 6.30$, $p F(1, 75) = 6.58$, $p F(1, 75) = 0.36$, n.s.,

partial $\eta^2 = .01$. We can conclude that perspective-taking was more effective for argumentation when writer and imagined reader were dissimilar.

To investigate the second hypothesis, the influence of the imagined reader's knowledge level on argument integration was examined. As we expected argument integration should increase with imagined reader's level of knowledge, we computed a linear trend contrast with the following contrast weights: pupils: -1; peers: 0; experts 1. The test of this contrast proved to be significant, $F(1, 76) = 4.83$, p

Conclusion

Writing to different audiences had an effect on the quality of argumentation, the essence of critical thinking. As predicted, the greater the difference between the knowledge level of the writers and their presumed readers, the greater the number of different arguments writers produced on the issue at hand. It can be speculated that taking the perspective of an imagined dissimilar reader supported the writer in "perceiving" arguments that would otherwise have been neglected when looking at the topic only from one's own point of view. The greater number of different arguments thus suggests that perspective taking counteracted the "my-side bias". The results indicated that students were able to integrate arguments and counterarguments depending on the imagined audience, although previous research found that students often fail in integration tasks. Our study showed that a small instructional add-on, the disclosure of an audience, was able to influence the performance on an argumentative writing task.

PAPER PRESENTATION

The development of students' logical operations and deductive patterns between grades 5 and 9

Tibor Vidakovich, University of Szeged, Hungary

The aims of the research were (1) to construct tests for the evaluation of logical operations and deductive patterns of students; (2) to diagnose the status of these logical structures among grade 5, 7 and 9 students; and (3) to examine the influence of the development of logical operations on the development of deductive patterns. For the assessment of the most frequent logical operations and deductive patterns of students, two parallel tests were constructed. The tests were administered to about 5,100 students. Improvements in the means of logical operations were significant between grades 5 and 7, and lower, but still significant between grades 7 and 9. The results of conjunction were the best, while those of disjunctive operations were lower. The most problematic operation is the conditional. The development of deductive patterns showed similar tendencies. Students' performances were the best in the tasks of modus ponens and modus tollens. The results of disjunctive syllogism were lower, and those of transitive syllogism were the lowest. The correlations between operational and deductive tasks were significant in most cases. For grade 5 and 7 students, higher correlation values were found in the cells of the exclusive-or and disjunction, while for grade 9 students, correlation values were higher in the cells of biconditional and conditional. The analysis of developmental processes revealed some parallel tendencies in the development of logical operations and deductive patterns. But the influence of the development of logical operations on the functioning of deductive patterns could not be unambiguously verified.

Objectives

A crucial question concerning students' deductive reasoning is how they understand logical operations and deductive patterns in textbooks and in teachers' oral explanations. Difficulties in understanding logical structures can hinder students' learning, and their academic progress, in general. The aims of our investigation were: (1) to construct tests for the evaluation of the most frequent logical operations and deductive patterns; (2) to diagnose the status of these logical structures in three groups of students (in grades 5, 7 and 9); and (3) to examine the hypothesis that the development of logical operations has a significant influence on the development of deductive patterns.

Theoretical background

Research on students' logical structures has been popular for decades, not only in psychology, but also in educational research. Since Piaget's works, operations of propositional logic have been playing an important role in the research of deductive reasoning (Inhelder and Piaget, 1958). Investigations focused primarily on conditionals (Wason and Johnson-Laird, 1972), though a small number of studies have been conducted on the development of the whole system of two-variable logical operations, as well (Johnson-Laird and Byrne, 1991). The main directions of research included the development of logical operations, typical errors when interpreting logical structures (e.g. Johnson-Laird, 2005). The relevant publications of the 2000's suggest that the interpretation of quantifiers may play an important role in syllogistic reasoning (e.g. Roberts, Newstead and Griggs, 2001). Context and content factors, prior knowledge and beliefs have significant effects on deductive reasoning (Evans and Feeney, 2004). These factors can profoundly influence the functioning of several components of deductive reasoning, e.g. that of conditionals (Dieussaert, Schaeken and d'Ydewalle, 2002) and quantifiers (Newstead and Coventry, 2000). Empirical research in this field has

concentrated on logical operations and deductive patterns. But there have been only few large-scale assessments conducted to map the development of the components of deductive reasoning (Vidákovich, 2005), although the information on developmental tendencies is important in fostering deductive reasoning.

Methods

Two parallel tests were constructed for assessing students' logical operations and deductive patterns. Each one included three subtests, one for assessing frequently used operations of propositional logic (conjunction, exclusive-or, disjunction, biconditional and conditional), and two for assessing frequently used deductive patterns of propositional and predicate logic (modus ponens, modus tollens, disjunctive syllogism, transitive syllogism). The tasks of logical operations contained a complex statement, with one of the logical operations, and four pairs of facts, representing the truth table of the operation. Students had to circle the letter of those pairs that matched the complex statement (Vidákovich, 2005). The tasks of deductive patterns contained two complex statements (premises), and the first part of a third complex statement (conclusion). Students had to finish the third statement so that the conclusion should be valid. The tests were administered to about 5,100 students; 2,100 from grade 5, 500 from grade 7 and 2,500 from grade 9. Although students were selected from volunteering schools, the sample sizes allow us to draw generalizable conclusions. The reliability parameters of the tests were fairly good for all sub-samples (Cronbach's alphas about or above 0.9). The task types in the two test versions were the same, and their results were also very similar.

Results

Improvements in the means of the logical operations were significant between grades 5 and 7 (p). The performances in the individual tasks reflected the same tendency, except for the task of conjunction. The results of this operation were relatively high (91%) already in the grade 5 sub-sample. The results of disjunctive operations were lower, especially in grade 5. In grade 9, achievements of disjunctive operations were much better. The most problematic operation was the conditional. Students' achievements in the conditional task were poor (50%, 55% and 58% for the three sub-samples). These results show that the development of this operation is slower than that of other operations. These results are concordant with the results of previous studies (Vidákovich, 2005). The development of deductive patterns seems to follow the tendencies found in the tasks of logical operations. Significant development takes place both between grades 5 and 7 (p). Students' performances in individual tasks followed similar tendencies, with significant differences. The results were the highest in the tasks of modus ponens and modus tollens (between 77% and 94%), the achievements in propositional tasks were better than those of predicate tasks (p). The correlations between operational and deductive tasks were significant (p). EDUCATIONAL RELEVANCE According to our results, the most significant development of logical operations and deductive patterns takes place before adolescence. The analysis demonstrated that there are some parallel tendencies in the development of logical operations and deductive patterns. There were significant, but not striking correlations between the development of logical operations and that of deductive patterns. In spite of these, our hypothesis, that the development of basic logical operations influences the results of deductive patterns, can not be unambiguously verified on the basis of the results.

PAPER PRESENTATION

Development in relations between time perspectives, delay of gratification and learning environment

Thea Peetsma, University of Amsterdam, Netherlands; Jaap Schuitema, University of Amsterdam, Netherlands; Ineke van der Veen, University of Amsterdam, Netherlands

After they start secondary school (at age 12 in the Netherlands), students' time perspectives on school and professional career and their self-regulated learning decrease, while their time perspectives on leisure increase. Some schools have implemented innovative learning environments to enhance motivation and learning. Possibly in schools with an innovative education concept, where learning is more related to students' experience and the relevance for themselves, the developments in time perspectives and learning are different. In this study we aimed to investigate the relations in the developments in time perspectives and delay of gratification in the first two years of secondary education. In addition, the dependence of these relationships on students' perceptions of the relevance of their learning was investigated. Also differences in academic school level, and gender were included in the analyses.

648 students participated in the study. A self-report questionnaire for time perspectives, on short and long term, academic delay of gratification, and students' perceptions of the learning environment was administered four times: at the start and after six months of the first and second school year. The results indicate that students' short term perspective on school and professional career was positively related to developments in students' delay of gratification and students' long term perspective on leisure was negatively related to delay of gratification. We also found a positive relationship between students' perceptions of the learning environment and the development of their future time perspective and delay of gratification.

Aim

Time perspectives are regarded as predictors of students' learning behaviour (e.g. Lens, 1986; Peetsma & Van der Veen, in press). Time perspectives on a school and professional career showed positive relations with their learning behaviour, as students' delay of gratification (Bembenutty & Karabenick, 1998), while future time perspectives on leisure showed negative relations.

Unfortunately, a decline in school motivation of young adolescents is a well-known phenomenon. This decline came across in various countries (Peetsma, et al, 2005). The phenomenon was a reason for some schools to implement innovative learning environments to enhance motivation and learning (Waslander, 2004). It was expected that schools where learning is more related to students' experience and the relevance for themselves, the developments in time perspectives and learning are different, but little longitudinal research is known.

In this study we aimed to investigate the relations in the developments in time perspectives and delay of gratification in the first two years of secondary education in the Netherlands (students of age 12-14). In addition, the dependence of the relationships between time perspectives and delay of gratification on students' perceptions of the learning environment was investigated. Also differences in school year, academic school level, and gender were taken into consideration. Understanding of the interrelations might be helpful preventing declines in motivation for school.

Theoretical background

The decline in motivation from the start of secondary school has been explained by a lack of 'person-environment fit', that is a poor integration of young adolescents in the school environment (Midgley et al., 1989; Roeser et al., 2000). Also developments in future time perspectives might be of influence (Peetsma, 1997; Peetsma & Van der Veen, in press). Students' time perspective on school and professional career became less important while future time perspective on leisure time did grow in importance. Future time perspective is generally described as a representation or conceptualization of a particular life domain in terms of time, characterized by "extension" and "valence" (see, e.g., Gjesme, 1996; Husman & Lens, 1999). Extension indicates the degree of remoteness of the representation in time. For students, "the time after finishing school" and "the current school year" seems to be meaningful long and short terms in time. The valence of the future time perspective indicates the value ascribed to a life domain in the future. The appreciation expressed by a person with respect to a certain life domain in the future plays an essential role in defining the concept of future time perspective as a motivational variable. Peetsma (1992) included an affective component in the concept of time perspective. She conceptualized time perspective in terms of three components (i.e., affect, cognition, and behavioural intention) aimed at a certain life domain. Cognition consists of ideas or expectations with regard to the future, and of knowledge of social realities. Affect is conceived of as an expression of feeling or general affect towards a particular life domain in the future, whereas the targeted behaviour in the future as behavioural intention.

Academic delay of gratification is regarded as an indicator of students' learning behaviour. The concept refers to students' postponement of immediately available opportunities to satisfy impulses in favor of pursuing chosen important academic rewards or goals that are temporally remote but ostensibly more valuable (Bembenutty & Karabenick, 1998).

A main characteristics of innovative learning environments proved to be the relatedness of learning to the students' worlds (Oostdam, et al, 2006). If students perceive what is being learned as relevant to their own lives, it might reduce the lack of fit between them and their schools. It seems important for teachers to help students understand the relevance of learning tasks to themselves and to relate the content to their prior knowledge. Possibly, in schools where learning is more related to students' experience and the relevance for themselves, the developments in time perspectives and learning behaviour are different.

Method

648 students in secondary education participated in the study. The students were from all academic levels of secondary education and at the start of the study the students were on average 12 years old.

A self-report questionnaire was administered four times: The first at the start of secondary education, the second half way through the first year, the third measurement at the beginning of the second year and the fourth half way through second year. All items in the questionnaire were rated on 5-point Likert scales.

Time perspectives on a school and professional career, and leisure time on short and long term were measured with four scales (24 items) of the TPQ (Peetsma, 1992). To measure the emphasis given by teachers to the relevance of what is being learned we combined three items from the TASC (Belmont, Skinner, Wellborn & Connell, 1988) with three items of a scale measuring 'connection to students' worlds' adapted from Thoonen, Slegers, Peetsma and Oort (2010). All scales showed sufficient to good reliabilities in this study.

The data were analysed using multivariate Latent Growth Curve Analyses (LGCA) with Mplus (Muthén & Muthén, 2007). The rate and level of growth of the five variables were examined and related to each other. To investigate differences in the rate and level of growth of the different variables and whether the relationships of the level of growth in the variables in the model differed between groups, a multi-group LGCA was performed with groups being students in school year 1 vs 2, traditional vs innovative schools, three academic levels of secondary education and boys vs. girls.

Results

The data of the first two measurements in the first year of secondary education have been analysed. The results indicate that students' short term perspective on school and professional career was positively related to developments in students' delay of gratification. Students' long term perspective on leisure was negatively related to delay of gratification. We also found a positive relationship between students' perceptions of the learning environment and the development of their time perspectives and delay of gratification. In the paper we include the analyses of the third and fourth measurement.

PAPER PRESENTATION

Determining Factors Influencing Attitudes Regarding Sciences : Case Study of Quebec Youth

Ghislain Samson, Université du Québec à Trois-Rivières, Canada

Youth interest and motivation regarding science and technology is both a political and academic concern. As a result, we have endeavored to examine these concerns from our students' perspectives. First, preliminary results are presented. An inquiry based on questionnaires and interviews has been conducted over a two-year span, involving various schools in Québec. Supporting Osborn, Simon and Collins (2003) and Toussaint (2004), our preliminary results seem to demonstrate that interest and motivation decrease in certain cases during the transition from elementary to high school. In other cases, interest and motivation remain high until adulthood. Secondly, we compare our results from Quebec with other countries. These comparisons will take gender differences into account. Thirdly, we provide various suggestions to encourage students at all levels to pursue science and technology (S&T). More importantly, we encourage students to continue to pursue their post-secondary schooling and training. Many Canadian and American projects suggest that interdisciplinary methods contribute to heightening motivation and interest regarding science and technology for both students and teachers.

Problem –

The science and technology (S&T) courses in high schools aim to develop a basic techno-scientific culture in all students. This is not the reality. Many inquiries and reports, such as PISA (2007), expose various difficulties regarding S&T learning among students. In Canada, the view on scientific culture is based upon four main principles. The fourth one specifically addresses attitudes. In response to this lack of student interest regarding science (Versailles, 2003), it seems that this motivation decreases as the students progress in school (Osborne, Simon et Collins, 2003; Toussaint, 2004).

In a knowledge-based economy where science and technology are being implemented in schools, students' attitudes regarding techno-scientific disciplines becomes an important question throughout their schooling.

Aims/Objectives -

This study's general objective aims to better understand the determining factors, particularly the attitudes (concept considered vague and complex in the literature) that encourage or discourage our youth in choosing S&T pathways. Specifically, two goals are pursued: 1) Document, based on a literature review, the concept of attitudes in science with students, from elementary school to college; 2) Determine, using validated tools, the representations, interests and attitudes of students towards science.

Methodology –

The participants are from schools in the Mauricie and Centre-du-Québec (Canada) area. (Two schools P, two schools S, and two schools C). These establishments were chosen based on their proximity and/or previous relations in other current projects. Using computerized research instruments such as databases, we did a literature review pertaining to the attitude concept, particularly in the context related to science and technology courses from elementary school onward (Obj.1). Also, we established a description of the interests and attitudes of Québec students enrolled in schools in these two regions (Obj.2).

Data collection –

In an exploratory descriptive study (Van der Maren, 1995), we used two methods to collect our data: 1) questionnaires (Thibert, 1980; Menis, 1989; Karsenti, 1998; Toussaint, 2004); and 2) focus groups. The questionnaires had open-ended and multiple-choice questions allowing us to collect information on different aspects: P, S and C were used to evaluate students' representations, interests and attitudes (Toussaint, 2004) regarding science and technology. At least 150 students participated. To better describe and understand the factors influencing the students' attitudes towards techno-sciences and to complement the data retrieved in the questionnaires, group interviews were conducted. Based on previous work on focus groups (Greenbaum, 2000; Krueger and Casey, 2000), interviews with three groups were scheduled to explore in greater detail aspects of the questionnaires. Each group included six to ten participants (one in elementary school, one in high school and one in college - Obj.2). The questions comprised in the focus group protocol are based on the results from the questionnaire. All discussions were taped and transcribed for analysis.

Data analyses –

Data from the multiple-choice questions was quantitatively analyzed (descriptive statistics, correlations and factor analysis). Data from the open-ended questions, from questionnaires and focus groups, was analyzed, using both quantitative and qualitative techniques (Larose et Lenoir, 1995; Scelles, 1997), as well as content analysis methods (Bardin, 2001; Paillé et Mucchielli, 2003). Students' attitudes towards science and technology in school as well as in their daily lives, including career orientation, were particularly considered during the analyses.

Results –

The repercussions of this study are of different natures. First, an update of the research related to attitudes directly associated with the interest towards science and are indirectly associated with the techno-scientific culture. This study also allows us to better understand how students perceive techno-sciences, and how it is perceived with regards to their future schooling or even career in science. Our preliminary results regarding self-efficacy, proactive learning strategies, scientific learning values, goals related to school performance and academic achievement as well as a stimulating environment for learning, confirm these results, such as those of Osborne, Simon et Collins (2003) and Toussaint (2004). Some, however, are more nuanced. Finally, among the other repercussions of this project, the instruments used (questionnaires and focus-group protocols) can be reused in other projects.

Discussion and Conclusion- In the United States, the GREEN (Global Rivers Environmental Education Networks) project contributes to integrated problem solving in real and current situations. Therefore, some authors, such as Stapp (2000), consider interdisciplinarity as a motivational source since it increases student interest as well as teacher interest. Also, interdisciplinarity helps create links and reinforces relevance in learning. What if schools could contribute in making S&T learning more relevant in a dynamic and realistic context where students would be proactive?

Principals References

Conseil de la science et de la technologie (2004). La culture scientifique et technique une interface entre les sciences, la technologique et la société. Rapport de conjoncture, Gouvernement du Québec, Sainte-Foy.

Charland, P. (2003). L'éducation relative à l'environnement et l'enseignement des sciences : d'une problématique théorique et pratique dans une perspective québécoise. *Vertigo-La revue en sciences de l'environnement*. Vol 4, no. 2, septembre (1-7)

Osborne, J., Simon, S. et Collins, S. (2003) Attitudes towards science: a review of the literature and its implications. *International Journal of Sciences Education*, Vol. 25, No 9, 1049-1079.

Stapp, W. B. (2000). Watershed Education for Sustainable Development. *Journal of Science Education and Technology*, Vol. 9(3), 183 p..

Toussaint, R.M.J. (2004). (dir.) Représentations d'élèves envers la Science et la Technologie. La relève scientifique en Mauricie Centre-du-Québec, Rapport de recherche.

PAPER PRESENTATION

To Keep the Golden Mean - Curvilinear Relationship between Interest and Physics Performance

Konstanze Jenderek, Goethe-University Frankfurt, Germany; Regina Vollmeyer, Goethe-Universität, Germany;
Anita Puttmann, Goethe-University Frankfurt, Germany

Deci and Ryan (2000) suggested the more topic-related input given by an instruction the more interest will be evoked. So we hypothesize firstly that an instructional manipulation would have an influence on interest. Furthermore researchers (e.g., Denissen, Zarrett, & Eccles, 2007; Tobias, 1994) have repeatedly tested a linear relationship

between performance and interest. However, Heckhausen (1989) presumed a curvilinear relationship between motivation and performance. So we hypothesize secondly a quadratic relationship between interest and performance. In our school experiment (N=94) we created three groups by inducing low, middle and high interest, by giving three different instructions and presenting different numbers of pictures with text. As a manipulation check we used the FAM-interest scale (Rheinberg, Vollmeyer, & Burns, 2001). Students studied a learning programme on torque lasting thirty minutes. Performance was measured through a knowledge test. The manipulation was not effective. Univariate variance analysis indicated that the manipulation did not affect interest, $F(2, 92) = .99$; $p = .38$. Though, interest impacted performance as we will show by discussing the second hypothesis. Results of a curve regression confirmed the quadratic relationship between interest and performance. First, we regressed performance on interest in a quadratic model explaining 11% of the variance ($p = .0030$). Second, we regressed performance on interest in a linear model not explaining significantly amounts of variance ($R^2 = .02$, $p = .23$). We found a reverse U-shaped relationship between interest and performance ($b = -1.32$, $p = .0030$), middle interest predicts highest performance, low and high interest predict lower performance. Further results and implications will be discussed.

Deci and Ryan (2000) suggested the more topic-related input is given by an instruction the more interest will be evoked. Therefore we expected in our first hypothesis that presenting more relevant information would have an influence on induced interest as well as on performance. Furthermore, researchers (e.g., Denissen, Zarrett, & Eccles, 2007; Randler, & Bogner, 2007; Schiefele, & Schreyer, 1994; Tobias, 1994) have repeatedly expected and found a linear relationship between learning performance and interest. However, Heckhausen (1989) presumed there could be a curvilinear relationship between motivation and performance. And therefore we predicted that working on a computer learning task in the context of three different levels of interest-inducing instructions would lead to a quadratic relationship between interest and learning performance, taking into account that interest is conceptualized as a component of motivation.

In our second hypothesis we expected a curvilinear relationship between interest and learning performance. We conducted an experiment comprising N=94 students from six classes of the 10th high school level. First, we created three experimental groups inducing (1) high, (2) middle and (3) low interest levels. We manipulated interest by presenting three different sets of instructions and showing different number of coloured, topic relevant pictures (zero versus four versus eighteen pictures) as well as topic relevant text. To test manipulation we used the FAM-interest scale (Rheinberg, Vollmeyer, & Burns, 2001). Other variables like previous knowledge, age and gender were controlled. In the main part of the experiment students studied a computer based learning programme on torque that lasted thirty minutes. Performance was measured using a knowledge test afterwards. First of all we checked whether the manipulation was effective. However, it did not work as it neither affected the FAM-interest, $F(2, 92) = .99$; $p = .38$, nor performance in the knowledge test, $F(2, 92) = .53$; $p = .59$. Only descriptive data supported weakly the expectations regarding the manipulation. As expected students receiving high level interest instruction showed greater interest ($M = 3.14$, $SD = 1.00$) than students under middle ($M = 3.01$, $SD = 1.27$) as well as under low ($M = 2.75$, $SD = 1.11$) interest instruction. To test the second hypothesis we employed curve regression analysis, which then was confirmed. First, we regressed physics performance on interest in a quadratic model, which explained 11% of the variance, $F(2, 92) = 5.41$, $p = .0030$. Second, we regressed the physics performance on interest in a linear model, which did not significantly explain enough of the variance ($R^2 = .02$, $F(1, 93) = 1.45$, $p = .23$). Furthermore the negative beta coefficient revealed that the relationship between interest and performance is reverse U-shaped ($b = -1.32$, $p = .0030$). We learned through this that average interest correlated highest to the physics performance, while low and high interest correlated with lower physics performance.

The results of this study are considered to be important for science as well as practically. Our first hypothesis has to be rejected. There was no support for Deci and Ryan's (2000) suggestion to manipulate interest through number of relevant information. Nevertheless, results confirmed the second hypothesis. Our findings question the traditional view of the relationship between interest and performance which is commonly thought to be linear. This research hopes, therefore, to provide an alternative perspective.

Future research should continue examining this curvilinear relationship e.g., to replicate this quadratic model on the one hand or to reject it on the other hand. Furthermore, the results have implications for education taking into account the effects of written instructions as they obviously have an impact on students' interest. By understanding the factors that may lead to an improved or poor student performance, teachers could improve their results by keeping to the golden mean. This means teachers could improve students' learning ability by not under or over motivating them. Nevertheless, the reasons why high interest leads to poorer performance than average interest remain unanswered. As yet, we do not understand what happens cognitively to cause this decline in performance when interest is high. Further results and implications will be discussed.

PAPER PRESENTATION

A quantitative and qualitative perspective for characterize the attitudes of primary school students

Orit Ben Zvi -Assaraf, Ben Gurion University of the Negev, Israel, Israel; Chagit Tishler, Ben Gurion University of the Negev, Israel; Shoshana Agranovich, Ben-Gurion University of the Negev, Beer Sheva, Israel., Israel

This study examines attitudes to school science classes amongst primary school children. Data was collected through a combination of quantitative and qualitative research tools, joined together to form a picture that draws on the benefits of both. 1298 primary school students in grades 4-6 were given a Likert-type questionnaire and asked to provide verbal explanations for their agreement/disagreement with each item. The items were divided into three "clusters," representing three central influences on student attitudes: "motivational factors", "locus of control" and "relevance". Our results revealed such things as the extent to which students value class discussion as a motivation to learn science, the importance of self-efficacy in determining how students' perceive their mastery of the material, and the role curiosity and a feeling that the material is relevant plays in students' willingness to learn it.

Theoretical Background

Science today is an integral part of the Western world and its culture. Unfortunately, the rising importance of science in students' lives is not necessarily reflected in their awareness of it, or in their desire to learn. To date, only a relatively small body of work has been devoted to assessing these attitudes amongst students still in primary school. However, as early as three decades ago researchers showed that age 8-13 is a crucial period in the development of attitudes towards science. Further research showed that a positive attitude to learning science has extensive ramifications for motivation to learn science. Attitudes towards learning science developed in primary school, it seems, influence the choices and decisions made by students later in their life.

Research Goals and Questions

This study aims to characterize the attitudes of primary school students towards learning science. The study offers a new perspective of the attitudes of elementary school students, combining quantitative and qualitative research tools to form a picture that draws on the benefits of both. We ask the following about students' attitudes towards science: Which motivational factors influence them?

2. How does locus of control impact them?
3. How do students assess the relevance of their science studies?

Population

1298 primary school students in grades 4-6, from twenty primary schools throughout Israel, representing different lifestyles (town, village, agricultural).

Research Tools

A questionnaire beginning with 12 Likert-type items, with the answers to each item also being explained in free writing. The second part included 8 semi-structured items relating to the same topics, designed to obtain additional data written by the children themselves. On the one hand, the qualitative tools provide in-depth data about the personal perceptions of every individual student. On the other, the size of the population and the data produced by the questionnaires provide a large sample that more accurately indicates which characteristics are more important to the population, and which explanations of their attitudes recur most frequently.

Results

The results are divided into three "clusters," corresponding to the three factors addressed in the research questions.

1. Motivational factors.

Data for this cluster was drawn from the following items in the questionnaire:

- 1* I enjoy science classes because we have interesting discussions about science-related topics.
- 2* I enjoy science classes because the teacher and students do experiments
- 3* I'm not really interested in the science we learn in class
- 4* I do not enjoy science classes, because I don't like class discussions
- 5* Science topics we learn in class are usually very interesting to me

Results showed that most students see class discussion as interesting (49.8% agreed with statement 1). The most common explanation for this was "because it is a funner way to study science." Nevertheless, it is noteworthy that only 5.5% of the students cited discussion as the source of interest in class, and only 9.6% see it as a good and efficient way of conducting a science class. The most common model arising from students' explanations is reading in the textbook combined with teacher's explanations (reported by 37.8%), and discussion of scientific topics conducted by the teacher (39.3%). Interest in the study topics is a key part of students' motivation to learn science, as shown by statement 3 (55.8% disagreement). This is also supported by such explanations as "this year we learned many interesting things."

2. Locus of control

Locus of control is considered a significant factor in creating a meaningful learning process. It was addressed in items 6 through 9:

6* If I don't understand a science concept, I'll turn to the teacher for an explanation

7* I feel that I have a good command and understanding of the science topics we learn

8* I take an active part in science classes and answer the teacher's questions orally

9* I take part in class discussions and express my opinion

52.7% of the students agreed with item 7; 40.8% agreed with item 8; 52.6% agreed with item 9. Explanations suggest that the main motive defining students' mastery of the subject is self-efficacy: "I know and I understand, I've got excellent perception!", "I feel that I know it well". Explanations for item 9 showed self-efficacy as a crucial factor in students' decision to take part in class discussions: "I know I've got a lot to contribute to the discussion and that's why I always answer and speak out", "I'm not a big shot in science..." Another factor addressed in explanations is their method of studying: "I listen in class and learn," "yes, because I study at home."

Aside from self-efficacy, the teacher is portrayed as a significant figure in the learning process (79.8% agreement with item 6). Explanations show that students perceive the teacher as a source of knowledge and authority: "yes, because he knows how to help with difficulties!" "yes, because she understands it best and can help me," "because when the teacher explains, I understand the material."

3. Relevance

This cluster was addressed by questionnaire items 10 through 12:

10* Science topics that I learn in school are important because they help me understand different phenomena in the world around me.

11* During science classes we deal with topics from everyday life.

12* Science topics we learn in class are not related to real life.

Studies have shown that primary school children find the materials learned in science more relevant than older students do. Our population found them highly relevant (77.4% agreement with item 10; 46.7% with item 11). Explanations show the importance of science as a central component in the students' interest: "it's fun to learn important things." Another recurring factor in their explanations was curiosity, "science lessons help me understand phenomena that I've wanted to understand for a long time."

The results emphasize the teachers' role in encouraging and accepting student autonomy and create a comfortable atmosphere for student expression, within a community of learners engaged in activity, dialogue, and joint thinking of topics relevant to them.

PAPER PRESENTATION

Subjective Theories of Students becoming Teachers about their Professional Identity.

Cindy Grzanna, TU Dresden, Germany

Against the background of partially dramatic and of continuous transformation of teaching in the last two decades and against the background of facing ongoing developments in society it seems to be essential to know more about the states of teachers' identities and its causes and effects to improve professional development of students becoming teachers.

Researching teachers' professional identity is problematic concerning definition of the construct of identity, and time frame, problems and influences of professional identity development. In the course of working life professional identity can change repeatedly and sometimes dramatically. The development of professional identity already starts with studies at university, and not at first with the occupation as a teacher. To solve the problems of research a detailed analysis is needed guided by following questions:

1. Which detailed state of professional identity exists after studies at university?
2. Which factors mainly influence the development of students' professional identity?
3. Which intentions of professional acting exist due to the developed professional identity?

Research partners were 14 VET-teacher students at the stage of the very end of their university study that also had passed an internship at school. Students' identity characteristics were identified according to the multi-layered model of identity regulation by Hauper (1995). Multi-relational semantic networks of students' professional identity were reconstructed by a so-called structure laying technique. The individual networks were analyzed with regard to the characteristics of the identity, and its causes and effects by a categorical and a structural content analysis. Based on

the identified intentions of professional acting existing due to the developed professional identity longitudinal studies with students becoming teachers on different stages can help to improve professional development.

Background and Research Questions:

Researching teachers' professional identity is problematic concerning definition of construct of identity, and time frame, problems and influences of professional identity development. In the course of working life professional identity can change repeatedly and sometimes dramatically. The development of professional identity already starts with studies at university, and not at first with the occupation as a teacher. To solve the problems of research a detailed analysis is needed guided by following questions:

1. Which detailed state of professional identity exists after studies at university?
2. Which factors mainly influence the development of students' professional identity?
3. Which intentions of professional acting exist due to the developed professional identity?

Theoretical Background

According to Haupers' (1995) model of identity regulation, identity is a multi-layered construct. In the narrower sense, identity is composed of three components: self, self-esteem and locus of control. The characteristics of these components result from the processing of several singular experiences which need to be individually meaningful, and affecting. These experiences are integrated, and thus form a professional identity which is valid across several situations, and thus is called over-situational identity. Both, singular experiences and over-situational identity function as motivational source for professional behaviour, professional acting and professional experience. Consequently, identity leads to professional behaviour and/or acting and/or experiencing. This, in turn, is a prerequisite and starting point for the prospective perceptions of individually meaningful and affecting experiences.

Design and Methodology

Research partners were 14 VET-teacher students at the stage of the very end of their university study that also had passed an internship at school. Students' identity characteristics were identified according to the multi-layered model of identity regulation by Hauper (1995).

Data were gathered by interviewing the research partners. The main ideas of each interview were reconstructed as a multi-relational semantic network, composed of concepts and named relations between the concepts. For that purpose, a so-called structure laying technique was used. The resulting networks were validated in the course of a dialogue between interviewer and research partner aiming at coming to a common understanding and to a consensus about the adequacy of the semantic network. The initial network reconstruction was modified partly in this process of validation.

Data analysis followed an idiographic approach. On the ideographic level the individual networks were analyzed with regard to the characteristics of the identity and its causes and effects. Therefore, both a categorical and a structural content analysis were conducted in order to make the individual networks comparable among each other with regard to their content and structure.

Results

As result of the content analyses the identity characteristics of the 14 students were identified. Due to the developed professional identity the intentions of professional acting were differentiated. This mountain of data is not part of this paper.

Beside the three components of over-situational identities (self, self-esteem and locus of control) the situational identities by self-perceptions, self-evaluations and facets of personal control of the practical experiences were analysed. Thus, it is proved that internships in schools are most meaningful and affecting for students' professional identity. Thus, the practical experiences in internships in schools are the factor that mainly influences the development of students' professional identity.

In particular the facets of personal control experienced in internships in school are surprising. Personal control is divided into attribution, anticipation, and influence of situational experiences in a retrospective view (Hauper, 1995). In this study situational experiences in internships in school were divided into sitting in on classes/observations, preparing lectures, and teaching. Concerning preparation of lectures, and teaching, the students see themselves mainly able to attribute, anticipate, and influence their situational experiences. Also attribution and influence of sitting in on classes/observations is mainly seen as possible by the students. So students seem to be well prepared to a great extend for their internship by university studies or other practical experiences.

Only the anticipation of sitting in on classes/observations is dispersing among the interviewed students. The anticipation of sitting in on classes/observations is dispersing from no anticipation over a partially anticipation to a fully anticipation. On the one hand students for instance are barely able to anticipate teachers' methods, and differences between pupils because of lacking experiences at their stage of becoming teachers. And on the other hand they i.e. see themselves able to anticipate differences between teachers observed in sitting in on classes/observations because these meet their expectations. So anticipation of sitting in on classes/observations depends on students' expectations.

Consequently in order to prepare future students to their internship in school they need to be informed about conditions that are likely to be expected. A handbook of diagnosed likely conditions supports students besides helping hands in terms of teacher mentors and school principals.

Conclusion and Relevance

Researching teachers' professional identity development at the stage of the university studies allow to draw first conclusions of causes and effects of teachers' professional development. Identified intentions of professional acting existing due to the developed professional identity of teacher students are an important starting point for longitudinal studies in this research field. Thus, identity characteristics, its causes and effects can be analyzed for trainee teachers in a lectureship at VET-schools and VET-teachers with different years of practical experiences to improve professional development.

The results allowing to draw conclusions how students becoming teachers at the stage of finished university studies are aware of and ready to cope with continuously changing working life. Based on the longitudinal study, it is possible to trace changes or routines in identity over time and find out whether changes in identity occur and thus whether professional flexibility is likely. Consequently, it will be possible to very precisely determine links for teacher training at universities and during continuous education and by that sustainable improve professional development.

References

Haußer, K. (1995). Identitätspsychologie. Berlin: Springer.

PAPER PRESENTATION

Investigating Knowledge Convergence in Computer-Supported Collaborative Learning with Video Cases

Jan Zottmann, University of Munich, Germany; Karsten Stegmann, University of Landau, Germany; Christof Wecker, University of Munich, Germany; Frank Fischer, Universität München, Germany; Freydis Vogel, Munich, Germany

Collaborative case-based learning is ascribed high potential with respect to the education of pre-service teachers as well as the further education of more experienced in-service teachers. Knowledge convergence is considered an important outcome of collaboration when homogeneous benefits are desired for all learners.

An empirical field study with 29 pre-service teachers and 25 in-service teachers was conducted to examine the following research questions:

(RQ1) To what extent does teaching experience affect learning processes regarding knowledge convergence in computer-supported collaborative case-based learning?

(RQ2) To what extent does teaching experience affect learning outcomes regarding the acquisition and application of conceptual knowledge as well as knowledge convergence in computer-supported collaborative learning?

(RQ3) To what extent are knowledge convergence and knowledge acquisition related? This study was implemented in the context of a 4-day teacher training that included individual and collaborative phases of case-based learning.

A new approach to measuring knowledge convergence was introduced using the positions of annotations (i.e., little flags placed on the time bar of the video) made by learners during their case analyses of the cases. Results show that teaching experience had indeed a strong influence on processes and outcomes of case-based learning: particularly the pre-service teachers benefitted from the training. In-service teachers should eventually be supported with instructions that help them to apply conceptual knowledge to cases.

Zottmann, J. M., Goeze, A., Frank, C., Zentner, U., Fischer, F., & Schrader, J. (in press).

PAPER PRESENTATION

Fostering the analytical competency of pre-service teachers in a computer-supported case-based learning environment - a matter of perspective?

Alison Kearney, Massey University, New Zealand

Many countries around the world are pursuing inclusive education systems at all levels, including the early childhood, school and tertiary sectors. This paper focuses on the school sector, and explores the proposition that a major barrier to inclusive education is a lack of teacher knowledge and understanding. It draws on data from recent studies to show that lack of attention to teacher learning in the area of inclusive education contributes to the exclusion of students from minority groups' experience – exclusion both from and within schools. Recommendations for teacher learning, both pre-service and in-service are explored.

Many countries around the world are pursuing inclusive education systems at all levels, including the early childhood, school and tertiary sectors. This paper focuses on the school sector, and explores the proposition that a major barrier to inclusive education is a lack of teacher knowledge and understanding. It draws on data from recent studies to show that lack of attention to teacher learning in the area of inclusive education contributes to the exclusion of students from minority groups' experience – exclusion both from and within schools. Recommendations for teacher learning, both pre-service and in-service are explored.

Teacher learning, and teacher knowledge are important considerations in the exclusion or inclusion of students from minority groups. This is for two main reasons. First, teachers often report a lack of knowledge and skills as a factor impeding their ability to successfully include these students in their classes (Kearney, 2009; Marshall, Ralph, & Palmer, 2002). Second, research consistently shows the importance of appropriate teacher attitudes and values for successful inclusive education and that teacher learning and knowledge can play an important part in developing these necessary beliefs and attitudes. For example Avramidis, Bayliss, and Burden (2000) and McDonald and MacArthur (2005) report that professional development and learning in the area of inclusive education can have a positive effect on developing teacher attitudes conducive to the facilitation of inclusive education. Similarly, Praisner (2003) found a correlation between school principals' involvement in professional development and learning about inclusive education, and their positive attitude to disabled students. Those with positive attitudes were more likely to provide a more inclusive education whereas those with negative attitudes were more likely to provide restricted education.

However, recent research in New Zealand reveals that while there is general agreement and understanding of the importance of teacher learning and teacher knowledge as a facilitator of inclusive education, there is also confusion and ambivalence regarding how this 'plays out in reality' with few school leaders pursuing programmes of teacher learning and professional development in this area, and a lack of consistency and valuing of inclusive education in initial teacher education programmes. For example, in a New Zealand study that sought to uncover barriers to inclusive education (Kearney, 2009), the majority of school principals responding to a questionnaire believed that successful inclusive education required knowledgeable and skilful teachers, with 65% believing it to be vital. However, when asked to provide a level of agreement with the statement 'to facilitate inclusion, we focus on increasing the capacity and capability of teachers', over 45% of the same respondents indicated that they did not do this. This discrepancy indicates some confusion or ambivalence regarding the important role played by competent teachers with regards to inclusive education.

Similarly, results from studies investigating the place of inclusive education in initial teacher education (ITE) programmes found that the majority of ITE providers did not have clearly articulated policy around inclusion within their qualifications, and that there was limited evidence of the degree to which ITE programmes responded to the literature on inclusive education. (Kane, 2005). Similar results were uncovered in another New Zealand study where McDonald and MacArthur (2005) reported that most teachers in New Zealand have come through initial teacher education programmes where the papers focussing on inclusive education were optional.

What then should be the nature of teacher learning and professional development in this area? This paper argues that it is not necessarily the widely held belief that this knowledge should take the form of special skills strategies around special interventions – research shows that there is little or no evidence that these are required to teach in inclusive education settings (Mittler, 2000; Thomas, Walker, & Webb, 1998). Rather research points to the effectiveness of teacher learning focussed on teacher attitudes, values and beliefs, and the link between these and teachers' practices in the classroom (MacArthur et al., 2005; Mittler, 2000). Rather, effective teacher learning for inclusive education provides opportunities to reflect on beliefs, values and attitudes and the relationship between these to teachers' day-to-day practice (MacArthur et al., 2005; Mittler, 2000). Teacher knowledge to facilitate inclusive education also involves an awareness of the power and hierarchy arrangements in schools that include and exclude some groups of students (Ewing, 2001). Issues of social justice, human rights and citizenship have also been shown to be important aspects of teacher knowledge in relation to inclusive education (McDonald & MacArthur, 2005).

PAPER PRESENTATION

The Role of Teacher Educator Inquiry in the Professional Education of Teachers

Frances Rust, University of Pennsylvania, United States; Joan Whipp, Marquette University, United States

This paper provides a robust review of pre- and in-service teacher educators' research on their practice aggregating it around questions and research that teacher educators are conducting around specific practices and content areas. The major research tool is manuscript review supplemented with interviews. The intent is to highlight the questions that teacher educators are asking about their practice, to determine the ways in which teacher educators are studying their practice, and to gather together lessons learned from these investigations—all for the purpose of developing what Hiebert, Gallimore, and Stigler (2002) describe as "a practical knowledge base" for teacher education.

Throughout the world, teacher educators and traditional university-based teacher education programs are under attack by those who feel they have a better handle on how to prepare teachers whether they be school districts, governments, for-profit organizations engaged in teacher preparation, or non-profit organizations engaged in residency programs designed to situate new teachers learning in schools and classrooms (Au, 2008; Berry, 2009; Wrigley, 2009). Individuals and their programs have been criticized for doing a "mediocre job of preparing teachers for the realities of the 21st-century classroom" (Duncan, 2009) which requires that they know how to manage classrooms for high-needs students and use data to improve instruction and boost student learning." Grossman (2008), Levine (2008), Zeichner (2010) and others have suggested that teacher education is in crisis and that traditional teacher preparation programs may be fast losing their grip on the field. It is critical, writes Grossman, that teacher educators demonstrate that their programs make a difference on student learning and that they improve the quality of research in teacher education so that it can credibly inform practitioners and policy makers.

The recent AERA Panel on Teacher Education Research was also critical of teacher education research suggesting that it was fragmented, limited largely to isolated case studies, and methodologically weak. In the face of this critique, however, a powerful counter narrative regarding teacher education and the role of research focused on teacher education is emerging. Drawing from research on evidence-based practice in a variety of professions including medicine, and law, this counter narrative focuses on two evidentiary frames: whether and to what extent various aspects of teacher education influence the ways in which new teachers practice. To answer these questions, increasing attention is being paid to evidence of carryover of the curriculum of individual teacher education programs and the instructional practice of teacher educators into the practice of their graduates during their first few years of teaching. Thus, the focus of research on teacher education is shifting from efforts to draw from program-comparative studies that have failed to provide clear evidence that certain approaches in teacher education may be more effective than others, and moving to more qualitatively-oriented studies aimed at identifying what works in individual programs and, from there, toward an aggregation of findings that could lead to a bridging of theory and practice (Hiebert, Gallimore, and Stigler, 2002; Korthagen, Loughran, & Russell, 2007; Author, 2010). As Zeichner and Conklin (2005) write, "...it is program substance not structure that is key in influencing prospective teachers. We need [qualitative, descriptive, context-sensitive, longitudinal] research that focuses more on the substance of programs and that goes beyond surface-level assertions about good program features (e.g., the importance of coherence, partnerships, mentoring, and modeling) to elaborate what these characteristics mean in practice and the particular configurations of these features (e.g., what good mentoring practice means) that enable the realization of desired outcomes. (p. 701) Such research begins to help teacher educators address those questions posed more than 20 years ago by Clark (1988) with answers that by making research about practice, "public, storable and sharable, and open for verification and improvement" (Hiebert, Gallimore, and Stigler, 2002, pp. 6-8) could make possible a fundamental reshaping of the field of teacher education. This paper provides a robust review of pre- and in-service teacher educators' research on their practice aggregating it around questions and research that teacher educators are conducting around specific practices and content areas. The major research tool is manuscript review supplemented with interviews. The intent is to highlight the questions that teacher educators are asking about their practice, to determine the ways in which teacher educators are studying their practice, and to gather together lessons learned from these investigations—all for the purpose of developing what Hiebert, Gallimore, and Stigler (2002) describe as "a practical knowledge base" for teacher education.

Our effort is to bring attention to the breadth and variety of research by teacher educators worldwide on teacher education that has evolved over the past 20 years. To date, from the close to 200 studies that we have identified, we have selected for this review those that offer models for research on practice. They are: a) grounded in clear conceptual frameworks, b) provide a robust research design with systematic analysis of data, and c) offer insight about what teacher educators are learning about effective teacher education as they study their own practice. Ball (2010), Cochran-Smith (2003, 2005), Hiebert, Gallimore, and Stigler (2002), Korthagen, Loughran, and Lunenberg (2005), and Murray (2008) hold that such inquiry is critical to reshaping teacher education practices and influencing

the work of teachers at both the preservice and inservice levels. As Ball (2010) notes, The current array of teacher preparation programs offers an unprecedented opportunity to move past trial and error and opinionated debate and to identify the key features of readiness for responsible practice and how it can be learned and assessed. (p. 12)

Following is a sample of the topics and questions that have emerged in this review:

Teacher induction. How can teacher educators support pre-service teachers in the first years of teaching?
Supporting teaching for social justice . How can teacher educators accomplish evidence-based decision making about teaching for social justice?

Teacher educator beliefs. How can teacher educators get beyond their own deficit models of and beliefs about preservice and inservice teachers who have had limited exposure to cultural diversity?

Teacher educator self-study processes and methods. What qualitative and quantitative methods are teacher educators using to develop evidence of program effectiveness?

Problems and Pedagogies of Practice . What core sets of practices embody the knowledge, skill and professional identity needed by entry level teachers?

Uses of New Technologies in Teaching and Teacher Education. How might teacher educators use new technologies to go public with teaching and teacher education?

Supporting Preservice and Inservice Inquiry into Practice. How can teacher educators build research capacity among preservice and inservice teachers?

PAPER PRESENTATION

Junior High School Students' Mechanisms and Explanations of their Perceived Constructivist Learning

Orit Ben Zvi -Assaraf, Ben Gurion University of the Negev, Israel, Israel; Haim Eshach, Ben Gurion University of the Negev, Israel; Moustafa Asley , , Department of Science and Technology Education, Ben-Gurion University of the Negev, Beer Sheva, Israel., Israel

The purpose of the present study is to examine the manner in which constructivist learning environment features, as well as the mechanisms at their base, are expressed in middle school students' conceptions. Thus the present study integrates the quantitative and qualitative approaches in order to arrive at a wider ranging and deeper understanding. 840 students from the 8th and 9th grade from over 15 schools participated in the study. Of the 840 students who completed the questionnaire, the explanations of 200 well-written questionnaires were further analyzed qualitatively. The findings of the study are presented in terms of the 4 scales employed in the CLES, namely: the Autonomy Scale, the Prior Knowledge Scale, the Negotiation scale, and the Student-Centredness Scale. The quantitative results arrived at in the present study concur with parallel studies conducted around the world. The findings indicate that a considerable portion of the students perceive their learning environment as being constructivist one and report positive attitudes towards the way they are being taught. In terms of the qualitative results, however, it appears that in some cases the students' explanations reveal that in fact, and contrary to the bare quantitative results, some students do not perceive their learning environment as being constructivist. This raises the question whether indeed the factors associated with constructivist teaching which are recognized by the students, indeed indicates that they exist in practice. This finding emphasizes the importance of combining qualitative and quantitative methods for arriving at a balanced view of classroom occurrences.

Constructivism and social constructivism which one can relate to as a theory of learning determines the way one learns, no matter what teaching strategies he or she will be exposed to. However, from the literature on science learning and teaching it appears that learning environment which might be considered as effective from constructivist point of view is one which the community of learners engages in activity, dialogue, and joint thinking of topics relevant to them. The teachers' role in such environments is to encourage and accept student autonomy and create a comfortable atmosphere for student expression. Much attention is given to the learner: to his/her previous knowledge, to his/her experience, to his/her thinking strategies, and to his/her motivation. The teacher is also to create a learning environment which invites the development of cognitive skills such as critical thinking, logical thinking, question asking, efficient knowledge use by way of data analysis, and arriving at conclusions. Such learning environments also enable learners to develop the skills to evaluate the learning process and product, as well as the ability to self-reflect. In parallel, skills belonging to the social domain also develop including those of engaging in conversation and dialogue, persuasion and decision-making abilities, team work, and task distribution. Finally, in the personal domain, the learner develops the skills such as persistence, internal drive, initiative taking, personal curiosity, responsibility taking and independence.

Diagnosing the different dimensions of the learning environment as perceived by the learners and analyzing the factors affecting it might explain the social processes being acted out in the class. As well, comprehending how the learners understand the environment's dimensions might assist teachers and educators in planning pedagogical interventions for the purpose of improving the teaching and learning process. Very few studies have examined the educational environment from the student's point of view. The tool most commonly employed in the literature to assess student attitudes towards their environment being a constructivist one is that of Taylor, Fraser's and Fisher (1997) Constructivist Learning Environment Survey (CLES), a Likert type questionnaire. The present study builds on the former but adds a qualitative dimension as well. Students are requested to supply an explanation to the scoring of the statements. Qualitative and quantitative approaches differ in their goals, study array, type of data gathered, how it is collected, its analysis, and the drawing of conclusions from it. The present study integrates the two approaches in order to arrive at a wider ranging and deeper understanding of students' mechanisms and explanations of their perceived constructivist learning environment.

Thus, the purpose of the present study is to examine the manner in which constructivist learning environment features, as well as the mechanisms at their base, are expressed in middle school students' conceptions. 840 students from the 8th and 9th grade from over 15 schools participated in the study. The sample was randomly chosen and represents students studying sciences in public schools in the southern part of Israel. Of the 840 students who completed the questionnaire, the explanations of 200 well-written questionnaires were further analyzed qualitatively. The findings of the study are presented in terms of the 4 scales employed in the CLES, namely: the Autonomy Scale, the Prior Knowledge Scale, the Negotiation scale, and the Student-Centredness Scale. The quantitative results arrived at in the present study concur with parallel studies conducted around the world. The findings indicate that a considerable portion of the students perceive their learning environment as being constructivist one and report positive attitudes towards the way they are being taught. From among the questionnaire's components, the "Negotiations scale" received the highest positive score while the "Previous knowledge scale" received the lowest score (Figure 1). In terms of the qualitative results, however, it appears that in some cases the students' explanations reveal that in fact, and contrary to the bare quantitative results, some students do not perceive their learning environment as being constructivist. For instance even when they agree with the statement in the questionnaire: "In science I talk with other students about the most sensible way of solving a problem" They explained in the qualitative part that the participation stems from their wish to gain higher scores in the course (external motivation) and they did not at all associate discussions with understanding:

a) Students don't speak out because they are afraid of the teacher (10.99%); b) You don't talk during class, only work (25.88%); c) No because I rely on myself and am not interested in others. What I think is the most logical (16.48%); d) Yes, to check if I'm right, to be sure (18.68%); e) Working with friends helps me understand (7.69%) and f) Yes, we argue about the answer, maybe they will suggest ways that will help me reach the right answer and good score (20.27%). This might indicate that although they participate in the discussions in class, the discussions might not contribute to their conceptual development. In other words, one cannot conclude that participating in class discussions indicates constructivist teaching. It is then argued that the fact that students do not perceive their learning environment as constructivist does not necessarily mean that in reality it is not a constructivist one, and vice versa. The findings of this study reveal a gap between the quantitative questionnaire results and the qualitative data. This raises the question whether indeed the factors associated with constructivist teaching which are recognized by the students, indeed indicates that they exist in practice. This finding emphasizes the importance of combining qualitative and quantitative methods for arriving at a balanced view of classroom occurrences. One approach which might address this gap is the explicit instruction strategies, where the relevant constructivist learning environment features are explicitly presented to the students so that they may become active participants in transforming and maintaining their learning environment as a constructivist one.

Figure 1: Averages of different scales comprising the constructivist learning environment (N=859)

Taylor, P.C., Fraser, B.J. & Fisher, D.L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research*, 27, 293–302.

PAPER PRESENTATION

Entertainment media as learning material – The problem of mental effort

Anja Hawlitschek, Fraunhofer Institute for Digital Media Technology, Germany; Helmut M. Niegemann, University of Erfurt, Germany

In this paper we examine the effects of pupils' perception of entertainment media on learning outcome. According to Salomon (Salomon 1984), the learner usually perceive entertaining learning material as "easy" and "undemanding"

which leads to a decreasing amount of invested mental effort and therefore a lower learning performance. Salomon suggests that the integration of an explicit instruction to learn is necessary for the usage of entertainment media in school. Results from other studies so far not support these findings. Nevertheless the "Salomon-Effect" influences the discussion about learning with entertainment media. Therefore, we see the importance for another research study to answer this question. We conduct a two-group experiment with pupils in a German secondary school. The results of our study indicate that there is no correlation between mental effort and learning outcomes. Increasing mental effort in the experimental group is not accompanied by increasing learning outcomes. These results are a challenge for the premature declaration of entertainment media as "for learning".

Introduction

This paper addresses an instructional problem concerning the usage of entertainment media in school, known as "Salomon-Effect". Salomon's studies (Salomon, Leigh 1984; Salomon 1984) result in a media pedagogical assumption, which consistently influences the discussion about learning with entertaining media: The usage in school should be accompanied by an explicit instruction to learn, to encourage the investment of mental effort. Otherwise, the pupils, who usually perceive entertainment media as "undemanding", would pay little mental effort and therefore achieve poor learning results (Petko 2008). Learning is here defined as knowledge acquisition which can be measured in terms of factual recognition and inference making. In an experiment Salomon tried to change the preconceptions of children towards the mental effort that is necessary to deal with learning material. He concludes: "children's (...) AIME (amount of invested mental effort) and their inference making – are penetrable through the manipulation of the demand characteristics of TV" (Salomon, Leigh 1984: 133). Other studies come to different results: Beentjes (Beentjes 1987) could not show a relation between the media type and AIME. Heers (Heers 2005) could not identify an impact from the learning instruction on mental effort on the one hand and a relation between invested mental effort and learning outcome on the other. Moreover Salomon himself could not identify in every measure an effect on learning outcome (Salomon, Leigh 1984: 125).

We therefore see the importance to conduct another research study concerning this question. If the explicit demand to recognize the entertaining material as learning content is a prerequisite for learning, the usage of entertainment media in school have to be reconsider.

Research Design

Our study took place in a grammar school in Berlin, Germany. 31 pupils from a tenth class were randomly assigned into two groups. The experimental group had a written learning instruction: "Read the following text very careful. Think about the meaning of the story. After reading, we will ask you questions concerning the content of the text." The control group had the written instruction: "You can now read a comic. Have fun!" This instruction was supposed to encourage the typical attitude of reception towards entertainment media – enjoyment.

As learning material we chose a comic strip, which was clearly identifiable as entertainment media. After reading the comic each pupil got the questionnaire and the test for learning outcome. The scale for measuring mental effort contains the following items (cf. Salomon 1984):

- I worked hard to understand the story.
- I invested much mental effort to comprehend the story
- I tried very hard to understand the story.

The participants rated on a seven-point Likert-scale ranging from "strongly disagree" (= 1) to "strongly agree" (= 7). Factual recall was measured through multiple-choice, inference making was measured through open questions. Two researchers rated the inference making test on the basis of a "solution model". Satisfying inter-coder reliability was achieved.

Hypotheses based on Salomon's theory (Salomon 1984) are:

Hypothesis 1: The learning instruction has a positive influence on mental effort.

Hypothesis 2: The learning instruction has a positive influence on performance.

Hypothesis 3: Mental effort has a positive influence on performance.

Results

To examine the first hypothesis an analyses of variance (ANOVA) was conducted with the learning instruction as independent and mental effort (Cronbach's α : .880) as dependent variable. The result did yield a main effect on mental effort (see table 1).

To examine the second hypothesis an ANOVA was conducted with the learning instruction as independent and the learner's performance as dependent variable. The results did not yield a significant main effect on factual recall ($p = .137$, $d = 0.421$) and inference making ($p = .595$, $d = 0.129$).

To examine the third hypothesis the correlation between mental effort and the learner's performance was measured. The result neither yields a correlation between mental effort and factual recall ($r = .129$; $p = .498$) nor between mental effort and inference making ($r = .087$; $p = .648$).

Discussion

Our results indicate that the communication of the entertainment media as learning material do not lead to the expected results. There is no significant main effect from the learning instruction on the learner's performance. Although mental effort could be manipulated through the learning instruction it had no influence on learner's performance. The learning instruction seems to produce only a feeling of effort. The estimation of the media can be altered but without influences on the learning behavior. These results correspond with results from research projects in the field of Cognitive Load Theory, which used similar items. For example DeLeeuw/Mayer (DeLeeuw, Mayer 2008) also do not find a correlation between mental effort and the learner's performance. There are so far no indicators which support Salomon's assumption, that the perception of entertainment media as "for learning" yields better learning performance. Further research has to be done to investigate the correlation between entertainment media and cognitive processing more deeply.

References

- Beentjes, H. (1987): Mental effort and perceptions of TV and books. A Dutch replication study based on Salomon's model of learning. Paper presented at the European Conference for Research on Learning and Instruction. Tübingen.
- DeLeeuw, K.; Mayer, R. (2008): A comparison of three measures of cognitive load. Evidence for separable measures of intrinsic, extraneous, and germane load. In: Journal of Educational Psychology, Jg. 100, H. 1, 223–234.
- Heers, R. (2005): Being There. Untersuchungen zum Wissenserwerb in virtuellen Umgebungen. Online: http://w210.ub.uni-tuebingen.de/dbt/volltexte/2005/1648/pdf/Diss_Heers.pdf.
- Petko, D. (2008): Unterrichten mit Computerspielen. In: MedienPädagogik, H. 15. Online: <http://www.medienpaed.com/15/petko0811.pdf>.
- Salomon, G. (1984): Television is "easy" and Print is "tough". The differential investment of Mental Effort in Learning as a function of perceptions and attributions. In: Journal of Educational Psychology, Jg. 76, H. 4, 647–658.
- Salomon, G.; Leigh, T. (1984): Predispositions about learning from Print and Television. In: Journal of Communication, Jg. 34, H. 2, 119–135.

PAPER PRESENTATION

A design-based methodology for practice-oriented research

Cees Terlouw, Saxion University of Applied Sciences, Netherlands

Learning and instructional researchers function in academic and in practical settings. Doing research in an academic setting usually also intends the application of the results in an educational practice. Doing research in a practical setting implies even more explicit pursuing a double goal: developing 'practice' and 'theory'. Practitioners ask for a concrete 'situated' solution, but also for a more general practice-oriented theory for application in other situations. Therefore, both settings are confronted with a theory - practice gap. What methodology, especially which practice-oriented research model, can be used to bridge the gap working as a researcher in a practical setting? We consider the practice situation as a community that is involved in a multi-level, complex learning situation. Besides students, also the other stakeholders such as teachers and managers must learn to apply the intervention. A researcher should also be a stakeholder in such a collaborative learning situation. A dialogue between the different stakeholders is central in such a community. Therefore, an interactive research model is necessary in which managers, researchers and user-groups interact throughout the entire research process. Based on a knowledge theory an ideal typical model for a practice-oriented research project is formulated that consists of such components as practice problem, knowledge base, reasoning mechanisms for extracting and integrating knowledge from the knowledge base, and a knowledge application and acquisition system. An empirical study on transition to higher education will be used to demonstrate the model as a logic-in-use and as a means to improve the model.

Problem

Learning and instructional researchers function in academic and in practical settings. The relation between research and practice is relevant in both settings. Doing research in an academic setting usually intends – on the short- or long-term – the application of the results in an educational practice. This way of working is confronted with a theory – practice gap (De Corte, 2007). Doing research in a practical setting implies more explicit pursuing a double goal: developing 'practice' and 'theory'. Practitioners ask for a concrete 'situated' solution, but also for a more general practice-oriented theory for application in other situation. Therefore, this way of working is also confronted with a theory - practice gap. What methodology can be used to bridge the gap working as a researcher in a practical setting?

Theoretical framework

Several positions are taken for bridging the gap between 'practice' and 'theory' (e.g. Journal of Learning Sciences, 2004 about Design Based Research; Phillips, 2006, De Corte, 2007). The possibilities and limits for 'theory' and 'practice' of the use of objective instruments, double-blind randomized design (the "Golden Standard"), and different levels of empirical evidence characterize the discussion. However, from the perspective of a researcher working in a practice setting the discussion lacks a solution, because the character of the practice situation is not taken into account. For such a researcher I characterize the situation as a multi-level, complex learning situation, because besides students, also the other stakeholders such as teachers and managers must learn to apply the intervention. A researcher is also part of such a collaborative learning situation. A new object / concept is designed and constructed for their collective activity (the planned intervention), implemented in practice, improved in order to solve a problem in practice, and to develop theoretical knowledge and concepts. Engeström & Sannino (2010) call such a complex, collaborative learning process in a community 'expansive learning'. A dialogue between the different stakeholders is central in such a community. Therefore, an interactive research model is necessary in which managers, researchers and user-groups interact throughout the entire research process. This model includes the definition of the problem, the development, selection, implementation, and improvement of the intervention, the theoretical reflection, and the application of the research insights in these components. (Ellström, 2008). Conceptualization and interpretation of the research takes place in a knowledge circulation process between 'researchers' and 'practioners' in order to solve the practical problem and to develop practice-oriented theory. The more specific research question is: Which are the components of a practice-oriented research model that involves a knowledge circulation process between 'researchers' and 'practioners' in order to solve the practical problem and to develop practice-oriented theory?

A model for practice-oriented research

Our grounding for the model is a knowledge theory for practice-oriented research of Strike (1979) in which the concept 'research program' is central. This knowledge theory have three components: (a) the theoretical-normative hard core that is fixed during a research project, (b) action plans to realize the former that can be changed based on the implementation results in practice, and (c) the evaluation of the results of implementation in practice. Based on this knowledge theory an ideal typical model for a practice-oriented research project consists of the following related components (see figure 1): Practice problem. A state of affairs that according to some practioners in an educational community is a problem. The stakeholders must agree on the definition of the problem; Knowledge base. The practice problem activates the present practical and theoretical knowledge for knowledge circulation. The stakeholders must agree which knowledge should be used in the collective knowledge base; Reasoning mechanism. Cognitive and social functions used to get the knowledge available for knowledge circulation and application; Knowledge Application and acquisition system. This system consists of the following parts: Instruction-learning theoretical framework. This is the theoretical-normative 'hard core', the grounding theoretical framework used in the project as a starting point for action. Several action plans must realize this framework, First action Plan. A more specific intervention theory is specified or chosen for the specification of the intervention that should solve the practice problem. The intervention is an IF-THEN proposition, Second Action Plan. This plan concerns a systematic procedure for Instructional Design for developing the intervention chosen Third Action Plan. The resulting instructional design, the intervention, is detailed and constructed in an instructional plan and connected with an evaluative research plan, Execution. The instructional and research plan are executed in the practice for solving the practice problem, Evaluation. Based on the research plan the results of the intervention are evaluated, and Feedback. The evaluative conclusions are feed back to the action plans and the execution for improvement. Several cycles can take place; Reasoning mechanism. Cognitive and social functions used for integrating the evaluative results in the collective knowledge base. Explicit argumentation in terms of claims, evidence, warrant, rebuttal, and backing are important for the growth of practical and theoretical knowledge.

Reconstructed logic and logic-in-use

The former model is reconstructed logic. We will demonstrate the logic-in-use by reporting research on designs of study counseling meetings in order to help high school students learning to transit smoothly to higher education. This research is used to improve the model.

References

- De Corte, E. (2007). Design-experiments: a tool for bridging the theory-practice gap relating to education. Paper presented at the Programme of the 12th Biennial Conference for Research on Learning and Instruction (EARLI): Developing potentials for learning, Budapest August 28 - September 1.
- Ellström, P. E. (2008, September 10-12). Knowledge creation through interactive research: a learning approach. Paper presented at the ECER, Gothenburg.
- Engeström, Y. & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. Educational Research Review 5(1), 1-25.
- Journal of the Learning Sciences 2004, 13(1).

Phillips, D.C. (2006). A guide for the perplexed: Scientific educational research, methodolatry, and the gold versus the platina standards. *Educational Research Review* 1(1), 15-27.

Strike, K. A. (1979). An epistemology of practical research. *Educational Researcher*, 8(1), 10-16.

PAPER PRESENTATION

Technology-supported assessment of text-based learner's outcome

Nadine Schlomske, University of Jena, Germany; Michaela Glaeser-Zikuda, University of Jena, Germany; Pablo Pirnay-Dummer, Friedrich-Schiller-University of Jena, Germany

Text-based learners' performance is, in particular, difficult to assess. The study in this presentation focuses on technology-supported possibilities in text-oriented assessment university and school. For comparison (external criterion), the study uses expert model solutions, which allows a comparison of students' individual performance and the expert solution with the tools at hand. Secondly, we tested to what degree the instrument may be supportive and feasible for teachers in assessing students' performance at schools, and how diagnostic competencies may be enhanced. Design, methods, and first results of the study are presented. Finally, implications of the study for assessment at school and university will be discussed.

Assessing learners' performance is an important issue in all educational fields. The instruments currently used at schools and universities are rarely objective, reliable, and valid in their procedures and analyses. Text-based learners' achievements are, in particular, difficult to evaluate (see Ingenkamp & Lissmann, 2008; Klauer, 1982; Linn, Klein & Hart, 1970). The study focuses on technology-supported possibilities in assessing text-based learner's outcome with T-MITOCAR (Text-Model Inspection Trace of Concepts and Relations).

The technology-supported assessment with T-MITOCAR is theoretically based on mental models (c.f. Seel, 1991, Johnson-Laird, 1983). Learners construct mental models in order to explain the world on the basis of their knowledge. The statements presented in a person's knowledge must be plausible according to his or her knowledge of the world, regardless of whether they are true in reality or not (Seel, 1991). Mental models are only constructed if a person cannot explain a particular situation on the basis of his or her present knowledge of the world. Experts differ from novices not only in the amount of knowledge available to them, but also in their knowledge structures (Pirnay-Dummer, 2006).

Observing learner's performance requires diagnostic competencies (Hoge & Coladarci, 1989). Helmke (2009) defines the construct of diagnostic competencies as the knowledge one has of the empirical standards (objectivity, reliability and validity) and of the sources of errors which can occur during the process of evaluating learner's performance, as well as the ability to search for a test, and finally, use and evaluate the same test. In addition, three components are distinguished: the correctness of observation, the variation of observation, as well as the ability to rank students' achievement.

In accordance with the empirical findings in text-based performance assessment, the following research question is of interest: Can T-MITOCAR be used to evaluate written learners' outcomes? Furthermore, may this instrument support teachers in assessing students' text-based performance?

T-MITOCAR is a computer-based software (Pirnay-Dummer & Ifenthaler, 2010; Pirnay-Dummer, Ifenthaler & Spector, 2010) that is automated in its procedure and analysis and has been proven in delivering homogeneous, reliable, and valid results in multiple studies. It measures a specific set of properties of language re-representations and generates associative graphs from texts using heuristics from computer linguistics and graph theory. Based on the instrument learners' progress has already been tracked with a high prediction validity (Schlomske & Pirnay-Dummer, 2009).

The presentation focuses on two studies. The first study that was conducted on the university level includes a sample of (N=37) students in the domain of school education. In the second study a sample of (N=180) students in the domain of educational psychology was selected. Students write an exam at the end of the semester which consists among other things of two tasks where students produce written texts. Based on specific criteria two lecturers independently evaluate students' text-based performances. For comparison (external criterion), the study uses written expert model solutions, which are examined by experts in the domain beforehand, in order to guarantee its validity. This allows a comparison of each individual performance and the expert solution within T-MITOCAR. Finally, the core measures identified by the instrument are compared with the grades the lecturers assigned to the written exams. This allows the examination on whether it is possible to assess teacher's identification of grades for the individual performances with T-MITOCAR.

In a second step, this assessment tool will be tested in school context to what degree the instrument may be used in supporting assessment at school. A group of teachers will be trained in their diagnostic expertise in order to assure their assessment of tests with sufficient accuracy. Moreover, the teachers' knowledge and diagnostic competencies will be assessed before and after being trained. Possible effects of T-MITOCAR on teachers' competencies will be also tested. Finally, results and implications of the study for assessment at school and university will be discussed. If the procedure with T-MITOCAR turns out to be reliable and valid in comparison to established assessment and testing, it may lead to the introduction of automated assessment tools regarding text-based performances to complement the process or help teachers with the time consuming effort of classical grading. However, there are limits in grading with technology-based tools as well as there are aspects of grading, like for instance, writing style that can only be assessed by teachers so far.

PAPER PRESENTATION

How do different task types affect the multimedia effect and what role does WM play in it?

Erlijn van Genuchten, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Anne Schueler, Knowledge Media Research Center, Germany

As part of a series of studies about the involvement of working memory in learning with text and pictures, we investigated whether the size of the multimedia effect (i.e., students learn more from text and pictures than from text only) and the involvement of WM components differ between task types. We distinguished between conceptual, causal, and procedural tasks. Ninety-seven students were assigned to a text-only, text-picture or picture-text group (the horizontal layout of the text and picture was manipulated) and studied tasks from these three task types. The results showed that the multimedia effect was smallest in conceptual tasks and largest in procedural tasks when considering free recall of information. A similar pattern was found for recall verification items. The opposite pattern was found for transfer verification items; here, the multimedia effect was largest in conceptual tasks and did not exist in procedural tasks. These results suggest that the value of adding pictures to text depends on the type of information and the type of learning that is required. Finally, the question of whether the importance of working memory components differs between task types could not be answered; measuring working memory involvement appeared problematic due to insensitivity of the working memory capacity measures. Therefore, we proposed to use a dual-task paradigm in future experiments to measure working memory involvement.

The Cognitive Theory of Multimedia Learning (CTML; Mayer, 2009) holds that working memory (WM) is involved in constructing knowledge representations when learning from text and pictures. CTML is based on Baddeley's WM model (1986) — consisting of the central executive (CE), phonological loop (PL), and visuospatial sketchpad (VSSP). The CE is a control system with the capability to focus, divide, and switch attention, and to link WM with long-term memory. The PL and VSSP are responsible for holding and rehearsing verbal and visuospatial information, respectively. However, CTML does not acknowledge fully that WM is composed of these components, that these components process different types of information (i.e., verbal, visuospatial), that the importance of these types of information, and hence WM contribution, may vary depending on task type, and that therefore the size of the multimedia effect (i.e., students learn more from text and pictures than from text only) may vary between task types. We investigated whether the relative importance of text and pictures, and therefore the size of the multimedia effect, as well as the involvement of WM components differ between task types. We distinguished between conceptual tasks, focusing on concepts and their relationships (e.g., members in a family tree; Hiebert & Carpenter, 1992), causal tasks, focusing on cause-and-effect chains (e.g., functioning of the heart; Mayer, 2009), and procedural tasks, focusing on the temporal order and spatial relationships between actions (e.g., assembling a cupboard; Brunyé, Taylor, Rapp, & Spiro, 2006). We also distinguished between recall (remembering) and transfer (reasoning) of information (Mayer, 2009). Specifically, we investigated whether the multimedia effect is larger and whether the VSSP is more involved during learning when pictorial information is more important, and conversely, whether the multimedia effect is smaller and whether the PL is more involved during learning when verbal information is more important. We also investigated whether the CE is particularly involved in the integration of text and pictures when verbal and pictorial information are equally important.

Method

Ninety-seven students were assigned to the text-only, text-picture or picture-text condition (the horizontal layout of text and pictures was manipulated). They studied tasks from three task types (i.e., conceptual, causal, procedural). Students performed two blocks consisting of three learning tasks (one of each task type), post-test questions, and two WM capacity tests. Nine learning tasks were developed — three conceptual, three causal, and three procedural — about a fictitious country. Accuracy on three categories of post-tests was assessed: (a) verbal (written) and pictorial (drawn) free recall, (b) verbal and pictorial recall verification items (yes/no), and (c) transfer verification items (yes/no)

including text-picture integration items. All considered information given in just the picture or in both text and pictures. WM capacities were gauged using digitalised versions of the Digit Span task (PL), Corsi Block task (VSSP), Listening Span task (CEPL) and Spatial Span task (CEVSSP).

Results

In our regression analyses, we predicted accuracy of free recall, recall verification items and transfer verification items from PL and VSSP capacity, condition, task type, and learning time simultaneously. CE capacity was not included, because many students scored zero on the CEPL and CEVSSP task. Investigating PL and VSSP involvement was less problematic, although the range of scores was small. Contrary to our assumptions and contrary to CTML, no relationships between WM measures and learning outcomes were found. We found a multimedia effect for all task types and dependent variables except for transfer verification items in procedural tasks. For free recall, the multimedia effect was smallest in conceptual tasks, larger in causal tasks, and largest in procedural tasks. For recall verification items, the multimedia effect was largest in procedural tasks with no differences in effect size between conceptual and causal tasks. For transfer verification items, the multimedia effect was largest in conceptual tasks. All reported results were significant at the alpha .05 level.

Discussion

The results show that the multimedia effect was confirmed, that is, students learned more from text and pictures than text only in all but one case. The multimedia effect was smallest in conceptual tasks, larger in causal tasks and largest in procedural tasks when considering free recall accuracy. A similar pattern was found for recall verification items. These results imply that memory for the given information is fostered by pictures especially in procedural tasks and less in causal and conceptual tasks. The opposite pattern was found for transfer verification items — the multimedia effect was largest in conceptual tasks, smaller in causal tasks, and did not exist in procedural tasks. These results imply that the ability to draw inferences based on the given information is fostered by pictures in conceptual and causal tasks but not in procedural tasks. Together, these results suggest that the value of adding pictures to text depends on the type of information and the type of learning that is required. However, future studies are required to confirm this pattern of findings. The results about WM involvement show that measuring WM involvement using WM capacity was problematic in this study. The significant proportion of students scoring zero implies that the task instructions were unclear or that the tasks were too challenging. As a result, these capacity measures did not differentiate between students with different WM capacities. Therefore, more sensitive measures, such as a dual-task paradigm, should be used in future studies to measure WM involvement during learning from text and pictures.

References

Baddeley, A. D. (1986). Working memory. Oxford, UK: Oxford University Press. Brunyé, T. T., Taylor, H. A., Rapp, D. N., & Spiro, A. B. (2006). Learning procedures: The role of working memory in multimedia learning experiences. *Applied Cognitive Psychology*, 20, 917-940. Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 65-97). New York: MacMillan. Mayer, R. E. (2009). Multimedia Principle. In R. E. Mayer (Ed). *Multimedia learning second edition* (223-241). New York, NY: Cambridge University Press.

PAPER PRESENTATION

Do spatial text contents interfere with picture processing?

Anne Schueler, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

According to the multimedia principle texts presented together with pictures lead to better learning than the presentation of text alone. The aim of the reported study was to examine whether this superiority of text-picture presentation is influenced by the text contents that have to be processed: A multimedia effect was expected only when text containing non-spatial information had to be processed, but not when text containing spatial information had to be processed. This hypothesis is based on the assumption that the processing of spatial text contents might interfere with the processing of spatial picture information and the execution of eye movement in spatial working memory. Eighty-four students participated in an experiment based on a 2x2 design with picture presentation (with vs. without) and text contents (visual vs. spatial) as independent variables. In the learning phase, participants received information about different fishes. Afterwards, they had to recall this information. The results of the experiment confirmed the hypothesis that a multimedia effect appears only with non-spatial text contents: Whereas learners who received visual text contents benefited from picture presentation, learners who received spatial text contents did not. These findings are in accordance with the hypothesis that there is a specific interference in spatial working memory when processing spatial text information together with pictures. Therefore, the presentation of pictures together with

spatial text contents should be avoided. Instead, it might be better to convey spatial information only through pictures and to reduce the amount of spatial information conveyed through the texts.

In the research on multimedia learning, there have been several recommendations on how to present text and pictures to learners to support a deeper understanding of the presented topic. According to one of these recommendations, the so called multimedia principle, texts presented together with pictures lead to better learning outcomes than the presentation of text alone (Mayer, 2009). However, contrary to this general recommendation, we expect that pictures are beneficial only for learning when presented together with non-spatial text contents but not when presented together with spatial text contents. This assumption is based on finding concerning the structure of working memory (WM), and especially of the Visuo-Spatial Sketchpad (VSSP) as one of WM's substructures. The VSSP consists of a component which mostly deals with processing visual characteristics of objects (e.g., shape or colour), and a component which is responsible for handling relational or spatial information (Logie, 1995). Under very specific conditions not only pictures but also text will be processed in the VSSP, namely, if the text contains information about visual (e.g., colours or shapes; e.g., Deyzack, Logie, & Denis, 2006) or spatial aspects (e.g., locations of objects or spatial relations; e.g., De Beni, Pazzaglia, Gyselinck, & Meneghetti, 2005). Finally, the spatial VSSP is not only responsible for the processing of spatial information but also for the control of movements, especially eye movements (Postle, Idzikowski, della Sala, Logie, & Baddeley, 2006). Based on these findings, we assume that spatial text contents interfere with the processing of pictures in the spatial VSSP, because the processing of spatial pictorial contents, spatial text contents, and the control of eye movements take place there. Accordingly, the presentation of spatial text contents together with pictures should not enhance learning outcomes compared to the presentation of spatial text contents without pictures.

When presenting pictures together with text that does not contain any spatial information, one would expect less interference because the load is distributed more equally across the different VSSP components. Accordingly, when presenting text not containing any spatial information, pictures should be beneficial for learning (see also Schmidt-Weigand & Scheiter, in press). To test this hypothesis 84 participants were randomly assigned to four groups, resulting from a 2x2 design with picture presentation (with vs. without) and text contents (visual vs. spatial) as independent variables. We expected that only learners who received visual text contents would profit from the presentation of pictures, resulting in better learning outcomes compared to the other three groups, which should not differ from each other. A computerized learning environment, which consisted of information about fictitious fishes, was presented to learners. The texts differed with regard to contents: Learners with visual text contents received information about the visual characteristics of the depicted fishes, that is, the colour or form of a specific component (e.g., "The pectoral fin has the same light brown color as the dorsal fins"). Learners with spatial text contents received information about the spatial characteristics of the fishes, that is, the place of a component or its spatial relation to other components (e.g., "The pectoral fin lies between the two dorsal fins"). In the picture groups, pictures were presented on the screen showing the fish described in the texts, whereas in the non-picture groups the corresponding part of the screen remained blank.

After the learning phase, learners had to write down everything they recalled about two of the presented fish. To test our assumptions we used orthogonal contrast analysis following a procedure proposed by Niedenthal, Brauer, Robin, and Innes-Ker (2002). We created a contrast that described the hypothesized rank ordering of the means and two additional contrasts that were orthogonal to the first contrast and to each other. Then all three contrasts were entered simultaneously as independent variables in a multiple regression analysis, in which participants recall performance was regressed on all three contrasts.

As expected, the regression analysis revealed that learners with visual text contents and pictures ($M = 30.00\%$) differed significantly from learners with visual text contents without pictures ($M = 17.96\%$), learners with spatial text contents and pictures ($M = 19.16\%$), and learners with spatial text contents without pictures ($M = 11.29\%$), $F(1, 84) = 14.25$, p R^2 change = .14. The other three conditions did not significantly differ from each other, $F(1, 84) = 1.79$, $p = .17$, R^2 change = .04. To summarize, pictures supported learning only when presented together with non-spatial text contents, but not when presented together with spatial text contents. Furthermore, the recall of visual and spatial text contents did not differ when no pictures were presented, which indicates that the missing multimedia effect with spatial text contents can not be traced back to higher difficulty of these texts. Therefore, these findings support the hypothesis that there is a specific interference in spatial VSSP when processing spatial text information together with pictures. To conclude, the presentation of spatial text contents together with pictures should be avoided. Instead, it might be better to convey spatial information only through pictures, because they are assumed to be more efficient than texts to convey information about visuo-spatial properties.

References

De Beni, R., Pazzaglia, F., Gyselinck, V., & Meneghetti, C. (2005). Visuospatial working memory and mental representation of spatial description. *European Journal of Cognitive Psychology*, 17, 77-95.

Deyzac, E., Logie, R. H., & Denis, M. (2006). Visuospatial working memory and the processing of spatial descriptions. *British Journal of Psychology*, 97, 217-243.

Logie, R. H. (1995). Visuo-spatial working memory. Hove, England: Erlbaum.

Mayer, R. E. (2009). Multimedia learning. 2nd edition. Cambridge: Cambridge University Press.

Niedenthal, P. M., Brauer, M., Robin, L., & Innes-Ker, Å. H. (2002). Adult attachment and the perception of facial expression of emotion. *Journal of Personality and Social Psychology*, 82, 419-433.

Postle, B. R., Idzikowski, C., della Sala, S., Logie, R. H., & Baddeley, A. (2006). The selective disruption of spatial working memory by eye movements. *The Quarterly Journal of Experimental Psychology*, 59, 100-120.

Schmidt-Weigand, F., & Scheiter, K. (in press). The role of spatial descriptions in learning from multimedia. *Computers in Human Behavior*.

PAPER PRESENTATION

Disentangling the influence of argument type and comprehensibility on information persuasiveness

Lisa Scharrer, University of Muenster, Germany; Marc Stadtler, University of Muenster, Germany; MaryAnne Britt, Northern Illinois University, United States; Rainer Bromme, Universität Muenster, Germany

The presented experiment investigates whether inconsistencies in previous findings on the persuasiveness of different argument types (causal vs. noncausal) might be explained by argument comprehensibility acting as a confound. To assess whether argument types differ in their persuasiveness independently from their comprehensibility, both factors were manipulated orthogonally. The differential persuasive effects of argument type and comprehensibility were assessed with 88 undergraduates in a 2 (argument type: causal vs. noncausal argument) * 2 (comprehensibility: comprehensible vs. incomprehensible) within-subjects design. Participants read four arguments about medical issues and evaluated their credibility and strength. Furthermore, claim acceptance and confidence in the acceptance decision were measured. Results show that although laypeople deem causal arguments as stronger and more credible, argument type has no effect on acceptance of a claim as true and confidence in the acceptance decision. In contrast, comprehensibility not only has an effect on argument evaluation but also on claim acceptance and decision confidence. Our results suggest that inconsistencies in previous findings on the persuasiveness of argument types might be at least partly accounted for by confounding effects of argument comprehensibility.

Background and rationale

In the context of science communication, a factor which has previously received attention as a potential influence on laypeople's acceptance of scientific claims is the type of argument in which information is presented: In "causal arguments", scientific claims are supported by explanations of the underlying mechanism (e.g. "Cholesterol increases the risk of cardiovascular disease because it blocks the blood vessels"), whereas in "noncausal arguments", claims are supported by references to statistical data (e.g. "Cholesterol increases the risk of cardiovascular disease because 84% of people suffering from heart attack have above-average cholesterol levels"). It is assumed that causal arguments induce stronger claim acceptance, since their coherence and plausibility account for the human desire to understand and predict the world (Tobin & Raymundo, 2009). However, whereas some studies have indeed confirmed a persuasive advantage of causal arguments (e.g., Slusher & Anderson, 1996), other findings showed recipients to consider noncausal arguments as more convincing (Brem & Rips, 2000; Sandoval & Cam, accepted). One possible explanation for these mixed results is that argument comprehensibility might have acted as a confound; according to Trout (2002), understanding an argument causes feelings of success and consequentially positive affect towards the claim, which then leads recipients to accept the claim as correct. Moreover, a persuasive advantage of causal over noncausal arguments might only be brought out if arguments are well understandable; only when comprehensibility is high should recipients be able to appreciate the coherence and plausibility of explanations as favourable qualities. As comprehensibility has previously not been controlled, it is therefore possible that detected differences in persuasiveness between argument types might at least have partly resulted from variations in their respective comprehensibility. Our current experiment disentangled the influence of argument type and comprehensibility on laypeople's argument evaluation and claim acceptance. For this purpose, argument type and comprehensibility were manipulated orthogonally. Furthermore, we examined laypeople's confidence in their claim acceptance by assessing their desire to revert to the 'division of cognitive labour' (Bromme et al., 2010; Keil et al., 2008), i.e. their need to consult an expert for decision support rather than relying on their own judgment. We hypothesized that across argument types, laypeople will agree more strongly and confidently to claims supported by comprehensible than incomprehensible arguments. Furthermore, we expected an interaction effect of argument type and comprehensibility; laypeople should agree more strongly and confidently to claims supported by causal arguments than to claims supported by noncausal arguments when argument comprehensibility is high. However, no difference in persuasiveness should occur when comprehensibility is low.

Methods Participants and Design Eighty-eight

undergraduates were each allocated to four experimental conditions in a 2x2-repeated measurement design with the within-subject factors argument type (causal vs. non-causal) and comprehensibility (comprehensible vs. incomprehensible).

Materials and Procedure

Expository texts about four fictitious medical issues were generated, each consisting of an argument supporting an issue-related causal claim. For every text, four variations were created, analogous to the experimental conditions. In the causal argument conditions, the claim was supported by an explanation of the underlying mechanism and in the noncausal argument conditions by statistical data. Comprehensibility of both argument types was manipulated by use of technical terms and inclusion/omission of unnecessary, distracting detail. Participants completed a booklet containing one version of every expository text, each preceded by a scenario description which required participants to decide about the claim accuracy. The booklet also comprised Likert-scale measures to capture perceived argument comprehensibility, perceived argument strength and credibility, claim agreement and confidence in the agreement decision (indicated by confidence in one's claim judgment and desire to consult an expert for decision support). Claim agreement and decision confidence were assessed before and after participants read an argument.

Results

A manipulation-check revealed that comprehensibility varied between text versions as intended and independently from argument type. Regarding our hypothesis about the persuasive effect of argument comprehensibility, results showed that, as expected, comprehensible arguments were perceived as stronger ($F(1,87)=11.41$, $p<.001$). The hypothesized interaction effect of comprehensibility and argument type was not confirmed: No interaction of comprehensibility and argument type on either argument credibility or strength was observed, and neither did an interaction of both factors on claim agreement, confidence in laypeople's own judgment or desire to consult an expert reach significance. Our data also revealed unhypothesized main effects of argument type on claim evaluation. Participants rated causal arguments as stronger ($F(1,87)=13.067$, $p=.001$, $\eta^2=.131$) and slightly more credible ($F(1,87)=6.607$, $p=.012$, $\eta^2=.071$) than non-causal arguments. No main effect of argument type on claim agreement or decision confidence in the agreement decision was found.

Theoretical and educational significance

In summary, our results show that although laypeople evaluate causal and noncausal arguments differently regarding argument strength and credibility with causal arguments being slightly preferred, this does not transmit to their actual acceptance of a claim as true and confidence in their acceptance decision. In contrast, comprehensibility proved to be of great importance not only for argument evaluation but also for laypeople's claim acceptance and decision confidence. Comprehensibility might therefore at least partly account for previous findings of a varying persuasive impact of different argument types. The present results have implications for the communication of scientific information to laypersons: Depictions of science issues tailored towards lay audiences often increase comprehensibility not only by omission of technical terms or unnecessary detail but by concealing complexities which are in fact relevant for an informed judgment of the proposed claims (Goldman & Bisanz, 2002). This may lead lay readers to overestimate their ability to evaluate the information, cause them to accept claims as true and refrain from gathering further expert information. Thus, on a practical level, our results can inform instructors about the risks of presenting oversimplified information in terms of uncritical claim acceptance by readers.

PAPER PRESENTATION

Effects of Learner generated Representations as a Strategy for learning from Text and Pictures

Felix Wagner, University of Ulm, Germany; Tina Seufert, Ulm University, Germany

Learner generated pictorial representations such as drawings as a strategy to support text comprehension has been analyzed in several studies with inconsistent results. Beneficial effects that were found in text based learning material could not yet be verified in material comprising text-picture combinations. In a pre-study we investigated the effects of learner generated drawings when learning from text and pictures. As results have shown, generating one's own representation increases extraneous cognitive load, consequently hinders learning and is also dependent on the learners' spatial abilities. Learners do not invest effort in generating more comprehensive pictures but rather externalize visual perceptions of the already given pictures. Based on these findings we are conducting a 2x2 factorial design to investigate whether learner generated representations are more helpful for learning with text only or for learning with text and pictures.

Introduction and Theoretical Background

To understand scientific topics represented with text and pictures, learners need to select, organize and integrate relevant information of each representation into a coherent mental model (Mayer, 2005). Recent studies investigated

beneficial effects of learner generated representations when learning with verbal material. Findings revealed positive as well as negative effects on learning: Instructed to generate an external pictorial representation, learners are fostered to mentally represent the topic's global structure (Seufert, Zander, & Brunken, 2007; Van Meter, Aleksic, Schwartz, & Garner, 2006; Van Meter & Garner, 2005). Results of these studies also indicate interaction effects for learners with high and low spatial abilities using the strategy of generating representations (Seufert, et al., 2007). Despite these positive effects, generating representations also increases cognitive load and hence, hinder learning (Leutner, Leopold, & Sumfleth, 2009).

In the present pre-study we investigated effects of learner generated pictorial representations when learning from text and pictures. We expect that being instructed to generate coherent pictorial representations of a to-be-learned subject learners are activated to build a coherent mental model as well. We also assume interaction effects between learners with high respective low spatial abilities.

Method

33 psychology-students were randomly assigned to the experimental or the control group and were given material about a biological process including text and pictures. The experimental group was instructed to take graphical notes while learning, the control group was instructed to take notes in any form. In addition to learners' prior knowledge specific characteristics have been assessed as control variables. For analyzing the ATI-effects two groups with low respective high spatial abilities have been built by a median split, hence all analyses have been conducted as a 2x2 factor ATI-design.

Learning outcomes (including recall, comprehension and transfer), the amount and quality of the constructed representations have been assessed after the phase of learning and constructing. Moreover cognitive load had to be rated subjectively after learning on a 5-point likert scale from 1= very low mental effort to 5 = very high mental effort (based on Paas, 1992).

Results

Concerning the assessed control variables, the groups did only differ with respect to their current motivation, hence it has been included as covariate in all ANOVAS. For learning outcomes we found - contrary to our expectation - no treatment effect and no main effect for spatial abilities or ATI-effects on the learning outcomes for neither of the subscales.

For the amount and quality of pictures a main effect for the instruction was found: the amount of pictures that have been constructed ($F(1,28)=8.73$ $p<.01$, $\eta^2=.24$) as well as their quality ($F(1,28)=8.11$, $p<.01$, $\eta^2=.23$) were higher in the experimental group. No main effect for spatial abilities or ATI-effect could be revealed. However, contrasts showed that especially learners with low spatial abilities have responded to the instruction.

For cognitive load during the learning process no treatment effect or main effect for spatial abilities was found. By trend we found an ATI effect ($F(1,28)=3.88$, $p=.059$, $\eta^2=.22$) (see Figure 1): Contrasts revealed that learners with high spatial abilities reported a higher cognitive load in the experimental group ($MD=-1.01$, $SE = 0.37$, $p=.011$) whereas learners with low spatial abilities did not differ significantly between the groups.

Summary and Discussion

We analyzed the effects of learner generated pictorial representations while learning from text and pictures. Results showed that the instruction led to a higher amount of pictures produced as well as a higher quality. But drawing pictures as a learning strategy for learning with text and pictures had no impact on either of the learning outcome subscales.

Learners with high spatial abilities seem to invest more effort in drawing but without any positive effects on the assessed learning outcome. Hence, the highly reported load could be extraneous load that constrains the active learning process. These results are consistent with studies reporting an increase of cognitive load and the learners' need of support and guidelines during construction (Leutner, et al., 2009; Van Meter, et al., 2006). Based on the model of text and picture comprehension by Schnotz and Bannert (2002), learners externalize only visual perceptions of the already given pictures and are not engaged in building or interacting with the mental model.

In a follow up study we are investigating the inconsistent findings of learning generated representations when learning from text only compared to learning from material comprising text and pictures. Substantial interest is whether learner generated representations will show different effects depending on the learning material (text+pictures vs. text only). We expect that generating graphical representations will be most effective when learning

from verbal material whereas learning outcomes will decrease in the condition of text-picture learning material. Concerning cognitive load we expect that generating graphical representations will increase cognitive load during the learning phase. We also assume that the amount and quality of learner generated representations will be moderated by spatial abilities.

References

- Leutner, D., Leopold, C., & Sumfleth, E. (2009). Cognitive load and science text comprehension: Effects of drawing and mentally imagining text content. *Computers in Human Behavior*, 25(2), 284-289.
- Mayer, R. E. (2005). Cognitive Theory of Multimedia Learning. In R. E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (pp. 31-48). New York: Cambridge University Press.
- Schnotz, W., Seufert, T., & Bannert, M. (2002). Towards an integrative view of text and picture comprehension: Visualization effects on the construction of mental models. In J. Otero, J. A. Leon & A. E. Graesser (Eds.), *The Psychology of Science Text Comprehension* (pp. 385-416). Mahwah, NJ: Erlbaum.
- Seufert, T., Zander, S., & Brunken, R. (2007). Das Generieren von Bildern als Verstehenshilfe beim Lernen aus Texten. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 39 (1), 33-42.
- Van Meter, P., Aleksic, M., Schwartz, A., & Garner, J. (2006). Learner-generated drawing as a strategy for learning from content area text. *Contemporary Educational Psychology*, 31(2), 142-166.
- Van Meter, P., & Garner, J. (2005). The Promise and Practice of Learner-Generated Drawing: Literature Review and Synthesis. *Educational Research Review*, 17(4).

PAPER PRESENTATION

Supporting scientific discovery learning by feedback that is adapted to strategy use

Jessica Marschner, University of Bochum, Germany; Hubertina Thillmann, Ruhr-University Bochum, Germany; Joachim Wirth, Ruhr-University Bochum, Germany; Detlev Leutner, Duisburg-Essen University, Germany

Several studies showed that learners often fail in using appropriate strategies in scientific discovery learning (SDL) (Azevedo, Cromley & Seibert, 2004). Therefore learners need some instructional support referring to strategy-use. Support should be given during learning and should be adapted to learners' individual strategy use (Azevedo et al., 2004). According to models of self-regulated learning, feedback is relevant to regulate the strategy use adequately (Butler & Winne, 1995). Feedback can also produce positive effects on motivation (Kluger & DeNisi, 1996). Our research questions were: Is adaptive support more beneficial for SDL than non-adaptive support? Can feedback adapted to learners' strategy use increase the effects of adaptive support on SDL? 93 students learned with a computer-based learning environment. They were assigned to four conditions: receiving either adaptive feedback, or adaptive prompts, or non-adaptive prompts or no support (control group). We used logfile data to assess strategy use and a questionnaire to assess current motivation. Results reveal that learners in the feedback condition could be more motivated than learners with other support. Additionally, the feedback group showed significant more good strategy use than the control group and the non-adaptive prompt group. According to theoretical assumptions we showed that feedback adapted to individual strategy use is an appropriate support to enhance SDL.

Aims of the study

Studies show that learners often make mistakes and rarely use appropriate strategies during scientific discovery learning (SDL) (Azevedo, Cromley & Seibert, 2004; Klahr & Dunbar, 1988). Appropriate cognitive strategies for SDL are described within the Scientific Discovery as Dual Search (SDDS) model by Klahr and Dunbar (1988). It describes strategic experimenting as an interaction between two spaces. In the hypothesis space, generating hypotheses takes place. In the experiment space, these hypotheses should be tested by conducting systematic experiments, i.e. experiments using the control-of-variables strategy (CVS). Conclusions from those experiments should then be drawn in the hypothesis space again, which may result in new or modified hypotheses. To help learners using these strategies, some instructional support is needed. Studies show further that learners have strategy knowledge available but don't use it (Veenman, van Hout-Wolters & Afflerbach, 2006). A prominent method to overcome such a production deficiency is prompting (Bannert, 2003). However, results of prompting studies show that the effectiveness could be enhanced further. One approach to do this is to adapt support to learners' individual needs (Azevedo et al., 2004). According to Schwonke, Hauser, Nýckles and Renkl (2006) adaptive support should be perceived as more beneficial than non-adaptive support. Another approach is to provide additional strategy-use-related feedback which should increase learners' motivation to use the support (Kluger & DeNisi, 1996). Furthermore, feedback during the learning process should improve learners' monitoring which in turn should enable learners to regulate their strategy use adequately and to eliminate mistakes (Butler & Winne, 1995). So far adaptive support in general and especially feedback adapted to strategy use is practically not used in SDL. Thus, our questions were: Is

adaptive support more beneficial for motivation and strategy use in SDL than non-adaptive support? Can positive effects of adaptive support be increased by providing additional feedback which is adapted to individual strategy use?

Methodology and research design

A sample of 93 German high school students took part in this study (mean age: 14.62 years ($SD = 0.62$); 35.5 % male, 63.4% female). All learned self-regulated within a computer-based scientific discovery learning environment on 'buoyancy in fluids'. This learning environment consisted of a hypothesis space, in which hypotheses could be charted, and an experiment space, in which simulated experiments could be conducted. Students had to find out as much as possible about 'buoyancy in fluids'. During the 20-minute-phase of self-regulated learning learners' mouse-clicks were registered into logfiles. Different support measures, all regarding experimenting strategies, were implemented into the computer-based learning environment and were given during learning. Students were randomly assigned to one of four different learning conditions. Group one received adaptive feedback which means that information about their previous experimenting strategy performance was added to an adaptive prompt. These adaptive prompts were adapted to learners' individual strategy use and prompted that strategy which was used insufficiently so far. Group two received adaptive prompts without feedback. Group three received non-adaptive prompts (general hints to good strategy use) without feedback. Group four was the control group and received no support at all. Before and after learning, all students had to fill in a "current motivation" questionnaire. Based on behavioral logfile data, a measure for good strategy use was calculated. It measures conduct of experiments with CVS according to stated hypotheses and drawn conclusions, as it is described in the SDDS model.

Results

First, we tested whether the support conditions differ in students' current motivation. To account for baseline differences, we used the gain in the current motivation score from before learning to after learning. As expected, the ANOVA shows a significant difference between the various support conditions ($F(3,86) = 2.18$, $p \eta^2 = .071$) (see Figure 1). Contrasts show a higher gain in motivation for the feedback condition compared to the adaptive prompt condition ($t(86) = -1.89$, $p t(86) = 2.28$, p

Second, we examined whether the experimental groups show a difference in good strategy use. Figure 2 shows that the group with adaptive feedback has the highest score in good strategy use. Results of an ANOVA indicate a significant difference between groups ($F(3,86) = 2.20$, $p \eta^2 = .072$). Contrasts show significant differences between feedback condition and control group ($t(86) = -1.90$, $p t(86) = -2.51$, p

Theoretical and educational significance

From a theoretical perspective, our study supports the assumption that feedback information fosters monitoring (Butler & Winne, 1995) because we could improve strategy use by strategy-related feedback but not by prompts.

From a practical perspective, our results provide helpful information for designing appropriate methods to support self-regulation competencies. Providing learners adaptive feedback during SDL with information about their shown strategy use and adaptive hints to further strategy use is beneficial for learning. It can keep up motivation and can enhance strategy use.

References

- Azevedo, R., Cromley, J.G. & Seibert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia? *Contemporary Educational Psychology*, 29, 344-370.
- Bannert, M. (2003). Effekte metakognitiver Lernhilfen auf den Wissenserwerb in vernetzten Lernumgebungen [Effects of metacognitive learning aids on knowledge acquisition in networks of learning environments]. *Zeitschrift für Pädagogische Psychologie*, 17, 13-25.
- Butler, D.L. & Winne, P.H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65, 245-281.
- Klahr, D. & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science*, 12(1), 1-48.
- Kluger, A. N. & DeNisi, A. (1996). The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, 119, 254-284.
- Schwonke, R., Hauser, S., Nýckles, M. & Renkl, A. (2006). Enhancing computer-supported writing of learning protocols by adaptive prompts. *Computers in Human Behavior*, 22, 77-92.
- Veenman, M.V.J., van Hout-Wolters, B.H.A.M. & Afflerbach, P. (2006). Metacognition and learning: conceptual and methodological considerations. *Metacognition and Learning*, 1, 3-14.

PAPER PRESENTATION

Experiences of linking schools' learning environments to students' personal online environments

Teemu Valtonen, University of Eastern Finland, Finland; Tiia Koponen, University of Eastern Finland, Finland; Mikko Vesisenaho, University of Eastern Finland, Finland; Stina Hacklin, University of Eastern Finland, Finland

Supporting students' collaborative learning has long been a target of using different ICT tools in education. Today, social software emphasising users' communication and active role as producers of content provides interesting possibilities for building learning environments that enable and foster collaborative learning activities. Use of social software for learning is also interesting because of its popularity among today's students. However, students' reactions to mixing the tools and environments used for learning and leisure can bring challenges.

In this paper, we describe a pilot study of using Facebook as part of a learning environment. The aim of using Facebook was to link online learning environments and students' personal online environments. This paper reports students' reactions to using Facebook in the learning process and how students' learning was affected by bringing the learning process into their personal online spaces. The study was conducted in a university context and the target group consisted of 46 teacher students.

Background

Supporting students' collaborative learning has long been a target of using different ICT tools in education. According to Dillenbrough (1999), collaborative learning is a "situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms". From this perspective, social software is well suited for collaborative learning. Social software emphasises users' communication and active role as producers of content. Social software is interesting for teaching because of its popularity among today's students who are characterised as net generation. The assumption is that net generation students have readiness to use the Internet and ICT. This readiness should be taken into consideration in schools, i.e., to bring learning activities to environments where students already are. However, students' reactions to mixing the tools and environments used for learning and leisure can bring challenges. Earlier results about students' reactions are contradictory (Jones et al. 2010; Roblyer et al. 2010). We argue that social software provides tools for concretising and making visible the mechanisms of collaborative learning. The question is can we take advantage of students' motive for using Facebook, i.e., motive for reading the RSS feeds by their friends for learning. In this study, we used Facebook as part of the learning environment. The aim is to link online learning environments to students' personal Facebook profiles.

Research

This pilot study was conducted as part of student teachers' ICT and pedagogy course (N=150 in 7 groups). Students built their own blogs as their learning environment and linked them to other students' blogs using RSS. The teacher created a Facebook profile for the course and linked students' blogs to the profile. Participation in the Facebook pilot was voluntary and altogether 50 students from different groups participated. At the end of the pilot, students responded to a questionnaire (N=46) focusing on students' experiences of the pilot. The research questions were: How do students react to connecting school activities and their Facebook profile? Does the use of Facebook affect students' learning?

Results

Here we provide preliminary results from the pilot. Questionnaire contained statements using a 5 point scale, 1 indicating strong disagreement and 5 strong agreement. The first three statements were merged into a subscale for measuring students' attitudes toward the experiment (alpha value .84).

These statements were:

- Course contents on my Facebook page did not bother me
- I could use Facebook as part of my studies also in the future
- Facebook is well suited for higher education learning

Respondents were divided into three groups align with quartiles (Q1, Q3) of distributions of subscale above:

Groups:

Average of the subscale

N

Neutral attitude

2.8

22

Negative attitude

1.4

11

Positive attitude

4.1

13

These results indicate that students' experiences varied. Most of the students had a rather neutral opinion. Results of the Negative attitude group indicate that they do not want to use Facebook in their studies while students in the Positive attitude group find Facebook suitable for their studies.

The second part of the questionnaire dealt with the effect that using Facebook had on interaction and motive during the course.

The following statements were used for building the second subscale:

- Use of Facebook increased awareness of the work done by my peers
- Facebook helped me familiarise myself with other students' work
- Being reminded of other students' work on my Facebook page increased my motive for the studies

When compared to the three groups described above, we can see differences.

Groups:

Average of subscale

Neutral attitude

2.9

Negative attitude

1.1

Positive attitude

3.4

General attitude toward the experiment aligns with students' experience of the effect of using Facebook. Students with negative attitude indicated clearly that using Facebook did not increase their awareness of each others' work or motive for learning. On the contrary, students with positive attitude indicated that using Facebook increased their motive and awareness of each others' work.

Results from qualitative data brought up more information, aligning with the results described above. Students with negative attitude experienced that a large amount of feeds on their personal page was disturbing and caused lack of interest. Also, they felt lack of interest in the topic of the course as well as lack of time. On the contrary, students with positive attitude found it useful that they could see each others' work and progress in Facebook. These students indicated that seeing the work of their peers on their Facebook page reminded them about the course and doing their assignments. Also, students indicated that active presence of contents by their peers supported their own learning. An important result was also that students indicated willingness for reading especially the feeds by the students in their own small group. Altogether, students found the experiment a refreshing change from the normal teaching and learning practices. Yet, most of the respondents indicated that using Facebook did not change their ways of studying. Based on these preliminary findings we can state that students' experiences of connecting school activities to their personal Facebook page varied, which demands more research. However, the results are encouraging for further developing the idea of linking environments for leisure with environments for learning. Especially important was the indicated interest in reading the RSS feeds by their friends and classmates. This brings further ideas for developing software such as Facebook as tools of collaborative learning. In the presentation, we bring up more detailed results from the experiment, especially regarding the qualitative data.

References:

- Dillenbourg, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), Collaborative-learning: Cognitive and Computational Approaches (pp. 1-19). Elsevier.
- Kabilan, M., Ahmad, N. & Abidina, M. (in press.). Facebook: An online environment for learning of English in institutions of higher education? The Internet and Higher Education.
- Roblyer, M., McDaniel, M., Webb, M., Herman, J. & Witty, J (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. The Internet and Higher Education, 13(3), pp. 134-140.

PAPER PRESENTATION

Technopedagogical design versus reality in an inter-institutional online remedial course

Manuel Juarez, CENIDET, Mexico; Jose Luis Ramirez, CENIDET, Mexico; Ana Remesal-Ortiz, Universidad de Barcelona, Spain

The authors present a case study on the design and implementation of a remedial online course, implemented in collaboration among three different institutions nationwide. The course was addressed to computer engineering master students. After several years of detecting certain lack of basic skills in logical language, the course was designed to offer the students the chance to overcome these deficiencies. The design of the course foresaw the participation of instructors from three institutions and the collaboration of students from the same institutions working in pairs both synchronously and asynchronously via a learning management system (Moodle) in a blended modus. Altogether, three instructors and fourteen students took voluntarily part in the experience. The course design is grounded in the second generation of activity theory. The eventual, actual development of the course was thoroughly followed by an external auditor and questionnaires were gathered at the end from students and instructors, in order to collect information about their satisfaction with the course. Results of this external evaluation point to problems in the design and implementation of the blended course and challenges set by the distribution of participants in time and space, which usually are defended as the very advantages of e-learning. The discussion of results will particularly address these challenges.

NOTE: All references have been avoided for the sake of blind review.

Background and research questions

The authors present a case study on the design and actual development of an inter-institutional blended online computer supported course. The course is offered as a remedial online course for Computer Engineering Master (CEM) students. During the past decade a growing lack of skills in logical language was identified in one national institution among students entering the CEM program. After several attempts of addressing the need for assistance, an online course was designed. The course was carried out twice entirely online before extending it to an inter-institutional blended proposal. These two first implementations were quite successful. However, the extension to an inter-institutional and blended context was less satisfactory, due to additional unforeseen challenges. In this paper, these challenges will be addressed.

The basic techno-pedagogical design of the course is grounded in the second generation of activity theory. The interaction of students among themselves and of students with the instructor of the course was regulated by the team accelerated instruction (TAI) model. Basis for the orientation of actions were designed in order to scaffold students construction of translation skills from natural and logical mathematical language. The participants were offered both synchronous (video-conferences and chat) and asynchronous tools (general whole class forum and small team private forum) along the course.

After a thorough audition of the course, the following questions rose, and eventually guided this study:

- (a) 1) Was the participants' interaction in accordance with the course design? Did it develop as expected?
- (b) 2) In case of unexpected phenomena, what happened? What could be a likely reason for the actual development of the course?
- (c) 3) What conclusions can be drawn for future design of similar courses which combine face-to-face and online modus, and promote inter-institutional collaboration, both among students and among instructors?

Participants and design

Three national institutions participated in this course. The course was in pilot phase, hence, the participation was voluntary and eventually three instructors and fourteen students took part in the course. It was offered through the learning management system Moodle and lasted 4 weeks (October 2008). The techno-pedagogical design of the course regulated the interaction of participants in the following way:

- (1) 1) The course contents were designed by all instructors in collaboration.
- (2) 2) A principal instructor (who was more experienced in e-teaching, for having developed the previous two editions of the course in a single institution) was in charge of the main whole class activities in the online platform.
- (3) 3) The other two instructors were in charge of additional educational online support and individual tutoring upon request by the students. In addition, they carried out the face-to-face part of the course in their respective institutions.
- (4) 4) Students from different institutions would collaborate in pairs, gathering always two students who were very unlikely to meet face-to-face, due to geographical distance.

(5) 5) After working in pairs, whole class discussions were organized for the clarification of contents, by means of video-conference.

Data collection

All throughout the course, an external auditor was following the process, from the design phase until the final assessment of students. Different sorts of data were collected: system log files, forum and chat interaction of students and instructors, and a final satisfaction questionnaire to all participants involved in the course. All the data were put together for a qualitative, comprehensive analysis of the course.

Results

Unexpectedly, this third edition of the online remedial course was less successful than the previous two editions. The authors (designers, instructor and auditor of the course) had to face this situation and identified eventually the challenges of the specific context. Despite the high satisfaction rate of the participants, clear deficiencies could be placed at:

- (1) 1) The lack of experience of the instructors in e-learning/e-teaching
- (2) 2) The lack of experience of the students in e-learning
- (3) 3) The extreme demand of co-regulation through the geographical distribution, which ended up in a limited online interaction among students, who preferred the direct face-to-face interaction with their peers at their home institution.

Particularly the last point is challenging in the context of distance computer supported education since, traditionally, one of the advantages of this kind of instructional proposals was placed in the time and space distribution, which should enhance the chances for complex knowledge construction. However, in this case, even the implementation of synchronous audio and video tools did not offer such kind of advantages to overcome the geographical distribution. The key for such a disappointing result was eventually placed in the blended mode of the course. It seems evident, hence, that the design of blended courses requires the consideration of very particular factors and elements that do differ from purely online proposals. These particular factors and elements will be presented for discussion.

PAPER PRESENTATION

Students' aims for building Personal Learning Environments

Teemu Valtonen, University of Eastern Finland, Finland; Stina Hacklin, University of Eastern Finland, Finland

ICT provides numerous ways to meet the needs of today's society and student generation. An interesting newcomer in the field of ICT and education is the concept of personal learning environments (PLE). PLE refers to teaching and learning emphasising student central role in two ways: first, students are the designers of their own learning environments and second, teaching and learning emphasises students' role as self-directed learners. These features indicate a strong change in the roles and responsibilities of students and teachers. Typically, teachers and schools have been responsible for building and administrating the learning environments used. Also, teacher's role as the leader of the learning process has traditionally been stronger and more visible.

This paper outlines some features and challenges related to the use of PLEs. The paper also provides insight into students' experiences and aims related to their PLEs after the first implementation year. The context of the study reported here is an EU funded "PeLE" project for developing the use of PLEs for everyday teaching and learning. This is a qualitative method study and the research data consists of 27 student-made descriptions of their PLEs.

Today's world, described as knowledge society, and today's students as net generation, ready and willing to use ICT for learning, pose challenges for schools and teachers. ICT provides numerous ways to meet the needs of today's society and student generation. An interesting newcomer in the field of ICT and education is the concept of personal learning environments (PLE). PLE has been suggested as one solution for the challenges described above. This paper outlines some features and challenges related to PLE and provide insight into students' experiences after the first year of using PLEs.

This paragraph outlines central features of PLE employing mainly the ideas by Attwell (2007) and Downes (2005). PLE refers to teaching and learning that emphasises students' central role in two ways. First, students are expected to build their own learning environments with the ICT tools and software they find appropriate. Second, the idea of using PLEs emphasises students' self-directed learning, i.e. students' more active role in the learning process. These features indicate a strong change in the roles and responsibilities of students and teachers. Typically, teachers and schools have been responsible for building and administrating the learning environments used. Also, teacher's role as the

leader of the learning process has traditionally been stronger and more visible. These changes pose challenges both for students and teachers. In this paper, we concentrate on students' perspective.

PLE allows students to use the tools they find appropriate for their learning. They can also personalise their learning environment and link it to their life outside schools. At best, this approach will also bring new ideas for teachers and schools about how to take advantage of different software and ICT, such as mobile technologies, for learning. However, there are also challenges. Even though today's students have been described as net generation, they do not necessarily have skills to use their knowledge and ICT skills for learning (Valtonen et al. in press). Another challenge relates to learning skills. Skills for learning relate to students' meta-cognitive skills, i.e. skills for planning, controlling and evaluating learning. According to Hakkarainen et al. (2007, p 72-73), the problem is that development of these skills is typically of teachers responsibility and that students do not necessarily develop these skills without guidance.

Research settings

This paper concentrates on personal learning environments created by students of a university of applied sciences and a vocational institute. The context of the study is an EU funded "PeLE" project. The aim of the project is to develop the use of PLEs for everyday teaching and learning. This is a qualitative method study and the research data consists of 27 student-made descriptions of their PLEs. The object was that students outline the aims that they had for their PLE and describe the overall experiences of using a PLE. These are the results after the first year into the project. The research question was to see how students see PLEs and what is the aim of their PLEs?

At the beginning of the project, students were instructed about the ideas of PLE. For students who had no idea about possible software that they could use, teachers suggested the Ning-environment. In addition to using PLEs to support students' learning, the project also had an aim to direct the PLEs to special focus areas according to student's discipline. For example, students of business were suggested to build their PLEs focusing on seeking of jobs and business cooperation. Despite these suggestions, students were free to design their environments in the way they wanted.

Results

Results indicate that most of the students chose the Ning environment as their PLE environment. Exception was the computer science students who built their PLEs from the scratch or chose to use different software, e.g. Wordpress or Blogger. Results from students' descriptions of their PLEs provided the following aims for designing PLEs.

PLEs as learning environments: The aim of the first approach is to build environments to work as traditional "learning environments" with strong similarities to learning management systems (LMS), such as Moodle. Students uploaded their learning assignments into their PLEs so that their teachers were able to comment them and give feedback. The PLEs contained a clear, curriculum bound structure.

PLEs as reflection environments: The aim was that PLEs would be platforms for students' reflective thinking, aimed for summarising and deepening learning of the course content. Students wrote down their experiences of these courses and practice periods. These environments usually contained blogs or other similar tools for students' writings and for teacher's and other students' comments.

PLEs as tools for bringing up students' skills: These PLEs were designed for bringing up students' skills and knowhow. These PLEs typically consisted of a CV, a large portfolio of students' assignments and projects and other material for introducing the person. This approach was typically used as a tool for showcasing students' skills for their teachers and when applying job.

In addition, students mentioned the importance of collaborative activities in their PLEs. Another feature that divided students' experiences was the openness of their PLE, whether everyone should be able to access their PLEs or only the people they chose. These results can be seen as the first step toward taking advantage of PLEs. It seems that the traditional way of using LMS still shows in students' work. Also, results indicate that building PLEs is a task that needs support, even if the students belong to the net generation. Altogether, students were mainly positive about the possibility to build their own learning environments.

References:

- Attwell, G. (2007). The personal learning environment – the future of learning? *eLearning Papers*, 2(1), 1-8.
- Downes, T. (2005). E-learning 2.0. *eLearn Magazine*.
- Hakkarainen, K., Bollström-Huttunen, M., Pyysalo, R. & Lonka, K. (2004). *Tutkiva oppiminen käytännössä: matkaopas opettajille*. Helsinki, WSOY.

Valtonen, T., Pöntinen, S., Kukkonen, J., Dillon, P., Väisänen, P. & Hacklin, S. (in press). Confronting the technological pedagogical knowledge of Finnish Net Generation student teachers. *Technology, Pedagogy & Education*.

PAPER PRESENTATION

The digital school and teacher education in Norway

Rune Krumsvik, University of Bergen, Norway

This paper focuses on how the new national curriculum for school and the new general plan for teacher education in Norway change the underlying premises for teaching and learning in today's schools. This has become particularly pressing as a result of the new educational reform 'Knowledge Promotion' whereby digital competence is now the fifth basic competence in all subjects at all levels as well as in the new teacher education in Norway. The aim of the paper is to consider ICT in the light of these policy documents, relevant research studies, teacher education and the general digitisation of schools in the Norwegian context. The question considered by the paper is how the new curricula in school and the general plan for teacher education in Norway influence the underlying premises for teaching and learning in today's schools and teacher education Norway.

The main focus of this paper is why the new national curriculum in Norway (MOK, 2006), a new general plan for teacher education (MOK, 2010), the digitisation of schools and the use of ICT make it necessary to highlight the possibilities, dilemmas and challenges schools and teacher education are facing today. This has become particularly pressing as a result of the new educational reform 'Knowledge Promotion' (MOK, 2006) whereby digital competence is now the fifth basic competence in all subjects at all levels (stages 1 to 13, 6-19-year-olds), as well as in the new teacher education (MOK, 2010). Consequently, Norwegian schools are infiltrated with new technology, and obligatory ICT in all subjects is in many ways making us question both our general perception of 'technology' as an educational term and teachers' use of technology in school. The introduction of this national curriculum has created a situation where the pedagogical and didactical conditions in Norwegian classrooms have changed considerably. This situation calls for a more in-depth consideration of how ICT influences 'how teachers teach and learners learn' in the digital era as well as how it is reflected in the new teacher education. Neither Norway nor other countries have highlighted the ICT challenges to which teacher education has been exposed as a result of the digitisation of society and schools. Kirschner, Wubbels and Brekelmans (2008) observe that the majority of teacher educators (TE) have paid the ICT area little attention and researchers have largely ignored ICT in teacher education. Against this background the aim of the article is to consider ICT in the light of policy documents, research studies, teacher education and the general digitisation of schools in the Norwegian context and formulate advice that may be useful for other countries. The question considered by the paper is how the new curricula in school and the general plan for teacher education in Norway influence the underlying premises for teaching and learning in today's schools and teacher education in Norway. In recent years, Norway has become one of the leading countries with regard to accessibility of technology in society and schools, and consequently there is a need for more knowledge and awareness about how this situation influences socio-cultural participation, socio-economic patterns and digital divides. This digitisation of society and schools in Norway leaves little doubt that the digital revolution has made its mark on both society and school systems to an even greater extent than in other countries. In recent years, Norway has been one of the highest ranking nations in relation to technology penetration in society (Castells, 2001; Vaage, 2005, 2008, 2009; Utdanningsdirektoratet, 2008; OECD, 2010). According to the Norwegian Media Monitor (Vaage, 2009), in 2009 92% of Norwegian households owned a PC (average 2.1 PC per household) and 91% were connected to the Internet (82% with broadband access). Among young people, 97% of 16-19-year-olds had broadband access at home in 2009. 98% of the Norwegian population owned a mobile phone in 2009 and 65% of households used their PC for an hour and 46 mins every day in 2009. In elementary schools there were 3.7 pupils per PC in 2009 (Hægeland, Kirkebøen & Raaum, 2009). In upper secondary schools, there was one pupil per PC in 2009, and for the first time in Norwegian history, every pupil who started their upper secondary education in 2008-09 received their own laptop free of charge from the government (Utdanningsdirektoratet, 2008) and 55% of 9-15-year-olds and 70% of 16-24-year-olds used social media (Facebook, Twitter, etc.) every day (Vaage, 2009). Of these, 41% of 16-19-year-olds spent five hours or more every day in front of a screen in their leisure time outside school (Vaage, 2008). For elementary pupils (age group 9-16) the tendency is the same and digital learning resources are increasingly replacing textbooks for homework (SAFT, 2006). In some counties, paper textbooks have been replaced by digital textbooks for several subjects in upper secondary schools. Consequently, Norway is a particularly good starting-point when it comes to technology access and the opportunities, challenges and dilemmas it faces in the running of schools. One can therefore ask to what extent does this have any impact on pupils' knowledge and learning?

As regards the pedagogical use of ICT in teacher education and schools in Norway, there are three important frame factors that must be considered: the enormous digitisation of society and school in the last ten years, the new

national curriculum (MOK, 2006) for schools and the new general plan for teacher education (MOK, 2010). These frame factors have altered so many of the underlying conditions for teaching, learning and knowledge that although many of the former conceptions of pedagogy and didactic are still valid, Krumsvik and Almås (2009) found it necessary to revitalise general didactic to take into account the new pedagogical and didactical streams we are facing today. To describe this situation in conceptual terms, we found it appropriate to present a new concept, digital didactic, which takes into account the didactical terrain teachers, pupils, teacher students and TEs' are treading in digitised schools and teacher education. One definition of this concept is: 'Digital didactic is an instructional theory of technology which puts a special focus towards the art of teaching in technology dense learning environments' (Krumsvik & Almås, 2009:14). When revitalising pedagogy and didactic for the digitised school and teacher education, however, it is quite clear that one has to give particular consideration to the structures which have strongest impact on teachers' and TEs' professional development today.

The aim of the paper is to consider ICT in the light of these policy documents, relevant research studies, teacher education and the general digitisation of schools in the Norwegian context. The question considered by the article is how the new curricula in school and the general plan for teacher education in Norway influence the underlying premises for teaching and learning in today's schools and teacher education Norway. The methods used in the study was quasi statistics (Maxwell 2005) and document analysis (Merriam 2009).

PAPER PRESENTATION

Using social media to activate unemployed youth and early school leavers

Paulo Moekotte, Utrecht University, Netherlands; Henk Ritzen, Applied University Edith Stein, Netherlands; P. Robert Jan Simons, Netherlands School of Educational Management, Netherlands

The paper presents the results from the first phase of an education design research, identifying and describing design criteria that can be used for designing learning arrangements that are (1) designed for school leavers and unemployed youth with little or no access to learning opportunities; (2) more context driven than curriculum driven; (3) situated in an out-of-school context and (4) providing malleable technology that can be appropriated by the intended users.

Learning is seen as of the greatest importance in trajectories and tracks aiming at promoting participation on the labour market. But most job counselling or work-placement programmes do not entail training or education because of the dominant 'work-first approach' or because of the difficulties that social services or job counsellors encounter when trying to match supply and demand.

Data has been gathered from contextual analysis, combining desk research and interviews of focus groups of managers, and needs analysis, i.e. several interviews of focus groups consisting of social professionals and school leavers. The contextual and needs analysis have been combined with findings from the literature study..

The findings that will be presented, illustrate the constraints and perceived needs of professionals and youth with regard to attention in guidance and counselling tracks for social competencies and social capital as contributing factors to self-sufficiency and opportunities, and the use of social media in the process of negotiating goals, establishing agreements and carrying out individual 'learning contracts'.

Introduction

In the Netherlands like in many other countries, many early schoolleavers become disengaged with learning (Appleton, Christenson & Furlong, 2008) and finally are 'pushed' or 'pulled' out of the vocational educational system (Meng et al., 2009). A relatively large number of the local unemployed youth above 18 (n=11390) in the region of Twente in the Netherlands is low-skilled (78% are qualified under ISCED 3C short level) and can be considered 'inactive' and hard to reach (60% not registered/on welfare). The reluctance to register one self can be seen as part of the problem of social services to reach unemployed youth.

Rationale

Persistent problems like social exclusion (Eimers & Verhoef, 2004; Roest, 2010), unemployment (Ewalds, 2009) and school drop-outs, have proven that economic improvement in its own, does not warrant or create the opportunities for early school leavers to participate in a lasting way. Learning is still seen as of the greatest importance in trajectories and tracks aiming at promoting participation on the labour market, but most job counselling or work-placement programmes do not entail training or education because of the dominant 'work-first approach' or because of the difficulties that social services or job counsellors encounter when trying to match supply and demand (Inspectie Werk en Inkomen, 2008). Seeing employment as an important factor for lasting self-sufficiency and taking into account the labour market demand for flexibility, more lasting effects of counselling programmes could be expected if the transition to work would also encompass more attention for the development of participatory

competencies (Wildemeersch et al., 2001). Furthermore educational institutions should spend more attention to social competencies and social capital as factors that influence economical and social participation and opportunities to grow in a lasting way (Bronneman-Helmers & Herweijer, 2004; Berghouwer & Van Wieringen, 2006; De Graaf-Zijl et al., 2006; Hovels, Visser & Schuit, 2006).

Research questions

The questions that should be answered with regard to the arrangement that should be developed, are the following:

- which social competencies contribute to active participation?
- how can social capital be developed and sustained?
- which educational, technological and social affordances are required to design the according learning arrangements?

This research aims at developing criteria that can be used for designing learning arrangements that are (1) designed for school leavers and unemployed youth with little or no access to learning opportunities; (2) more context driven than curriculum driven; (3) situated in an out-of-school context and (4) providing malleable technology that can be appropriated by the intended users.

The focus of these arrangements is on developing young people's social competencies, communicative skills and social capital (resources and meaningful connections) to enhance their self-sufficiency and ability to react to and cope with labour market demands. Depending strongly on the willingness and ability of several local institutions to cooperate, the research is designed with requirements like interaction and collaboration in mind.

Theoretical framework

Important theoretical insights and concepts with respect to this research are drawn from several theories, i.e.

- adaptive structuration theory (Desanctis & Poole, 1994)
- affordance theory (Gibson, 1977)
- theory of situated learning (Wenger & Lave, 1991)
- the appropriation theory (Bakhtin, 1979/2000)
- the concept of the technology appropriation cycle (Carroll, 2004)
- the concept of the sociability of CSCL environments (Kreijns, Kirschner & Jochems, 2002)
- the construct of psychological ownership (Barki1, Pare & Sicotte, 2008; Gaskin and Lyytinen, 2010)

Research design

This research is designed as an educational design research (Van den Akker et al., 2006) comprising of several phases or stages of research activity. The paper will cover the first, preliminary phase of research that leads to the identification and description of design criteria to be used for the development of an educational intervention. This preliminary phase consists of three major research activities:

- a contextual analysis of the local policies and practices combined with the data analysis of the local results (desk research) and focusgroups with managerial representatives from local stakeholders
- a needs analysis in the form of focusgroups of social professionals and school leavers
- a literature study or review

The combination of the needs analysis and literature study aids in the identification of the design criteria for an educational intervention whereas the contextual analysis frames the requirements, intricacies and demands that are inherent to the local context. A final element that is part of the preliminary phase is the study of 'inspiring examples' which resemble the case at hand. These inspiring examples may be subjected to 'reverse engineering' in order to detect additional criteria that can be used.

The research is conducted in the region of Twente in the Netherlands. A design study requires interaction and collaboration between researchers, teachers, and other stakeholders. Among these stakeholders are representatives from municipalities, social services and local youth work. Such interaction opens up possibilities for richer, more relevant research, but also brings along methodological challenges as methodological quality and rigor have to be paired with contextual relevance and usability. The research therefore requires a qualitative research approach on a local scale. In this sense the contextual analysis can be considered to be treated as a case study on a regional level (Hamel, Dufour & Fortin, 1993).

The first phase of this research will be concluded in February of 2011. The needs analysis and part of the contextual analysis is being conducted in the form of semi-structured interviews with focus groups consisting of local social professionals and managerial representatives (from educational institutions, municipalities, social services and youth

work) and focus groups consisting of local youth who have dropped out of school or are considered 'at risk' of quitting school. These school leavers are selected by means of 'key informant recruitment' (Peek & Fothergill, 2007) by the social professionals or teachers/counsellors who work with them. The interviews are guided by a lead questionnaire. Three different questionnaires have been created to conduct the semi-structured interviews. The interviews are recorded, transcribed and labelled with the aid of a software tools for qualitative analysis (Atlas TI) en further statistical analysis (SPSS).

Findings

Results from the first phase of this research will be presented during the EARLI 2011 conference "Education for a Global Networked Society" in Exeter, UK.

PAPER PRESENTATION

Towards a New Motivational-Based Model of Innovation Adoption

Ellen Usher, University of Kentucky, United States; Francesca Fanni, Università della Svizzera Italiana, Switzerland;
Jayson Richardson, University of Kentucky, United States

In this presentation, we seek to offer a conceptual model that draws on insights from two complementary theories of behavioral change—diffusion of innovation theory and social cognitive theory—to explain why individuals and groups adopt any given innovation. Both theories have been used extensively to explain human action (or inaction) in a variety of domains and settings. We situate this new conceptual model within the field of education, where the potential for technological innovation has created new possibilities and challenges for administrators, teachers, and students. We then offer implications for practices that enhance the adoption of educational technology innovation in diverse global societies.

Relevance of EARLI: Learning and Instruction

Psychologists and education researchers alike have long attempted to identify those behaviors that produce better learning outcomes for students. These behaviors have historically included curriculum development, classroom management, pedagogical mastery, and classroom practices. At the close of the first decade of the twenty-first century, optimized instruction seems to rest increasingly on the successful integration of digital technologies for individualized learning. This calls for educators who are both competent and confident in their ability to adopt new instructional technologies.

Among the aims of the EARLI 2011 conference is to examine how technology is creating new possibilities and challenges for teachers. In this conceptual paper we seek to identify the willingness or reluctance of teachers and school leaders to adopt and implement new learning technologies in their practice. The goal of the proposed theoretical paper is to present complementary insights from two theoretical viewpoints regarding behavior change.

Complementary Theoretical Perspectives

Perspective 1: Diffusion of Innovations Theory

Rogers' (2003) model of the diffusion of innovations theory refers to the "process by which 1) innovation 2) is communicated through certain channels 3) over time 4) among the members of a social system [author's emphasis]" (p. 11). According to Rogers, adoption of novel ideas, practices, or objects requires "a decision to make full use of an innovation as the best course of action available" (p. 473). He designed a model to explain the processes through which ideas, practices, or objects are communicated and thereby adopted by members of a particular society, that is, the process by which innovations lead to systemic change.

Rogers (2003) identified five attributes that influence a person's choice to adopt an innovation: relative advantage, compatibility, complexity, trialability, and observability. He called these five attributes, perceived attributes of innovations. Other authors have expanded these attributes and called them perceived characteristics of innovations (PCIs) (Moore & Benbasat, 1991). These innovation attributes are realities perceived by the end user and thus are specifically determined by the individual. Rogers (2003) notes there are five stages in the innovation adoption process:

1. Knowledge – First exposure to innovation.
2. Persuasion – Actively seeks out information about the innovation.
3. Decision – Weighing advantages / disadvantages of innovation; decision to adopt or reject.
4. Implementation – Use of innovation to a varying degree.
5. Confirmation – Final adoption of innovation.

Perspective 2: Social Cognitive Theory

In social cognitive theory, human functioning is viewed as the product of a dynamic interplay of personal, behavioral, and environmental influences. How people interpret the results of their own behavior informs and alters their environments and the personal factors they possess which, in turn, inform and alter subsequent behavior. This is the foundation of Bandura's (1986) conception of reciprocal determinism, the view that (a) personal factors in the form of cognition, affect, and biological events, (b) behavior, and (c) environmental influences create interactions that result in a triadic reciprocity (see Figure 1).

Social cognitive theory provides an agentic view of human behavior in which individuals, through their own self-referent thoughts and feelings, can in part determine the course of actions they take. Of these self-referent thoughts, none is more important than the beliefs individuals hold in their own capabilities, or self-efficacy beliefs (Bandura, 1997). For this reason, "what we know, the skills we possess, or what we have previously accomplished are not always good predictors of subsequent attainments because the beliefs we hold about our capabilities powerfully influence the ways we behave" (Madewell & Shaughnessy, 2003, p. 381). This refers to "the knowing-doing problem—the challenge of turning knowledge about how to enhance organizational performance into actions consistent with that knowledge" (Pfeffer & Sutton, 2000, p. 4).

Towards an Integrated Theoretical Model of Technology Adoption

We propose that social cognitive theory helps bridge the knowing-doing gap that likely takes place at the persuasion stage in Rogers' (2003) model. That is, a focus on this stage could help researchers to discern key differences between adopters and non-adopters. A better understanding of the personal factors that operate at this stage (e.g., self-efficacy) could lead to targeted and specific interventions that directly address the challenges experienced by school practitioners who work in technologically-supported educational systems. Social cognitive theory can be used to not only explain why this gap exists and why an implementation lag may exist, but also can provide us with an understanding of how better to support end users so that effective innovation adoption is increased.

Significance

The proposed conceptual model is needed in the field of education for two reasons. First, given the limited funding that is dedicated to technology-focused professional development, using allocated funds in targeted, specific ways can increase spread, sustainability, and scalability of a technology innovation. Second, schools are struggling to understand how best to train teachers and thus prepare students for a technology-suffused world. By understanding where to allocate resources and funding (i.e., which teachers need more support and when), school leaders are better poised to make more appropriate allocations of their limited resources. This debate is imperative given the need for seismic shifts in the innovative uses of technology in diverse learning settings.

References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Madewell, F., & Shaughnessy, M. F. (2003). An interview with Frank Pajares. *Educational Psychology Review*, vol. 15, pp. 375-397.
- Meyer, G. (2004). Diffusion methodology: Time to innovate. *Journal of Health Communication*, 9, 59-69.
- Moore, G. C., & Benbasat, I. (1991). "Development of an instrument to measure the perceptions of adopting an information technology innovation." *Information Systems Research*, 23, 192-220.
- Rogers, E. M. (2003). *Diffusion of innovations* 5th ed. New York, NY: Free Press.
- Pfeffer, J. & Sutton, R. (2000). *The knowing doing gap: How smart companies turn knowledge into action*. Boston, MA: Harvard Business School.
- Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology*, 81, 15-24.

PAPER PRESENTATION

Modeling the characteristics of innovative, progressive schools

Liisa Ilomäki, University of Helsinki, Finland; Minna Lakkala, University of Helsinki, Finland

The paper describes elements, structures and practices for an innovative, progressive school. It aims at creating a model for understanding innovation based on empirical results but which is also a practical tool for schools to reflect on and improve their pedagogy. The preliminary results indicate that successful schools have a whole-school strategy and collaborative aims, visions and practices.

Modeling the characteristics of innovative, progressive schools

Liisa Ilomäki and Minna Lakkala, Technology in Education Research Group TEdu University of Helsinki

Aims

The aim of our study is to investigate schools for creating a model about necessary elements, structures and practices for an innovative, progressive school. The society has expectations for school to educate children for the knowledge society with relevant digital and academic competence, but the international findings from schools show that digital technology is only seldom used for improving pedagogies or for ensuring that all students acquire relevant digital competences (OECD 2010; Pedersen et al., 2006).

The background for our work is multifaceted: the extensive research about school improvement, the studies about innovations, and the research about pedagogical practices, especially the approaches emphasizing knowledge creation. Our specific interest is to include digital technology in the research focuses: we are interested in studying how the new digital technology has influenced schools and how new technologies can be used to improve pedagogical and knowledge practices in schools. The main functions of school are often conservative and apparently even contrary to innovation orientation. However, the trends for knowledge-creation pedagogy are well in-line with many elements of innovation policy. In this sense we focus also on the promotion of innovations in schools, connecting it to the improvement of pedagogical and knowledge practices.

The first version of the school model was developed using empirical data from nine schools in the research project assessing The Developing School Project of Espoo City during 2000–2004. In the present study, we have collected data from five schools in Finland to update the model. The elements of the innovative, progressive school are modeled as follows:

1. The vision level of the school: The content of the vision, The vision of using digital technologies, The coherence of the vision, Intentions for progressing
2. Leadership: Distributed leadership, Principal's networking, The role of the principal
3. The culture of knowledge work: Shared knowledge practices, Networking on school level, Collaborative ICT-projects
4. Digital technology in use: Accessibility and sufficiency of resources, ICT tools in use, Students' and teachers' digital competence and use of technology, Support for digital technology and pedagogy
5. Working practices of teacher community: Pedagogical collaboration and sharing of expertise, Culture of expertise, Teachers' networking
6. Pedagogical practices: Conceptions about the pedagogical use of digital technologies, Learning activities that utilize digital technology, Support for improving knowledge practices, Digital technologies supporting motivation

Our aim is to build the model for explaining connections between the school level practices and the classroom level, and for integrating the investigation of new technology and concrete everyday practices at school (see Ilomäki, 2008). The phenomena are actualized on "lower" levels but the "upper" level has a strong impact on the realization of phenomena. We suggest that there is a strong and essential interaction between different levels; this is one of the main starting points of our study. Investigating the culture of knowledge work on the school level and on knowledge practices on the classroom level is a new research perspective.

The aim of the current research project is, further, to develop a practical, theory-based model for schools to improve their own practices. There is a need for practice-oriented methods that help schools and teachers themselves to reflect and even investigate their own practices and thus improve those (Angelides, Leigh & Gibbs, 2004). The aim is to narrow the gap between empirical research and practical school work (Wikeley, Stoll & Murillo, 2005).

Methodology

In order to capture the multilevel and multifaceted phenomena in a school, the methodological background is in the mixed methods research (Teddle & Tashakkouri, 2003), which intentionally engages a multiple set of approaches and leads to a better understanding of the objects of investigation. In our study, the data collection concentrates on the main actors – students, teachers and the principals – and the data is both qualitative and quantitative.

The study is a multiple case study; and the data from five schools consist of:

- videotaped classroom observations (five lessons from each school in which ICT is used);
- interviews of five teachers and the principal;
- questionnaires concerning the competence and use of digital technologies (all teachers and 6th and/or 9th grade students);
- other material and observations about technology usage in the school.

Preliminary analyses from three schools are ready, and the analyses from two other schools will continue during the autumn 2010.

Findings and educational implications

Results from the first three schools indicate that there are major differences between primary and secondary level school in their working culture. Innovations and improvements seem to be easier to conduct on primary level. In best schools there is a well-functioning teacher community which has shared vision, aims and practices for improving the school. The use of digital technology is very diverse; at best it is inspiring and wide spread, at worst limited and old-fashioned. Students' possibilities to use and learn digital media embedded in the learning and knowledge creation activities are not equal because of the differences between schools and between teachers within one school.

Schools need explicit support for whole-school development work. The model appears to be a useful tool for schools to reflect their practices. Resources for technology or training are not enough; supporting the community is central. Collaborative development projects appear to be a good way to train; more resources should be put on them but emphasizing projects that concern the whole school or aim at disseminating the practices wider from the most active teachers. Data from all five schools will be used to further specify the innovative, progressive school model and the recommendations.

Significance of the study

New methods and tools are needed to disseminate and implement digital technologies in education, for teachers and schools. The model appears to be a practical and collaborative tool for schools to reflect their own practices. The model has raised interest and suggestions for collaboration in research fields and in training organizations.

PAPER PRESENTATION

Procrastination In An Online Learning Context: Effect of collaborative task

Virginie Demeure, Universitat Autònoma de Barcelona, France; Margarida Romero, Esade, Spain

The well known phenomenon of procrastination is studied here within the context of online distance learning. This context is particularly of interest in regards to the advancement of the characterisation of procrastination behaviour. Although many studies have gathered several characteristics which enable procrastination, such the level of responsibility of the students on the time-on-task regulation, very few studies focused on online distance learning. Within this specific context, this paper explores the impact of collaborative learning tasks compared to individual tasks, in regards to individual procrastination behaviours by analyzing anticipated temporal patterns and the actual temporal learning patterns of online distance students engaged successively in individual and collaborative learning tasks. The results of this study conducted in an authentic context of online distance learning showed a global positive effect of collaborative activities in regards to individual procrastination behaviours. Indeed, compared with individual context, online students tend to increase their time-on-task earlier regarding the deadline in collaborative context. They also start to work on the task at non-conventional moments, (i.e. week end and early/late hours of the day), since the mid-term of the activity, thus signalling feelings of time constraint. Finally, the comparison between anticipated and actual temporal patterns of learning activities, show that students deviate more from their anticipated pattern in a collaborative context, this tendency increasing with the approach of the deadline. Implications of these results for online distance education are discussed at the end.

Academic procrastination is a well known phenomenon consisting in behavioural postponement leading to time pressure and often linked in the literature with a lack of self efficacy in self regulation.

In a context of high time flexibility, such as in distance education, in which students have the possibility to regulate their time-on-task allocation, procrastination, can have serious implications. Indeed, in a distance education context, external regulations by peers or teachers fall dramatically and if students are not able to self regulate, they have more chances to fail at the task.

Distance education has, however, the particularity to be mostly chosen by adults with work and family constraints, which allows for other explanations in relation to behavioural postponement. To avoid this kind of confusion, e-learners were asked to declare their available time for academic task on a specific tool. This information was also visible by the other members of their group to facilitate collaboration and students had the possibility to change their initial declaration all along the task.

As explained previously, distance education contexts, due to their high time flexibility, can facilitate procrastination. However, the specificities of collaborative environments should act as a barrier against procrastination behaviours.

Two group phenomenons lead us to think that procrastination should be less important in a collective task than in an individual task.

Firstly, working in a group can increase the temporal pressure because of group interdependence. Indeed, teammates often divide the work to do among themselves, and regularly pool their work to advance on the task. This type of organization is close to adding intermediate milestones along the task. In this situation, learners' tend to organize their time-on-task considering their group organization and the internal milestones and responsibilities defined by the group. As a result of this interdependency, time flexibility in collective activities is reduced, increasing at the same time, the time structure and pressure through out the task. We could suppose that the reduction of time flexibility and the highest level of interdependency will incite the students to work more regularly, and reduce the interdependency level.

Secondly, as predicted by the Social Facilitation Theory of Zajonc (1965), working in a group can lead to an improvement in performances because of the simple fact that the student is being observed.

The objective of this study is to explore, in an authentic CSCL context, the impact of collaboration on academic procrastination. The data of students ($n = 66$) having to realize successively individual and collaborative tasks are analyzed at this aim. The general tendency of work on the task during the time allowed is considered regarding three periods: the beginning of the task, the mid-term of the task, and the end of the task. As well, in order to have time pressure indicators, we consider the use of weekends and late hours of the night by students to work on the task across these three periods.

Data was recollected both from the Knol environments used by students to produce the task (writing first individually, then collaboratively a paper on the theme of CSCL), and from the collaborative awareness tool enabling students to declare prospectively their availability for the academic activity. The Knols logs describe the type of contribution made by each group member, with its date and hour of publication. For our analysis, we considered the date of the contribution in relation to the beginning of the task, (day after the start of the activity), the day of the week when the contribution was made and at what hour. The tools logs describe the same information but prospectively declared by students.

Results were analysed using within subject ANOVA and show a main effect of individual/collective dimension [$F(2,51) = 28.93$, $p = .02$], a main effect of phases (beginning of the task, mid-term and end of the task) [$F(2,102) = 24.66$, $p = .02$], and an interactional effect between these two variables [$F(2,102) = 7.70$, $p = .001$, $\eta^2 = .07$].

The first effect is due to the fact that students tend to increase their academic work at the approach of the deadline (mean participation of 2.35 ($SD = .46$) at the beginning of the activity, to 6.97 ($SD = 1.08$) at the mid-term, and to 11.98 ($SD = 1.84$) at the end of the task). The second one comes from the fact that students in collaborative context made more contributions (mean = 11.73 $SD = 1.81$) than in individual context (mean = 2.47 $SD = .38$). Finally, the interaction effect shows that, whereas in collaborative context students tend to constantly increase their work from the beginning to the end of the task, in individual context a rise is observed at the end of the activity, leading us to think that there is a higher rate of procrastination behaviours.

Complementary results exploring time pressure show that students in the individual context tend to work longer in the day (between 6 a.m. and 9 p.m.), at the end of the task than at the beginning and mid-term (between 10am and 1pm), whereas in a collaborative context, they work at the same time periods (between 10 a.m. and 9 p.m.), from the beginning to the end [$F(10,510) = 1.23$, $p = .27$].

Finally, analysis comparing prospective declarations and actual participation in regards to the academic tasks, show that students in individual contexts tend to work more during non projected moments than in collaborative contexts [$F(1,27) = 32.09$, $p = .02$]. This tendency increases with the approach of the deadline [$F(5,135) = 4.65$, $p = .001$, $\eta^2 = .13$], in both contexts.

These results suggests higher procrastination behaviours and time pressure in an individual context than in collaborative one, evoking a positive effect from group work on procrastination. This study having been conducted in authentic and thus quasi-experimental context, means that these results need to be verified deeply, however, the development of a collaborative task in distance education has to be considered as a possible preventive measure for procrastination and failure.

PAPER PRESENTATION

Learning Through Collaborative Creation of Knowledge Objects in Teacher Education

This contribution presents an empirical study of object-oriented collaboration, in which groups of teacher students work on shared knowledge objects that will be used at their internship places. The study addresses the problem of how higher education students attend to open-ended problems, which requires them to materialize their theoretical and practical knowledge into knowledge objects (e.g., didactic material, evaluation instruments, research reports), and collaborate with peers. The knowledge creation approach to learning, which places collaborative creation of knowledge objects at its core, served as a guide for a pedagogical design that attempts to support students' learning in situations as the one described above. The mechanisms of collaborative creation of knowledge objects are central to this investigation, with a focus on productive interactions and mechanisms of knowledge object elaboration. We collected different types of data, during a one-year long design study. The analyses followed three lines of investigation: analysis of group interactions, of concepts and ideas uptake, and of object co-construction and development. Findings unveiled distinctive mechanisms of collaborative creation of knowledge objects and showed various degrees of idea sharing and of co-elaboration of object iterations. These findings assist us in formulating recommendations for future research and pedagogical design, especially regarding pedagogical settings and technological support for object co-construction and co-elaboration.

Introduction and theoretical considerations

In this contribution we investigate how teacher students learn in collaboration through creating and developing knowledge objects that will be employed at their internship places. We focus especially on mechanisms of object-oriented collaboration within student groups and we provide a detailed insight into how knowledge objects are developed and elaborated by a number of groups. Higher education institutions are nowadays consistently challenged to expose students to knowledge practices they will perform as professionals. At the same time, students are confronted with increasingly demanding learning situations, which feature problems with an open-ended character and challenge them to make their own knowledge explicit. This involves theoretical and practical knowledge being materialized in knowledge objects (e.g., in educational material, evaluation instruments, research reports), where this knowledge becomes transparent for all participants. Becoming actively involved in such complex processes and creating sophisticated knowledge objects is a challenging task for students. The knowledge creation approach to learning (Paavola & Hakkarainen, 2005) can serve as a guide to develop new practices of learning and instruction, which places collaborative creation of knowledge objects at its core. Knowledge creation processes not only shape the knowledge objects constructed but are also transformed by the actions that are performed on these objects (Stahl, 2006). Nevertheless, little is known about the mechanisms of learning in collaboration when creating these knowledge objects. Collaborative learning has been extensively studied from the perspective of dialogic interaction, but less attention was given to how students interact productively when they work together on objects that materialize their knowledge. Furthermore, the way these knowledge objects are constituted and iterated is also an aspect that deserves in-depth investigation.

Empirical setting, methods and data

We collected a rich set of data, consisting of: a) interaction data; b) knowledge objects, both produced in KPE or during fieldwork and c) reflection data. The analyses consisted of three discrete processes. First, we selected and coded action-relevant episodes from the group's interactions, in order to understand the nature of their interactive activities, employing a coding scheme developed based on a similar data set. Second, we mapped the relevant concepts and ideas discussed during the analyzed interactions, and examined whether they were taken-up and materialized into the knowledge objects and their iterations. Finally, we operationalized object progression and elaboration, and analyzed how relevant concepts and generated ideas were gradually materialized and elaborated into object iterations. We identified how concepts and ideas were taken-up from one interaction to another. We employed an instrument derived from the integrative complexity system by Cummings, Schlosser and Arrow (1996) to determine the type and degree of elaborations from one iteration to another.

Results

The findings indicate that most student groups became engaged in co-constructing shared knowledge objects, but also that individual elaboration and division of labor, without much feedback on object iterations, occurred. Results indicate that groups employed different strategies to organize their work. The analyzed interactions proved also to be of heterogeneous nature. The productive interactions that explicitly contributed to the conceptual enrichment and development of the shared knowledge objects were those labelled as 'creating shared understanding' and 'collaborative generative'. The analyses of the interactions and object versions also yielded sets of relevant concepts, considered by the group as relevant for the knowledge object to be developed. The concept-maps showed that the majority concepts and ideas put forward in the 'productive' type of interactions was taken-up, expanded and elaborated. Elaborations led to the materialization of the groups' shared views and stances. Co-construction moments

occurred in some groups' work, such as discussing ideas and concepts and then following up and materializing these ideas into iterations of the objects. Elaboration of object sections was, however, often done individually, and the outcomes were placed in the group's shared space, where the other group members could read it and provide it with feedback. Finally, individual contributions were closely combined with joint activities. Individual elaboration led to numerous feedback moments by the other group members. The findings indicate that the sections of the object that were discussed and provided with feedback more than once showed a higher degree of elaboration. Some groups had difficulties to concretize the knowledge on the matter into the object iterations. Most recurrent situation was that ideas were discussed but not taken-up and not materialized. In these groups mutual feedback and revisions on iterations of the objects were less common. Theoretical and practical significance This paper focused on understanding the mechanisms of collaborative creation of knowledge objects, by analyzing interactions of students engaged in an authentic project and by tracing the development process of the knowledge objects students worked on. The findings call for attention to students' understanding of this pedagogical setting and of the type of co-construction task must engage in; also, to how these types of designs can provide more clear scaffolds for students when engaging in the object (co-)elaboration process.

References

Cummings, A., Schlosser, A., & Arrow, H. (1996). Developing Complex Group Products: Idea Combination in Computer-Mediated and Face-to-Face Groups. *Computer Supported Cooperative Work (CSCW)* 4, 229-251. Paavola, S., & Hakkarainen, K. (2005). The knowledge creation metaphor – An emergent epistemological approach to learning. *Science & Education*, 14, 535-557. Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press.

PAPER PRESENTATION

Effects of Distributed Tutorship in a Blended University Course

Nadia Sansone, University of Bari, Italy; Maria Beatrice Ligorio, University of Bari, Italy

In this paper the distributed tutorship is considered as a mean to sustain active and constructive participation in a blended university course. Role Taking principles are used to assign to students specific functions and responsibilities. Covering a specific role means for students taking up a new position, being able to participate from a different point of view and, consequently, to appropriate new learning strategies. This study refers to a blended university course about e-learning, offered at a specialized level of Work Psychology, where students in turn perform the role of e-tutor. Quantitative and qualitative analysis were conducted to observe how students participation was affected by the Role Taking. Results show that students covering the role of e-tutor steadily increased their participation, even when the role was dismissed. Furthermore, they modified their participation style by becoming more supportive of the group and more collaborative. Therefore they acquired new positions during the course, especially in their participation to the group work. Practical implications can be seen in terms of indications of how to organize and structure virtual online group and collaborative learning.

Introduction

Universities and Higher Education institutions are increasingly offering online and/or blended courses (Alvarez, 2005; Bonk & Graham, 2006). These courses provide many advantages, but they often suffer of a limited students' participation and of a difficulty in setting effective constructive collaborative learning. In order to overcome these limits, online Role Taking (RT) proves to be an effective educational strategy through which specific functions and responsibilities are assigned to students (Hare, 1994; Mudrack & Farrell, 1995; Topping, 2005). Through RT students feel entitled to assume new positions and to structure their participation at the service of the group (Harre & Van Langenhove, 1992). In fact, RT is mainly intended for: (a) modeling individual behavior and regulating intra-group interaction, (b) facilitating learning, (c) stimulating group cohesiveness and a sense of responsibility towards the group, (d) supporting coordination (Johnson et al., 1992). Furthermore, RT fosters knowledge-building because it promotes students' focussing on the learning goals (Schellens et al, 2005; Strijbos et al., 2004).

The context

This research refers to a course on E-learning delivered in a blended mode at a specialized level of Work Psychology, activated at the University of Bari (Italy) during the 2006-2007 academic year. It lasted 14 weeks and it was structured into seven didactic units. Seventeen students attended the course (12 F, 5 M), divided into two groups. The starting point of each unit was the professor's offline lecture. Right after, the professor assigned the educational material to be read. As suggested by the Progressive Inquiry Model (Muukkonen, Lakkala & Hakkarainen, 2003), a research question guides the reading, the preparation of written reviews on that material and the consequent online discussions. Each group had one student playing the e-tutor and this role was re-assigned at each unit. In this way at the end of the course twelve students could cover this role. During the first unit, an expert tutor modeled the role. For

the rest of the course she supervised the e-tutors by giving them advises when requested. In fact, the supervision of the expert tutor gradually faded away and at the end of the course she intervened only occasionally. Furthermore, students covering this role could use a specific web-forum, within the virtual space of the course, to talk and compare about their experience of being e-tutors.

E-tutors were in charge of the group management by: (a) making sure all group members read the educational material (b), checking everyone posted online their reviews (c), inviting the group to read all the reviews, (d) supporting the participation to the web-forum discussion in order to answer to the research question.

Aims

This paper aims to observe how university students' participation is affected by taking the role of the e-tutor during a blended course. In particular, we want to understand whether covering a role can foster the acquisition of new positions as members of a group.

Methodology

To pursue our aims we chose to observe the two students covering the role of e-tutor during the third unit, which occurred halfway the course. This choice satisfied the need to contrast students participation before covering the role (during the first two units), whilst playing it, and once it was dismissed, during the subsequent four units.

A quantitative analyses was run on the total number of notes posted online by all the students. Frequency and mean were pondered considering the total number of notes produced by the group for which the e-tutor was playing the role. These values were calculated for each unit. Through this analysis we could monitor how much the e-tutors intervened through all the seven units.

The notes posted by the two e-tutors were also qualitatively analyzed through a content analysis. Five categories were outlined and they could be conceptualized as positions taken during the group activities, but with different focus: (a) educational: on the content (b) collaborative: on the group interaction, (c) supportive: on individuals, (d) organizational: on time and on the virtual space, (e) emotional. Two independent judges categorized the notes by discussing the contrasting categorization until reaching 100% of agreement. The percentage of each category was calculated for every unit.

Findings

Through the quantitative analysis we found that all the students reached the pick of their participation when playing the e-tutor. This applies also to our two target students (see Table 1).

Unit E-tutor 1 E-tutor 2

1	20%	7%
2	39%	8%
3	51%	10%
4	27%	9%
5	17%	8%
6	26%	3%
7	25%	1%

Table 1. Percentage of notes posted by the two target e-tutors for each unit.

Their participation changed also qualitatively. In particular, when playing the role, these students adopted a supportive position (i.e. "Good job! I think you explained the central topic very well; probably you could tell us where you found the additional information you gave us. However, you've been great!") (see Table 2).

Category E-tutor 1 E-tutor 2

Educational	21%	12 %
Collaborative	27,1%	25,5%
Supportive	36,1%	30%
Organizational	5,2%	16,5%
Emotional	10,6%	16%

Table 2. Distribution of categories whilst playing the role of e-tutor (Unit 3)

Moreover, during the four units after taking the role, the two e-tutors display different patterns:

- a) e-tutor 1 adopted a more collaborative position, aimed to offer help, negotiate decisions and propose solutions (Unit 4: 28 %, Unit 5: 40 %, Unit 6: 33 %, Unit 7: 32 %);
- b) e-tutor 2 wrote notes more referring to the educational material, displaying an educational position (Unit 4: 28 %, Unit 5: 26 %, Unit 6: 29 %, Unit 7: 33%).

By looking at the first two units, before playing the e-tutor, we found that these students never used these position. These positions appeared whilst playing the role and, to a certain extent, were maintained even when the role was dismissed.

Theoretical and educational significance

Increasing the quality of the participation is one of the most important goals of online and blended education. This research shows that RT promotes students' appropriation of collaborative and educational positions that were maintained even when students no longer acted as e-tutor for their group. From this result it can be gathered indications on how to structure students participation online. It can be also deduced that more roles could be designed so to maintain students participation high and effective.

PAPER PRESENTATION

Teacher learning within multiple collaborative settings in primary schools

Jannet Doppenberg, Eindhoven University of Technology, Netherlands; Anouke Bakx, Fontys PABO Eindhoven, lectoraat L&I., Netherlands; Perry den Brok, Eindhoven University of Technology, Netherlands

During the last two decades there has been a growing awareness of the potentially strong role of teacher collaboration in relation to teacher learning. When teachers collaborate with their colleagues, learning can take place in different formal and informal settings. Because most studies focus on teacher learning in one collaborative setting, often related to a specific innovation in a school, little is known about how teachers learn within regular multiple collaborative settings in schools. Moreover, while theoretical 'ideals' of teacher learning are abundant in the literature, relatively little is known about what teacher learning actually looks like in everyday work. The aim of this exploratory study was to obtain more detailed understanding of teacher learning in collaboration with colleagues at primary schools during everyday work. In this study teacher learning was investigated within multiple existing collaborative settings, taking into account both the undertaken activities by teachers and learning outcomes. Data was collected through semi-structured interviews with two teachers and one school leaders within seven primary schools. Analysis of the qualitative data showed that teacher learning does take place within different collaborative settings in schools however, with different degrees of intensity and outcomes across these various settings. Thus, depending of the collaborative setting more or less different activities and learning outcomes were reported by teachers and school leaders.

Rationale and theoretical framework

During the last two decades there has been a growing awareness of the potentially strong role of teacher collaboration in relation to teacher learning (Levine & Marcus, 2010; Westheimer, 2008). Collaboration with colleagues is seen as a powerful learning environment, which stimulates the professional development of teachers, the innovative development of schools as well as student learning and also characterises professional learning communities (McLaughlin & Talbert, 2006; Vescio, Ross, & Adams, 2008; Westheimer, 2008). When teachers collaborate with their colleagues, learning can take place in different settings which may vary from formal settings like team meetings to informal settings like hallway encounters (Little, 1990, 2003). Because most studies focus on teacher learning in one collaborative setting, often related to a specific innovation in a school, little is known about how teachers learn within regular multiple collaborative settings in schools (Orland-Barak & Tillema, 2006). Moreover, while theoretical 'ideals' of teacher learning are abundant in the literature, relatively little is known about what teacher learning actually looks like in everyday work (Borko, 2004; Little, 2003). In this study teacher learning is defined as a process of conscious and unconscious undertaken activities by teachers in collaboration with colleagues, which lead to change in cognition and/or behaviour at the individual and/or group level (Meirink, 2007). However, what teachers actually do in collaborative settings and what undertaken activities lead to learning is quite unclear, especially in the context of primary education. Thus, to better understand teacher learning in this project, it is studied within regular multiple collaborative settings, taking into account both the undertaken activities by teachers and learning outcomes.

The aim of this (exploratory) study was to obtain more detailed understanding of teacher learning in collaboration with colleagues at primary schools during everyday work. Accordingly, the following three research questions were formulated:

- 1) In what settings at the workplace do primary teachers and school leaders report that teachers learn in collaboration with each other?
- 2) What learning activities are reported to be undertaken by primary teachers in these settings?
- 3) What are the reported individual and group learning outcomes as a result of collaboration in these settings?

Method To obtain insight into teachers' and school leaders' perceptions of teacher learning in collaboration with colleagues in schools, data was collected through semi-structured interviews with two teachers and one school leader within seven primary education schools (21 interviews in total). The data analysis was conducted in different steps. First, the transcribed interviews were analysed based on meaningful fragments. Second, the meaningful fragments were placed in a within case matrix to understand the relation between collaborative settings and the undertaken activities and learning outcomes. Third, data of these matrices was analysed in more detail with key-concepts from the literature and categories emerging from the data. Fourth, a frequency analysis was conducted for each case. Frequencies for each collaborative setting were determined with respect to activities and learning outcomes as reported by the respondents. Finally, a cross-case analysis was carried out across cases (schools). In the cross-case analysis the result of the cases were combined and summarised in overview matrices (Miles & Huberman, 1994).

Results and conclusions

The reported collaborative settings could be categorised based on the persons involved, the aim and frequency of the setting, in: group of schools, school team, part of a team, working group, class, informal and collegial support. The categories identified in our study for activities could be categorised in terms of categories distinguished by Little (1990). For the categories; story telling and scanning, aid and assistance, and sharing singular activities were identified and for the category joint work compound series of activities were identified. Individual as well group learning outcomes could be categorised. However, the subcategories of the learning outcomes at the individual and group level were not equivalent. In literature activities and learning outcomes are assumed to be strongly related with each other. However, the respondents in our study usually connected learning outcomes to collaborative settings rather than activities. Depending of the collaborative setting more or less different activities and learning outcomes were reported. It seems that there is a correlation between the sum and amount of different reported activities and the reported learning outcomes however, from this study this cannot be directly inferred. Besides, the results seem to confirm that the dependency between teachers correlates with learning outcomes (Little, 1990). In the presentation the categories and conclusions will be discussed in more detail.

References

- Borko, H. (2004). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher*, 33(8), 3-15.
- Levine, T. H., & Marcus, A. S. (2010). How the structure and focus of teachers' collaborative activities facilitate and constrain teacher learning. *Teaching and Teacher Education*, 26, 389-398.
- Little, J. W. (1990). The Persistence of Privacy: Autonomy and Initiative in Teachers' Professional Relations. *Teachers College Record*, 91(4), 509-536.
- Little, J. W. (2003). Inside Teacher Community: Representations of Classroom Practice. *Teachers College Record*, 105(6), 913-945.
- McLaughlin, M. W., & Talbert, J. E. (2006). *Building School-Based Teacher Learning Communities: professional strategies to improve student achievement*. New York: Teachers College Press.
- Meirink, J. A. (2007). Individual teacher learning in a context of collaboration in teams. Doctoral dissertation. Leiden: ICLON.
- Miles, M. B., & Huberman, A. M. (1994). *Quality data analysis*. Thousand Oaks, CA: Sage.
- Orland-Barak, L., & Tillema, H. (2006). The 'dark side of the moon': a critical look at teacher knowledge construction in collaborative settings. *Teachers and Teaching*, 12, 1-12.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80-91.
- Westheimer, J. (2008). Learning among colleagues: Teacher community and the shared enterprise of education. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of Research on Teacher Education: Enduring Questions in Changing Contexts*, Third Edition (pp. 756-783). New York: Routledge.

PAPER PRESENTATION

Indicators and instruments in the context of IBSE – A meta-analysis of research from 2005-2009

Inquiry learning, Organization of educational research, Science Education

Jana Heinz, Technische Universität München, Germany; Alexander Groeschner, Technische Universität München, Germany; Katrin Lipowski, Technische Universität München, Germany; Tina Seidel, Technische Universität München, Germany

This study conveys research on inquiry based science education (IBSE) with a focus on indicators and instruments. We conducted a literature review about IBSE in the fields of policy, teacher education/teacher professional development and instruction from 2005-2009. As a result of searching in the database "Web of Science" 600 articles were found and

coded with regard to their focus on motivational-affective, cognitive or metacognitive contents. We furthermore differentiated between empirical and non-empirical articles. The results of our review emphasize that the majority of research on IBSE is rather fragmented and specific to individual research questions as well as to single aspects of IBSE. By this study we want to contribute to supplying a systematic overview about instruments and indicators in the field of IBSE.

Theoretical framework

Scientific research in politics and society points to the need of enhanced scientific literacy. (OECD, 2010) Scientific knowledge and competences are regarded as prerequisites for an active participation of people in everyday and public life.

In this process, schools are regarded as key players. They should provide applicable scientific knowledge and competences as well as keep and develop the interest of students in scientific subjects. To adopt learning outcomes to these demands, teaching and learning approaches are on the test bench. One of the learning and teaching approaches regarded to be especially suited to meet these demands, is inquiry based science education (IBSE). (European Commission, 2007)

Research in educational science conveys numerous studies investigating IBSE. Mostly however, they analyze single features of IBSE and single implementation levels in the educational system. Some recent reviews systematically consider indicators and instruments in the context of IBSE – however without an explicit analysis of them (Minner, et al. 2010; IAP, 2007).

This study aims at providing a systematic collection of indicators and measures in the field of IBSE. To receive a comprehensive picture about the implementation of IBSE, we extended the scope of this review beyond a focus on instruction (1). We additionally considered research about IBSE in the implementation areas of politics/stakeholders (2) as well as teacher education and teacher professional development (tpd) (3).

Research method and design

Our review on indicators and instruments in the field of IBSE was guided by the following research questions:

1. How many studies about IBSE can be found from 2005-2009?
2. How are these studies distributed in the implementation areas of instruction (teachers, students) (1), politics/stakeholders (2) and teacher education and tpd (3)?
3. How are the instruments underlying these studies distributed with regard to cognitive, metacognitive or motivational-affective dimensions?

We searched the internet-database: "Web of Science" with ten key words, for instance: "inquiry based science teaching", "science teaching and learning", or "science literacy and scientific literacy". Each of these keywords was crossed with the three implementation level keywords: "policy, stakeholders", "teacher educators, teacher education", "teachers" and „students, pupils".

The research led to a total of 600 studies. After excluding studies due to a missing focus on IBSE, 538 studies remained. We then differentiated the studies according to their empirical or non-empirical approach.

In a second step we summarized studies, indicators and measures according to their implementation level (policy and stakeholders; teacher education and tpd; instruction).

The indicators and instruments on these three levels were further clustered around the dimensions of IBSE that were investigated (indicator area). Here we differentiated between cognitive, metacognitive and motivational-affective measures. Cognitive measures and indicators refer to student achievement or teacher professional knowledge of IBSE. Metacognitive instruments include learning and teaching strategies as well as strategies used by politicians and stakeholders to implement IBSE. Motivational-affective dimensions cover beliefs, attitudes or self-efficacy.

Three independent coders categorized the publications with regard to the categories "implementation level" and "indicator areas". Inter-rater agreement reached a mean of 80 % of codes.

Results

The majority of studies could be found on the instruction level with 160 of them investigating teachers and 222 students. In the area of policy/stakeholders 63 studies were counted and 93 studies in the field of teacher education and tpd.

We found 360 empirical and 178 non-empirical studies. A closer look at this distribution reveals that the amount of empirical studies was more than twice as high as the amount of non-empirical studies in the area of teacher education and tpd as well as in the area of instruction with a focus on teachers. In contrast to these results, in the area of policy and stakeholders more non-empirical than empirical studies were counted.

In a next step, we examined the instruments the studies were based on. As a result, tendencies in the measuring foci on the different implementation levels become visible. Thus the distribution of the instruments on each implementation level differs notably, especially with regard to the measured dimensions of IBSE.

The majority of instruments in the context of IBSE are focused on motivational-affective aspects. Most of these instruments can be found in the area of teacher education and tpd (43). A similar amount of instruments can be found in the area of instruction, namely 57, of which 29 focus on teachers and 28 on students. 18 motivational-affective instruments can be located in the field of policy/stakeholders.

Cognitive measures are predominately used in the area of instruction with a focus on students (57), followed by instruments investigating teachers in the area of instruction (13). Only three cognitive instruments could be found that are used in the areas of policy/stakeholders and teacher education as well as tpd.

Looking at the distribution of metacognitive measures, the lack of measures in the area of policy/stakeholders is notable. The majority of metacognitive measures are located in the area of instruction/students (57).

Discussion

As a result of this review the importance of further empirical studies on the policy level can be stated. Looking at the instruments, our review shows the focus of cognitive instruments is on students and student learning. In contrast, motivational-affective instruments can mainly be found in research on teacher education, tpd and teachers. Thus, research about teachers concentrates on attitudes, beliefs and opinions about IBSE. This finding points to the demand of the development of adequate instruments to measure IBSE related knowledge of teachers, university instructors and administrative stakeholders who are especially responsible for implementing IBSE into the classroom teaching practice.

Bibliography

- European Commission. (2007). Science Education NOW: A renewed Pedagogy for the Future of Europe. Luxembourg: Office for Official Publications of the European Communities.
- IAP. (2006). Report of the Working Group on International Collaboration in the Evaluation of Inquiry-Based Science Education (IBSE) programs.
- Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-Based Science Instruction—What Is It and Does It Matter? Results from a Research Synthesis Years 1984 to 2002. *Journal of Research in Science Teaching*, 47(4), 474–496.
- OECD. (2010). Education at a Glance 2010. OECD indicators. Paris: OECD.

PAPER PRESENTATION

Preprofessional competences: an evaluated experience working with problem based learning model

Rosario Del Rey, Seville University, Spain; Eva M Romera, Cordoba University, Spain; Rosario Ortega-Ruiz, Universidad de Cordoba, Spain

Assessment is presented as one of the greatest challenges of High Education focused on competences. But it has been one of the subjects least raised (AGAE, 2009) in Spain, after three academic courses analysing pre-professional projects adequacy as a learning tool in an experimental European Credit Transfer System –ECTS– implementation. The aim of this work is to design and develop Problem Based Learning (PBL) profits evaluation instruments in relation with the subject Psychology of Instruction of Psychopedagogy degree students' competences. For that, two instruments were used, the first one, focused on students' perception about the development of general competencies, and the second one based on student's perception about the methodology used in pre-professional projects, focused on following dimensions: motivation, practical implementation, impact on learning and knowledge transfer. Main results

showed that students had a positive perception about the methodology by pre-professional projects in relation with four dimensions of study. Moreover, there were found positive results regarding to general, cognitive, professional and transversal competence development.

Introduction

In line with what is proposed in Declarations of Bergen (2005) and London (2007), nowadays the society hopes of graduates that they have not only specific knowledge, but also know how to apply them to solve complex problems effectively. This implies the need to combine data acquisition of information with the development of useful skills to the professional field (Dochy, Segers, Van Den Bossche, and Gijbels, 2003). In this sense, Problem Based Learning (PBL, hereafter) is presented as a tool that produces benefits on competence development, compared to traditional methodologies based on the transmission of knowledge. PBL was used for the training of doctoral students but actually is a didactic tool which has shown positive results related the development of the high level competences in university students in general. The PBL model starts from the premise that we learn from meaningful and motivating problems to the students. A methodology used to develop the PBL is the model we have called Education Based Pre-Professional Projects (EBP, hereinafter) (Ortega, Rodriguez, Romera and Garcia, 2009).

This work parts from a review of international studies related to this field of study (Fernandez et al., 2006), which establishes five categories that include different aspects that have been taken into account in assessing the implementation of the PBL model: emotional component, performance practice, learning effects, generability (to other subjects, utility of learning, etc.) and skill development. Specifically, this work focuses on the evaluation of innovative processes in relation to the PBL model.

The main objective is directed to the design and implementation of tools to assess the benefits of PBL focusing the general cognitive knowledge, the transversal and the professional skills of Psychopedagogy students at the University of Córdoba. Psychopedagogy is a master studies to training the School Counsellor in Spain.

Procedure

The program has been developed in double-shifts, morning and evening, of Psychology of Instruction, a four-month subject of the first year of Degree of Psychopedagogy. Pre-professional projects were developed in practice sessions. The sample consisted of 146 students, who also participated in the project completed the questionnaire "Evaluation of academic success Based Learning" (Romera, Del Rey and Ortega, 2009), composed of 33 Likert-scale items (1-5) on: Motivation- achievement, practical implementation, knowledge transfer, effects on learning and coping with professional problems.

Results

Positive perception of perceived achievement and motivation by students in relation to the carrying out pre-professional projects, obtaining an average of 3.85 (SD = .66). Practical realization: an average of 3.91 (SD = 0.68). Transfer of knowledge greatly values the influence of working by projects to achieve these objectives, with a mean of 3.98 (SD = 0.72). Effects on learning an average of 3.97 (SD = .71) by grouping the four variables that make up this dimension.

No statistically significant differences were found based on gender or shift schedule. Furthermore, linear regressions were made to deepen variables related to skill development. Results highlight that in relation to procedure skills is found that there is an increased competence development ($F_{1,129} = 24.971$; $p = .00$) when there is greater motivation, better able to learning to learn, greater assessment of their scores on evaluation and higher use of learning. Perceived motivation is what else might be influencing the variability of our dependent variable ($R^2 = .30$).

Conclusions and Discussion

It is concluded that there is an overall positive perception by students on the benefits of pre-professional projects, highlighting the opportunity of learning to cope with problems in their professional reality, creating in them the feeling and the satisfaction of having learned useful strategies that allow them to continue learning throughout life, it is, learn to learn. With regard to skill development, students seem to express a positive view on it, which can lead us to believe that this type of methodologies not only promote competence at a generic, cognitive, procedural and transversal level, but also is linked to development metacognitive skills that allow students be aware and reflect on their own learning (Boakaerts, 1999).

A weaknesses was the demand for more tools to help them. In this sense, for the next year we try to promote the use of virtual tools such as real sources of support, following the approach of the new proposed based on e-learning which is proving to have a good impact on university students' motivation (Schneckenberg, 2005).

References

Agencia Andaluza de Evaluación (AGAE) (2009). I Jornadas Andaluzas de Innovación Docente Universitaria. Córdoba.

- Boekaerts, M. (1999). Self-regulated learning: Where are we today? *International Journal of Educational Research*, 31, 445–457.
- Declaration Bergen (2005). The European Higher Education Area - Achieving the Goals.
- Declaration London (2007). Towards the European Higher Education Area: Responding to the challenges of a globalized world.
- Dochy, F., Segers, M., Van Den Bossche, P. & Gijbels, D. (2003). Effects of problem-based learning: a meta-analysis. *Learning and Instruction*, 13 (5), 533-568.
- Fernández, M., García, J. N., Caso, J. N., Fidalgo, R. and Arias, O. (2006). El aprendizaje basado en problemas: revisión de estudios empíricos internacionales. *Revista de Educación*, 341, 397-418.
- Ortega, R. Rodríguez, A. J., Romera, E. M. and García, C. (2009). Percepción estudiantil de su actividad de aprendizaje bajo un modelo de Enseñanza Basada en Proyectos. In F. Villamandos, E. Gómez and I. González, *Experiencias Piloto en la Implantación del EEES en la UCO* (pp. 41-50). Vicerrectorado del Espacio Europeo de Educación Superior y Estudios de Grado. Universidad de Córdoba.
- Romera, E. M., Del Rey, R. and Ortega, R. (2009). Evaluación del éxito académico del Aprendizaje Basado en Problemas. Documento no publicado.
- Schneckenberg, D. (2005). El e-learning transforma la educación superior. *Educación*, 33, 143-156.

PAPER PRESENTATION

Managing transitions and continuity of scripted inquiry learning

Yang YANG, University of Exeter, United Kingdom; Stamatina Anastopoulou, University of Athens, Greece; Mike Sharples, University of Nottingham, United Kingdom; Charles Crook, LSRI, United Kingdom; Shaaron Ainsworth, University of Nottingham, United Kingdom; Claire O'Malley, University of Nottingham, United Kingdom; Mike Paxton, University of Nottingham, United Kingdom

A web-based toolkit, named nQuire, has been designed for networked portable devices to support inquiry learning. It has been tested with a class of Year 8 students and their science teacher through a sequence of activities including problem formation, question setting, investigation, discussion and presentation across different contexts. This study aims to understand how the nQuire toolkit enabled transition and continuity of learning across contexts. Taking a multi-method research approach, knowledge transfer across time, inquiry phases and locations were investigated. We make recommendations for ways to manage transitions across these three dimensions. For the 'time' dimension, the toolkit should offer more flexibility in sequencing the activities. For the 'inquiry phase' dimension, the toolkit should empower the teacher and students to socially and continuously construct meaning across different phases. For the 'location' dimension, the connectedness afforded by the toolkit should provide students with more contextual information, in order to overcome negative situatedness in contexts.

Introduction:

This study aims to understand continuity of inquiry learning and transfer of knowledge across time, inquiry phases and locations. A class of 13-year-old students and their science teacher were recruited to use an inquiry learning toolkit on netbooks and mobile data-probes. The toolkit supports students through a sequence of activities including investigation, debate, inquiry and presentation across formal and informal settings (Anastopoulou et al, 2010). They iterated three scientific inquiries across different contexts, i.e. their classroom, a nature reserve, their school grounds and a private garden which they did not visit.

Our research questions were:

- 1) How does the teacher manage transition and facilitate knowledge transfer across time, inquiry phases and locations?
- 2) From the teacher's perspective, how does the toolkit function to support knowledge transfer across time, inquiry phases and locations?

Theory and Challenge:

Learning is continuous. Our experiences continue across spatial, temporal and social contexts; and learning happens whenever there is a break in the flow of routine daily experiences and we reflect on the current situation, resolve to address a problem, to share an idea, or to gain an understanding (Sharples et al., 2002). Mobility afforded by technology provides learners with greater diversity of experience, unbounded by time and location (Looi et al, 2010). Hence, within exploiting mobility, continuity of learning needs to be maintained and sustained across contexts (Chan et al, 2006). Situated learning (Brown et al, 1989) offers a perspective in contextual learning. These authors argue that 'knowledge is situated, being in part a product of the activity, context and the culture in which it is developed and used.' On the other hand, Bereiter (1997) criticises the weakness of situatedness in relation to problems of transfer,

saying: "as learning proceeds it tends to become less and less generalisable to other situations...advanced stages of situated learning may, in fact, begin to yield negative transfer." Hence, both the richness of contextual learning and the seamlessness of transitions by overcoming situatedness need to be acknowledged. In this study, the contexts are defined as configurations of three dimensional elements: time, inquiry phases and locations.

1) Time is linear and not reversible. Across time, learning is structured in activities and lessons (stages) by the nQuire toolkit.

2) Inquiry phases are sequential but can be revisited and reiterated.

3) Locations are discrete and parallel to each other. Thus, the challenge to the teacher was how to manage the complexity of structured movement between stages, inquiry phases, and locations.

Methods:

In order to unpack the complexity, we adopted a multi-method research approach to reveal the inquiry learning process and capture the teacher's perspective. During ten science lessons and a day fieldtrip to a nature reserve, an intervention took place with 28 Year 8 students and their science teacher. The students conducted three different inquiries (observation, correlation and experiment) on an overarching topic of birds and noise pollution. The inquiry learning process was firstly documented in the teacher's lesson plans, the researchers' observation notes and the students' log files in the toolkit. Secondly, the teacher's interpretation of the process was captured by 10 after-lesson interviews with the teacher. The interviews were semi-structured and designed to be 20-30 minutes long.

Results and Discussion: Transitions between Inquiry Phases (See Figure 1) Figure 1: Transitions between inquiry phases The numbers in Figure 1 represent the number of directed transitions between the phases. When carrying out three different inquiries, the students had the chance to enact the different inquiry phases more than once. But not every inquiry phase was interconnected. It reveals that the transition between 'reflection' and 'plan' occurred more frequently than other phases. This strong interconnection was intended to improve continuity between what students did in the past and what students will do next.

Knowledge Transfer between Inquiry Phases

We identified that students had difficulties in linking between the activities of different lessons. This issue was particularly a matter of concern for the teacher in lesson 7, when the students needed to enact data collection twice. They had collected baseline data in lesson 5. And they were asked to plan to collect comparison data in lesson 7. Figure 2 shows how activities in lesson 7 were sequenced across time, locations, inquiry phases and inquiries. Figure 2: The Sequence of activities in lesson 7 We have addressed 'context' as a configuration of three dimensional elements. Sequencing activities within a lesson or across lessons is one type of configuration. Changing the sequence of activities will also change the learning context of each individual activity. This example not only indicates the complexity of the context, but also highlights that the toolkit should be flexible in sequencing and reconfiguring activities.

Knowledge Transfer between Inquiries

We also identified that specific strategies arise when students move from one inquiry to the next. Mobility of data requires students to make sense of the data collected from another context and envision what happened in another context. The teacher was challenged to facilitate students to make sense of what happened, based on a certain amount of relevant information. The toolkit as a networked boundary object should be able to provide more contextual information, in order to overcome the negative situatedness. With richer contextual information the teacher will be able to guide the students to continually elaborate and de-contextualise their skills and understanding.

Conclusion:

In order to optimize the students' experiences, we make recommendations for ways to manage transitions across these three dimensions. For the 'time' dimension, the toolkit should offer more flexibility in sequencing the activities. For the 'inquiry phase' dimension, the toolkit should empower the teacher and students to socially and continuously construct meaning across different phases. For the 'location' dimension, the connectedness afforded by the toolkit should provide students with more contextual information, in order to overcome negative situatedness in contexts.

PAPER PRESENTATION

Results of federally-funded RCT using PBL in high school economics

Jason Ravitz, Buck Institute for Education, United States; John Mergendoller, Buck Institute for Education, United States; Neal Finkel, WestED, United States

Over the years, supporters of project- or problem-based learning (PBL) in K-12 have generally had to rely on limited research, weak research methods, and sometimes mixed results. Results from a federally funded, randomized

controlled experiment in high school economics provide evidence for the efficacy of PBL and should fuel growing interest in this approach to instruction. The study examined the impact of a one-week summer professional development institute and use of five PBL curriculum modules on the economic knowledge of approximately 7,000 12th grade students, taught by 76 teachers in 66 schools. Student outcomes that were studied included scores on the standardized Test of Economic Literacy (TEL), and scores on performance assessments of student conceptual understanding. Teacher outcomes included confidence in teaching economics and satisfaction with teaching materials. The findings, prepared by the Regional Educational Laboratory West (REL West) at WestEd, indicates there were significant positive impact for students of teachers who received the curriculum compared to their peers and teachers scored higher in satisfaction with teaching materials and methods than those in the control group.

Why study economics?

In the US, forty-eight states now include content standards in economics, with 40 requiring their implementation, and 17 requiring a course in the subject for graduation. (National Council on Economic Education 2007). Economics is a required course for high school graduation in California and Arizona, the two states where the study takes place, and is usually taught to seniors for one semester. While there is growing agreement on the need for some economics content in K–12 education, there is less consensus about how to teach it effectively (Walstad, 2001, Watts, 2006).

Why study PBL?

PBL is an approach to instructional design that can help organize the curriculum and deliver instruction. It provides a mechanism to gain student attention, to motivate and anchor learning. There have been relatively few well-designed K-12 experiments, however a few studies do suggest PBL can be effective in diverse K-12 settings (Barron & Darling-Hammond, 2008; Boaler; 1992; Edutopia, 2001; Marx, et al., 2004). Research involving higher education settings has generally shown promising results, particularly for longer-term learning outcomes (Strobel & van Barneveld, 2008; Walker & Leary, 2008).

There has been an evolution of thinking about what PBL is. PBL can no longer be equated with “minimally-guided or “discovery learning” (Hmelo-Silver, Duncan & Chinn, 2007; Mayer, 2004; Kirschner, Sweller & Clark, 2006). Gradual consensus appears to be building that not all PBL is created equal. Considerable effort has to go into problem or project design, scaffolding and management of learning activities, and the requisite professional development for teachers in order for PBL to be effective.

A PBL approach to economics

The approach to PBL in this study represents a modification of the problem-based approach originally developed for use in medical schools (Mergendoller, Maxwell, and Bellisimo 2000). The step-by-step teaching guide that is provided is the cornerstone of each module, as provided by Social Studies School Service (2010). It lays out for teachers the problem statement, introduction, placement in curriculum, concepts taught, objectives, content standards, time required, lesson description, resource materials, sequence of the unit, procedures, and do’s and don’ts.

Research Questions

The research questions for the study reflect the expected changes in teacher knowledge and practice, attitudes toward teaching economics and student outcomes, they include:

1. Does PBE change students’ content knowledge in economics?
2. Does PBE change students’ problem-solving skills in economics?
3. Does PBE change teachers’ content knowledge of economics?
4. Does use of PBE change economics teachers’ instructional practices?
5. Does the use of PBE change teachers’ satisfaction with teaching materials and methods use?

Note. A full report of methods and results for all five research questions are available from Finkelstein, et al. (2010) . This paper draws extensively from their report.

The study population and sample

This study targeted high schools in urban, suburban and rural areas and engaged teachers who committed to teach economics for two semesters during the 2007/08 academic year. After random assignment, and accounting for attrition and missing data, the intervention group for Spring 2008 included 35 teachers and their 2,502 students, while the control group included 29 teachers and their 1,848 students.

Measures

The primary outcome measure for this study is content knowledge gains for students in economics measured by the Council for Economic Education's Test of Economic Literacy (TEL), a 40-item closed-response exam (Walstad and Rebeck, 2001). This is a widely accepted, standards-aligned test used across the United States to measure economic literacy among high school students.

Student problem-solving skills are measured with open-response performance assessments of applied economics concepts (performance task assessments) developed by the Center for Research on Evaluation, Standards, and Student Testing at the University of California, Los Angeles (UCLA CRESST). These written tasks gave students the ability to demonstrate problem-solving skills as they answered open-ended essay questions, as outlined by Baker, Aschbacher, Niemi & Sato (1992) and Niemi (1996).

All outcome variables were treated as continuous variables in the impact analyses (estimated using multilevel or single-level linear regression models). To increase the precision of the estimates, a set of baseline characteristics of students and teachers was included in the models as covariates.

Key Findings

Results indicate that students whose teachers had received professional development and support for use of the PBL economics curriculum outscored their control group peers on the Test of Economic Literacy by 2.60 items (effect size = 0.32).

Student academic performance was also assessed using open-ended performance tasks that tested problem-solving abilities in short essays. On a composite score of these tasks, students in the intervention group outperformed those in the control group (effect size = 0.27, $p < .05$).

Finally, the economics teachers who used the PBL approach were significantly more satisfied with the materials and methods than their peers who did not use the curriculum. The effect size was quite substantial (effect size = 1.09, $p < .01$).

Conclusion

The positive outcomes from this study are ground breaking in many ways. We are not aware of any other federally funded studies of this kind that examined PBL in a K-12 setting. However, in other respects this study only scratches the surface.

A study like this only looks at "bottom line" differences attributable to the intervention. It does not address variations in the outcomes due to the quality of implementation or differences within teachers (e.g., who was more successful teaching economics than others using the curriculum and with which students, or how their practices in general and implementation of the curriculum differed).

Observations of classrooms indicate that implementation of the PBL units varied enormously depending on the individual teacher. There were a lot of teachers in both treatment and control groups who were extremely engaging and had a certain "spark" for economics that was conveyed to students, while in both groups there were teachers who lacked this spark. (Personal communication with Neal Finkelstein, September 24, 2010)

There is an inherent inability for this study, as it was designed, to untangle curriculum and pedagogy. The treatment group received not just a PBL approach to curriculum but a series of information sessions and materials designed to support their content knowledge and teaching during the curriculum. This makes drawing conclusions about the effectiveness of the PBL approach problematic without further investigation.

PAPER PRESENTATION

Paying for Quality? Associations between private school fees, performance and use of resources

Peter Davies, University of Birmingham, United Kingdom; Neil Davies, University of Bristol, United Kingdom

Using a sample of schools responsible for teaching 70% of 18 year-olds in private schools in England this study investigates effects of resource variation on students' attainment in private schools. The restriction of focus to private schools alleviates some of the problems with studies of resource use in the state sector. That is, (i) there is substantial

variation between private schools in the per student level and deployment of resources; (ii) there is very limited between school compensatory finance; and (iii) since these schools operate in a competitive market they are expected (e.g. Hanushek 1997) to face incentives to use additional resources in ways that increase students' attainment. If market incentives encourage improvements in student attainment we should expect find (i) that parents pay higher fees in schools which achieve higher value added; and (ii) that schools with higher per student income devote that additional income largely to uses of resources for which there is greater evidence of positive impact on attainment. Contextualised Value added was found to be significantly (peach of a lower pupil-teacher ratio, higher average staff earnings, larger school size and a lower proportion of teachers in the staff. Higher fees (at age 11 and 18) were found to be significantly positively associated with value added, the size of the school (students enrolled) and average staff earnings and negatively associated with the pupil-teacher ratio and the proportion of teachers in the staff.

Aims

1. To investigate effects of resource variation on students' attainment in private schools. The restriction of focus to private schools alleviates some of the problems with studies of resource use in the state sector: (i) there is substantial variation between private schools in the per student level and deployment of resources; (ii) there is very limited between school compensatory finance; and (iii) since these schools operate in a competitive market they are expected (e.g. Hanushek 1997) to face incentives to use additional resources in ways that increase students' attainment.
2. To provide indicative evidence of effects of market forces on schooling quality. If market incentives encourage improvements in student attainment we should expect find (i) that parents pay higher fees in schools which achieve higher value added; and (ii) that schools with higher per student income devote that additional income largely to uses of resources for which there is greater evidence of positive impact on attainment.

Methodology

Two OLS regression models (dependent variables of contextualised value added in one and termly fees in the other) with robust standard errors are tested. The independent variables included in the models are: (school resources) staff salary levels, pupil-teacher ratio, teachers as a percentage of all staff, (peer effects) average examination grade per student at age 18, dummy variable for faith school status, (household income) average weekly wage by region, (school assets) school reserves per pupil. These data are compiled in a unique data set from school web sites, school official accounts lodged with the UK charities commission and school performance tables published by the Department for Schools, Children and Families. The sample comprises all private schools in England included in the national Times Independent School league tables for which individual school level data are available through accounts published by the Charity Commission. This sample of 348 schools accounts for 70% of all 18 year olds educated in private schools in England.

Findings

1. Contextualised Value added was found to be significantly (peach of a lower pupil-teacher ratio, higher average staff earnings, larger school size and a lower proportion of teachers in the staff.
2. Higher termly School fees (at age 11 and 18) were found to be significantly positively associated with value added, the size of the school (students enrolled) and average staff earnings and negatively associated with the pupil-teacher ratio and the proportion of teachers in the staff.

Theoretical and educational significance

Relationships between resources, value added and fees in private school have not previously been investigated despite strong claims (e.g. Hanushek 1997) that these would be likely to show significant resource effects demonstrating the efficacy of market incentives in schooling. This neglect perhaps reflects the difficulty in compiling data sets which include the appropriate variables for schools outside the state sector. One previous study (Graddy and Stevens 2005) using data on private schools in the UK found that value added was higher in private schools with lower pupil teacher ratios. This study uses a more secure basis than Graddy and Stevens in measuring value added and includes additional measures of resource use: salary levels and the proportion of teachers in the staff complement. In addition, the associations found between fees, value added and resource use are consistent with the hypothesis that market forces provide incentives to schools and parents which encourage more efficient use of resources. Whilst these findings do demonstrate causation they provide useful starting points for further study. References Graddy, K. And Stevens, M. (2005). The impact of school resources on student performance: a study of private schools in the United Kingdom, *Industrial and Labor Relations Review*, 58, 3, pp. 435-451. Hanushek, E.A. (1997) Assessing the effect of school resources on attainment, *Educational evaluation and policy and analysis*, 19, 2, pp. 141-164.

PAPER PRESENTATIONS

Last year in Secondary School. Any problem?

Merce Clariana, UAB Universitat Autònoma de Barcelona, Spain; Concepcion Gotzens, Universitat de les Illes Balears, Spain; Candido Genovard, Universitat Autònoma de Barcelona, Spain; Teresa Dezcallar, Universitat Autònoma de Barcelona, Spain

The purpose of this study was to investigate both the academic and psychological changes observed in 196 female secondary and university students aged 16 to 22. To find out about these developmental and learning transformations we analyzed 3 so-called "good for learning" variables: previous cultural knowledge, average mark, and conscientiousness. To such helpful characteristics, we added 3 "bad for learning" characteristics: academic procrastination, academic cheating, and extraversion.

While we were expecting a steady increase in good for learning variables (Knowledge, Mark, and Conscientiousness) and a continual decrease in bad for learning features (Procrastination, Cheating, and Extraversion) over the years, none of the kind has been found. First of all, the progress made by our variables was neither steady nor did it followed the hypothesized direction. On the other hand, the students aged 18, who are finishing secondary school and get ready to go to university, were found to exhibit the worst characteristics with regard to learning and studying. According to our data, the 18 years-old are significantly different from all other students in all the variables analysed. They are less conscientious, have less previous knowledge, get lower grades at school, are more extravert, and tend to procrastinate and cheat more in academic settings. So the initial question is still open: Is there any problem at the end of secondary school?

The study analyses relevant academic and personality characteristics of female students attending secondary schools and universities in Barcelona (Spain).

The research was carried out during last year. Depending on their current age and course, the girls were assigned to one of the following groups:

- Age 16, fourth year compulsory secondary school students, n=47.
- Age 18, last year post-compulsory secondary school students, n=35.
- Age 20, second year Psychology undergraduates, n= 62.
- Age 22, final year Psychology undergraduates, n=52.

As we were looking for homogeneous samples, males and students from other ages were not included.

The aim of the study was to test the evolutionary pattern of the following variables:

- "Good for learning":
 - o K = Previous cultural knowledge.
 - o M = Last term academic grade average.
 - o C = Conscientiousness.
- "Bad for learning":
 - o P = Academic procrastination.
 - o F = Academic faking and cheating.
 - o E = Extraversion.

According to previous results (Dietz et al., 2007; Furnham et al., 2009; Komarraju et al., 2009; Rätty et al., 2010; Shokri et al., 2007; Spinath et al., 2010)), "good" variables were supposed to show an increasing tendency from ages 16 to 22. When the students reach their final year at the university they have survived a long selective process, and they are meant to have gained skills to cope with the academic demands. So, we expected the 22 year-olds to be expert learners, to know a large amount of content (K), to have developed a high conscientiousness (C), and to have got high marks in their previous modules (M).

Also, undergraduates aged 22 were supposed to show low levels of the "bad" variables. Close to graduation, the girls were thought to know to overcome procrastination (P), to replace cheating for studying to pass the courses (F), and to withdraw from deficient study tendencies commonly associated with extraversion (E), such as the lack of perseverance and the incapacity to reject social activities when they struggle with the scheduled time for studying. In summary, we expected a consistent growth of "good" variables (Knowledge, Marks, and Conscientiousness) from ages 16 to 22, and a continuous decrease of "bad" variables (Procrastination, Cheating, and Extraversion) at the same age interval.

To test our hypotheses we asked the participants to answer the following questionnaires:

- K. Knowledge of curricular content from secondary school; 12 items; Alpha=.78.

- M. Last academic term average mark.
- C. Conscientiousness (MacCann et al., 2009); 10 items; Alpha=.90.
- P. Procrastination (Clariana & Martin, 2008); 15 items; Alpha=.92.
- F. Cheating (Clariana & Martin, 2008); 10 items; Alpha=.82.
- E. Extraversion (Rammstedt & John, 2007); 2 items; Alpha=.73.

The raw data from the questionnaires were then transformed to T-notes (mean=50 and SD=10), to have them represented appropriately on a graph. In addition, some ANOVAs series were performed to find out whether the differences for the same variables between ages were significant. Figures 1 and 2 show the results.

---Figure 1---

There are significant differences in the "good" variables (previous knowledge, marks, and conscientiousness) for the different ages, but they do not progress as we had hypothesized through the age and course of the students. The characteristics change but neither in the direction nor at the pace we thought. Firstly, none of the "good" variables alterations show a progress in a straight steady line. Secondly, these beneficial characteristics reach their highest level both at 16 and at 20 years of age, when the students are just starting post-compulsory secondary school or have begun at university. As a conclusion, this result may suggest that the beginning of an educational cycle is a positive time, because it helps the students develop advantageous attitudes to learning.

---Figure 2---

Besides, the traits which are said to disturb academic learning, procrastination, cheating, and some aspects of extraversion, are attaining peak values when the students are 18, when they are ready to finish post-compulsory secondary school and start university. Moreover, the age 18 group is the one that got the worst results in the "good" variables, so all in all, it is possible to conclude that at 18 the students have the worst profile for school learning.

Thus, experts should be asking what happens when the students are 18 and reach the end of secondary education. Is it the age or some other developmental or social factors? Or is it the education system, the high level of difficult contents, the almost all declarative type of curricular knowledge they are taught, the kind of instructional methodology, pressure to get a place university, the difficulty university entrance exams we oblige them to take...?

More research will have to be carried in the future in order to answer these questions.

Clariana, M., & Martin, M. (2008). Escala de Demora Academica. *Revista de Psicología General y Aplicada*, 61, 37-51.

Dietz, F., Hofer, M., & Fries, S. (2007). Individual values, learning routines and academic procrastination. *British Journal of Educational Psychology*, 77, 893-906.

Furnham, A., Monsen, J., & Ahmetoglu, G. (2009). Typical intellectual engagement: Big Five personality traits, approaches to learning and cognitive ability predictors of academic performance. *British Journal of Educational Psychology*, 79, 769-782.

Komarraju, M., Karau, S. J., & Schemck, R. R. (2009). Role of the big five personality traits in predicting college students' academic motivation and achievement. *Learning and Individual Differences*, 19, 47-52.

MacCann, C., Lee Duckworth, A., & Roberts, R. D. (2009). Empirical identification of the major facets of Conscientiousness. *Learning and Individual Differences*, 19, 451-458.

Räty, H., Kärkkäinen, R., & Kasanen, K. (2010). To be or not to be? Pupils' explanations of the malleability of their academic competencies. *Educational Research*, 52, 247-261.

Shokri, O., Kadiver, P., Farzad, V., Vallolah, S., & Akbar, A. (2007). Role of personality traits and learning approaches on academic achievement of university students. *Psychological Research*, 9, 65-84.

Spinath, B., Freudenthaler, H., & Aljoscha, C. (2010). Domain-specific school achievement in boys and girls as predicted by intelligence, personality and motivation. *Personality and Individual Differences*, 48, 481-486.

PAPER PRESENTATION

Feminization of the teaching profession and the system level context

Svenja Vieluf, German Institute for Internat. Educational Research, Germany: Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

Policy makers and researchers have frequently drawn public attention to the process of feminization of the teaching profession. Triggered by economic and sociocultural changes this tendency may have some potential downsides; it may contribute to teacher shortages and a lack of male role models for boys. But while a similar pattern can be observed across a large number of education systems, there are also noticeable cross-national differences in the actual proportions of female teachers and principals. Some potential reasons and consequences of these differences

are discussed in the literature. The present contribution combines information from different public databases to examine this question empirically and to shed light on the system level context for differences in the degree of feminization. Analyses with data from 23 countries show that the proportion of females in the teaching profession is negatively related with average wages for teachers, but not with other economic variables or the global gender gap index. At the individual teacher level there is some evidence for differences in professional practices between men and women. Finally, the proportion of women in the teaching profession does not appear to be related with student achievement in math and reading, but significant relations are found with the size of the gender gap in reading. These findings suggest that the level of feminization may in fact be relevant for the aim of equity in education. It further suggests for policy makers to be aware of the relationship between the gendering in school organization and teachers' wages.

Background and Aim of the Study

During the 20th century women have entered a number of male dominated professions. For teachers this process of feminization has advanced far already. However, the predominance of women in classroom teaching contrasts sharply with the relative absence of women in school management positions. A similar pattern has been documented in a large number of education systems, but there are also noticeable differences between countries in the rate to which feminization has occurred (OECD, 2009). This suggests some scope for policy influence. To explain the process of feminization of the teaching profession the literature suggests a prominent role of sociocultural and economic factors (e.g. Acker 1996; Benavot, 1989). Based on the queuing model (Thurow, 1975) it can be argued that differences between countries in the gender ratio may be related with differences in wages and career opportunities for teachers. On the other hand also gender ideologies may have an influence, especially those that consider requirements of the teaching profession – e.g. social competencies – to be female qualities (e.g. Drudy, 2008). The rate of female teachers may be higher in societies where such traditional norms prevail. But whatever the reasons are, does it actually matter that most teachers are women? Two arguments are frequently raised: With a number of countries facing teacher shortages, it is argued that the supply of teachers could be improved by attracting more men to the profession (OECD, 2009). Moreover the gender gap in teaching is blamed for boys' underachievement, arguing that they lack role models for academic success (e.g. Arnot et al., 1999; Mills et al., 2004). Finally there is evidence that instructional practices may also vary as a function of the teacher's gender (Martin, Yin, & Baldwin, 1998; Klieme & Vieluf, 2009), which could potentially affect the general achievement level of students. In summary the process of feminization of the teaching profession is a culture general phenomenon, but it has occurred at different rates. Research suggests that the degree may be related to several context variables, educational processes and outcomes, but many questions are still left open. The present paper aims at answering some of these questions by taking a closer look at the country level context of the phenomenon. More specifically two research questions will be examined, (1) what characterizes education systems with lower versus higher gender inequalities in the teaching profession, and (2) are gender inequalities in the teaching profession related to educational processes and outcomes?

Method

The paper draws on data from different large scale surveys and public databases. Information on teachers' gender, beliefs about the nature of teaching and learning, teacher self efficacy classroom teaching practices and teacher cooperation is based on the OECD Teaching and Learning International Survey (OECD, 2009). The Programme for International Student Assessment (OECD, 2007) is used as a source for data on educational outcomes. Indicators on the expenditure on education and annual statutory teachers' salaries in public institutions were taken from Education at a Glance (OECD, 2010). Moreover country level data on GDP per capita (World Bank, 2009), the global gender gap index (World Economic Forum, 2010), and women's share of labor force (United Nations, 2010) are used. Most analyses are conducted at the level of education systems. At this level the sample consists of 23 countries that have participated in TALIS. Due to this small sample size mainly descriptive analyses are carried out. However, to examine gender differences at the level of individual teachers, multilevel multiple regression analysis is used with a representative sample of 73,100 teachers.

Results

Across the countries participating in TALIS on average 69% of the teachers are female. Percentages above 80% are found in Eastern European countries, while in Australia, Denmark, Mexico, Spain, and Turkey the gender ratio is more equal (52-69%). Analyses relating this degree of feminization of the teacher profession to other characteristics of education systems show that neither GDP per capita nor the expenditure on education is a relevant correlate. No significant relations are further found for the global gender gap index, or women's share of labor force. However, a strong correlation is found for teachers' salaries; the higher the starting and maximum salary of teachers in a country, the lower the proportion of women in the profession ($r = .78^{**}$ and $r = .45^{**}$). Regarding relationships with educational processes and outcomes, findings are also mixed. At the individual teacher level significant differences between men and women exist with regards to their self reported professional practices. In a majority of countries

women agree less with a direct transmission view on teaching, they report to use more structuring and student oriented classroom teaching practices than men, and their participation in cooperative activities with other teachers is also higher (see table 1). But at the level of education systems the degree of feminization of the teaching profession is neither related with general student achievement in reading and mathematics nor with the achievement gap in mathematics. A significant relationship is only found with gender equity in reading; the higher the percentage of female teachers in an education system the stronger the tendency of girls to outperform boys in this domain ($r = .53^{**}$).

Discussion

Policy makers and researchers have frequently expressed concern about the feminization of the teaching profession occurring in a number of countries. The present study suggests that the proportion of female teachers may in fact be relevant for student learning. While the degree of feminization does not have an effect on the general level of achievement, a significant association is found with the size of the gender gap in reading. This can be interpreted as confirmation of the hypothesis of a lack of role models for boys, but it may also have other causes. By all means, the findings suggest that counteracting gender imbalances is a potential direction for policy-makers, considering the importance of gender equity for society. Teacher's wages seem to be one potential instrument of governance. However, more experimental and longitudinal research is needed to clarify the causal chain behind these relationships.

PAPER PRESENTATION

Factors influencing teachers acceptance of national educational standards in Finland and Germany

Annette Fruehwacht, University of Wurzburg, Germany; Walter Mueller, University of Wurzburg, Germany;

Uwe Maier, University Erlangen-Nuernberg, Germany

According to the OECD (Arbeitsgruppe Internationale Vergleichsstudien 2007) national educational standards are said to be a characteristic of successful school systems. Finland as one of the most successful PISA participant has national educational standards since the 1970s. As a consequence of sobering PISA results, German federal states implemented educational standards in the past decade. However, the countries Finland and Germany both realized national performance standards in a different way. While Finland controls educational standards on the regional level, Germany has established educational standards and mandatory testing on the school system level. Based on school governance theory (Kussau & Brýsemeister 2007), a qualitative transnational field study with teachers from Finland ($N=10$) and Germany ($N=20$) examines in which way such educational policies are handled by primary teachers. In both countries the results reveal influencing factors to teachers' attitude and logic of their actions. First and foremost teachers' way of handling the national educational standards is dependent on their pedagogical beliefs. We only found some country-addicted factors influencing teachers' patterns of action.

Introduction and aim of the study

Education policies in all countries define national educational standards in order to guarantee equality and to raise the quality of the national school performance level. Implementation and effects of educational standards on teaching, instruction and student achievement are evaluated in different ways. In Germany the national assembly of the state secretaries of education ("Kultusministerkonferenz") has implemented a national accountability test-system for 3rd graders whereas in Finland communal authorities control educational standards in the field of primary education with a system of trust and discussions with teachers and principals. Both evaluation methods are intended to influence teachers' routines of action. This transnational comparative study focuses on how primary teachers understand and use national educational standards.

Theoretical framework and research question

Governments in all countries try to influence school and classroom level by top-down regulations such as national educational standards. Research on the actual effects of such regulations deals on the one hand with effects on institutional level (e.g. Verhaeghe et al. 2010) and on the other hand with effects on teachers' professional work. In school governance theory, Kussau and Brýsemeister (2007) define the teacher as an individual actor within a complex school system. Individual teachers act as professionals and mostly do not react on top-down reform inputs in a predictable way. School governance theory stresses that practitioners develop their own individual patterns of action how to make sense of educational reforms. However, theory of school governance also strengthens the fact that the constellation of actors on different system levels impacts on the individual action (Kussau & Brýsemeister 2007). School system features influencing the constellation of actors can be found on different system levels: (A) judicial

institutionalisation: implementing of curricula, national educational standards, (B) organisational framework: implementing of control mechanisms like mandatory testing systems and (C) school climate: in-school arrangements. This model allows analyzing the relation of reform efforts such as educational standards and teachers' professional work. We used a cross-country comparative approach for a quasi-experimental variation of school system features and educational policies (Finland, Federal German state Bavaria) to find out what factors of the institutional framework influence teacher usage and acceptance of educational standards. (A) Finland has national education standards for several years. The explication of those standards is made by local authorities. That procedure is intended to guarantee an adaption to individual local conditions. (B) The control system in primary education is very low and local authorities are in charge of it. (C) In Finland every school has the obligation of developing school curricula which shape their school profile. (A) In Germany the federal states implemented national education standards for primary education in 2004. (B) National educational standards are evaluated by a large mandatory assessment. (C) Current policies intend to enhance school-autonomy which is assumed to change in-school constellations.

According to school governance theory we want to find out if and to what extent the different factors (A - C) in countries with different approaches to educational standard reform impact on how teachers make sense of and use educational standards.

Methodology

We conducted expert interviews in Bavaria with teachers from the 3rd grade (N=20) and in Finland with teachers from the 4th grade (N=10). Data were analyzed with Qualitative Content Analyses (Mayring 2010). Interview data were divided into sections according to the subject sections of the interview guideline. After that the statements were classified in deductive and inductive categories. Thus each country had its own system of categories. Afterwards both systems were compared and conclusions could be drawn.

The validation of the data was made by a conceptual validation. The classifications of the data into the category system were made by several persons who are well-acquainted with the project. In addition the data were validated by construct validation. Teachers' statements were justified with statements from school authorities and by interviewing all teachers of the 3rd grade at one school. Furthermore non-reactive data like tests were drawn into consideration.

Results and discussion

The analyses reveal that acceptance and usage of national education standards and mandatory testing systems is low. The transnational methodology allows the assumption that institutional impact on teachers' pattern of action is low and first and foremost influenced by individual school conditions and personal characteristics. The reasons can be linked to school governance theory (Kussau & Brýsemeister 2007). The results reveal that judicial implemented parameters (A) seem to have a highly limited influence on teachers. Mandatory testing systems which are able to affect the pattern of action of some teachers, are more influential (B). We also found cases which allow the conclusion that institutional regulations (A) are only brought into usage through an implicit way, such as mandatory testing systems (B). Furthermore the results show that school climate (C) is supposed to have an impact on the individual teacher action. An atmosphere of collaboration and regular conferences are likely to influence teachers' action in a positive way. In regard to acceptance and usage of educational standards and mandatory testing systems a basic discontent at school and a bad relationship between teachers (C) are negative influencing parameters.

We draw the overall conclusion that the impact of different national reform policies on the implementation of educational standards is lower than school features and teachers professional beliefs about school and teaching.

References:

- Arbeitsgruppe Internationale Vergleichsstudien. 2007. Vertiefender Vergleich der Schulsysteme ausgewählter PISA-Teilnehmerstaaten
- Kussau J., Brýsemeister T. 2007. Educational Governance: Zur Analyse der Handlungskoordination im Mehrebenensystem der Schule. In Educational Governance. Handlungskoordination und Steuerung im Bildungssystem, ed. H Altrichter, T Brýsemeister, J Wissinger, pp. 15–54. Wiesbaden: VS Verlag für Sozialwissenschaften | GWV Fachverlage GmbH Wiesbaden
- Mayring P. 2010. Qualitative Inhaltsanalyse. Grundlagen und Techniken. Weinheim: Beltz. 11., vollst. überarb. Auflage.
- Verhaeghe G, Vanhoof J, Valcke M, Petegen P van. 2010. Using school performance feedback: perceptions of primary school principals. *School Effectiveness and School Improvement* 21 (2):167–88

PAPER PRESENTATION

Women who choose a science-oriented major – factors determining career decision-making

The current longitudinal study examines the career and vocational decision-making of 481 female high school leavers during transition from high school to higher education. The aim of the study was to understand whether female students who intended to study Science, Technology, Engineering or Mathematics (STEM) finally did or did not choose a science-oriented major two years later. Quantitative and qualitative analyses were combined. Results from quantitative analysis indicated that the majority of the students who intended to choose a STEM field finally put their intentions into practice. These students demonstrated better competencies in mathematics, placed more importance on pursuing academic activities and on choosing a major that matched their area of interest and their practical orientation in comparison with students who entered social sciences or humanities. However, their endorsement of the stereotype of women's inferiority in mathematics was comparatively higher. Qualitative analysis revealed that learning experiences and role models were decisive for their decision-making, whereas counselling was hardly ever mentioned in their narratives, nor was gender. It was concluded that the blend of high aspirations, interest, practical orientation and a strong desire to conform could lead to conflicts in a male-dominated STEM context, which might challenge the female students' sense of identity. This paper discusses possible implications for higher education.

Introduction

The globalisation of markets causes a great worldwide demand for qualified employees in the state-of-the-art technology. This can be contrasted with the stagnating number of students entering Science, Technology, Engineering and Mathematics (STEM) in various European countries. As a result, an increasing pressure on the educational system can be observed in order to raise the number of students in these disciplines. The European Higher Education System is, therefore, challenged to create new recruitment strategies and counselling programmes to attract and retain students. During the past decade, many University programmes have particularly been established to support women to choose science-oriented majors.

Aim of the study

There is a wealth of knowledge from international research on career and vocational decision-making about the importance of factors, such as interest, ability, choice of mathematics, participation in high-level courses in mathematics, competence beliefs, self-efficacy in mathematics, perceived difficulty and expectations of success in mathematics, attitudes toward science-related domains, gender stereotypes, as well as background characteristics, including socioeconomic status, gender and ethnicity (Holland, 1997; Eccles (Parsons) et al., 1983; Pekrun, 1993; Bandura, 1997; Eccles, 2005; Wigfield & Eccles, 2002; Lent et al. 2005; Bonnot & Croizet, 2007). Nevertheless, there is little research on the extent to which female high school leavers, intending to choose a STEM field, actually carry their intentions to completion within a two-year span. The current study aims at gaining insight into the factors and circumstances influencing former high school students in their decision to choose or not to choose a science-oriented university major.

Methodology

This research project started in 2006 and is based on a longitudinal study, which combines quantitative and qualitative data and aims to evaluate the correlations between the intention of choosing a science-oriented major and the actual realisation of that intention. The study includes 481 former Swiss female high school students, who were questioned about their career options six months before finishing high school and then followed up with another questionnaire two years later. For the purpose of this paper a sample of 144 women studying engineering, information technology, natural sciences, social sciences or humanities was selected in order to examine the impact of several predictors on the choice of 'STEM studies versus social sciences or humanities'. A logistic regression was carried out to compare these two groups, and grounded theory (Glaser & Strauss, 1967, 1998; Strauss & Corbin, 1996) was used to analyse qualitative data. Out of the 144 sample, 12 students were selected for follow-up interviews one year later in order to qualitatively assess the consistency of their decisions. Quantitative and qualitative data of the different parts of the study were then combined in a 'Triangulation process' (Denzin & Lincoln, 2005; Kelle, 2006; Flick, 2008).

Findings

Overall, the results indicate that the majority of young women, who intended to choose STEM studies during high school, accomplished their goals two years later. These students had attended more advanced courses of mathematics than students with a major in social sciences or humanities. Women with a STEM major were found to have had better grades in mathematics during high school and placed more importance on choosing a major that matched their area of interest and their practical orientation, in comparison with those in the social sciences or humanities. In addition, they attached more importance to the opportunity of pursuing academic activities. However,

their endorsement of the stereotype of women's inferiority in mathematics was higher than that of women studying social sciences and humanities. Findings from the qualitative analysis showed that learning experiences had led to a particular interest in sciences and role models within the family or a wider network played a significant role during the decision-making process, whereas counselling was hardly ever mentioned. What seemed to be decisive for their choice, was a wide range of career options, as well as an interest in practical application. Female students presented themselves as career and family oriented but did not specifically mention gender in their narratives. Mathematics did not seem to play such an important role and was seen as a 'necessary evil' to pass the examinations and to achieve the career goal. Moreover, abilities in mathematics were cautiously presented as 'not bad' rather than 'good'.

Theoretical and Educational Significance of the Research

The current study contributes to the literature on career and vocational decision-making. The results are broadly in line with other studies and confirm Holland's (1985) and Engler's (1993) assumptions positing that a 'good fit' between interest and requirements of a specific working environment, or a disciplinary culture is of significant importance for choosing a university major. However, the study sheds light on important factors beyond interest and competence in mathematics, such as gender stereotype endorsement. The involvement in STEM studies does not seem to prevent women from stereotype internalisation (see also Eccles et al., 1994). It is assumed that female students strive to balance the threat of social identity (Tajfel, 1987) by presenting themselves as different from other women in order to restore a positive identity (Codol, 1984; Bonnot & Croizet, 2007). It can be concluded that the blend of high (intellectual) aspirations, interest, practical orientation and a strong desire to conform could lead to conflicts in a male-dominated STEM context, which may challenge their sense of identity. Internalizing their group inferiority in terms of mathematical skills might lead to a vulnerability to stereotype threat during their future career. The findings, thus, confirm the need for interventions in higher education. Yet, interventions should not only focus on individuals but also on other factors, such as parents, teachers, lecturers, peer groups, counsellors and administrative planning. Hence, it can be inferred that science-oriented subjects should be taught in more consideration of social identity and that a more 'gender-neutral' classroom instruction in (higher) education might help to support and retain women in the STEM fields.

PAPER PRESENTATION

Student characteristics associated with academic performance. The Generation Psy study

Bjorn de Koning, Erasmus University Rotterdam, Netherlands; Sofie Loyens, Erasmus University Rotterdam, Netherlands

This study reports on the recent findings obtained in the Generation Psy project, which aims to identify the student factors related to academic performance as well as the temporal stability of these factors throughout all three bachelor years. Data from nine cohorts of psychology students (N = 1793) were used. The variables that were examined are gender, age, ethnicity, secondary school grade point average (GPA), level of prior education, intelligence, personality characteristics, students' professional behavior as well as their prior educational attainments at university. Using multiple regression analyses, a number of these factors were shown to have an influence on academic achievement, as measured by students' annual university GPA and the number of obtained credit points.

Results indicated that students with better secondary school grades and a higher pre-university education obtained higher course grades and more credit points in all bachelor years. In addition, students who are intelligent, conscientious, introvert, and emotionally stable also performed better in the first two bachelor years. Moreover, students' professional behavior and prior attainments at university also had a strong and persistent influence on students' grades and credit points. These results suggest that the students' pre-university knowledge as well as the knowledge and skills they acquire during their studies have a strong influence on academic performance in all bachelor years. Specific aspects of intelligence and personality also play an important role in academic performance, especially in the first bachelor years. These findings might have important implications for selecting and supporting students in higher education.

Currently, increasing student retention and graduation rates are one of the main challenges in higher education. In most European countries the number of students who obtain a bachelor degree is at best 55% (Van Den Berg & Hofman, 2005). In recent years, researchers have identified a wide variety of factors associated with students' academic achievements varying from student-related characteristics, such as personality (e.g., Chamorro-Premuzic & Furnham) and the study environment such as classroom climate (e.g., Bruinsma & Jansen, 2007). Of these factors, student-related characteristics seem to be most relevant in explaining differences in academic performance (Van Den Berg & Hofman, 2005). Accordingly, the current paper reports on findings from a large-scale study set up at the Erasmus University Rotterdam, called the Generation Psy project, which examines students' personal background

variables and individual differences in order to explain and predict student persistence and dropout in university education.

The Generation Psy project uses a database, called Isis, which contains data of almost ten cohorts of students. The present study can therefore provide novel insights into the student factors associated with academic performance. First, this study examines the influence of student characteristics on academic performance throughout all three bachelor years, whereas the majority of prior research only investigates performance in the first bachelor year. This allows us to investigate the extent to which variables influencing academic performance in the first year also influence performance in the subsequent bachelor years. Second, our study examines a large number and a wide variety of student-related factors simultaneously such as gender, age, personality, intelligence, and prior educational attainment. Most previous studies only focus on several of these variables and do not consider a large number of student factors in a single study. Third, the present study is conducted in a curriculum that is based on the principles of problem-based learning rather than in a traditional teacher-centered curriculum (Schmidt, 1983). Consequently, our study provides insight into the relative contribution of a wide variety of student-factors to academic performance, the temporal stability of these factors, and the generalizability of previous findings to another type of curriculum.

Data were collected from the three bachelor years of the psychology curriculum of the Erasmus University Rotterdam, from the academic years 2001/2002 to 2009/2010. The total number of students in the sample was 1753 (male = 452, female = 1298, mean age = 20.04 years). Information on the student background variables and outcome variables was obtained from the Isis database.

Different outcome variables available in Isis were used in this study: 1) the grade point average (GPA) computed over all courses in a bachelor year, 2) the total number of received credit points computed per bachelor year. The student background variables provided by Isis and used in this study are gender, age, ethnicity, GPA in secondary education, type of pre-university education (VWO -which is the highest stream in secondary education-, higher vocational education, or another preparatory training such as foreign diploma), personality (i.e., extraversion, agreeableness, conscientiousness, autonomy, neuroticism), and intelligence (i.e., abstract reasoning, verbal reasoning, numerical reasoning). In addition, students' GPA obtained in the first and second bachelor years were used as predictors for students' performance in the second and third bachelor year respectively. Furthermore, separate GPA's were computed for students' observed learning activities (i.e., preparation for tutorial meetings, participation during the meetings, and fulfillment of chair and scribe during the meetings) in bachelor 1 and bachelor 2 and these were included as predictors for academic performance.

In order to investigate the relationship between student factors and academic performance, multiple regression analyses per bachelor year with the above mentioned student factors as predictors and course GPA and the number of credit points as dependent variables were conducted. These analyses revealed that the higher the students' secondary school GPA, the higher their grades and the more credit points they obtained throughout all bachelor years. Similarly, students' pre-university education has a significant influence on the number of credit points and course GPA in bachelor 2 and 3 (VWO > higher vocational education > other). Gender had a minimal influence on academic performance, indicating that females obtained higher course GPA's than males only in bachelor 1. Ethnicity and age did not significantly influence students' academic performance. These findings suggest that the prior knowledge students bring with them to university has a determinant influence on academic performance. This might have important implications when looking at which aspects to consider for selecting students for educational programs. Furthermore, higher GPA for observed learning activities and course GPA are also associated with higher scores on both outcome measures of academic performance during all bachelor years, but the effects were strongest in the first year. This suggests that making students aware of the fact that their initial study activities and grades influence subsequent academic performance as early as possible could help them to perform well academically later on in their studies and ultimately to obtain a bachelor degree.

With respect to personality and intelligence, conscientious, introvert and emotionally stable students as well as those with higher verbal, numerical, and abstract intelligence obtained higher course GPA's and more credit points in the first two bachelor years. Autonomy and agreeableness did not significantly influence academic performance. These results suggest that intelligence and certain personality traits should be considered when selecting students for university or to identify students in a curriculum who are at risk of academic failure.

References

- Bruinsma, M., & Janssen, E. P. W. A. (2007). Educational productivity in higher education: An examination of part of the Walberg educational productivity model. *School Effectiveness and School Improvement*, 18, 45-65.
- Chamorro-Premuzic, T., & Furnham, A. (2003). Personality predicts academic performance: evidence from two longitudinal samples. *Journal of Research in Personality*, 37, 319-338.

Schmidt, H. G. (1983). Problem-based learning: Rationale and description. *Medical Education*, 17, 11–16.
Van Den Berg, M. N., & Hofman, W. H. A. (2005). Student success in university education: A multi-measurement study of the impact of student and faculty factors on study progress. *Higher Education*, 5, 413–446.

PAPER PRESENTATION

Factors Promoting and Hindering Collaborative Learning – Students' Experiences from a Virtual Course

Essi Vuopala, University of Oulu, Finland

The aim of this study is to investigate factors promoting and hindering collaborative learning during a virtual course. Students (N=86) from seven universities participated CSCL course for two months. Students were divided into 8 small groups. The course consisted of three differently structured studying phases in a virtual environment Optima. After the each phase the students filled in an on-line questionnaire in which they reflected factors that affected their small group's collaboration.

In the analysis of on-line questionnaires (N=311) students' descriptions about factors promoting and hindering collaborative learning were analysed and coded into five categories: course arrangements, factors related to group, tutoring, individual factors and factors related to the Optima. Each small group's collaborative learning during each phase was also coded either successful or less successful based on students' experiences. In order to characterize successful and less successful collaborative learning situations small groups' Optima discussions (N=330) were analysed according to their contents.

The findings indicate that the most important factors promoting collaborative learning are related to 1) group (shared understanding, argumentative and reciprocal discussion), 2) course arrangements (pedagogical model) and 3) tutoring. Factors hindering collaborative learning are related to 1) group (problems in communication), 2) course arrangements (too loose schedule) and 3) personal issues (lack of studying skills).

Analysis of discussion notes indicates that in successful collaborative situations the mostly used message type was reciprocal message, whereas in less successful collaboration students' messages were mostly independent.

Recent research in Computer Supported Collaborative Learning has shown successful results in enhancing learners to reflect their thoughts together with other learners and promote deep learning (Scardamalia & Bereiter, 2006.) However, collaborative learning is not easy and it sets new roles and challenges for learners: How to collaborate effectively and benefit from other learners? In order to provide support for learners it is important to identify the critical requirements of collaborative learning (Kirschner, Sweller, & Clark, 2006).

In former studies concerning requirements of collaborative learning the focus of the analysis has been in groups' functionality and interaction between group members (e.g. Arvaja, 2005; Lipponen, Rahikainen, Lallimo & Hakkarainen, 2003). Results have shown that successful collaborative learning requires for example deep level discussions, learners' equal participation to collaborative activities and common ground (e.g. Stahl, 2007). However, less is known about learners' experiences of collaborative learning. In order to design, implement and support students' collaboration it's essential to understand learners' perspective.

The aim of this study is to explore university students' experiences about factors promoting and hindering collaborative learning in a virtual course. Specific research questions are:

1. What factors promote and hinder collaborative learning?
2. How do successful and less-successful collaborative learning situations appear in the contents and structure of on-line discussions?

Methods and analysis

Data has been collected from an international CSCL-course which lasted for two months. The students (N=86) were from five Finnish, one Norwegian and one German universities and they were divided into groups of eight to ten students. The pedagogical structure of the course was aimed at promoting collaborative learning, and consisted of virtual studying in Optima environment.

In Optima, small groups' collaborative learning was supported with three pedagogical models, namely a) loosely structured theme discussion, b) discussion with functional roles and c) problem-based learning. Each studying phase lasted two weeks, and after each two-week phases the students filled in an on-line questionnaire in which they reflected the collaboration in their own small group. Each student had to define whether their collaborative learning

was successful or less successful and what factors promoted and hindered collaborative learning during each studying phase.

In the qualitative content-driven analysis of on-line questionnaires (N=311) each small groups' collaborative learning during each three phases was defined either successful or less successful based on students' descriptions (presuming that at least 80% from small group's members defined their collaborative learning either successful/less successful). In order to characterize successful and less successful collaborative learning situations small groups' discussion notes (N=330) were coded according to their contents. Finally students descriptions about factors promoting and hindering collaborative learning were analysed and coded into five different categories: course arrangements, factors related to group or group's behaviour, tutoring, individual factors and factors related to Optima environment.

Results and conclusions

Questionnaire data results indicate that the most important factors promoting collaborative learning are related to group and its' behaviour. 43% of respondents experienced that positive group processes such as active participation in collaborative actions, reciprocal discussions and shared understanding promoted collaborative learning. Factors related to group was also experienced the most significant factor which hinder collaborative learning (41% of respondents). Negative group processes, like problems in communication, prevented students to gain collaborative aims.

Secondly, students experienced that course arrangements have an important role in successful collaborative learning. 33% of respondents experienced that course arrangements, especially the tightly structured pedagogical model (problem-based learning), promoted collaboration in their small group. 20% of respondents experienced that factors related to course arrangements (e.g. loosely structured pedagogical model, too loose schedule, too heterogeneous study group) can also hinder collaborative learning.

Thirdly, 16 % of respondents experienced personal issues (e.g. motivation, studying skills) as factors which rather hinder than promote collaborative learning. The role of tutoring was experienced as factor which promote collaboration (10 % of respondents) Finally, factors related to Optima environment were experienced less significant requirement for successful collaborative learning.

Analysis of discussion notes supports findings from questionnaire data. In the situations which students defined their collaborative learning successful, the mostly used message type was reciprocal message where earlier discussions and others' opinions were taken into account and others' ideas were developed further. In less successful collaboration students' messages were mostly independent messages without connections to previous discussion. Analysis of discussion notes also indicate that in tightly structured studying phase discussion was more active and reciprocal than in loosely structured phase.

The results indicate that it is challenging to design, implement and support collaborative learning. In order to enhance successful collaborative learning, there is a need to consider appropriate pedagogical model and group formulation (e.g. group size, group members' background). It is also essential to ensure that students have sufficient skills to study collaboratively. In addition, learners need various kind of support during collaborative learning process.

References

- Arvaja, M. (2005). Collaborative knowledge construction in authentic school contexts. University of Jyväskylä. Institute for Educational Research. Research 14.
- Kirschner, P.A., Sweller, J. & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry based teaching. *Educational Psychologist*, 41, 75-86.
- Lipponen, L., Rahikainen, M., Lallimo, J., & Hakkarainen, K. (2003). Patterns of participation and discourse in elementary students' computer-supported collaborative learning. *Learning and Instruction*, 13(5), 487-509.
- Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 97-118). New York: Cambridge University Press.
- Stahl, G. (2007). Meaning making in CSCL: Conditions and preconditions for cognitive processes by groups. *CSCL Proceedings 2007*, 651-660.

PAPER PRESENTATION

Identification of Effective Mentoring Practices for New Academics

Heather Kanuka, University of Alberta, Canada

To gain a better understanding of how to implement effective mentoring relationships in research intensive universities a national survey was conducted. Three thousand names of invited participants were drawn randomly; a total of 1361 usable surveys were completed. Based on the results of the survey, focus groups were then conducted with new faculty members and department heads. Consistent with prior research, the outcomes of this study indicate that to be effective and sustainable, mentoring programs must include these components: mentor selection; mentor and mentee preparation; department and institutional support; and accountability. Perhaps unsurprisingly, this study also revealed the existence of barriers to implementing and sustaining effective mentoring programs. These barriers include reward systems, time, resources, and structuring of mentoring programs.

Mentoring Practices in Canadian Universities

As an applied research study the purpose of this project was to gain a better understanding of how to implement effective mentoring relationships, resulting in creating a campus-wide community in research-intensive universities, a survey was conducted. Three thousand names of invited participants were drawn randomly; a total of 1361 usable surveys were completed. Based on the results of the survey, focus groups were then conducted with new faculty members and department heads. The purpose of this study was to investigate mentoring practices within Canadian Universities.

The method used to collect the data was a questionnaire, with a follow-up focus group. The objectives of this study were to:

1. Identify current mentoring activities for new faculty members in universities that identify themselves as research-intensive across Canada
 2. Identify past mentoring activities for mid- to late-career faculty members in universities that identify themselves as research-intensive across Canada
 3. Determine if there are: (a) relationships between mentoring practices and academic career development; (b) relationships between mentoring practices and academic career satisfaction
- Participants There were two types of participants: Newly hired university faculty (within the last five years and non-tenured) and mid- to late-career university faculty (employed as an academic for more than ten years and tenured).

Results

The findings have implications for mentoring practices in research intensive universities in Canada. Following is an overview of the results. - The survey results reveal that fewer spontaneous mentoring relationships are currently being formed with new faculty (51.5% of mid- to late faculty had spontaneously formed relationships vs. 28.2% of new faculty) and fewer senior colleagues are offering to mentor new faculty (15.2% of mid- to late-faculty vs. 6.4% new faculty). - While it would seem obvious that new faculty should be provided with this information, the survey results show new faculty are not being provided with the following information:

- information of the formal institutional rules
- constructive feedback about teaching
- constructive feedback about research
- constructive feedback about committee work

As expected, there was strong agreement that an excellent mentor will have the following characteristics:

- accessible
- respected among professional peers within the institutions
- an exemplary researcher

Less clear is how mentors should be rewarded. New faculty believe mentoring support should be recognized on the faculty member's annual report, whereas mid- to late faculty believe recognition of mentoring should be informal. In regard to mentor assignment, there were inconsistencies. The greatest agreement occurred with mid- to late-faculty believing that mentoring relationships should be mutually formed with some combination of input from the new faculty member, mentor, department chair/head and dean. - The duration of the mentoring relationship should be ongoing until the new faculty member has attained tenure, requiring 2-4 hours / month. - There was agreement that preparation for mentoring should be provided by the university's faculty development centre (as compared to other options).

Minority faculty members (visible minority, sexual orientation) experience significantly less help in the following areas:

- lack of information and help in terms of expectations for achieving tenure and promotion
- absence of role models and mentors
- lower levels of perceived career satisfaction
- lower levels of good collegial relationships

Conclusions

Consistent with prior research, the outcomes of this study indicate that to be effective and sustainable, mentoring programs must include these components: mentor selection; mentor and mentee preparation; department and institutional support; and accountability (Kajs, 2002). Perhaps unsurprisingly, this study also revealed the existence of barriers to implementing and sustaining effective mentoring programs. These barriers include reward systems, time, resources, and structuring of mentoring programs. Despite the positive impacts of mentoring documented in three decades of research, not all mentoring relationships are successful (see also Sandler, 1993). Co-operative and group mentoring models, such as the mosaic mentoring model, offer a structure for mentoring programs that might have greater likelihood of overcoming the barriers. Problems that tend to cause mentoring relationships to fail often arise from the unstructured and spontaneous hierarchical dyads that characterize them. Boyle (1996) maintained that successful mentoring begins with institution-wide programs that provide support and resources to achieve a sense of connectiveness for new and early faculty members. Later research by Boyle and Boice (1998) revealed a strong justification for systematic mentoring and institution-wide programs. Research by Kalbfleisch and Davies (1993) supported these findings. Kalbfleisch and Davies concluded that those individuals who need help the most (e.g., visible minorities, non-traditional faculty) are the least likely to find it. Wunsch (1994) advanced this argument further by asserting that when individuals agree to enter into a mentoring relationship related to academic and career goals, the relationship moves from the personal to the institutional realm; this can result in inequity of opportunities, which the institution must address. To be exact, when some individuals have access to certain career advantages (e.g., mentoring relationships) and others do not, inequity of career opportunities (e.g., advancement, promotion) occurs. It is the responsibility of the institution to ensure that all individuals have equity of access to the same career opportunities. Structured mentoring relationships, such as the mosaic mentoring model, appear to be key to ensuring equity of access to mentoring relationships.

References

- Boyle, P., & Boice, B. (1998). Systematic mentoring from new faculty teaching and graduate teaching assistants. *Innovative Higher Education*, 22(3), 157-159.
- Boyle, R. (1996). *First-order principles for college teachers: Ten basic ways to improve the teaching process*. Bolton, MA: Anker Publishing.
- Kajs, L.T. (2002) Framework for designing a mentoring program for novice teachers. *Mentoring and Tutoring*, 10(1), 57-69.
- Kalbfleisch, P.J., & Davies, A. B. (Fall 1993). An interpersonal model for participation in mentoring relationships. *Western Journal of Communication*, 57, 399-415.
- Sandler, B. R. (1993). Women as mentors: Myth and commandments. *The Chronicle of Higher Education (Opinion)*, March, B3.
- Wunsch, M. A. (1994). Developing mentoring programs: Major themes and issues. In M. A. Wunsch (Ed.), *Mentoring Revisited: Making an Impact on Individuals and Institutions*, pp. 27-34. San Francisco: Jossey-Bass.

PAPER PRESENTATION

Shared regulation and knowledge construction

Angelika Meier, Institute for research in teaching and learning, Switzerland; Franziska Vogt, Pädagogische Hochschule des Kantons St. Gallen, Switzerland

This study investigates the shared regulation and knowledge construction of learning in an activity-oriented setting in the natural sciences. Twenty teams of students from grade 4 to 6 were video-recorded while working on an experimental task relevant for the understanding of climate change. Prior to working on the activity-oriented task, students responded to questionnaires on self-regulation and motivation as well as on prior knowledge of the topic. After working on the task, students were shown excerpts of the video and interviewed about the regulation of their learning process (video-recall). The analysis of the twenty videos and video-recalls provides information about the shared regulation of pairs in relation to their respective preconditions (prior knowledge and self-regulation) as well as task characteristics (problem-oriented task versus step-by-step instruction). Thus the research question for this study is: how do pairs of primary school children share the regulation of the activity-oriented learning process and thereby co-construct knowledge under these two conditions? The insights of this study are relevant for the provision of effective learning environments for primary school students in the natural sciences.

Aims of the study

The general purpose of this study is to establish how children with different ability in self-regulated learning (SRL) as well as with different levels of prior knowledge respond to the experimental tasks within the learning space

(Lernwerkstatt in German). Learning spaces evolve around a core theme. The theme for the present study focuses on climate change. A class with their teacher visits the learning space for the duration of a half-day. Students choose tasks freely and often work in small groups or pairs. Learning spaces seek to encourage students' self-regulated learning (SRL) through activating learning tasks, with the aim of a deeper understanding, an increase in intrinsic motivation and domain-related interest as well as a higher competence of self-regulation. To what extent students need instruction and how self-regulation can be fostered is controversially discussed amongst the teachers involved with learning spaces. Thus the extent of guidance is systematically varied in this research project: The same content is covered in a problem-oriented experimental task versus a step-by-step instruction for conducting the experiment. As collaborative learning settings are increasingly employed in classrooms, understanding students' shared regulation in relation to their self-regulation becomes paramount (Järvelä & Järvenoja, in press). Therefore, this study addresses the following research question: how do pairs of primary school children with different levels of SRL and of prior knowledge share the regulation of the inquiry-based learning process under two conditions (problem-oriented vs. step-by-step instruction)?

Methodology

The research has been conducted in the setting of the learning space. In a quasi-experimental design, two types of tasks were used: a problem-oriented task with only the description of the problem and materials for the experiment provided and a step-by-step instruction with directives of how to conduct the experiment and solve the problem. Eight classes (grade 4 to 6) visited the learning space and took part in the study. Prior to their visit, all students were given questionnaires which included scales of self-regulated learning (Bruder, 2006), goal orientation (Spinath, Stiensmeier-Pelster, Schöne, & Dickhäuser, 2002) interest in the topic, and familiarity with environmental issues (Frey et al., 2009). They also completed a test capturing the prior knowledge of the topic. The total number of participants in the study were 158 primary school students (79 girls) between 9 and 14 years ($M = 11.2$ years, $SD = 0.9$ years). Upon arrival in the learning space, pairs of students were randomly assigned to work on the prepared experiment. A total of 20 pairs were video-recorded while working on this task. Immediately after completion of the task, they were interviewed in a video-recall (Spärrer & Brunstein, 2006). The questions for the video-recall are based on Pintrich's (2004) model of self-regulation.

The videos and video-recalls were transcribed and then examined for evidence of shared regulation and knowledge construction (Bos & Tarnai, 1999). The focus is on how the teams build a shared understanding of the task, set themselves goals, adapt the goals to the current situation and react to difficulties when solving the given task. A qualitative data analysis software was used for micro-coding, using statement units, defined as a codable unit of speech (i.e., a word, a phrase, sentence, or sentences) within a turn, as units of analysis (Hogan, Nastasi, & Pressley, 1999). In addition, macro-coding of episodes including a significant shift in the content of the discussion or action was developed in relation to the inquiry-based learning cycle (Llewellyn, 2007). Within the episodes different types of regulation of learning can be observed, e.g. individual regulation and shared forms of regulation (Vauras, Liskala, Kajamies, Kinnunen, & Lehtinen, 2003).

Outcomes

A first analysis of six teams with differing levels of self-regulation allowed the development of the following macro-codings: Understanding of the problem, hypothesis, elaboration of the problem, interpretation of results and evaluation of solution. Results from preliminary analysis (Meier, 2010) suggest that problem-oriented tasks allow for more high-level dialogues. In contrast, the step-by-step instruction supports students in the evaluation of the evidence. This analysis, however, is now extended over the whole sample of 20 pairs and compared with the interview data from the video-recalls.

Theoretical and educational significance

The results of this research are of high practical relevance for developing effective learning spaces and in informing teacher education. The OECD (2006) report on students' interest in science recommends early, positive, hands-on experiences, and student interaction in the field of natural sciences for the development of interest and competence. In addition, the ability to work in teams is a key skill for today's students. The insights of this study help to provide further understanding of the processes of shared regulation amongst primary school children.

References

- Bos, W., & Tarnai, C. (1999). Content analysis in empirical social research. *International Journal of Educational Research*, 31, 659-671.
- Bruder, S. (2006). *Die Förderung von Selbstregulation bei Kindern unter Einbeziehung ihrer Eltern*. Berlin: Logos.
- Frey, A., Taskinen, P., Schütte, K., Prenzel, M., Artelt, C., Baumert, J., et al. (Eds.). (2009). *PISA 2006 Skalenhandbuch, Dokumentation der Erhebungsinstrumente*. Münster: Waxmann.

- Hogan, K., Nastasi, B. K., & Pressley, M. (1999). Discourse patterns and collaborative scientific reasoning in peer and teacher-guided discussions. *Cognition and Instruction*, 17(4), 379-432.
- Järvelä, S., & Järvenoja, H. (in press). Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. *Teachers College Record*.
- Llewellyn, D. (2007). *Inquire within. Implementing inquiry-based science standards in grades 3-8*. (2nd ed.). Thousand Oaks, CA: Corwin Press.
- OECD. (2006). Evolution of student interest in science and technology studies, from <http://www.oecd.org/dataoecd/16/30/36645825.pdf>
- Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, 16(4), 385-407.
- Spinath, B., Stiensmeier-Pelster, J., Schöne, C., & Dickhäuser, O. (2002). Die Skalen zur Erfassung von Lern- und Leistungsmotivation (SELLMO). Göttingen: Hogrefe.
- Späth, N., & Brunstein, J. (2006). Erfassung selbstregulierten Lernens mit Selbstberichtsverfahren. *Zeitschrift für pädagogische Psychologie*, 20(3), 147-160.
- Vauras, M., Liskala, T., Kajamies, A., Kinnunen, R., & Lehtinen, E. (2003). Shared-regulation and motivation of collaborating peers: a case analysis. *Psychologia*, 46, 19-37.

PAPER PRESENTATION

The influence of self-regulation competencies on learning with expository texts

Melanie Schuette, Ruhr-University Bochum, Germany; Joachim Wirth, Ruhr-University Bochum, Germany; Detlev Leutner, Duisburg-Essen University, Germany

The study focuses on competencies required for a successful self-regulated learning with expository texts. Although there has been a lot of research on self-regulated learning, there exists no commonly accepted model which describes all competencies necessary to fulfill the five main metacognitive demands during self-regulated learning, i.e. goal setting, planning, observing, evaluating, and adapting. We present a comprehensive theoretical framework which includes all competencies necessary to fulfill the metacognitive demands during self-regulated learning. Based on this framework, the aim of the study was to analyze if some of these competencies are more important in terms of a high learning outcome than others. We used a multiple regression to analyze the relative effect of the different competencies on learning outcome. Results reveal that the strategic competencies activating strategy knowledge and applying learning strategies as well as the metacognitive competency evaluating task demands are significant predictors of students' learning outcome. Based on these findings, we discuss the effects of prior knowledge as well as the effect of specific task features on the application of self-regulation competencies and, furthermore, with respect to the theoretical and practical use for further research.

Aims of the study

Self-regulated learning with texts has been studied extensively. On the one hand, psychological research proposed process models which describe different phases of self-regulated learning (e.g., Zimmerman, 2000). Within these phases, five metacognitive demands have to be met for a successful learning outcome: 1) goal setting, 2) planning, 3) observing, 4) evaluating and 5) adapting. However, process models do not explicitly specify the competencies needed to meet the metacognitive demands. On the other hand, researchers proposed component models which describe learners' competencies that foster self-regulated learning from texts (e.g., Boekaerts, 1997). Even though component models define competencies important for becoming a successful learner, they do not explicitly specify in which phase of the learning process the different competencies are needed. In sum, there exists no commonly accepted model which can describe all competencies necessary to fulfill the five metacognitive demands during self-regulated learning. Based on this gap in research, we developed a comprehensive theoretical framework which includes both the metacognitive demands as well as the necessary competencies during self-regulated learning (Schütte, Wirth & Leutner, in press). In terms of the five metacognitive demands, the authors identified nine competencies which are necessary to fulfill the metacognitive demands (see figure 1). Using this comprehensive framework, the aim of the study was to analyze the relative effect of the nine competencies on students' learning outcome in a realistic learning setting.

Methodology

The reported results are based on a sample of 559 German ninth grade high-school students. The mean age of the sample was $M = 14.92$ ($SD = .51$) with 52.1% of the students being female.

The design of the study was twofold. Per student we administered two expository texts which covered either topics from chemistry or physics. On day one, we administered the first expository text to the students to initiate self-regulated learning. Within 20 minutes, the students were asked to learn as much as possible while reading the

challenging text. Before and after reading the text, we used content-valid achievement tests to assess the (prior) knowledge of the students. One day two, we assessed the nine competencies relevant for fulfilling the five metacognitive demands using the second expository text. For each of the nine competencies the students filled in one test. The tests assessed whether the students had the competence (1) to evaluate the given task demands, (2) to evaluate their prior knowledge, (3) to set up learning goals, (4) to activate their strategy knowledge, (5) to apply learning strategies, (6) to adjust an action plan, (7) to evaluate their gained knowledge, (8) to evaluate the achievement of learning goals or (9) to evaluate the reasons for non-achieved learning goals. Thus, for each of the nine competencies the students received one score which indicates the degree of the specific competency. All nine competency scores were then used for the analysis of the relative effects of the competencies on learning outcome in a realistic learning setting assessed at day one.

Results

A multiple regression analysis was used to analyze the relative effect of the nine competencies on the learning outcome in a realistic learning setting. The results of the multiple regression analysis (see table 1) revealed that next to prior knowledge ($\beta = .34, p > .01$) three out of nine competencies assessed at day two were predictive for students' learning outcome assessed at day one. Significant predictors of students' learning outcome at day 1 were the competencies evaluating task demands ($\beta = .11, p > .05$), activating strategy knowledge ($\beta = .15, p > .01$) and applying learning strategies (text-highlighting strategy: $\beta = .14, p > .01$; concept mapping: $\beta = .09, p > .05$). However, the other three competencies in the forethought phase as well as all competencies of the self-reflection phase were not significant predictors of students' learning outcome. Possible reasons for this might be the lack of prior knowledge as well as the characteristics of the learning task when learning with expository texts (e.g. self-paced study time or specific task demands).

Theoretical and practical use

In the study a comprehensive theoretical framework was presented which includes metacognitive demands as well as necessary competencies to fulfill the metacognitive demands during learning. The comprehensive framework made it possible to analyze the relative effect of the different competencies on learning outcome in a realistic learning setting. The results showed that in addition to the strategic competencies activating strategy knowledge and applying learning strategies the metacognitive competency evaluating task demands was a significant predictor for learning outcome. In sum, the analysis of the relative effect of the competencies on students' learning outcome provide a deeper insight in the relevance of specific competencies during self-regulated learning which could be used for future study.

In terms of practical relevance, the identification of the most relevant competencies during self-regulated learning could be the first step for the development of more efficient training materials. Standardized tests to assess the most relevant competencies could be used to selectively promote only those competencies which are low instead of time consuming general trainings.

References

- Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction*, 7, 161–186.
- Schütte, M., Wirth, J., & Leutner, D. (in press). Selbstregulationskompetenz beim Lernen aus Sachtexten – Entwicklung und Evaluation eines Kompetenzstrukturmodells [Self-regulation in learning with expository texts - Development and evaluation of a competence structure model for determining competence levels]. *Zeitschrift für Pädagogik*.
- Zimmerman, B.J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic Press.

PAPER PRESENTATION

Investigating the quality of learning strategy use in self-regulated learning: a video study

Peter Ludwig, University of Koblenz-Landau, Germany; Claudia Finkbeiner, University of Kassel, Germany; Markus Knierim, University of Kassel, Germany

Up to now, learning strategy research has typically focused on how frequently certain types of learning strategies are used. It can be assumed, however, that it is not mainly the frequency of strategy use which influences the learning process and outcome but the adequacy of each single strategy used. Hence, the present video lab study ADEQUA adopts a micro-analytic approach to assessing the quality of strategy use. Learners of English as a foreign language (EFL) were videotaped while working in dyads on reading comprehension tasks in a self-regulated, cooperative learning environment. Multiple regression analyses show that the measurement of the adequacy of strategy use succeeded with high validity. Adequacy of strategy use turned out to have a significant effect on learning outcome when controlled for other predictors (EFL proficiency, cognitive ability, interest in EFL reading, previous school year's

EFL grade). ANCOVAs and regression analyses were used to identify the characteristics of students using strategies non-adequately.

Learning strategies are deemed significant to successful learning, especially in self-regulated learning environments. However, empirical evidence to corroborate this assumption was scarce initially, despite its well-established plausibility. In particular, this applies to correlational studies, most of which yielded no or only weak correlations between habitual strategy use (i.e., a learner's trait-dependent strategy style) and generalized measures of achievement (e.g., a student's grade). More recently, learning strategy research has attempted to capture learners' strategies through data collection procedures which are more proximal to specific learning situations. In studies using these procedures, strategy use has been found to correlate more strongly with (situation-specific) achievement. The video study ADEQUA (ADEQUAcY of Learning Strategy Use and Teacher Support Actions) picks up this trend in learning strategy research and develops it further. The study wants to gain empirical evidence as to how autonomous learning in the English as a Foreign Language (EFL) classroom can effectively be supported during cooperative classroom activities by means of teacher support actions.

Up to now, strategy research has typically focused on how frequently certain types of learning strategies are used. ADEQUA explores a new approach: Instead of taking the frequency as an indicator of the quality of the learning process and predictor of the learning outcome, the present study assesses the adequacy of each single strategy used during a given task. Adequate strategy use is conceived of as being situationally appropriate. Hence, ADEQUA adopts a micro-analytic approach.

The project consists of an extensive piloting phase as well as two main studies, i.e., a lab study and a follow-up field study. In both main studies, 9th grade EFL learners in Germany worked in dyads on reading comprehension tasks in a self-regulated, cooperative learning environment. For the lab study, student dyads were drawn from their regular classrooms in order to observe their independent use of learning strategies without their teacher's intervention. In the subsequent field study, the same tasks were implemented with whole EFL classes to observe how teachers supported their students. This presentation will focus on the lab study. The main emphasis of the lab study is on reconstructing the students' use of strategies and assessing the strategies' adequacy. Thus, we aim to gain a more thorough understanding of the impact of specific strategies at the micro level of students' actions. These insights are intended to guide the optimization of high-quality strategy use in student-centered learning environments.

In a student pre-survey, data on a range of student characteristics were collected, including students' questionnaire-based self-reports on self-regulated learning, and several standardized proficiency tests. Representing the core element of the lab study, the task performances of student dyads were videotaped. The recording took place separately for each pair of students in a dedicated room at the students' school. Special care was taken to make even cognitive strategies observable by designing the tasks in such a way that would require the students to communicate continuously with each other about the content of the text, any comprehension problems they were facing, and how to proceed working on the task. Immediately after the task performance, the students participated in a written post-survey which addressed retrospectively the students' task experience and perceived self-efficacy. Moreover, a task-specific reading comprehension test was administered. In an additional follow-up interview the students were asked to recall – based on the video recording of their task performance – the specific strategies they had used while working on the task. This stimulated recall procedure was intended to shed some more light on learning activities and processes which would otherwise be difficult to reconstruct. Subsequently, the video recordings of the students' task performance and the stimulated recall interview were used to identify the strategies employed. For each occurrence of each strategy, a group of raters assessed its adequacy (see above), based on theoretically founded criteria. These highly inferential assessments were aggregated in an index of strategy use quality for each student. A total of 15 whole classes with 352 ninth-grade students from eleven German schools participated in the pre-survey; all tracks of the German secondary education system were represented. For the videotaping of the task performance, 164 students were selected.

Key findings:

Firstly, multiple regression analyses show that the assessment of the adequacy of learning strategy use succeeded with high validity ($R=0.66$; p

Theoretical significance of the research:

In comparison to the prevailing approach to learning strategy research (which focuses on the frequencies of strategies used), the new approach taken here (which emphasizes on the adequacy of strategies used) can stand its ground. This becomes evident from our finding that (a) the habitual use of strategies in EFL reading as well as (b) the frequencies of the strategies actually used during the given task correlate less strongly with learning outcome than adequacy of strategy use does. Secondly, the determinants of adequate strategy use have been identified by means of ANCOVAs

and regression analyses. Students who tend to employ inadequate strategies and who may, therefore, be in greater need of teacher support share the following characteristics: (1) lower EFL proficiency and poorer EFL grades; (2) lower verbal cognitive ability; (3) immigrant family background; (4) they attend less prestigious tracks of the German secondary school system; (5) lower perceived interest in and engagement with the task; (6) they perceive the task to be difficult; and (7) they are doubtful of successfully completing the task.

Educational significance of the lab study:

The study contributes to our knowledge about which learning strategies students tend to use adequately vs. non-adequately in the given learning environment. The latter, therefore, may require the teacher's support. Moreover, we were able to identify typical characteristics of students who may be in need of additional support from their teacher in order to employ strategies more adequately and, hence, improve their learning processes and outcomes.

PAPER PRESENTATION

SRL and metacognition in young children: What can interview and observational data tell us about it?

Uta Wagener, University of Osnabrueck, Germany

Metacognition and self-regulated learning play an important role in learning and are an important predictor of learning outcomes. The presented study examines children in the first and second year of school (aged 6 to 8) in their daily classroom contexts. Methods of video observation and interviews are used to learn more about young children's self-regulated learning and to enlighten different facets of their competencies in this area.

Results of this qualitative study show that children were metacognitively active in their learning process. They knew and used different criteria for the evaluation of their work and they reflected about task properties and their own skills. Anyhow, in general they showed more of these competencies in the observations than in the interviews. The presentation addresses the question what this difference means and what kind of knowledge different data sources represent.

Another aspect that has to be considered is that children's self-regulation did not always occur in a way that was likely to promote learning effectiveness. Sometimes children focused their monitoring and regulation on aspects that are not central to the task, or they used it in the pursuit of non-learning goals. Nonetheless, these young children showed metacognitive knowledge and use of metacognitive procedures that are a basis for their further development as self-regulated learners.

Introduction

Metacognition and self-regulation play an important role in learning and have proven to be an important predictor of learning outcomes (e.g. Veenman, Van Hout-Wouters & Afflerbach, 2006; Paris & Winograd, 1990).

However, some experimental studies have stated deficits in children's monitoring and regulation (e.g. Kuhn, 2000). On the other hand, recent studies in naturalistic settings showed that already young children are metacognitively active, able to monitor and regulate their behavior (e.g. Whitebread et al., 2007). In the presented study, different methods of data collection have been applied in a naturalistic school setting and are used to enlighten different aspects of these complex phenomena.

Aims

The aim of the study was to develop a fine-grained analysis of young children's self-regulated learning in a naturalistic school setting. Children were observed in their daily classroom situation and indicators for self-regulation and metacognition were analyzed. Their perspective on their own learning was explored with interviews and thereby knowledge was compared with actions and behavior. Interview and observation have been used to enlighten different facets of young children's competencies in this area.

Methods and Methodology

For the investigation of metacognition and self-regulated learning the methods of observation, video-observation, and interview were combined. Data collection was conducted in three steps. In a first step learning processes were observed in three classes with 23 to 26 children, aged from 6 to 8, in different German primary schools. In a second step video observation was done in one of the classes and finally, interviews were conducted in the same class. This qualitative, microanalytic approach was chosen because there is evidence that methods such as self-reports or experiments are likely to underestimate the metacognitive competencies of young children (Whitebread et al., 2007). Observation in a naturalistic setting can be a way to learn more about children's metacognitive abilities (Winne & Perry, 2000). Interviews are a way of learning more about their thoughts and reflections.

In the analysis, inductive and deductive methods were used. Concepts that are central to self-regulated learning and metacognition were used to build codes such as "Use of criteria for evaluation" or "Evaluation of personal skills".

Inductive coding procedures (e.g. Strauss, 1987) were used to complement the analysis and to extend the theoretical view on self-regulated learning.

Interviews and observational data were analyzed independently at first and in a second step they were compared and matched systematically. The analysis of different sources of data was integrated in AtlasTi. Coding procedures and categories were regularly discussed in a team of researchers.

Findings

Results of this qualitative study show that children are metacognitively active. Children regularly spoke about metacognitive aspects during independent work phases without being prompted. They talked to themselves or to other children and these reflections were used as one indicator for metacognitive activities.

Children monitored their learning, they knew and used different ways for checking results, and they applied various criteria for the evaluation of their work during observation. They were also observed to link task properties to their own skills spontaneously.

In the interviews children were able to speak about strategies they used and thoughts they have about their learning. Anyway, they mentioned much less strategies in the interviews than they used during their learning activities. However, the amount of strategies and procedures that were mentioned increased when the questions focused on a specific task that the children had been working on recently.

We have to address the question what this difference means and what kind of knowledge these different data sources represent. If, during observation, children talk for example about a strategy for monitoring their results spontaneously while they are using it, but do not mention this in the interview, what kind of awareness is this? Can this be called metacognition (cf. Veenman et al., 2006)? An important point is how we can use these different forms of knowledge to foster further reflection and understanding.

Another aspect that has to be considered is that metacognitive activities did not always occur in a way that is likely to promote learning effectiveness. Sometimes children focused their monitoring on aspects that were not central to the task, or they used metacognitive monitoring in the pursuit of non-learning goals. Nonetheless, these children showed knowledge and use of metacognitive procedures.

Significance

Children in this study performed metacognitive activities and reflections that are a basis for their development as expert self-regulated learners. The micro-analysis of processes, contexts, and conditions of metacognitive monitoring is crucial to gain knowledge about what children think and do in learning situations. There has been a lot of discussion about methodological aspects and how to collect data about self-regulated learning and metacognition in young children; this study helps to enlighten the benefits of different data sources if we aim at learning more about children's competencies as well as difficulties in this area.

References

- Kuhn, D. (2000). Theory of mind, metacognition, and reasoning: A life-span perspective. In K. J. Riggs & P. Mitchell (Eds.), *Children's reasoning and the mind* (pp. 301-326). Hove, England: Psychology Press/ Taylor & Francis.
- Paris, S. G., & Winograd, P. (1990). How metacognition can promote academic learning and instruction. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instructions* (pp. 15-51). Hillsdale, NJ: Erlbaum.
- Strauss, A. (1987). *Basics of qualitative research*. Cambridge: University Press.
- Veenman M, Van Hout-Wouters, B. & Afflerbach, P. (2006) Metacognition and learning: conceptual and methodological considerations. *Metacognition and Learning* 1, 3-14.
- Whitebread, D., Bingham, S., Grau, V., Pino Pasternak, D. & Sangster, C. (2007) Development of Metacognition and Self-Regulated Learning in Young Children: the role of collaborative and peer-assisted learning, *Journal of Cognitive Education and Psychology*, 3, 433-55
- Winne, P. H. & Perry, N. E. (2000). Measuring self-regulated learning. In: M. Boekaerts, P. Pintrich, M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 535-566). San Diego, CA: Academic Press.

PAPER PRESENTATION

Effects of early bilingualism on deductive reasoning in elementary school age

Sebastian Kempert, Goethe-University Frankfurt, Germany; Ilonca Hardy, Goethe-Universität Frankfurt, Germany

In the present study we examined bilinguals' advantages in executive functioning when reasoning with conditionals of the form if p then q. Deductive reasoning is an area of cognition highly relevant for academic settings as mathematics and science learning. Specifically, we assumed that bilinguals would outperform monolinguals on conditionals with counterfactual and abstract content as these problems call for the application of attentional control and inhibition processes. In contrast, we did not expect differences between the groups on conditionals with concrete content as

well as on conditionals designed to put demands on working memory by providing additional information since general advantages in working memory of bilinguals have not been reported in the literature. In a study with a total of $N = 54$ German monolingual and German-English bilingual third-graders we confirmed the postulated differences in performance with bilinguals showing an advantage on conditionals with counterfactual and abstract content, while, as expected, we did not find any differences between the groups in performance on conditionals with concrete content and with additional information. The results are discussed in terms of the development of deductive reasoning and their possible relevance for school-related learning.

A growing number of studies report cognitive advantages of bilinguals (Adescope et al., 2010). Especially advantages in executive functioning (EF) have been repeatedly shown to be affected by bilingualism (Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008). This means that bilinguals in comparison to monolinguals are better able to focus their attention on relevant stimuli in ambivalent situations as well as to inhibit prevalent responses. It has been assumed that the necessity to separate two linguistic systems from early age on will result in a training and automatization of aspects of EF, namely attentional control and inhibition processes (Martin-Rhee & Bialystok, 2008). Bilinguals' advantages with regard to EF have been replicated with verbal as well as nonverbal tasks (Adescope et al., 2010). However, most of the tasks used in this research are highly artificial; practical implications with regard to school settings are rarely postulated. This is surprising since EF is considered an important factor for (school-related) learning processes (St Clair-Thompson & Gathercole, 2006).

In the context of bilingual advantages in academic domains, the investigation of deductive reasoning seems to be especially promising. Successful reasoning with conditionals of the form if p then q has been connected to working memory (WM) capacities and to processes of attentional control and inhibition: While for reasoning with conditionals of concrete content, WM is considered to be the most important factor, reasoning with conditionals of counterfactual or abstract content has been related to attentional control and inhibition processes (Handley et al., 2004). Here, reasoning has to be carried out solely on the basis of the formal structure of the conditional; additionally, prevalent (but invalid) answers may have to be inhibited in order to give a correct answer. Bilinguals, due to their enhanced EF, may therefore show an advantage on these types of reasoning tasks which are generally particularly difficult to answer. Advantages would be extremely interesting as the ability to reason deductively is an important prerequisite of participation in various academic domains such as scientific thinking (Zimmermann, 2007).

Background of the study

To investigate potential advantages of bilinguals in EF we conducted a study with 54 German monolingual and German-English bilingual third-graders. We assumed that bilinguals would outperform monolinguals on conditionals with counterfactual and abstract content as these problems call for the application of attentional control and inhibition processes. In contrast, we did not expect differences between the groups on conditionals with concrete content as well as on conditionals designed to put demands on WM by providing additional information as general advantages in WM of bilinguals have not been reported in the literature. Finally, since differences between monolinguals and bilinguals should be specifically traced back to attentional control and inhibition we did not expect differences in logical thinking abilities per se. Accordingly, group comparisons on indeterminate (typically more difficult) and determinate (typically less difficult) conditionals should reveal no group differences.

Method

54 third-graders (27 German monolinguals and 27 German-English bilinguals) participated in the study. As control variables, we administered a test of oral proficiency in German (and English for bilinguals) and a nonverbal test of cognitive ability. As an indicator for SES we used a books-at-home index. We developed five sets of conditionals of the form if p then q with the following variations in content: concrete, counterfactual, abstract, concrete with additional facilitative information, and concrete with additional distracting information. Each set included the four possible combinations of inference modi (modus ponens, modus tollens, affirmation of the consequent, denial of the antecedent) resulting in 20 conditionals.

Results

In a repeated ANCOVA including cognitive ability, verbal ability, and SES as covariates we found a significant difference between the two language groups on conditionals with counterfactual and abstract content, $F(1, 49)=7.40$, $pp=0.13$, while the effects of type of content and the interaction group \times type of content were insignificant. Univariate follow-ups confirmed a bilingual advantage on conditionals with counterfactual and abstract contents, $F(1, 49)=4.77$, $pp=0.08$; $F(1, 49)=2.96$, $pp=0.05$, respectively. In a further ANCOVA on conditionals with concrete content, facilitative, and distracting information, no significant differences between the groups were observed (group \times type of content: $F(2, 48)=0.14$, $p=.86$, $\eta^2p=0.00$, group: $F(1, 49)=0.09$, $p=.75$, $\eta^2p=0.00$) although the manipulation of the conditionals was successfully indicated by a significant effect of the factor of type of content, $F(2, 48)=3.34$, $pp=0.12$.

The direction of the manipulation was confirmed by pairwise comparisons. Finally, a repeated ANCOVA on the type of conditional reasoning (determinate, indeterminate) revealed a significant effect, $F(1, 49)=9.35$, $p=0.016$, while no group effects or interaction effects were observed.

Discussion

Drawing from results of previous research, we expected advantages of bilingual children on tasks that require attentional control and inhibition but not on tasks that call for additional resources in WM. Accordingly, we found statistically significant differences in the performance of the group of monolinguals and bilinguals on conditionals with counterfactual and abstract content, while no differences were observed with regard to conditionals with concrete content or with additional facilitating or distracting information. At the same time, this variation showed the expected effects for both bilingual and monolingual students. Finally, the data reveal that the two groups did not differ in their ability to solve determinate and indeterminate conditionals indicating that there are no differences in logical thinking abilities in general. Our results are promising as conditional reasoning is considered to play an important role in academic learning such as mathematics and the natural sciences. For example the formulation of hypotheses from theory and the design and interpretation of experiments are areas in which deductive reasoning is necessary. It is also in these domains where the confrontation with counterfactual or abstract contents is very likely. Future studies will need to replicate our findings in more applied settings such as science learning in order to specify bilinguals' application of EF in these domains.

References

- Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A Systematic Review and Meta-Analysis of the Cognitive Correlates of Bilingualism. *Review of Educational Research*, 80(2), 207–245.
- Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, 11(2), 282–298.
- Handley, S. J., Capon, M., Beveridge, D. I., & Evans, J. S. B. T. (2004). Working memory, inhibitory control and development of children's reasoning. *Thinking & Reasoning*, 10(2), 175–195.
- Martin-Rhee, M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition*, 11(1), 81–93.
- St Clair-Thompson, H. L., & Gathercole, S. (2006). Executive functions and achievement in school: Shifting, updating, inhibition and working memory. *The Quarterly Journal of Experimental Psychology*, 59(4), 745–759.
- Zimmermann, C. (2007). The development of scientific thinking skills in elementary and middle school. *Developmental Review*, 27, 172–223.

PAPER PRESENTATION

Content and Language Integrated Learning (CLIL): Predictor variables of dropout

Nadira Saab, Leiden University, Netherlands

Content and Language Integrated Learning (CLIL) is a form of education where students are educated in another language than their mother tongue. The goal of CLIL is improving the English proficiency next to providing the regular education. In 2008, 99 schools in the Netherlands used CLIL. This study investigates possible predictor variables of dropout in Dutch schools that use CLIL. Variables that are investigated include social economic status, parent support, affective factors (motivation, self-esteem), and cognitive factors (English proficiency, performance in primary school (CITO scores)). This study involves 512 seventh/eight-grade students who are participating in a CLIL program. The students are followed during the first two years of pre-university education (seventh and eight grade) In the first year, 7 % of the students dropped out. Based on preliminary results, it can be concluded that students who dropped out had a lower SES than students who continued with CLIL. Furthermore, students who dropped out had lower results on the English skills test. More results will be presented at the conference.

Theoretical and educational significance

Content and Language Integrated Learning (CLIL) is a form of education where students are educated in another language than their mother tongue. Most of the schools in The Netherlands that implemented CLIL use English as the second language. The goal of CLIL is improving the English proficiency next to providing the regular education. In 2008, 99 schools in the Netherlands used CLIL (European Platform, 2008). However, little research has been conducted into CLIL in the Netherlands. Huibregtse (2001) investigated the effects of CLIL on the academic performance of students. The study showed that students attending schools that integrated CLIL had higher grades for English than students who attended regular schools. No differences were found for grades of other subjects. Weenink (2006) compared the social economic background of parents of children attending the CLIL and parents of children attending gymnasium (small scaled regular pre-university education specialised in classical language such as Latin and Greek) with the social economic background of parents of children from regular pre-university education. It was found that most parents of

the first group were from higher social economic background than the second group. Furthermore, the first group stressed the importance of internationally oriented education more than the second group. In 2008-2009 41.785 students in the Netherlands dropped out of school (Secretary of OCW, 2010). 10.183 of these students were high school students. These students actually left school. In this study we see dropout as quitting the form of education the students is following, in this case CLIL. It is possible that students quit CLIL and go to regular education. Research into the factors that influence dropout show that social economic background, motivation, academic performance, gender, and self-esteem are possible predictors of dropout (Lee & Burkham, 2003; Luyten et al., 2003). Aim This study investigates possible predictor variables of dropout in Dutch schools that use CLIL. Variables that are investigated include social economic status, parent support, affective factors (motivation, self-esteem), and cognitive factors (English proficiency, performance in primary school (CITO scores)). Furthermore, difference in dropout rate between girls and boys is investigated.

Methodology

This study involves 512 seventh/eight-grade students from seven schools in The Netherlands who are participating in a CLIL program (297 boys and 215 girls). These schools teach half of the courses in English. The schools use a total immersion method (Wytzes, 2002; Van der Mee, 2003), which implies that students have to speak English rather than Dutch during those courses. A questionnaire measuring the variables described above was administered at two times: in the seventh and eight grade, both at the beginning of the school year. So the same students, except for the dropouts, are followed during the first two years of pre-university education (seventh and eight grade). At this moment, only the data of the first measurement is analysed. The results of the analyses with the data of the second measurement will be presented at the conference. In the first analyses, analyses of variance were used to find possible predictor variables..

Findings

In the first year, 7 % of the students dropped out. Based on preliminary results, it can be concluded that students who dropped out had a lower SES than students who continued with CLIL. This finding corroborates with findings from Lee & Burkham (2003) and Luyten, et al. (2003). Furthermore, students who dropped out had lower results on the English skills test (part of the questionnaire). A surprising result is that dropout students received relatively more support from their parents. This is in contrast with results from earlier research (e.g. Cutrona et al., 1994; Ryan, 2001; Wentzel, 1998) where more social support most often leads to better academic performance. However, in both groups the parents were more than willing to help the students with their homework. No differences were found between boys and girls.

References

- European Platform (2008) Huibregtse, I. (2001). Effecten en didactiek van tweetalig voortgezet onderwijs in Nederland. [Effects of bilingual secondary education in The Netherlands.] Doctoral dissertation, Utrecht University, Utrecht: Drukkerij Elinkwijk B.V. Weenink, D. (2006). Sociale reproductie in een tijdperk van mondialisering: wie kiest er voor het tweetalig onderwijs? [Social reproduction in an age of globalisation: who chooses for bilingual education?] Doctoral dissertation, University of Amsterdam, Amsterdam. (Secretary of OCW, 2010).
- Lee, V. E. & Burkham, D. T. (2003). Dropping out of high school: the role of school organization and structure. *American Educational Research Journal*, 40 (2), 353-393.
- Luyten, H., Bosker, R. J., Dekkers, H. & Derks, A. (2003). Dropout in lower tracks of Dutch secondary education. Predictor variables and variation among schools. *School effectiveness and School Improvement*, 14 (4), 373-411.
- Wytzes, L. (2002, October 5th). Het andere gymnasium. [The other gymnasium.] Elsevier; p.29.
- Van der Mee, G. (2003). Vraag naar tweetalig onderwijs groeit hard. *Het Onderwijsblad*, 30.
- Cutrona, C. E., Cole, V., Colangelo, N., Assouline, S. G., & Russell, D. W. (1994). Perceived parental social support and academic achievement: An attachment theory perspective. *Journal of Personality and Social Psychology*, 66, 369-378.
- Ryan, A. M. (2001). The peer group as a context for the development of young adolescent motivation and achievement. *Child development*, 72, 11-35.
- Wentzel, K. R. (1998). Social relationships and motivation in middle school. The role of parents, teachers and peers. *Journal of Educational Psychology*, 90, 202-209.

PAPER PRESENTATION

An investigation of foreign language learning attitudes among Turkish EFL learners

Ozgul Ozbak, University of Essex, United Kingdom

This paper reports on a pilot study that was conducted before the longer proposed study. The aim of the study was to look at the issue of foreign language learning attitude in depth via addressing two central research questions: What factors affect or determine Turkish EFL learners' attitudes towards language learning situation at tertiary level? What

are Turkish EFL learners' attitudes towards the EFL classes at tertiary level? Contrary to the traditional quantitative attitude surveys, this study adopted exploratory and qualitative methodology by employing diary entries and interviews as data collection instruments. Six Turkish EFL learners doing English classes at two different universities were asked to keep a weekly diary for three weeks. After the analysis of the diary data, three individual interviews and one group interview were conducted to go into detail of the diary findings. The results showed that participants found English classes necessary. They also reported that they liked English language. One important finding is that despite their favourable attitudes towards English language, they reported unfavourable attitudes towards the classes. Various factors related to the language classes, language teacher and language programme were found to affect the participants' overall language learning attitudes. Since this study is based on both theoretical and practical considerations, findings suggest considerable theoretical and pedagogical implications for foreign language learning. This paper presents the empirical results in detail and discusses the implications for both theory and practice.

Attitude has long been a matter of scholarly attention in second language acquisition field since it has been well defined by scholars that each individual learner has different disposition towards second language learning. Technically first initiated by Gardner (1985) with socio-educational model, attitude has been of interest to a number of scholars, (e.g. Burstall, 1975; Brown, 1983; Chambers, 1999; Clark and Trafford, 1996; Dörnyei, 2003; Ushioda, 2005). There is a plethora of research on the topic in SLA field, however, as Mitchell & Myles (1998:26) also mention, most language learning attitude research appeared within broader motivation research although attitude itself is an "umbrella term" covering a wide range of issues. (Baker, 1992:29). In Gardner's socio-educational model the term appeared in line with the target language community, language learning in general and language learning situation. However, since Gardner's focus was on integrativeness, attitudes toward the learning situation was not given considerable attention. With the educational shift in 1990s putting the classroom concept in the agenda, a number of critical treatments and theoretical expansions have emerged. (Dörnyei, 1994; Gardner & Tremblay, 1994; Oxford & Shearin, 1994).

In recent frameworks, classroom gained more importance than before but as already mentioned not in pure attitude research but within broader motivation research. Bearing in mind that although attitude and motivation are two closely related concepts since it's been well evidenced that attitude affect motivation and motivation affect overall L2 development (e.g. Gardner, 1985), there should be a clear-cut between the terms in order to better understand both issues in depth. (e.g. Crookes and Schmidt), and that as Chambers state "to treat them as one and same thing, however, is unhelpful." (Chambers 1999:26), this study aims to look at the issue of foreign language learning attitude in depth via addressing following research questions: What factors affect or determine Turkish EFL learners' attitudes towards language learning situation at tertiary level? What are Turkish EFL learners' attitudes towards the EFL classes at tertiary level?? As also addressed by some scholars, (e.g. Crookes and Schmidt, 1991) most of the attitude surveys initiated by Gardner and his AMTB and factor analysis have traditionally adopted quantitative methodology by collecting data via standardised likert-scale questionnaires and by employing statistical analysis with an aim to produce quantifiable generalizations of variables limited to the pre-set ones thus leaving the door closed to other attitudinal factors probable to arise in an explorative research. Because attitude is a complex and broad term stemming from individuals' emotional world and because it changes from person to person and open to interpretation, an exploratory approach was decided to be more consistent with this attitude survey.

This paper reports the results of a pilot study that was conducted before the longer proposed study to see how qualitative research instruments would work. Six Turkish EFL learners doing English classes at two different universities were asked to keep a weekly diary for 3 weeks. Before they start writing their diaries they were given a training session on diary writing. After the collection and analysis of the diary data, 3 individual and one group interviews were conducted to go into detail of the diary findings. T

he results showed that participants found English classes necessary. They also reported that they liked English language. One surprising finding is that despite their favourable attitudes towards English language, they had unfavourable attitudes towards the classes. Based on both diary and interview data, various factors were found to affect the participants' language learning attitudes. Among the most commonly reported ones are course materials, learning tasks, lesson topics and contents, lack of practice in classes, language skills classes with focus on grammar classes, teacher motivation, teacher personality, teacher feedback, teaching style, teacher modelling, non-native speaker of English teachers, teacher-student relationship, teacher authority, English classes as obligatory class, overall assessment, exam, homework and assignments. These reported factors were put under three categories: attitudes towards lesson related variables, attitudes towards teacher related variables and attitudes towards obligatory English preparatory programme as an external force.

This exploratory and qualitative study is based on both theoretical and practical considerations and findings indicated that attitudes towards the language is not necessarily in parallel line with attitudes towards the language classroom which indicates that in foreign language learning situation where exposure to the target language is mainly and in many cases only the classroom, language learning situation that is classroom has a great impact on overall language learning attitude. The findings of the present study also suggest considerable pedagogical implications for foreign language classrooms.

PAPER PRESENTATION

Comparing English and Japanese 5 year-olds development of language, a transversal skill.

Stasia Cwenar, Liverpool Hope University, United Kingdom

Japanese pupils consistently outperform English pupils in international league tables of academic performance, yet there is little data on their relative starting points prior to starting school. A comparative study has compared early performance in each country on a range of abilities significant in subsequent school success.

A total of 110 pre-school children with an average age approaching 5 years were individually assessed in a study matching gender, age, sample size and social background. Parent and educator interviews on early education provided further, qualitative data to augment and clarify quantitative results. Quantitative test results showed significant differences between performances of the Japanese and English children (Mean Rank for Japanese children was $M = 74.69$, with the Mean Rank for the English $M = 36.31$ (p

Qualitative data from interviews on the relative philosophies and practices of the two countries regarding child rearing, early education and communication competence are discussed, including those regarding the preparation of children for the shift from home to school styles of learning. The results overall are considered as to whether there is any relationship between the philosophy and practice of teaching in the pre-school years and latter educational performance.

Introduction:

Global competition has led to an interest in international comparisons of performance in education and the workplace, and more recently on the relationship between outcomes, curriculum and pedagogy. Tables of academic performance in Mathematics and Science (TIMSS) show that in general pupils from Pacific Rim and Scandinavia achieve the highest results (Mullis, Martin and Foy, 2005). For example, Japanese pupils consistently outperform English pupils by the age of 9 yet they do not begin formal schooling until age 6-7. Most school assessment deploys the 'secondary' language modes of reading and writing yet as Sage (2000a) suggests, around 75 percent of children experience some difficulty shifting from informal, home talk to formal, school discourse, dependent upon their ability to assimilate and assemble information. This may be attributed to current child-rearing circumstances and practices and less opportunities for extended, formal types of talk between the child and other adults.

Methodology:

This study forms part of a project designed to compare children's understanding as they approach statutory education and their 'primary' oral ability to make meaning from experience. The data will also consider any relationship between levels of cognitive-linguistic competence and later academic success. As English children start Primary education at around age 5 years and Japanese children at age 6+ years, tests were administered to participants whose average age was 5 years.

Participants: There were 55 Japanese and 55 English pupils aged 40-59 months, 56 males and 54 females (Japanese, $M = 49.09$; English, $M = 50.15$, p

Materials:

Activities which require participants to apply their existing knowledge in new situations reveal the nature and extent of underlying concepts and meta-cognitive abilities, while expression of ideas in natural language allows a valid examination of children's conceptual knowledge. On this basis two language tests were developed to examine the capacity of children to assemble and reproduce information.

Tasks involved a General Knowledge test and Retelling of a Story, the latter suggested by Beilin (1975) to be the best indicator of learning potential, with children reproducing information according to their cognitive and linguistic levels. They were designed to be 'culturally fair', age appropriate and valid for assessing cognitive development in young children. Cultural features that provide 'meaning' in the tasks (Anastasi, 1988; p.298) were protected as meaning-making was a key component of the cognitive assessment criteria. Reliability and validity were tested at the developmental stage for linguistic accuracy of target questions and tests by native speakers.

Also addressed were the ethical safeguards necessary when testing very young nursery/kindergarten participants, aged around five years and when conducting adult interviews. Consent was obtained through universities and schools which met the standards of each country, prior to project clearance and commencement.

Methods of Analysis:

Answers to the General Knowledge questions related to personal understandings essential for comprehending received language: animate/inanimate function, space, time and comparatives. Responses were coded as right or wrong. Responses to the Story Retelling task were examined for oral usage of propositions and coded for: correct ideas, sequence and degree of detail.

Results

Language tasks: Findings for the General Knowledge show that only 19 percent of the English 3-4 year-olds did not know their age, confirming that, in general, children's understanding of 'self' develops before that related to the wider world. There was no difference between the Mean Ranks of boys and girls; boys: $M = 20.75$, $SD = 6.97$; girls: $M = 20.04$, $SD = 7.09$. There was a strong correlation (Mann-Whitney U Test) between the results of the general knowledge and story re-telling tasks at $r = .311$ with a significance level of p

The Japanese children recalled the story more completely and coherently, demonstrating a significantly greater sense of narrative than the English children who paid greater attention to individual items than the story as a whole. Differences between performances of the Japanese and English children was statistically significant. The Mean Rank for Japanese children was $M = 74.69$, with the Mean Rank for the English $M = 36.31$ (p

Conclusion: Further qualitative data obtained in discussions and classroom observations in the Japanese kindergarten and elementary schools revealed a pattern of adult awareness of the major shift required of young children when moving from informal home talk to the more formal styles of school talk. For example formal speaking (in class) is coached as part of daily practice in Japan, and the strategy of providing opportunities for all children in the class to communicate their ideas, combine to provide a strong base structure for learning about written words and numbers. These are rarely seen in British educational practice and may relate to their relative underlying educational and child-rearing philosophies.

In a global society involving international cooperation and collaboration, comparative studies bring greater insights and understanding of both individual and group functions, and differing degrees of balance between the two. Intercultural comparisons must respect cultural differences involving unmatched variables, and importing educational practices without such consideration is inappropriate. Nevertheless the above results and other early years pedagogy may warrant wider examination in relation to international levels of performance in core or 'transversal' skills.

References

- Anastasi A. (1988; 6th edition) Psychological Testing. New York: MacMillan.
Beilin, H. (1975) Studies in the Cognitive Basis of Language Development. (New York: Academic Press).
Mullis, I V S., Martin, M O; Foy P. (2005) IEA's (International Association for the Evaluation of Educational Achievement) TIMSS, (Trends in Mathematics and Science Study), 2003. International Report on Achievement in the Mathematics Cognitive Domains: Findings from a Developmental Project. (Chestnut Hill, MA: Boston College).
Sage, R. (2000a) Class Talk: Effective classroom communication. (Stafford: Network Educational Press)

PAPER PRESENTATION

Explicit/implicit knowledge and working memory in L2 reading comprehension

Cem Alptekin, Turkey; Gulcan Ercetin, Bogazici University, Turkey

The distinction between explicit and implicit knowledge has been investigated in terms of the contribution of each type of knowledge to L2 development. However, little attention has been paid to the role of explicit and implicit knowledge in the development of language skills. That is, how explicit and implicit knowledge resources and the corresponding explicit and implicit processes of learning contribute to the development of a skill. Similarly, the limited research investigating the role of working memory (WM) in L2 skill development has largely ignored the delineation of interactions between WM and the declarative and procedural memory systems underlying long-term memory (LTM). Considering that late L2 learning predominantly occurs in a consciously controlled manner, with an enhanced declarative memory system and a corresponding attenuated procedural system, it can be assumed that explicit linguistic knowledge plays an important role in L2 reading compared to implicit knowledge and that interactions between LTM and WM represent the controlled processes of explicit knowledge. The current study aimed to shed light on issues relevant to a better understanding of how knowledge types (explicit and implicit) and memory systems (LTM and WM) interact for L2 reading comprehension. The participants were university students who were advanced

EFL learners. Correlations among the variables were obtained and examined through a factor analysis. The results indicate that explicit linguistic knowledge, WM capacity, and L2 reading constitute a factor altogether. Implicit linguistic knowledge constitutes a factor on its own, yet WM capacity is related to implicit knowledge to a certain extent.

The distinction between explicit and implicit knowledge has been extensively investigated in applied linguistics in terms of the contribution of each type of knowledge to L2 development. However, little attention has been paid to the role of explicit and implicit knowledge in the development of specific language skills. That is, how explicit and implicit knowledge resources and the corresponding explicit and implicit processes of learning contribute to the acquisition of a L2 skill. Similarly, the limited research investigating the role of working memory (WM) in L2 skill development has largely ignored the delineation of interactions between WM and the declarative and procedural memory systems underlying long-term memory (LTM). WM, for instance, consciously processes tasks that are fundamentally explicit. Accordingly, it predominantly subserves declarative memory (DM), which is in charge of storing and retrieving explicit knowledge. This is in sharp contrast to the operation of the procedural memory (PM), which is responsible for storing and retrieving implicit knowledge and skills. Considering that late L2 learning predominantly occurs in a consciously controlled manner, with an enhanced DM and a corresponding attenuated PM (Ullman, 2001), it is reasonable to assume that WM operations will have a significant relationship with the conscious processing of explicit knowledge.

The current study aimed to shed light on a number of issues relevant to a better understanding of how knowledge types (explicit and implicit) and memory systems (LTM and WM) interact for L2 reading comprehension, taken up as the language skill to be examined. To this end, the following research questions were investigated:

Are there significant relationships between explicit/implicit knowledge types and WM capacity?

Are there significant relationships between L2 reading and explicit/implicit knowledge types on one hand, and WM capacity on the other? Do these variables form coherent subsets that are relatively independent of one another?

It was hypothesized that there should be a significant relationship between explicit knowledge and WM capacity, as cognitive processes underlying both LTM-based explicit knowledge operations and WM functions are characterized by consciousness and attentional control. In contrast, a non-significant relationship was expected to be the case in what concerns the connections between implicit knowledge and WM functions since all WM operations, as indicated by Baars (1997), rely on conscious elements even in cases when these may recruit the mediation of unconscious resources to perform the given tasks (Hypothesis 1). Next, it was assumed that explicit knowledge rather than implicit knowledge would be closely related to L2 reading comprehension, considering that late L2 readers rely mostly on explicit knowledge as a result of their formal educational experience with L2 learning, not to mention the fact that PM, known to be responsible for implicit knowledge, attenuates with age, its linguistic functions being taken over by DM (Ullman, 2001). As for the relationship between L2 reading and WM capacity, a significant correlation was expected because of the significant associations observed between WM capacity and L2 reading comprehension in research findings (Alptekin & Erçetin 2009, 2010; Harrington & Sawyer 1992; Miyake & Friedman 1998; Leiser 2007; Walter 2004) (Hypothesis 2). Based on these hypothesized relationships, it was assumed that explicit knowledge, WM capacity, and L2 reading comprehension would form a coherent subset in a factor analysis as these variables are characterized by controlled explicit processes whereas measures of implicit knowledge would form a separate subset (Hypothesis 3).

The participants were 51 Turkish university students who were advanced EFL learners. They were given standard tests measuring their implicit L2 knowledge, explicit L2 knowledge, and L2 WM capacity. L2 reading comprehension was measured through a standardized reading test (Nelson-Denny). Correlations among the measures were obtained to explore the relationships. The data were also exposed to an exploratory factor analysis using principal components extraction and varimax rotation. The findings indicate that explicit linguistic knowledge, WM capacity, and L2 reading comprehension constitute a factor altogether. The relationship between the use of explicit knowledge and WM operations in the L2 is to be expected given that conscious and intentional processes of selective attention that are involved 'in the control, regulation and active maintenance of task-relevant information' in WM (Miyake & Shah 1999: 450) are also indicative of bottom-up processes of explicit knowledge that direct learners to focus on the relevant features of the L2 input. Therefore, explicit knowledge-based performance correlates with L2 reading comprehension since L2 readers' performance in reading is predominantly guided by the DM's explicit knowledge. The outcome is word-bound reading, characterized by lexical processing at the expense of syntactic processing—which is subserved by PM. This places a heavy load on WM capacity and hampers efficient L2 reading by preventing the interaction of bottom-up and top-down processes. The relationship between WM capacity and L2 reading comprehension corroborates previous evidence obtained between the two constructs (e.g. Alptekin & Erçetin 2010; Harrington &

Sawyer 1992; Leiser 2007; Walter 2004). WM, in fact, significantly contributes to reading comprehension due to both constructs sharing similar cognitive properties.

The results further indicate that implicit linguistic knowledge constitutes a factor on its own, yet WM capacity is related to implicit knowledge to a certain extent. This finding renders support to those critics (Halford et al. 2007; Hassin et al. 2009; Reber & Kotovsky 1997) of the prevalent position of viewing WM as operating intentionally and consciously on tasks that are strictly explicit. Evidently, although WM is primarily responsible for bottom-up processing of explicit data, it also attends to the input that is to be processed in a top-down way in the event input is of an implicit nature. In a way, the conscious components of WM help mobilize and guide unconscious routines that carry out automatic processing of implicit tasks (Baars & Franklin 2003) while they sustain controlled attentional processing for complex explicit tasks. Thus, technically speaking, WM is a central executive for all types of cognitive processing, with controlled processes of explicit learning taxing its limited capacity much more heavily than automatic processes of implicit learning. The implications of the findings for L2 reading instruction will be discussed.

PAPER PRESENTATION

Recreational and Academic Reading Motivation in Primary School

Jessie De Naeghel, Ghent University, Belgium; Hilde Van Keer, Ghent University, Belgium; Maarten Vansteenkiste, Ghent University, Belgium

Given the importance of reading motivation for reading frequency and academic reading performance, an in-depth understanding of reading motivation is essential to keep children motivated and encourage them to read. The first aim of this study was to develop and validate a questionnaire measuring recreational and academic reading motivation (SRQ-Reading Motivation), based on self-determination theory, and to explore fifth graders' reasons for reading. Second, the relationship between reading motivation, reading engagement, reading frequency, and reading comprehension was studied to deepen our understanding of reading motivation. 1260 fifth graders completed the SRQ-Reading Motivation, 8 subscales of the Motivation for Reading Questionnaire (MRQ), a standardized reading comprehension test, a scale concerning reading frequency, and reading self-concept. Teachers also rated their students' reading engagement. Exploratory and confirmatory factor analyses indicate that both recreational and academic reading motivation comprise two factors: autonomous and controlled reading motivation. Comparisons with the MRQ and the teacher rating of students' reading engagement confirm the construct validity of the instrument. Participants mainly report autonomous reading motivation in both contexts (recreational and academic). Not surprisingly, controlled reading motivation is fairly higher in the academic setting. Both structural equation models, designed to clarify the relationship between reading motivation and several reading outcomes, have a good fit and support the predictive utility of the SRQ-Reading Motivation questionnaire. As expected, autonomous reading motivation, relative to controlled reading motivation, is associated with more positive outcomes (i.e. more reading engagement, higher leisure-time reading frequency, more reading comprehension).

Relevance and Objective

Reading motivation declines as children grow older, starting already in primary school (Guthrie & Wigfield, 2000). This tendency challenges us, since reading motivation is a critical predictor of reading frequency (Guthrie, Wigfield, Metsala, & Cox, 1999) and reading performance (Taboada et al., 2009). In order to keep children motivated to read and to encourage reading motivation, an in-depth understanding of this concept is essential.

Theoretical Background

According to Guthrie and Wigfield (2000), reading motivation refers to "the individual's personal goals, values, and beliefs with regard to the topics, processes, and outcomes of reading" (p. 405), indicating different reasons for reading. However, a further examination of the dimensions of reading motivation is recommended (Watkins & Coffey, 2004) and should consider contextual differences (McKenna & Kear, 1990). In this perspective, Self-Determination Theory (SDT) (Ryan & Deci, 2000) presents a promising theoretical framework to conceptualise autonomous and controlled types of reading motivation. According to reading research (Guthrie et al., 1999; Taboada et al., 2009) and SDT (Connell & Wellborn, 1991; Ryan & Deci, 2000), autonomous reading motivation has been associated with more reading engagement, higher reading frequency, and better reading comprehension. However, an indirect relationship between reading motivation and comprehension via reading frequency (Guthrie et al., 1999) or through engagement (Connell & Wellborn, 1991) is also suggested.

Research Goals

The main goal of this study is to develop and validate a reading motivation questionnaire based on SDT, and to explore fifth graders' reading motivation in recreational and academic contexts. Further, the relationship between reading motivation, reading engagement, reading frequency, and reading comprehension is studied.

Research Method

Participants

1260 fifth graders from 45 Flemish (Belgium) primary schools participated.

Instruments

Based on SDT (Ryan & Deci, 2000), the SRQ-Reading Motivation was developed to capture autonomous and controlled reading motivation, in recreational and academic contexts (McKenna & Kear, 1990).

To validate this instrument, students completed 8 subscales of the Motivation for Reading Questionnaire (MRQ) (Baker & Wigfield, 1999) and teachers rated students' reading engagement (Reeve, Jang, Carrel, Jeon, & Barch, 2004). A standardized reading comprehension test (www.steunpuntloopbanen.be) and two scales concerning leisure-time reading frequency and reading self-concept (<http://pirls.bc.edu/pirls2006/>) were also administered.

Results and Discussion

Regarding the first aim, the results reveal that the SRQ-Reading Motivation can be seen as a reliable and valid questionnaire measuring reading motivation in recreational and academic contexts. Regarding the structural validity, exploratory and confirmatory factor analyses [recreational: $SB\chi^2=502.828$ ($df=116$, $p\chi^2=541.965$ ($df=116$, p indicate that reading motivation comprises two factors: autonomous ($arecreational=.94$, $aacademic=.94$) and controlled motivation ($arecreational=.84$, $aacademic=.85$), which corresponds to the theoretical motivation types within SDT (Ryan & Deci, 2000). The correlation pattern between autonomous and controlled reading motivation, the MRQ-subscale, and the teacher ratings confirm the construct validity of the instrument.

Descriptive results of the SRQ-Reading Motivation reveal that fifth graders' mainly report autonomous motivation in recreational ($M=3.55$, $SD=.96$) and academic contexts ($M=3.54$, $SD=1.00$). As expected, controlled motivation is slightly higher in the more demanding academic setting (recreational: $M=2.21$, $SD=.67$; academic: $M=2.60$, $SD=.77$).

Concerning the second goal, both SEM models depicting the relationship between reading motivation and reading-related outcomes, have a good fit [recreational: $SB\chi^2=.0755$ ($df=1$, $p>.05$), $RMSEA=.000$, $SRMR=.012$, $CFI=1.000$, $TLI=1.003$; academic: $SB\chi^2=1.148$ ($df=1$, $p>.05$), $RMSEA=.011$, $SRMR=.015$, $CFI=1.000$, $TLI=.998$] and support the predictive utility of the SRQ-Reading Motivation (Figure 1 and 2). Consistent with reading research (Guthrie et al., 1999; Taboada et al., 2009) and SDT (Ryan & Deci, 2000), recreational autonomous reading motivation relates positively to more leisure-time reading and comprehension. Recreational controlled reading motivation is negatively related to comprehension. Regarding academic reading motivation, only the equivalent pathways concerning reading frequency are significant. Both models confirm that engagement functions as a behavioral pathway between autonomous reading motivation and comprehension (Connell & Wellborn, 1991). The indirect relationship between reading motivation and comprehension through reading frequency (Guthrie et al., 1999) cannot be corroborated.

The development of the SRQ-Reading Motivation is of theoretical and empirical significance, since SDT is not applied in the context of reading research before and appears to be relevant for this area. Further, it allows teachers to get a grip on individual differences and students' development in reading motivation, and to evaluate reading promotion interventions. Additionally, the SEM models highlight especially the importance of autonomous reading motivation as antecedent of important reading outcomes, which is relevant for teacher behaviour in educational practice.

References

- Baker, L., & Wigfield, L. (1999). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly*, 34, 452-477.
- Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness - a motivational analysis of self-system processes. In M. R. Gunnar & L. A. Sroufe (Eds.), *Self processes in development: Minnesota symposium on child psychology* (Vol. 23, pp. 167-216). Chicago, IL: University of Chicago Press.
- Guthrie, J. T., & Wigfield, A. (2000). Engagement and motivation in reading. In M. L. Kamil, P.B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research: Volume III* (pp. 403-422). Mahwah, NJ: Lawrence Erlbaum Associates.
- Guthrie, J. T., Wigfield, A., Metsala, J. L., & Cox, K. E. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific Studies of Reading*, 3, 231-256.
- McKenna, M. C., & Kear, D. J. (1990). Measuring attitude toward reading: A new tool for teachers. *The reading teacher*, 43, 626-639.

Reeve, J., Jang, H., Carrel, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion*, 28, 147-169.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68-78.

Taboada, A., Tonks, S. M., Wigfield, A., & Guthrie, J. T. (2009). Effects of motivational and cognitive variables on reading comprehension. *Reading and Writing*, 22, 85-106.

Watkins, M. W., & Coffey, D. Y. (2004). Reading motivation: Multidimensional and indeterminate. *Journal of Educational Psychology*, 96, 110-118.

PAPER PRESENTATION

Testing a path model of text comprehension among 5th grade students

Vanessa Seuring, Justus-Liebig-Universität Giessen, Germany; Joachim Brunstein, Justus-Liebig-University, Germany

This study was designed to explore the effects of reading time, reading fluency, vocabulary and reading strategies on the text comprehension of fifth grade students.

Our aim was to test if reading strategies are an indispensable component of a path model of text comprehension. Additionally we wanted to explore if reading strategies are interconnected and sequentially affect text comprehension or if a model without those interconnections but with reading strategies showing parallel effects on comprehension, reveals a better fit for the data. The sample consisted of 217 fifth-grade students. The model fit was evaluated by the comparative fit index (CFI) and the standardized root-mean-square residual (SRMR).

The fit was not acceptable for a reduced model (CFI = .742; SRMR = .148), but it was for the resulting sequential model (CFI = 1.000; SRMR = .037) as well as for a parallel model (CFI = .950; SRMR = .059). Comparing the reduced model with the sequential model revealed a significant better fit for the latter (Delta Chi² = 79.46, p = .000).

The results of this study indicate that reading time, reading fluency and vocabulary have significant effects on text comprehension. Therefore combined intervention programmes, fostering all of these components, should be implemented. Additionally the reported results concerning the sequential interconnections of reading strategies provide information about the most effective order of strategy application.

This study was designed to explore the effects of reading time, reading fluency, vocabulary, and reading strategies on the text comprehension of fifth grade students. Data was analyzed using path analysis. Results reveal that a path model integrating sequentially interconnected reading strategies shows the best fit for the data.

Evidence for the effects of reading fluency on text comprehension comes from German studies analyzing data collected in the course of the PISA-studies (Artelt, Schiefele, Schneider & Stanat, 2002; Schaffner, Schiefele & Schneider, 2004). But the connection of reading fluency and text comprehension is not unquestioned. The effects of training studies for fostering reading fluency for example do not in all cases transfer to text comprehension (Kuhn & Stahl, 2003).

The effects of vocabulary instruction on children's comprehension of text were proved through a meta-analysis by Stahl and Fairbanks (1986), who reported an effect size of .30 of vocabulary instructions on comprehension measures. Furthermore in the direct and inferential mediation model of reading comprehension (DIME model) by Cromley and Azevedo (2007) the direct effect of vocabulary made the largest contribution to comprehension. They also found a significant indirect effect of vocabulary on reading comprehension mediated by inference. Lately Cromley, Snyder-Hogan and Luciw-Dubas (2010) tested the fit of the DIME model for a sample of biology students and found a better fit for a modified model including a path from vocabulary to reading strategies and therefore an additional indirect effect of vocabulary on reading comprehension.

The importance of reading strategies for text comprehension was proved by studies comparing reading experts with novice readers (Bereiter & Bird, 1985; Pressley & Afflerbach, 1995) as well as by studies analyzing models of text comprehension (Artelt et al., 2002; Schaffner et al., 2004; Cromley & Azevedo, 2007). Additionally a lot of research was done in the area of fostering reading strategies through interventions (e.g. Palincsar & Brown, 1984; Fuchs, Fuchs, Mathes & Simmons, 1997; Souvignier & Mokhesgerami, 2006).

Aims

The major purpose of this study was to analyze how the variables reading time, reading fluency, vocabulary and reading strategies contribute to text comprehension. Furthermore our aim was to test if the integration of reading strategies (clarifying, questioning, summarizing and predicting) in a model of text comprehension account for unique variance beyond reading time, reading fluency and vocabulary (sequential model vs. reduced model). Additionally we

wanted to explore if reading strategies are interconnected and sequentially affect text comprehension (sequential model) or if a model without those interconnections but with reading strategies showing parallel effects on comprehension, reveals a better fit for the data (parallel model).

Method

The sample consisted of 217 fifth-grade students of 10 classes. Text comprehension, vocabulary and reading fluency were assessed using standardized German tests (Souvignier, Trenk-Hinterberger, Adam-Schwebe & Gold, 2008; Weiß, 1998; Auer, Gruber, Mayringer & Wimmer, 2005). Reading strategies were assessed using an experimenter developed test (Seuring & Spßrer, 2010). Students had to read a text passage and apply the four strategies to the passage. For the analysis the polarity for the variable clarifying was changed to simplify interpretation of results. Therefore the respective variable in the model is named "clarity". Reading time was assessed by one item asking the students for the daily time they usually spent voluntarily on reading in their spare time (scaled from 0 = "no time" to 5 = "more than two hours daily"). Data collection was cross-sectional. During the testing students were not allowed to use additional material, as dictionaries.

Results

Data was analyzed using Amos 18. According to recommendations by Hu and Bentler (1999) for sample sizes N The fit was not acceptable for the reduced model ($CFI = .742$; $SRMR = .148$), but it was for the resulting sequential model ($CFI = 1.000$; $SRMR = .037$) as well as for the parallel model ($CFI = .950$; $SRMR = .059$). Comparing the reduced model with the sequential model revealed a significant better fit for the latter ($\Delta\chi^2 = 79.46$, $p = .000$). Figure 1 shows the resulting sequential model with standardized path coefficients. The only path hypothesized which failed significance was the one from predicting to reading comprehension.

Figure 1: Sequential model with standardized path coefficients. *p p p

Educational significance of the research

Even though directional connections were analyzed in this study, because of the cross-sectional design, there cannot be drawn conclusions regarding causality. So the evidence for causal relations we get from this study should be verified with longitudinal data.

Still the results of our study indicate that reading time, reading fluency and vocabulary have significant effects on text comprehension. The comparison of the reduced and the sequential model reveals that reading strategies are an indispensable component of a path model of text comprehension. With regard to intervention studies the reported results concerning the sequential interconnections of reading strategies are of essential importance. They provide information about the most effective order of strategy application. Additionally, not only strategies, but also reading time, reading fluency and vocabulary have significant positive effects on text comprehension. Therefore combined intervention programmes, fostering all of these components, should be implemented

PAPER PRESENTATION

Effects of guided oral reading interventions for poor readers in grades 2 through 4

Ron Oostdam, University of Amsterdam, Netherlands; Henk Blok, Kohnstamm Institute, University of Amsterdam, Netherlands

On nearly every primary school one might find students lagging behind in reading fluency. These students keep reading slowly or with many errors. We wanted to know if guided oral reading would be an effective remedy for low achieving readers in the lower grades. Guided oral reading implies that a student reads a text aloud, while an experienced reader supervises the reading process and provides feedback or help when necessary. A total of 126 reading retarded students from grades 2 to 4 participated in the study. They were randomly divided between two treatment groups and a non-treated control group. In the treatment groups the intervention was delivered in a one-to-one setting by a para-professional in one of two versions, either in a repeated reading or in a continuous reading format, depending on how often students had to practice with the same text. Each student went through 48 reading sessions of 20 minutes, with a maximum of four sessions each week. Measurements included tests for fluency, reading comprehension, vocabulary, and reading attitude. The results demonstrate that guided oral reading is effective for improving fluency and reading attitude. Within and between grades the two versions (continuous or repeated reading) proved to be equally effective. Effects with regard to reading comprehension and vocabulary could not be established.

On nearly every primary school one might find students lagging behind in reading fluency. These students keep reading slowly or with many errors. Reading fluency is important because students who recognize words effortlessly should be able to devote more attention to reading comprehension. In theories regarding information processing and verbal efficiency, improving the level of reading fluency (speed and accuracy of reading text) frees students to devote

more of their attention to understanding the meaning of text. In other words, improving reading fluency is a prerequisite for improving reading comprehension, which in turn is an important basic skill for the educational career of students.

We wanted to know if guided oral reading would be an effective remedy for low achieving readers in the lower grades. Basic assumption is that a lack of reading fluency can best be remediated as early as possible in order to prevent serious arrears.

Guided oral reading implies that a student reads a text aloud, while an experienced reader supervises the reading process and provides feedback or help when necessary. In this paper the results are discussed of a study into the effectiveness of two methods of guided oral reading: repeated reading and continuous reading. Because students with low reading fluency have problems with recognizing words quickly as well as recognizing them accurately, repeated reading is often recommended for improving the reading rate. Repeated reading is a method according to which students reread a passage until mastery or near mastery level is achieved. By doing so students will increase their feeling of being a competent reader which will motivate and stimulate their reading development. Alternatively, the method of continuous reading is suggested. Continuous reading implies that the student reads new texts as much as possible. Rather than the repetition of reading a limited number of texts, reading different texts across a range of text types should generate reading improvement. Continuous reading is more in line with how students read in daily life and should therefore be more motivating and stimulating. Students practice more by reading different texts and are exposed to a broader number of words within different contexts. This should not only improve reading fluency but also their vocabulary knowledge and in turn overall reading comprehension.

Each of the two methods of guided oral reading could generate different outcomes for students in the different grades, i.e. the different stages of reading development. For students in grade 2 repeated reading might have greater impact on improvement in rate and word recognition due to the fact that they experience feelings of becoming more competent. For older students in grade 3 and 4, continuous reading could be more effective because repeated reading might become rather boring and demotivating.

In our study the effectiveness of the two methods of guided oral reading was tested. The overall question was: how does repeated reading compare with continuous reading for improving the reading rate and overall reading outcomes of struggling readers in grades 2 to 4?

A total of 126 reading retarded students from grades 2 to 4 of eight primary schools in the Netherlands participated in the study. Within each class students were randomly divided between two treatment groups and a non-treated control group. In the treatment groups the intervention was delivered in a one-to-one setting by a para-professional in one of two versions, either in a repeated reading or in a continuous reading format, depending on how often students had to practice with the same text. Each student went through 48 reading sessions of 20 minutes, with a maximum of four sessions each week. Measurements included standardised tests for fluency, reading comprehension, vocabulary, and reading attitude. Monitoring of treatment fidelity was done by means of questionnaires and observations.

Based on multi-level analyses the results demonstrate that guided oral reading is an effective method for improving fluency as well as reading attitude. Within and between grades the two versions (continuous or repeated reading) proved to be equally effective. Effects with regard to growth in reading comprehension and vocabulary could not be established. In relation to these results implications for the educational practice are discussed.

PAPER PRESENTATION

Teaching and Learning about social and moral values for active citizenship in the early years

Susan Walker, Queensland University of Technology, Australia; Jo Brownlee, QUT, Australia; Charlotte Cobb-Moore, Queensland University of Technology, Australia; Eva Johansson, University of Gothenburg, Sweden; Jo Ailwood, University of Newcastle, Australia; Gillian Boulton-Lewis, QUT, Australia

Research suggests that there is a correlation between teachers' beliefs about knowing and their approaches to teaching (Edwards et al, 2008). However, there has been little investigation into the relationship between these beliefs and teaching moral values and we know little about how children learn moral values (Halstead & Pike, 2006). This study investigated: what teachers think and do in the classroom to promote social and moral learning; and what children think about social and moral values. Eleven teachers were interviewed about beliefs about the learning and teaching (epistemic beliefs) of social and moral values and 100 children were interviewed concerning their ideas about social and moral values around concepts of fairness and "doing the right thing". There were a range of views about how children learnt moral values. Teachers stated that children learnt from observation, structured and incidental

teaching, from discussions, reflections, from active engagement and their everyday experiences. Children explained that doing the right thing was related to showing concern for others, following the rules and obeying the teachers. The children related fairness to being nice and caring for others. The findings contribute to our knowledge about effective teaching for social and moral learning in the early years.

Schools have long been seen as institutions for preparing children academically, and for life as moral agents in society. This recognition has resulted in values education becoming a part of the curriculum in many schools. Moral values, are both positive and negative qualities (good or bad), that we express and experience in our own and others' behaviour, acts and attitudes. Research suggests that there is a correlation between teachers' beliefs about knowing and their approaches to teaching (Edwards et al, 2008). A substantial body of research spanning the last 30 years shows that we hold core beliefs about knowing and learning (epistemic beliefs) which may influence our learning and teaching practices. These are core beliefs because they are considered to filter all other knowledge and beliefs including the knowledge we enact about teaching and learning. The range of epistemic beliefs has been described by Kuhn and Weinstock (2002) as a developmental trajectory from absolutism (reality is replicated, knowledge is absolute and transferable), to subjectivism (knowledge is based on personal opinions) and then finally to evaluativism (judgments involving evidenced-based critique of multiple perspectives).

Typically, this progression from absolutism to evaluativism is described as a shift from naïve to sophisticated beliefs. However, there has been little investigation into the relationship between these beliefs and teaching moral values and we know little about how children learn moral values (Halstead & Pike, 2006). This study investigated: what teachers think and do in the classroom to promote social and moral learning; and what children think about social and moral values. The focus is on teachers' epistemic beliefs, how teachers describe their teaching practices for children's moral learning, how they conceptualize children's moral learning and on young children's perspectives of values and participation in school in relation to active citizenship learning. Teaching for moral values, or moral pedagogy, refers to a variety of teaching practices that aim to develop moral awareness, reasoning, understanding, and behaviours in children. Basourakos (1999) has described moral pedagogies that fall into two dominant paradigms. He describes the first as conventional moral pedagogy in which abstract moral reasoning is taught directly to children. The epistemology of this approach reflects moral knowledge as absolute and transferable. Teaching approaches that emerge from this tradition would include strategies like direct instruction in moral values or modelling appropriate values in interactions with children.

An alternate pedagogy, according to Basourakos (1999) is described as contextual moral pedagogy which takes a different epistemological perspective to the conventional pedagogies. From this perspective, moral knowledge is constructed within and related to certain contexts. In contextual moral pedagogies, children are encouraged to reflect on multiple "truths". This means that there is no one truth in moral values and moral education helps children to reflect with sensitivity on competing perspectives. Eleven teachers were interviewed about beliefs about the learning and teaching (epistemic beliefs) of social and moral values. Results from the teacher interviews indicated that teachers in our study demonstrated three main ways of thinking about moral education. These understandings were reflected in teaching practice for learning moral values, their beliefs about children's learning of moral values and their epistemic beliefs. The teachers understood moral pedagogy as: "following others"; "reflecting on points of view"; and "informed reflection for action". Teachers who understood moral pedagogy as "following others" believed that moral values are best learnt through modelling, extrinsic rewards and discussion, reflecting a conventional moral pedagogy. These teachers also held subjectivist epistemic beliefs. In the second way of thinking, described as "reflecting on points of view", teachers describe a focus on evaluating different perspectives as a way of knowing. Their moral pedagogy was about building meaning through problem solving, taking responsibility, and children making decisions. All of the teachers who described "reflection on points of view" also talked about practical ways of knowing. That is, they referred to evaluating knowledge based on what works in practice. In the third and final way of thinking about moral education, teachers viewed knowledge about moral values and pedagogies as an informed construction using both research and practice, reflecting a contextual moral pedagogy. These teachers' epistemic beliefs went beyond a focus on the practical - what works - to include an evaluation of research perspectives (evaluativism).

100 children were interviewed concerning their ideas about social and moral values around concepts of fairness and "doing the right thing". Children were asked a series of open-ended questions, relating to their rights and responsibilities, including their ideas about: right and wrong in school choices and decisions in school. Children's responses reflected both moral issues (e.g., concern for others' feelings) and social conventional issues (e.g., the value of authority and rules in the school). Children explained that doing the right thing was related to showing concern for others, following the rules and obeying the teachers. The children related fairness to being nice and caring for others. Doing the right thing refers, according to the children, to moral values, but also to disciplinary values to ensure or maintain the order in school. The value of others wellbeing and the value of the good disciplined student stand out

as common threads working together in the children's descriptions. Implied in this is a value of authority, taken for granted by the children. Decisions in school seem from the children's understandings to be strongly connected with the teachers' authority.

Teaching moral values for active citizenship is strongly emphasized in early education and teachers need various competences to be able to help children acquire such values. This study indicates an intertwined relationship between moral values and epistemic beliefs. One cannot exist without the other. Complex epistemic beliefs seem to be productive in teachers' (and children's) constructions and understandings of moral values central for active citizenship. These values concern being an active part in a community, knowing and sharing rights and responsibilities for others' wellbeing and for the common good. The findings contribute to our knowledge about effective teaching for social and moral learning in the early years.

PAPER PRESENTATION

Good teachers for special education in Italy

Maja Antonietti, University of Modena and Reggio Emilia - Department of Education and Human Sciences , Italy;

Roberta Cardarello, University of Modena and Reggio Emilia, Department of Education and Human Sciences, Italy;

Maria Cristiana Martini, University of Modena and Reggio Emilia, Department of Communication and Economics, Italy

Since 1971 in Italy all children with special needs should be included in regular school: that implied the closure of almost all special schools and the introduction of particular forms of support that were clearly identified - some years later - with support teachers (Gelati, 1996). Support teachers' profession should be relevant for school integration and individualised teaching, but they are still not completely recognized (Gelati, 1996; Ianes, 2004). This research starts from previous studies on teachers opinion about their profession (e.g. Cardarello et al., 2009), by deepening the analysis of the support teacher's profile. The aim of this research is twofold: to identify which areas of profession preschool and primary school teachers ascribe to support teachers profession and to verify if professional identity influences those opinions. Through an ad hoc questionnaire teachers' opinions on support teachers' competences were collected. Factor analysis highlighted 10 main areas of support teacher competences and we identified differences in teachers opinions about the main areas of support teacher competences according to professional experience.

In Italy Act 118 (1971) and 517 (1977) defined that all children with special needs should be included in regular school, that implied the closure of almost all special schools and the introduction of particular forms of support that were clearly identified - some years later - with teacher specialized for supporting children with special needs, also called support teachers (Gelati, 1996). The professional identity of support teachers was not well defined: in the last 30 years teachers training was initially based on a medical training model, while after 1984 more attention was given to pedagogical and psychological aspects (Albanese, 2006). In the praxis, support teachers often work only with children with special needs, even if they have the co-responsibility of the classes where they work (Act 104/1992).

According to regulations and the Italian pedagogical literature (Albanese, 2006; Ianes, 2004) support teachers are expected to:

- know the development and the way of learning related to the different disabilities;
 - be able to plan activities and lessons according to special educational needs by using the ICF approach;-
 - be able to use observation and documentation methods;
 - promote inclusion;
 - connect the school with local social and health services;
 - possess good communication and relationship capability for mediation, particularly with parents.
- Support teachers are assumed to be relevant for special education, particularly for school integration and individualised teaching, but in the past they were often considered less important teachers (Ianes, 2004) and the reason is probably the ambivalent definition of their professional role.

In Italy empirical researches about inclusion practices are rare (Begeny & Martens, 2007), but those about support teachers are fewer. The legitimation of his/her role into the school is yet an open question, although support teachers represent about 10% of teachers as a whole (Fondazione Agnelli, 2008). This research moves from previous studies (e.g. Cardarello et al., 2009) investigating teachers' opinion about their profession, and attempts to describe the school world through the eyes of the teachers themselves. The intention is to obtain a description of crucial points of the profession practice, and to verify how much some aspects which literature highlighted as central were actually deemed to be important.

The aim of this research is twofold: to identify which professional areas preschool and primary school teachers ascribe to support teachers and to verify if the teaching experience influences this opinion; a survey was conducted to collect data on the teachers' personal characteristics, professional experiences and opinions. The sample includes 714 Italian teachers of primary and pre-school from Emilia-Romagna, interviewed through a self-administered questionnaire at the beginning of a University specialization course they attended (2004/2005; 2006/2007); 95% of teachers attending the courses participated in the survey. The questionnaire was designed to survey several aspects of the class teachers and support teachers profile; the questionnaire's sections mainly used in this study was devoted to ask teachers' opinion on the importance of a series of 36 competences for the support teacher's professional profile. The 36 items were drawn from the pedagogical literature and refer to a wide range of professional competences (see, e.g., Coggi et al., 2004; Perrenoud, 1999), and were asked on a 4-point quantitative scale. Although the measurement scale is numerical, some doubts arise about the metric properties of such a short scale, hence the collected data are considered ordinal variables and preliminarily re-scaled through an optimal scaling procedure (Gifi, 1990).

After assessing the adequacy of a factorial approach (on the whole set of items, Cronbach's Alpha is equal to 0.839), re-scaled scores are analysed using factor analysis with Varimax orthogonal rotation (Kaiser, 1958), in order to highlight the main independent competence areas. 10 factors were extracted, accounting for 52.3% of the total variance: they refer to lesson and teaching tools, emotional and social awareness, ethical purpose of learning-by-doing, knowledge of special needs and appropriate technologies, individualized teaching, disciplinary contents, school management, collaboration with colleagues, networking, children competences assessment. Unrelated factor scores have been computed through the Anderson-Rubin method, and then analysed to compare the values assumed in different sub-groups of the teachers population.

The analysis of variance conducted on factor scores helps to identify differences in the ideal profile of support teachers, as seen by subgroups of teachers with different individual and professional experiences. Among the preliminary results, we can mention that individualised teaching, disciplinary contents, school management and networking are considered equally important by different subgroups of teachers (support and class teachers, primary and pre-school), while in general support teachers credit their professional role with a wider range of needed competences than class teachers do; in some sense this implies a richer and more complex picture of the professional profile. On the other hand, class teachers attribute to the support activity a higher degree of emotional and social awareness, maybe because, seen from a distance, the emotional challenge is the most striking aspect.

References:

- Albanese, O. (Eds.) (2006). *Disabilità, integrazione e formazione degli insegnanti*. Bergamo: Junior.
- Begeny, J. C, Martens, B. K. (2007). Inclusionary education in Italy – A literature review and a call for more empirical research. *Remedial and Special Education*, 28 (2), 80-94.

PAPER PRESENTATION

The role of accountability in school placement decisions: An experimental study

Florian Klapproth, University of Luxembourg, Luxembourg; Matthias Bohmer, University of Luxembourg, Luxembourg; Sabine Glock, University of Luxembourg, Luxembourg; Sabine Krolak-Schwerdt, University of Luxembourg, Luxembourg

Within an experiment Luxembourgish teachers were presented with 16 case descriptions of fictitious students, and the teachers were required to make a school placement decision for each student. Two experimental conditions were realized which differed according to the accountability of the teachers. It was found that teachers of the low-accountability condition considered less cues that were performance-related, but more cues that were not related to performance for their school placement decisions than teachers did who were in the high-accountability condition. Implications might be drawn with respect to real school placement decisions.

Introduction

One structural characteristic of educational systems which has been repeatedly discussed is school placement, which corresponds to an ability-based grouping of students in different school tracks at a specified moment of their school career. It has often been hypothesized that school placement may lead to phenomena of social and ethnic segregation (e. g., Ehmke, Siegel, & Hohensee, 2005).

School placement decisions may even get worse if they are made within a group. In group decisions, the accountability for the decision is distributed over the group members (Latané, Williams, & Harkins, 1979) which may result in reduced accountability for each group member. According to dual process models of social cognition (Fiske & Neuberg, 1990; Tetlock & Lerner, 1999), low accountability should lead to heuristic information processing which is characterized by its cognitive economy and the predominance of stereotypes that guide the information processing,

resulting in less information being considered for the decision. In contrast, high accountability corresponds with an information integrating mode in which each single piece of information is regarded.

One example of school placement decisions made within groups is the Luxembourgish school system. The groups involved consist of primary and secondary school teachers and schools inspectors, and the decision is taken at the end of six years of primary school. The students are then oriented towards three clearly hierarchical tracks, which are the Enseignement Secondaire (ES), the Enseignement Secondaire Technique (EST) and the Enseignement Prééparatoire (PREP). Students are generally oriented towards the ES when they have a flawless achievement profile. An achievement profile showing difficulties in one or more subjects generally leads to an orientation towards the EST track, while students with major learning difficulties are oriented towards the PREP track.

Aims of the Study

With the study at hand we investigated the cognitive processes of teachers that determine the choice of the future school type. More precisely, we examined which cues influenced the transition decision of teachers beyond pure school performance data that teachers have at hand regarding a specific student under different degrees of accountability.

Hypotheses

In terms of regression analysis, both processing modes should differ in the number of significant regression weights that are pertinent to school performance, with more significant regression weights being expected for high accountability than for low accountability. However, when put under low accountability, teachers should base their decisions on more cues that are not related to school performance (like migration background or gender) than when high accountability is induced.

Method

Within an experiment Luxembourgish teachers were presented with 16 case descriptions of fictitious students, and the teachers were required to make a school placement decision for each student. Two experimental conditions were realized which differed according to the accountability of the teachers. In the lowaccountability condition, the teachers were encouraged to make a noncommittal suggestion of the track which they considered most suitable for each student, leaving the final decision to a group. In the high-accountability condition, the teachers were told to make a school placement decision of which they were solely responsible.

Participants

21 Luxembourgish primary school teachers (six men and 15 women) took part at the experiment and were randomly assigned to two experimental conditions ($n_{\text{high}} = 10$, $n_{\text{low}} = 11$). The mean age of the participants was 35.1 years ($SD = 10.3$).

Stimuli and Materials

Each case description entailed seven attributes which were (1) school marks in the main subjects, (2) scores of standardized school performance tests, (3) working and learning habits, (4) social behaviours, (5) nationality, (6) socio-economic status, and (7) gender. The attributes were coded as dichotomous variables. To create a case description, combination of the values of the variables (0; 1) was done under the constraint that the intercorrelations between the variables should be minimal. In fact, the variables "school marks", "test scores", "nationality" and "socioeconomic status" were completely independent from one another, and with the remaining variables maximum intercorrelations were found not be larger than $r = .25$.

Procedure

The case descriptions, printed on sheets of paper, were presented successively and in random order. After each case had been presented, the participants were asked to make a school placement decision for this case, choosing between three options which were ES, EST, and PREP.

Results and Discussion

Since PREP was chosen less than 5 % of the choices, the dependent variable was transformed to a dichotomous criterion, containing the values "ES" and "Non-ES". After that, logistic regression analysis was performed separately for both experimental conditions.

For the high-accountability condition, the regression weights for "school marks", "test scores", and "working and learning habits" were high and significant. For the low-accountability condition, regression weights were high and significant for "school marks" and "test scores", and high but almost significant for "gender".

As was hypothesized, teachers of the low-accountability condition considered less cues that were performance-related, but more cues that were not related to performance for their school placement decisions than teachers did who were in the high-accountability condition.

Implications might be drawn with respect to real school placement decisions taking place in groups like in the Luxemburgish school system. However, caution is indicated when directly relating experimental data to educational practices. Further investigations of our research group are dedicated to this problem.

References

- Ehmke, T., Siegel, T., & Hohensee, F. (2005). Soziale Herkunft im Ländervergleich. In M. Prenzel et al., (Eds.), PISA 2003: Der zweite Vergleich der Länder in Deutschland. Was wissen und was können Jugendliche? (pp. 233-264). Münster: Waxmann.
- Fiske, S. T., & Neuberg, S. L. (1990). A continuum of impression formation from category-based to individuating processes: Influences of information and motivation on attention and interpretation. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 23, pp. 1-74). New York: Academic Press.
- Latane, B., Williams, K., & Harkins, S. (1979). Many Hands Make Light The Work: The Causes and Consequences of Social Loafing. *Journal of Personality and Social Psychology*, 37, 822-832.
- Tetlock, P. E. & Lerner, J. S. (1999). The social contingency model: Identifying empirical and normative boundary conditions on the error-and-bias portrait of human nature. In S. Chaiken & Y. Trope (Eds.), *Dual process theories in social psychology*. New York: Guilford Press.

PAPER PRESENTATION

Dealing with teaching dilemmas in higher education

Elisabeth Wegner, University of Freiburg , Germany; Matthias Nuckles, University of Freiburg, Germany

Teaching is a complex task that comprises many contradictory demands. Therefore, teachers continuously need to decide between competing goals that cannot be fulfilled at the same time. For example, students should be offered opportunities for self-determination to be motivated and to learn effectively. On the other hand, in order to establish a learning community, teachers also need to set up rules, thereby undermining students' possibilities for self-determined learning. Dealing with such dilemmas requires the ability to make reflective judgments. That is, teachers should be aware of the existence of dilemmas, and they should be able to make informed didactic decisions by carefully weighing and evaluating the pros and cons inherent to a contradictory or dilemmatic situation. Forty university lecturers in differing levels of teaching experience and training in teaching participated in a structured interview that challenged them with dilemmatic decisions. A content analysis of the interviews showed that teachers experienced the dilemmas in three conceptually different ways: as non-ambiguous, as dilemmatic or as problems to be addressed individually depending on context. Also, the perceived content focus of the problems differed: mainly as being of didactic nature (i.e., contradiction of different learning goals or different methods) or as rooted mainly in values (such as fairness of assessment, freedom of choice). Teachers who focused on values tended to see decisions as non-ambiguous. Teachers with training were more likely to describe the problems in didactic terms, which indicates that training influences the general epistemological conception of teaching.

Theoretical Background Teaching is a complex and ill-structured task which often confronts those that undertake it with contradictory demands. Several authors have described fundamental dilemmas of teaching as follows:

- Students need to learn in a self-determined fashion, but prescribing or enforcing self-determined learning poses a contradiction to the general idea of self-determined learning.
- Assessment needs to be reliable and at the same time valid. However, increasing reliability (e.g. by using multiple choice tests) often reduces validity and vice versa.
- Teachers should make no discriminations between students, but each student has different needs and abilities which have to be taken into account. It is the very nature of these dilemmas that they cannot be resolved, because two (or more) goals are equally important.

In trying to reach one of the goals, the other is automatically affected, resulting in a conflict between the goals. These teaching dilemmas can be described in terms of ill-structured problems, that is, "problems where there is not a single unequivocal solution which can be effectively determined [...] by employing a particular decision-making procedure." (Kitchener, 1983, p.224). All problem-solving activities are fundamentally influenced by processes that monitor the epistemological nature of the problem, such as its solvability, the limits thereto or the certainty of knowing (Kitchener, 1983). Consequently, in order to balance different goals and to make adequate, informed didactic decisions, teachers need to develop appropriate conceptions with regard to the contradictory nature of the abovementioned dilemmas. The epistemological conception of teaching is therefore an important aspect of teaching competence. However, little

empirical research has been conducted on teachers' ability to deal appropriately and reflectively with these teaching dilemmas. Previous studies are largely theoretical and case-based or restricted to certain phenomena such as conflicting goals in cooperative learning. The present study seeks to fill this gap by exploring how teachers deal with dilemmatic decisions and which factors influence this ability. More precisely, we investigated university teachers' argumentative reasoning and decision-making when reflecting on teaching dilemmas.

Participants and Methods

A total of 40 university lecturers with an average of 8.6 years of teaching experience ($SD = 9.0$) were interviewed. Twenty-three of the teachers had participated in staff development programs or had received other forms of training in teaching. We developed a structured interview procedure containing a number of teaching dilemmas and guiding questions. The interview was inspired by Kohlberg's "Moral Judgment Interview" (Colby & Kohlberg, 1987) and King and Kitchener's "Reflective Judgement Interview" (King & Kitchener, 1994). Our interview contained the following dilemmas:

- Compulsory vs. voluntary writing of learning journals with journal writing introduced as a self-guided learning method (see Nýckles, Hýbner & Renkl, 2009)

- Abstract vs. concrete opening in an introductory lecture- Individual oral vs. standardized written assessment Teachers were asked to explain how they would handle each dilemmatic situation.

They were further asked to explain their decision and to identify criteria which would influence their decision. Finally, we asked them to assess how ambiguous they felt with their decision. A two-dimensional coding system was developed. The first dimension, the general epistemological understanding of the nature of the problem, contained three categories:

1. non-ambiguous (one option is generally better than the other),
2. dilemmatic (both options have pros & cons, no decision or decision on basis of pragmatic aspects or personal preferences) and
3. context-based decision (different aspects collide, certain criteria have to be taken into account).

The second dimension, the perceived content focus of the problem, differentiated between the main focus of the problem (as related to didactic concepts, such as learning goals, or related to values, such as freedom or fairness). Answers were rated by two independent raters. Inter-rater reliability was good (Cohens Kappa between .77 and .94, depending on the dilemma).

Results and Discussion

The tendency to judge a given dilemma as non-ambiguous increased with the tendency to conceive of the dilemma as a matter of values rather than as a didactic problem, $r = .39$, $p(t(25.58)) = 2.72$, $p r = .234$, ns., nor the content focus, $r = .09$, ns. The results indicate that the university teachers in our sample indeed understood the presented dilemmas differently and that the epistemological understanding of the dilemma was related to the content focus of their reasoning. Participation in training seemed to enhance the tendency to think in didactic categories, thus indicating that training had an effect on the perspective university teachers adopted to reason about complex didactic situations. In summary, our study suggests that the theoretical approach of conceptualizing didactic decision making as a form of reflective judgment (see Kitchener & King, 1994) proved to be fruitful. Further research should aim at clarifying the implications for current models of teaching competence (see Borko & Putnam, 1996) and investigate, how the ability to make informed didactic decisions relates to other aspects of teaching competence, such as teacher beliefs, or the ability to react flexibly to student behavior in an ongoing and dynamic classroom discourse.

SYMPOSIUM

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Invited SIG

Learning in movement: conceptualizing in-between and across site learning

Chairperson: Eva Hjerne, University of Gothenburg, Sweden

Organiser: Tania Zittoun, Institute of psychology and education, Switzerland

Sanne Akkerman, Utrecht University, Netherlands

Discussant: Sten Ludvigsen, University of Oslo, Norway

Learning demands the use of knowledge, from one situation to another, or from one site to another one. Learners themselves have to move in and out of different social settings during the same day or the same week. How can people learn and develop despite the fact that they have to engage in activities in extremely diverse situations? Drawing on pragmatism, dialogical theories and a generally speaking sociocultural understanding of learning, recent studies emphasise three mutually dependent processes: the identity processes learning entails, the necessary processes of meaning making it demands, as well as the need to appropriate specific symbolic systems and develop specific skills.

This invited symposium groups three papers that examine learning in young adolescents – a life period during which moving in and through various social situations becomes central. In the first paper, Akkerman and Van Eijck explore how participations in different social worlds of biology students impinge on school experiences. A dialogical approach is proposed to explain students' identity across situations. In the second paper, Petersson, Lantz-Andersson, and their colleagues follow students asked to solve a task related to climate change. With an approach inspired by John Dewey, they show how students progressively learn to use the language required by a scientific enquiry. In the third paper, Zittoun explores learning in literature and philosophy classes. With an emphasis on semiotic processes, she highlights processes by which students confer personal sense to learning situations thanks to their experiences in non-academic sites.

Learner's identity through and across sites

Sanne Akkerman, Utrecht University, Netherlands; Michiel van Eijck, Technical university Eindhoven, Netherlands

Both cognitive and socio-cultural traditions have traditionally theorized learning in terms of processes of progression within single communities. Since 1995, educational scholars have started to focus on learning as a horizontal process of boundary crossing between multiple communities. Problematic in this approach is that boundaries are often analytically laid out on system level, without explaining whether and how boundaries relate to discontinuities at the level of a learning process of an individual student. What is needed is theoretical elaboration on how an individual learner can be simultaneously part of one and another practice. By drawing on a dialogical approach to Self we intend to theorize learners as participants of practices and transcendent selves. Doing so, we point out that boundaries are dynamically evolving discontinuities that mediate or obstruct potential hybridizations of school and everyday life experiences in learning.

Objective

For long educational theories have discussed how learning progresses within a single domain or community, be it in terms of acquiring certain domain expertise or in terms of becoming a central participant in a particular community. We argue that a student should not be approached as an abstract object of study and educational theory, but as a whole person participating in school as well as many other practices. The focus of this paper is to understand how this complexity relates to his or her learning process. We first elaborate on the notion of 'social individual' according to educational theory. Also we point out a shift from focusing on learning vertically within single social systems towards learning horizontally across multiple social systems. This interest in multiple systems is encouraged by renewed discussion about how transfer should be perceived (e.g., Konkola, Tuomi-Gröhn, Lambert, & Ludvigsen, 2007) as well as by the so-called third generation of activity theory that takes two activity systems as its minimal unit of analysis (Roth & Lee, 2007). It has been proposed to study learning in horizontal movement as a process of crossing boundaries between systems. This literature tends to conceptualize boundaries on system level, and, as we contend, currently lacks to explain the complexity of learning in horizontal movement on the individual level of a student. Understanding this complexity requires a psychological reconsideration of both the individual as well as the social nature of a human's Self, that is, a Self that is simultaneously belonging to and is separate of a social unit (Valsiner & Van der Veer, 2000).

Theoretical framework

To answer our main question we draw from recent psychological and philosophical insights on identity, specifically on Dialogical Self (e.g., Hermans & Dimaggio, 2007; Marková, 2006; Wertsch, 2007) and as strongly rooted in the philosophical and literary work of Mikhail Bakhtin in the 1920s and 1930s (Bakhtin, 1981, 1986). In contrast with a poststructuralist approach towards self as completely decentered, a dialogical approach defines the self as a continuous attempt to make the self a whole, despite the existence of socially informed sub-identities that try to maintain their relative autonomy. We elaborate on how these insights provide initial answers to the question posed, and hence, are valuable to advance educational theory with respect to both vertical as well as horizontal processes of learning.

Modes of inquiry

To address the question in a concrete real-lived context of education, we look at the reflections of a student on his learning process and describe how multiple social systems are negotiated and collide within his learning practice. This data was collected during a design research project in secondary biology education. Two specifically designed teaching units were observed and ten students were interviewed afterwards. The interviews were semi-structured and were designed with the aim to understand whether the unit was feasible and comprehensible to the students and what they had learned about the cardiovascular system and the monitored phenomena by conducting measurements. In the paper we focus on data from the interview with one student to exemplify four observations. The four observations are interpreted by drawing on a dialogical approach to identity.

Results

Our theoretical exploration is connected to four observations: The everyday life of the students impinge on the life within school. On a system level we can speak of school and everyday life as distinct practices in which learners engage. The interview shows how classroom experiences are not isolated from experiences a student has in out of school contexts. The everyday life of students is not singular but consists of a multiplicity of social worlds. The interview shows how the student refers to different practices in which he engages, each informing him differently in his stance within a specific learning situation. This illustrates Bakhtin's concept of multivoicedness. The multiplicity can create fragmentation which can only be resolved by self dialogue. The interview suggests that the multiplicity creates a fragmentation in terms of a diversity of positions and perspectives of the student that do not necessarily coincide. The Dialogical Self theory proposes that the self coheres as far as these different positions are confronted, negotiated and dialogically interrelated. Historically informed boundaries in learning processes can prevent potential 'hybridization' in learning. The interview reveals that the student, though learning in other positions than merely being a student in a biology class (e.g., being a son of a medical doctor, being a swimmer), does not connect this learning to what he perceives as learning within school. This illustrates that an educational practice that addresses students only as peripheral participants of a school community (in this case a biology class) has monological consequences in the sense that students themselves connect learning to 'acquisition of knowledge' and to traditional school artifacts like books. We elaborate on how this prevents hybridization by addressing the other subject positions of the student that are relevant for the particular learning situation.

References

- Bakhtin, M. M. (1986) Speech genres and other late essays. (V. W. McGee, Trans.). Austin: University of Texas Press.
- Bakhtin, M. M. (1981). The dialogic imagination. (M. Holquist & C. Emerson, Trans.). Austin: University of Texas Press.
- Uomi-Grßhn, T., & Engestrßm Y. (Eds.) (2003). Between school and work: New perspectives on transfer and boundary-crossing. Amsterdam: Elsevier.
- Hermans, H. J. M. and G. Dimaggio (2007). Self, identity, and globalization in times of uncertainty: a dialogical analysis. *Review of General Psychology*, 11, 31-61.
- Marková, I. (2006). On the 'inner alter' in dialogue. *International Journal for Dialogical Science*, 1, 125-147.
- Roth, W.-M., & Lee, Y.-J. (2007) "Vygotsky's Neglected Legacy": Cultural-Historical Activity Theory. *Review of Educational Research*, 77, 186–232.
- Salgado, J. and H. Hermans (2005). The return of subjectivity: From a multiplicity of selves to the dialogical self. *E-Journal of Applied Psychology: Clinical section*, 1, 3-13.
- Valsiner, J., & Van der Veer, R. (2000). The social mind: Construction of the idea. Cambridge, UK: Cambridge University Press.
- Wertsch, J. V. (1997). Narrative tools of history and identity. *Culture & Psychology*, 3, 5-20.

Sense-making through and across spheres of experiences

Tania Zittoun, Institute of psychology and education, Switzerland

Learning can be said to occur when one is able to use knowledge – and a person is likely to use knowledge if she understand a situation as calling for certain type of activities. As past studies have shown, one critical moment for questioning people's uses of knowledge is located as people move through various spheres of experience – from school, to sport's club, to daily shopping and back. In order to understand why people might actually use knowledge developed in one sphere of experience in another one, a series of studies brought us to emphasize the necessary mutually dependence of three types of processes – learning, identity processes as well as sense-making processes. In this paper, based on a recent research on secondary school students, I will specifically examine processes of sense-making in and across spheres of experiences. I will show what they entail, what they enable, but also, what might facilitate to constrain their emergence. Theoretical and educational consequences will be highlighted.

The aim of the paper is to show the relevance of a close examination of sense-making processes in current analysis of the so-called "boundary crossing" phenomena. Indeed, current dominant formulations emphasize identity aspects of belonging to certain community of practices and associated to specific learning activities. Complementing these approaches, a sociocultural understanding of learning and development emphasizes semiotic processes at the heart of human action, best understood under the notion of "sense making" (Bruner, 1990; Valsiner & Rosa, 2007). Past studies on transitions in the lifecourse have indeed emphasized the mutual dependency of identity processes, learning and sense-making (Perret-Clermont & Zittoun, 2002; Zittoun, 2006, in press).

Our current reflection is based on a study exploring young adults' uses of literary and philosophical texts in and out of school. This study took place in 15 group classes, in three high schools (2 pre-academic, one vocational) and in 3 disciplines (French literature, philosophy and "general education"). Data consisted of interviews with teachers (n=16), a general questionnaire with students (n= 205) as well as face-to-face interviews (n= 20) and focus groups (6 groups) with students, and video- and audio-recorded classroom interactions. Each set of data was analyzed independently, and data was then analyzed transversally along case studies (Grossen, Zittoun & Ros, in press)

In this paper, I will present a case study to explore what sense making entails, enables, but also, what might facilitate or constrain its emergence. First, I will show how a person develops different sets of activities, identity definitions and learning strategies in different spheres of activities (at school and in leisure, "extracurricular" activities). Following sense-making processes (including the elaboration of affects, connecting events through time, progressive distanciation from experience, and imagination) I will show how learning or knowledge developed in one sphere of experience can usefully be used in another sphere (Zittoun & Grossen, in press.). Second, drawing on analysis of classroom interactions and teachers' discourse, I will highlight the social and intersubjective conditions likely to facilitate students' sense making processes, appropriation of knowledge, and possibly, knowledge use. More specifically, the importance of dynamic of recognition of the student's work of sense making, in addition to the usual structure of intersubjectivity taking place in the classroom, appears as central.

The implications of these observations are twofold. First, at a theoretical level, they contribute to highlight the interdependency of learning, identity and sense making. They emphasize the affective and symbolic dimensions of sense making, and thus, of learning. They finally remind the social and cultural nature of these supposedly more "subjective" processes. Second, at a theoretical level, these observations seriously question the status given by school to so-called "extracurricular activities". First, our research shows that these have a subjective and practical considerable importance in young people's lives, although these are usually ignored in evaluation and school programs. Second, it suggests that the trigger of students' commitment into learning and knowledge use can, in some cases, precisely lie in these extracurricular activities. The question is therefore how and under which modalities such observations help to transform educational practices. Based on cases of "good practice", the study thus proposes to consider simple dynamic of "recognition" of students' sense making that can take place in the classroom.

References

- Bruner, J. S. (1990). *Acts of meaning*. Cambridge: Harvard University Press.
- Grossen, M., Zittoun, T. & Ros, J. (in press). Boundary crossing events and potential appropriation space in philosophy, literature and general knowledge. In E. Hjørne, G. van der Aalsvoort & G. de Abreu (Eds.), *Learning, social interaction and diversity – exploring school practices*.
- Perret-Clermont, A., & Zittoun, T. (2002). *Esquisse d'une psychologie de la transition*. *Education permanente*, (1), 12-14.
- Valsiner, J., & Rosa, A. (Eds.). (2007). *The Cambridge handbook of sociocultural psychology*. Cambridge: Cambridge University Press.
- Zittoun, T. (2006). *Transitions. Development through symbolic resources*. Coll. *Advances in Cultural Psychology: Constructing Development*. Greenwich (CT): InfoAge.

Zittoun, T. (in press). Lifecourse. In J. Valsiner (Ed.), *Handbook of Culture and Psychology*. Oxford: Oxford University Press.

Zittoun, T. & Grossen, M. (in press). Cultural elements as means of constructing the continuity of the self across various spheres of experience, In M. C  sar & B. Ligorio (eds.). *The interplays between dialogical learning and dialogical self*. Charlotte: InfoAge, 2010/2011.

Knowing nature through experimentation: Science literacy and the situatedness of knowing

Emma Petersson, Faculty of Education, Sweden; Annika Lantz-Andersson, G  TEBORGS UNIVERSITET, Sweden; Geraldine Fauville, University of Gothenburg, Sweden; Roger Saljo, Goteborg University, Sweden

The background of the present study is an interest in issues of learning and knowing across social settings. In recent years, such problems have come to be understood in terms of literacy, i.e. the ability of people to use textual and multimodal resources to understand real-world issues. The analysis reported here takes its point of departure in John Dewey's argumentation that learning about scientific methods and inquiry can provide such a platform for learning generalized skills. Students (aged 16-17), studying the environment and climate issues, had access to a virtual lab, referred to as the acid ocean virtual lab, to conduct inquiries and experiments that concern climate change. The analysis builds on a sample of 80 students who took part in written problem-solving test as outcome measure. The students were required to design an experiment addressing a specific environmental issue. The problem was given as an individual written task before as well as after teaching/lab sessions. The results show that students increase their use of scientifically relevant terminology ('sample', 'measure' etc.) and they improve their ability to outline an experiment during the course. However, science literacy also implies realizing what a relevant interpretation of a problem is in order to be able to answer it through a scientific experiment.

Almost a hundred years ago, the pragmatist philosopher, psychologist and educationist John Dewey articulated the problems of how organize teaching and learning so as to accommodate to the increasing production and specialization of scientific knowledge (Dewey, 1966, 1997). It is no longer possible, so his argument was, for schools to keep up with the dramatic expansion of scientific knowledge in all the different disciplines. One of his ideas of how to deal with this problem was to focus on generative skills and insights that carry across contexts and situations. One such set of generative skills is offered by scientific inquiry itself. This implies that one should learn some of the procedures and a language for how to observe and codify the world in scientifically relevant manners (Wickman, 2004). In modern parlance, this could be understood as an issue of how one becomes literate in science matters. At another level, these reflections by Dewey also concern the fundamental problems of situatedness and transfer in learning; issues that continue to create intense debates (Ludvigsen, 2003; Resnick, S  lj  , Pontecorvo, & Burge, 1997). The more complex society becomes in terms of its knowledge base, the more schooling has to focus on generative skills that transfer across settings.

The present study reports an empirical investigation in a naturalistic setting of how students (aged 16-17) learn to do research and how research is conducted in terms of experiments and data collection. This implies identifying how experiments are carried out and what characterizes experiments as a mode of generating knowledge. Knowing about experimentation as a method exemplifies what Dewey conceived as a general insight that has implications across settings. The students, studying marine science within the context of upper-secondary school, were given a problem about how to generate an answer to a problem about water quality in the case of building a fishery that, potentially, could pose a danger to the marine environment. The question was formulated as:

You are an environmental scientist who is hired to complete an environmental impact report for a proposed project. Tropical Fisheries of Hawaii plans to open a fish hatchery on the Luau River, and the river opens to a bay with a large coral reef. Biologists are concerned that water discharge from the hatchery could impact the pH of the river and the bay. What sort of an experiment could you do to see if a change in pH might have an effect on the growth of the coral?

The study is longitudinal and the problem was given before and after teaching, in both cases as an individual writing task. The students participated in a collaboration between Swedish and Californian schools on issues of climate change, environmental pollution and habitat preservation. The schools engaged in networking activities using various media, and they also had access to digital tools such as virtual labs and carbon dioxide footprint calculators. In the present study, however, the students only had access to a virtual lab, referred to as the acid ocean virtual lab, to conduct their inquiries. The analysis builds on a sample of 80 students who took part in both the pre- and post-test.

The paper reports observations on how students a) the appropriate a scientific language (e.g. learn to use terminology such as 'sample', 'measure', 'control group' etc.), and b) how they reason about how to organize an experiment/a study before and after the course. The latter dimension is evaluated through a hierarchical model of the learning

outcome that goes from not understanding how the issue could be addressed to giving a functional account of how an experiment could answer the question presented. The five-level category system is as follows:

- Category 1. Don't know/no answer
- Category 2. Suggests solution to problem with water (but does not describe a study)
- Category 3. Suggests testing the water (or PH or corals)
- Category 4. Suggests testing the water and corals
- Category 5. Outlines study/experiment

The results show that the prevalence of scientifically relevant concepts in the students' responses increases significantly (from a mean of 1,8 to 2,9, z However, an important observation is that in order to be able to reason scientifically one must also be able to understand the problem posed, and how a research study can be organized in response to a particular problem. Thus, it is not enough to learn about scientific concepts and experimentation, one must also learn how such resources can be made relevant in a particular context and in response to a particular question. Put differently, a major difference between the students concerns whether they suggested a solution to the problem asked by outlining a study/an experiment, or if they engaged in analysing the problem of what would happen to the water quality if the hatchery was built. Interpreting a problem as a research problem is different from responding to it as a practical, political concern. Learning what it implies to see a problem as a research issue is per se an important element of science literacy.

References

- Dewey, J. (1966). *Democracy and education*. New York, NY: The Free Press.
- Dewey, J. (1997). *How we think*. Mineola, NY: Dover.
- Ludvigsen, S. (2003). Workplace learning across activity systems: A case study of sales engineers. In T. Tuomi-Gröhn & Y. Engeström (Eds.), *Between school and work. New perspectives on transfer and boundary crossing*. (pp. 291-310). Amsterdam: Elsevier.
- Resnick, L., Säljö, R., Pontecorvo, C., & Burge, B. (1997). *Discourse, tools, and technology. Essays on situated cognition*. New York: Springer.
- Wickman, P.-O. (2004). The practical epistemologies of the classroom: A study of laboratory work. *Science Education*, 88, 325-344.

SYMPOSIUM

Invited EARLI

Walking under a Chinese umbrella: The influence from Chinese educational philosophy to ECE development

Chairperson: Asta Birkeland, Bergen University College, Norway

Organiser: Li Li, University of Exeter, China

Discussant: Debra Myhill, Exeter University, United Kingdom

This symposium focusing on the cultural aspect of educational philosophy and its impact on early education curriculum, includes three papers from different perspectives to look at the development of curriculum reform, teacher development and the role of information communication technology. The first paper reviews the development of China's early education curriculum policy and how the social cultural beliefs and power distribution exert a powerful influence on the curriculum reform. The second paper discusses the relevance of traditional educational beliefs advocated by Lao Zi to modern kindergarten teacher education. This paper particularly applies Lao Zi's philosophy in teacher education and how teachers should practice accordingly. The third paper presents a review on the application of information technology in early childhood education in China based on a 10-year IBM KidSmart Young Explorer program in China. These three papers, taking different perspectives, collectively and individually presents early education development in the Chinese socio-cultural context, which hopefully will promote more discussion and interest in Chinese educational philosophy.

Review on the Application of Information Technology in Early Childhood Education in China

Lipin Guo, East China Normal University, China

Based on the development of the IBM KidSmart Young Explorer program in China over the past ten years, and by using the methods of questionnaire survey and the like, this study presents a review and reflections on the application and the development of information technology in early childhood education in China. The study shows that the development in the past ten years lays a solid foundation for the application of information technology in early childhood education. And the study believes that the further effective promotion in the application of information communication technology should be guided by the principle of educational equity and harmonious development of

society advocated by the state. The study also offers suggestions on the further effective application of information technology in early childhood education

Review on the Application of Information Technology in Early Childhood Education in China

Based on the development of the IBM KidSmart Young Explorer program in China over the past ten years (from 2001 to 2010), this study presents a review and reflections on the application of information technology in early childhood education in China. Methods used in the study include a questionnaire survey of more than 600 participating kindergartens in different provinces and cities of China; a longitudinal comparative analysis of the survey results over ten years; field observation and teacher interview in some of the representative kindergartens, and text analysis on the specific programs adopted by some kindergartens for the integration of information technology into the curriculum. This study gives a detailed description of the overall development of information technology equipment for early childhood education in China over a ten-year period. Our results provide insights into: the progress in the competency and training of kindergarten teacher in information technology; progress in the development and application of digital resources in the kindergarten curriculum; , the development of theoretical and practical thinking on the integration of information technology with curriculum; related research progress in the appropriateness of the application of information technology for young children and its effect on young children's health, and the digital and network development in the early childhood education service system. This study shows that in the past decade IBM KidSmart Young Explorer program has gone through three stages in promoting the application of information technology in early childhood education: the stage of experience accumulation based on large cities in eastern China (2001 to 2004), the stage of pilot experimentation in favor of the second and third scale cities in the western China (2005 to 2007), the stage of promoting equity in education (2008 to 2010). The development of information technology in early childhood education coincides with the development tendency of China's education reform. This study shows that the education philosophy for the kindergarten principal to introduce information technology equipment into the kindergarten and the concept for teacher to use information technology equipment are critical in determining whether or not information technology can effectively support the enhancement of education. The longitudinal comparative study of the teachers' questionnaire shows that in the past ten years of program development, information technology in China has developed rapidly and the individual competency of kindergarten teachers in information communication technology has also improved significantly. However, theoretical thinking as well as teacher's capabilities in how to effectively apply information technology in kindergarten education has not improved much. Therefore, during the promotion of this program, much emphasis is placed on enhancing teachers' professional qualifications, helping teachers to change their ideas and thinking, stressing the assisting role of information technology in education and teaching as "learning by use of computer" instead of "learning computer", highlighting the integration of the computer-assisted means with the kindergarten curriculum, and improving teacher's educating and teaching abilities. The application of information technology in early childhood education of China has not only its own characteristics and advantages, but also some barriers. The development in the past ten years lays a solid foundation for the application of information technology in early childhood education. And the further effective promotion in the application of information should be guided by the principle of educational equity and harmonious development of society advocated by the state. In the end, the study offers some suggestions on the further effective application of information technology in early childhood education, particularly on the formulation of the relevant policies in the future.

Historical Reflection on the Development of China's Early Education

Zhaocun Li, East China Normal University, China

With the introduction of western teaching concepts like constructivism during the 1990s, China's preschool curriculum policy has gradually changed and begun to emphasize the democratization of curriculum policy and the integration of curriculum implementation, etc. The study shows that China's preschool curriculum policy is reflected from such aspects as social culture, power distribution in curriculum policy, and intrinsic mechanism of the implementation of curriculum policies. The study suggests that the greatest breakthrough in China's kindergarten curriculum reform has been the recognition of the value of children's play in the development of children and setting up play as the basic activity in kindergartens in the form of legislation. However, some different problems emerge in the play arrangement of kindergarten curricula, which reflect the contradiction between teachers' cognition and practical operation of play.

With the introduction of western teaching concepts like constructivism during the 1990s, China's preschool curriculum policy has gradually changed and begun to emphasize the democratization of curriculum policy and the integration of curriculum implementation, etc. Since the beginning of the 20th Century, early childhood education in China has been developing in the context of ongoing conflict and reconciliation of western and eastern culture, traditional and modern culture. During the 1990s, with the introduction of western teaching concepts like constructivism, China's

preschool curriculum policy has gradually changed and begun to emphasize the democratization of curriculum policy and the integration of curriculum implementation. For example, in recent years, the greatest breakthrough in China's kindergarten curriculum reform has been the recognition of the value of children's play in the development of children and legislating for the introduction of play as the basic activity in kindergartens. In 2001, the promulgation of the guideline of kindergarten education reflected this change at policy level. However, some different problems emerge in the implementation of the guideline of kindergarten curricula, which reflect the contradiction between the ideas of the curriculum policy and social culture. This study shows that China's preschool curriculum policy is reflected from such aspects as social culture, power distribution in curriculum policy, and intrinsic mechanism of the implementation of curriculum policies. The main goal of this study is to examine the cultural adaptability of current early childhood education curriculum policy in China and to explore in which aspects the ideas advocated by current curriculum policy are concur or differ from Chinese traditional culture. The primary methods we used are interview and classroom observation. We chose experts who participated in building the Guideline of Kindergarten Education, teachers, parents and educational officials as interviewees. In order to obtain data which could be compared on several levels, we conducted interviews and classroom observations in Shanghai, the most developed city in China, and at Qufu, a relative developing small city. According to the interview data, we analyzed the interactions between the ideas of the curriculum policy and Chinese traditional culture from the following aspects: children's ideas, teachers' ideas, the ideas of learning and play, the perceptions of power and responsibility. Based on theoretical analysis, we found that in Chinese traditional culture the emphases on teacher's role of guidance, the dialectic relationship between imitation and creativity, the focus on the formality of learning and the discrimination of play, and the conscience of teaching all effect the implementation of the current curriculum policy. For example, in Chinese traditional culture, play was often linked to self-indulgence and to time-wasting. It is regarded as being in opposition to achievement. As the saying goes, achievement is founded on diligence and wasted in play. Influenced by this traditional idea, play in the kindergarten is often not valued by parents. A second example suggests that, in Chinese traditional culture, creativity and imitation are not opposing concepts but harmonious ones. Although creativity is a kind of transcending to existing values, and a process of exploration, it cannot be detached from traditional concepts of teaching and learning. Profound knowledge base and solid basic skills are prerequisites of development of creativity. In Chinese traditional literature and art education, so-called Linmo, which means imitation, creativity begins by imitating super calligraphy works of predecessors. So called "After reading up three hundred Tang poems, you can at least intone poems even you can't write them" emphasize the writing beginning from imitating super literature works of predecessors. According to this traditional idea, we have to reflect on the relationship between the guidance from teacher and children's independent activities. Finally, we put forward some suggestions about curriculum reform of early childhood education in the context of Chinese traditional culture

Chinese Traditional Culture In Kindergarten-based Curriculum Development

Yu Qian, East China Normal University, China

This study looked at two cases of kindergarten-based curriculum in Shanghai which deeply influenced by Chinese traditional culture and art. It also explored the reconstruction of curriculum and teacher's roles in this process. In these cases, kindergarten teachers tried to integrate traditional Chinese culture and art into the current curriculum and to help the children understand them better. China presents one of the most dramatic examples of rapid economic transitions in the world. However, we need to pay more attention to our history, especially the traditional culture. While Chinese traditional culture means something classic and ancient, 'School-based curriculum' is a new term that emerged from China about one decade ago. It emerged as an international trend since 1970s, departing from the traditional curriculum that was derived from a centralized decision-making process to a curriculum that is determined by individual schools and teachers (Eggleston, 1980; Marsh, 1989, 1997; OECD, 1979; Sabar, 1985; Skilbeck, 1984). After that, some Chinese kindergartens have kept trying to develop their own curriculum in different ways. Li (2006) investigated how school-based curriculum development (SBCD) was interpreted and implemented in a Chinese context like Hong Kong. Some studies also emerged in Shanghai (Li and Li, 2004; Zhu, 2003).

Eggleston, J. (Eds.) (1980). *School-based curriculum development in Britain: A collection of case studies*. London: Routledge & Kegan Paul.

Espinosa, L. (2005). Curriculum and assessment considerations for young children from culturally, linguistically, and economically diverse backgrounds. *Special issue of Psychology in the Schools* 42 (8), 837-854.

Zhu, J. X. (2003). *Kindergarten curriculum* (in Chinese). Shanghai: East China Normal University Press.

Li, H. (2006). *School-Based Curriculum Development: An Interview Study of Chinese Kindergartens*, *Early Childhood Education Journal*, Vol. 33, No. 4, February 2006.

Stormont, M., Espinosa, L. Knipping, N. & McCathren, R. (2003). Supporting vulnerable learners in the primary grades: Strategies to prevent early school failure. *Early Childhood Research & Practice*. 5(2)

SYMPOSIUM

New Perspectives on Cognitive Load Measurement

Chairperson: Babette Park, Saarland University, Germany

Organiser: Babette Park, Saarland University, Germany

Discussant: Bobby Hoffman, University of Central Florida, United States

The increasing amount of recent publications that focus on Cognitive Load Theory mirrors the relevance of the cognitive load construct. However, the current discussion on how to measure the construct of cognitive load while learning points to a research gap. The present symposium aims at closing this research gap and giving an impulse for more research on valid and reliable cognitive load methods. Therefore, different methods for measuring cognitive load are presented (DeLeeuw, Mayer, Giesbrecht, & Scheiter; Park & Brýnken; van Gog, Kirschner, Kester, & Paas). Van Gog et al. focus on the most frequently used subjective mental effort rating scale and show how timing and frequency of mental effort measurements affect the results obtained. DeLeeuw et al. show how to measure cognitive load by a new paradigm adapted from the field of visual attention differentiating between so-called perceptual load and working memory load. This new perspective on cognitive load holds promise for both the measurement and theory of cognitive load during learning. Park and Brýnken present how to measure cognitive load in an objective way by using secondary task performance in the frame of the dual-task paradigm. In contrast to the until now used secondary tasks, the new presented secondary task is characterized by its independence from the presentation mode of the learning instruction (primary task). The whole symposium will be discussed by Bobby Hoffman (University of Central Florida) and Gregory Schraw (University of Nevada, Las Vegas).

When to Measure Cognitive Load with Mental Effort Rating Scales

Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Femke Kirschner, Erasmus University Rotterdam, Netherlands; Liesbeth Kester, Open University of the Netherlands, Netherlands; Fred Paas, Erasmus University Rotterdam & Open University of The Netherlands, Netherlands

Subjective mental effort rating scales are widely used to measure cognitive load in research on learning and instruction. However, timing and frequency of application of those rating scales differs, from repeatedly within or immediately after every task, to once after a sequence of tasks. Three experiments are presented here that investigate how timing and frequency of mental effort measurements affect the results obtained. The findings from Experiment 1 and 2, using task sequences containing both simple and complex tasks, show that a single rating after a sequence of tasks results in a higher mental effort score than the average of ratings provided immediately after every task. Experiment 3 shows that this also goes for sequences of complex tasks only, but not for simple tasks only. Taken together, the experiments suggest that there is something about a sequence of tasks that makes the whole more than the sum of its parts when it comes to rating invested mental effort. As long as it is unclear what that is, repeatedly measuring mental effort seems to be preferable.

Subjective mental effort rating scales are widely used in research on learning and instruction to measure cognitive load (for reviews, see Paas et al., 2003; Van Gog & Paas, 2008). Most used are (adapted versions of) the multi-dimensional NASA-Task Load Index (NASA-TLX; Hart & Staveland, 1988) which incorporates measures of perceived performance, effort, frustration, and mental, physical and temporal task demands (e.g., Gerjets et al., 2006; Kester et al., 2006; Scheiter et al., 2010) and (adapted versions of) Paas's (1992) 9-point mental effort rating scale.

An important question, however, is when to apply subjective rating scales. Researchers tend to apply them at different intervals, sometimes at certain intervals during a task, which is possible without interfering with task performance or learning when a single item scale is used (Ayres, 2006; Van Merriënboer et al., 2002; Yeo & Neal, 2004, 2008), sometimes immediately after every task in a learning or test phase, which requires learners to retrospect only on the task they just finished that is probably still (partly) activated in working memory (single-item scale: Kirschner et al., 2009; Paas, 1992; Paas, & Van Merriënboer, 1994; Van Gog et al., 2006, 2008; Van Merriënboer et al., 2002; Wouters et al., 2009), and sometimes only once at the end of the entire learning or test phase, which requires learners to provide a retrospective judgment of the cognitive load imposed by a whole sequence of tasks (single-item scale: Kalyuga et al., 2001; NASA-TLX: Gerjets et al., 2006; Kester et al., 2006; Scheiter et al., 2010). When a mental effort rating scale is applied multiple times, the average of ratings is usually used as an indicator of cognitive load experienced during the learning phase or test phase.

Given these differences in the timing and frequency with which rating scales are applied, there are likely to be differences in the results obtained, and as a consequence, in the conclusions that are drawn. A theoretical reason for favoring the measurement of mental effort immediately after each task over a single measurement at the end of a sequence of tasks, is that students may be able to retrospect on a single task, but it is unclear what that measurement at the end of the sequence reflects. To address the issue of whether the timing and frequency affect the results obtained, we conducted three experiments.

Participants in Experiment 1 ($N = 87$) were given six problems, three simple ones (low in cognitive load, e.g.: "Suppose today is Tuesday. What day of the week is tomorrow?") and three complex ones (high in cognitive load, e.g., "Suppose 5 days after the day before yesterday is Friday. What day of the week is tomorrow?"; see Sweller, 1993). Depending on their randomly assigned condition they rated their invested mental effort on the 9-point rating scale (Paas, 1992) after every task ($n = 44$) or once at the end of all six tasks. There were 4 different sequences of the tasks to ensure order would not affect the results. Participants were given 1 minute to find the answer to each problem, and they had to do it mentally. The mean mental effort invested in all six problems from the condition that rated it immediately after each task was 3.75 ($SD = 1.06$), whereas that of the condition that rated it after all problems was 5.23 ($SD = 1.40$). This difference is significant, $t(85) = 5.56$, $p = .000$. A closer look at the data from the condition in which invested mental effort was rated immediately after each task, shows that the mean mental effort invested in the simple problems was 2.03 ($SD = .79$) compared to 5.47 ($SD = 1.64$) in the complex problems. Note that the mean effort invested in the complex problems is almost equal to the mental effort investment indicated by the group that rated it after completing all tasks. Because a between-subjects design was used in this study, a possible explanation for these findings might be that participants in the condition that provided a single rating at the end of the series of tasks did not have a good recollection of the tasks or the effort they invested in each task, and mainly remembered the most complex tasks on which they then based their judgment.

Experiment 2 ($N = 39$) therefore used a within-subjects design. The same tasks as in Experiment 1 were used, again in four different sequences, but participants now rated invested mental effort both after each task and after all six tasks. Again, the effort score provided after the sequence of tasks ($M = 4.87$, $SD = 1.43$) was again higher than the average over six tasks ($M = 3.99$, $SD = 0.93$), $F(1,35) = 39.99$, $p = .000$.

So, for task sequences that contain both simple and complex problems, the findings from Experiments 1 and 2 imply that researchers measuring cognitive load either after each task or after a sequence of tasks will come to different conclusions regarding participants' mental effort investment, with the single measure leading to a higher score. But if students indeed give the complex problems more weight when providing a mental effort rating at the end of a sequence of tasks, the effect that this leads to a higher score than the average of ratings immediately after each task should disappear when tasks are all simple or all complex.

Experiment 3 ($N = 45$) investigated this, using a mixed design with between-subjects factor task complexity (six simple tasks, $n = 22$; six complex tasks, $n = 23$) and within-subjects factor effort rating (after each task and after all six tasks). A repeated measures analysis showed a highly significant interaction effect, $F(1,43) = 14.76$, $p = .000$, indicating that the rating at the end was higher than the average of ratings for the complex problems, but not for the simple problems.

Results will be discussed in terms of monitoring mental effort investment under different cognitive load conditions, and in terms of consequences for measuring cognitive load in research on learning and instruction.

Measuring Perceptual Load in Multimedia Learning

Krista DeLeeuw, Knowledge Media Research Center, Germany; Richard E. Mayer, University of California, United States; Barry Giesbrecht, University of California, Santa Barbara, United States; Katharina Scheiter, Knowledge Media Research Center, Germany

To successfully measure cognitive load, we must fully understand its structure and associated processes. Currently, theories and measures of cognitive load during learning have only considered processing that occurs in working memory, but this may not be the complete picture. As some studies using dual-task measures already hint at, perceptual processing may play an important role in the experience of cognitive load. In two studies, we have shown that in multimedia learning, adding visual (rather than auditory) text to pictures (Study 1) and presenting text close to (rather than far from) pictures (Study 2) increases the demand for perceptual processing, as measured by a new paradigm adapted from the field of visual attention. This paradigm is able to differentiate between so-called

perceptual load and working memory load, and holds promise for both the measurement and theory of cognitive load during learning.

To successfully measure cognitive load during learning from text and pictures (multimedia), we need to understand the underlying structure comprising the experience of load. Current theories and measures of cognitive load focus on processing that occurs in working memory, but this may not be the complete picture. The Cognitive Theory of Multimedia Learning (CTML, Mayer, 2009) describes cognitive processes that learners must engage in during learning and the working memory (WM) channels upon which those processes rely. Cognitive Load Theory (CLT, Sweller, van Merriënboer, & Paas, 1998) describes different types of demands learning tasks can impose on limited WM. We argue that basic perceptual processing also plays an important role and that effective measures of perceptual processing are necessary to advance the field.

Based on CTML and CLT, several measures of cognitive load have been relatively successful at predicting learning outcomes and supporting these theories. Perhaps the most successful have been dual-task measures. Dual-task measures require a response to a secondary task which is thought to use the same cognitive resources as the primary (learning) task. When the learning task requires more of that resource, performance on the secondary task decreases. For example, Bruenken, Steinbacher, Plass, and Leutner (2002) and DeLeeuw and Mayer (2008) had learners work on a primary task, multimedia lessons that contained pictures with visual text (visual-only) and/or pictures with narration (audiovisual). As a secondary task, learners responded as quickly as possible in a visual monitoring task. Learners responded more slowly in the visual-only condition, which the researchers interpreted to indicate, based on CTML, that the visuospatial channel of WM was overloaded by the visual text and therefore processed the visual secondary task less efficiently. However, this interpretation neglects the possibility that perceptual processes, rather than WM processes might be at play. The visual monitoring task used in these studies might require only basic perceptual processing resources, which would imply that the primary task differed in terms of perceptual processing. Moreover, many multimedia learning effects stem from physical changes in the stimulus—adding visual text to an animation, placing text in a different location, adding arrows in a diagram to direct attention—that can change the way learners process information perceptually. Thus, differences between processing visual-only and audiovisual presentations might be perceptual. By integrating perceptual processing into theories of cognitive load, we will be able to more precisely define the resources demanded by learning tasks. This sort of refinement also requires measures that can differentiate between working memory and perceptual processing.

In a series of studies, we investigated a measure of perceptual load. We used common multimedia materials that tend to result in better learning and lower cognitive load, and compared them to materials that decrease learning and increase load. Importantly, we have used differences between materials that involve a physical change. To measure perceptual load, we have created a new type of dual-task measure by adapting a paradigm from the field of visual attention. This paradigm (e.g. Lavie, 2005) has shown that interference from task-irrelevant distractors during a visual identification task decreases when perceptual load is increased by making the identification task more difficult. This task is similar to dual-task measures, except that it does not require a response – learners should ignore the distractors in order to facilitate performance on the primary task. To adapt the paradigm, we presented visual task-irrelevant distractors next to a multimedia lesson, using eye tracking to measure distraction (i.e. how often learners look at distractors). According to the logic of the paradigm, high perceptual load will cause learners to look at distractors less because they have fewer available perceptual resources.

In Study 1, we examined the modality effect (Mayer, 2009) in a within-subjects design; 36 university students learned from a visual-only lesson and an audiovisual lesson, with counterbalanced lesson topics. We found that, consistent with a perceptual load explanation of the modality effect, participants looked at task-irrelevant distractors less during the visual-only condition than the audiovisual condition, $t(35) = -4.29$, p

In Study 2, we examined spatial contiguity (Mayer, 2009) in a similar within-subjects design; 27 university students learned from a lesson in which visual text was placed very near relevant parts of pictures (integrated) and one in which text was placed far from relevant parts (split). We found that participants looked at distractors less in the integrated condition than in the split condition, $t(26) = -4.11$, p . Importantly, learning outcomes paralleled perceptual processing. This study indicates that in extreme cases, integrated materials may increase perceptual load due to visual cluttering.

These two studies provide initial validation for a measure of the perceptual processing required by a lesson. Promisingly, Lavie's paradigm can also differentiate between perceptual and WM load. In studies of visual attention, higher WM load leads to increased distraction. In future work, we will investigate multimedia manipulations that should lead to WM load and do not involve a change in the visual stimulus, e.g., the coherence of narrated text. If this

measure can differentiate between perceptual and WM load within the setting of multimedia learning, it could prove to be an effective tool in investigating the relative contribution of these two types of load in learning from multimedia. References Bruenken, R., Steinbacher, S., Plass, J. L., & Leutner, D. (2002). Assessment of cognitive load in multimedia learning using dual-task methodology. *Experimental Psychology*, 49(2), 109-119. DeLeeuw, K. E., & Mayer, R. E. (2008). A comparison of three measures of cognitive load: Evidence for separable measures of intrinsic, extraneous, and germane load. *Journal of Educational Psychology*, 100, 223-234. Lavie, N. (2005). Distracted and confused?: Selective attention under load. *Trends in Cognitive Sciences*, 9(2), 75-82. Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). New York, NY, US: Cambridge University Press. Sweller, J., van Merriënboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10(3), 251-296.

The Rhythm Task - A New Method for Measuring Cognitive Load

Babette Park, Saarland University, Germany; Roland Bruenken, Saarland University, Germany

The present studies join a series of studies about directly measuring cognitive load while learning with multimedia instruction by using the dual-task paradigm. The goal of the present work was to develop a secondary task, which measures cognitive load in a direct and continuous way. In addition and in contrast to the until now used secondary tasks, this new method is characterized by its independence from the presentation mode of the learning instruction (primary task), as the secondary task is realized by internalized cues: A previously practiced easy rhythm is executed continuously by foot-tapping of the learner while learning. The suitability of this method was examined in the frame of three studies ($n = 30$ each). Results show that rhythm precision and errors allow a precise and continuous measurement of cognitive load during the learning process.

Theoretical Framework and Objectives

The present work was initialized due to recent publications in cognitive load research, which discuss the widespread and most frequently used subjective rating scale of Paas (1992) and recommend using objective and direct methods for measuring cognitive load (Plass, Moreno & Brünken, 2010). Direct measurement can be realized for example by brain activity measures and dual-task performance (Brünken, Plass, & Leutner, 2003). A series of studies could already show that secondary-task performance is a reliable and valid method to measure cognitive load (e.g. Brünken, Plass, & Leutner, 2004; DeLeeuw & Mayer, 2008). Within a dual task paradigm, e.g. differences in resource consumption caused by different presentation forms of the learning material (primary task) can be obtained by differences in a simultaneously performed secondary task. The by now used secondary tasks are realized by auditory or visual cues in the learning instruction. For example, participants have to monitor a letter in the upper part of the computer screen and have to press the space bar, when a color change was observable. However, it is unclear, whether auditory or visual secondary tasks do measure total cognitive load, or rather modality-specific aspects. Moreover, these mentioned secondary tasks are reactive with respect to the learning task, as they require a conscious disruption of the learning process to respond to an auditory or visual cue.

The objective of the present work is to solve this reactivity problem by a continuous motor task. Because some authors showed that an additional motor task like frequent tapping seems to stimulate cognitive processing of and the performance in primary tasks in a positive way (Brown & Marsden, 1991; Emerson & Miyake, 2003), the motor task for our purpose should not be characterized by frequent tapping, but require inhibition processes. Inhibition processes are good indicators for executive control processes (Cohen et al., 1997), which can be interpreted as a modality-unspecific total cognitive load indicator. For instance, an easy rhythm with pauses already requires inhibition, when learners have to consciously inhibit to tap. Moreover, the motor task should be independent from the primary task, which can be realized by internalized cues. The new invented secondary task should allow a precise and continuous measurement of cognitive load in the learning process.

Methods and Data Sources

The suitability of a new invented secondary task for continuously measuring cognitive load while learning was examined in the frame of three studies ($n = 30$ each). As primary task, we used computer based learning material with or without seductive details. The seductive details were already confirmed to induce a negative learning effect in the first study, $F(1, 29) = 2.92$, $p_{\text{etap}}^3 = .10$ (Park, Moreno, Seufert & Brünken, in press). The second study should show the hypothesized cognitive load effect and examine the new invented method. 30 high-school students were randomly assigned to one of the two experimental groups (with vs. without seductive details). The learning instruction consisted of a self-paced multimedia environment about the structure and function of a cellular molecule. Learners had to execute the foot-tapping rhythm task simultaneously to learning and continuously all over the learning session under both conditions. The rhythm was written in four-four time that is the easiest meter for playing music and was: tap – tap – pause – pause / tap – tap – pause – pause /.... and so forth. Learners were introduced to this rhythm task

before the learning session started. Working memory capacity, spatial ability, prior knowledge, and time-on-task served as control measures. Learning success was assessed with a learning performance test. Total cognitive load was measured by subjective ratings of mental effort (Paas, 1992) and by the rhythm task, which allowed analyzing the precision (standard deviation from individual rhythm baseline in milliseconds) as well as errors or rate changes (sum of rhythm rate changes in milliseconds). Finally, the third study should replicate the effects of the second study with another instructional design effect, the modality effect.

Results and Conclusions

In line with the first study, learners of the second study took significantly more time to learn in the seductive details-condition than learners who learned without seductive details, $t(27) = 9.96$, p

SYMPOSIUM

Students' critiques of teaching practices and their influence on learning conditions

Chairperson: Dimitris Pnevmatikos, University of Western Macedonia, Greece

Organiser: Dimitris Pnevmatikos, University of Western Macedonia, Greece

Discussant: Wiel Veugelers, University of Amsterdam, Netherlands

Teacher – student interaction is considered an important variable in learning and instruction. Especially, students evaluate their teacher's behaviors inside the classroom and their critiques could constitute a crucial factor for the establishment of a good learning environment. This evaluation is subjective and not necessarily in agreement with what teachers consider as a good behavior. Moreover, we do not know exactly how the general feeling that students have about their teacher's behavior is constructed. This symposium aims to present recent research evidence that shows some of the aspects that arise during the teacher – student interaction inside the classroom and have an effect on the learning conditions. Specifically, the first paper will show that students acknowledge their teachers' content competence, professional preparation, teaching ability, responsibility and sense of duty while highlighting a lack of their teachers' competence in social interaction, understanding and communication. The second paper will show that an increased number of experiences of just and constructive interactions with their teachers will affect the students' positive perceptions of the open classroom climate, which is associated with the effective learning conditions. The third paper, through providing the role of emotions, will show which specific teachers' behaviors influence children's justice perceptions of their teachers, and how they affect children's judgments of their teacher's behavior.

The gap between teachers' understanding of learning environment and communication and students' experience

Mary Koutselini, University of Cyprus, Cyprus; Sophia Agathagelou, University of Cyprus, Cyprus

This paper presents a study aiming at investigating teachers' understanding of teaching and students' experiences in secondary schools of Cyprus concerning both learning environment and teachers' competences for effective communication. The results of the study reveal the gap between students' and teachers' perceptions concerning empathy, collaboration, and communication and indicate differences between the perceived curriculum (teachers' perceptions) and the experienced curriculum (students' experiences). Although students acknowledge their teachers' content competence, professional preparation, teaching ability, responsibility and sense of duty, find a lack of teachers' competences for social interaction, understanding and communication. For the purposes of this study, two questionnaires were developed, one addressed to representative number of students ($N=1282$) and one to teachers. Statistical analysis of the data includes descriptive and factor analysis. Interviews with teachers and students allow further interpretation of the quantitative data. The results are interpreted in light of the Critical pedagogy discourse and its concern about teaching and curricula that de-personalise schooling and communication. The syndrome of undifferentiated teaching of the "content" prevents students from learning and teachers from pedagogy.

Introduction

Are there any differences between teachers' and students' understanding of effective learning environment and communication? What key competences do teachers attribute to themselves? What key competences do students attribute to their teachers? These are the main questions that are being answered in this study comparing aspects of the perceived and experienced curriculum as it has been defined by Goodlad (1983). Empathy and collaboration as key competences of both effective learning environment and teaching are examined and the gap between students' and teachers' perceptions are presented in light of the Critical pedagogy discourse.

Method

Participants in the study were 545 secondary school teachers of a variety of disciplines, as well as 1282 students of the second class of Gymnasium (age 14) and of the first class of Lyceum (age 16) all over Cyprus. A mixed methodology

has been used for data collection, quantitative and qualitative. The quantitative instruments were two questionnaires, one addressed to students and one to teachers. The teachers' questionnaire measures teachers' understanding about the characteristics of their teaching, while the students' questionnaire refers to students' experiences regarding teaching and learning environment. The statements in the students' questionnaire correspond to the statements in the teachers' questionnaire and vice versa so as to allow comparison between students' and teachers' perceptions. The study was completed with semi-structured interviews with teachers and students who gave their explanation about the gap between teachers' and students' perceptions. Factor analysis, discourse and content analysis are the methods of data analysis.

Findings

Students see mainly their teachers' content competence, professional preparation, teaching ability, responsibility and sense of duty and find a lack of teachers' competences for social interaction, understanding and communication. None of the statements in the teachers' questionnaire has a mean score below 3.00 (Likert scale 1-5), showing lack of awareness about their deficiencies, fact that has been confirmed during the interviews. Agreeing with the relevant bibliography, it is confirmed that girls tend to rate their teachers higher on average than boys. Both teachers and students agree that teachers have good subject-matter

Knowledge, respect the responsibilities they undertake and explain the lesson in a clear manner for all students. However, factors that are considered crucial for a constructive communication and learning, such as the relationship and interaction between students and teachers, linking school activities with activities beyond school - extracurricular activities and having students' views listened to and valued (Kerr et al, 2004) are indicated with the lowest mean scores.

Discussion

Differences in teachers' and students' beliefs on "qualitative teaching" are a crucial issue on Learning and Instruction. The gap between teachers' and students' understanding of the learning environment and students' perception that there is a lack of empathy and communication urges for the need to personalise schooling and teaching in a way that moral development of both, teachers and students will include awareness of empathy and collaboration in non prescribed -routine activities and materials (Koutselini, 2005, 2008). Pre-defined routine activities and understanding teaching as delivery of content lead to undifferentiated activities that do not take into account students' real needs, learning and developmental. The discussion of the paper aims at contributing to the construction of a broader context than the positivistic one for understanding Learning and Instruction. Moreover, the investigation of the gap between the perceived and the experienced curriculum should point out preconditions for practicing democracy in a daily basis.

References

- Goodlad, J. I. (1983). A place called school. New York: McGraw-Hill.
- Kerr, D., Ireland, E., Lopes, J., Craig, R., & Cleaver, E. (2004) Making Citizenship Education Real: Citizenship Education Longitudinal Study: Second Annual Report. National Foundation for Educational Research.
- Koutselini, M., (2005). The problem of discipline in light of modern-postmodern discourse-A case study. *Education and Society*, 23(1),25-43.
- Koutselini, M. (2008). Listening to students' voices for teaching in mixed ability classrooms: Presuppositions and considerations for differentiated instruction. *Learning and teaching*, 1(1), 17-30.

Do teachers' practices inside the classroom differentiate their students' perception of open classroom
Instructional Design, Morality, Teacher thinking

DORIT ALT, Zefat Academic College, Israel

How students experience their everyday school life partly depends on their perception of the climate in classes. Positive class climate perceptions, construct student efficacy and adaptive patterns of engagement. A key component of class climate considered to be the teacher's instructional behavior. This raises the need to explore the affect of teacher's behavior on their students' perception of the class climate. This study examines the hypothesis that increased experiences of just and constructive interactions with their teachers will affect the students' positive perceptions of the open classroom climate. Six teachers and 83 students studying at four 12th grade classes in four Israeli high schools participated the study. A qualitative research included content analysis of guiding principles for open instruction of the "Mass Media for High School" curriculum, and class observations, aimed at documenting and

classifying teachers' instructional behavior. Students' perceptions of the classroom climate were assessed using two questionnaires: "Classrooms" and "School Curriculum" (Torney-Purta et al., 2001). Different instructional behaviors were found between the teachers. In two schools the teachers were classified as "open climate" instructors, whereas the other teachers had failed to implement "open" instructional methods. Accordingly, students of the latter teachers perceived the classroom climate and the curriculum as less open and democratic. This study stresses the central role of the teacher in creating perceptions of favorable social classroom climate among their students.

This study aimed at investigating whether different types of teachers' practice at class influence their high school students' perceptions of the classroom social environment. How students experience their everyday school life partly depends on the climate in their classes (Eder, 1996, 1998; Ichilov, 1984). Class climate is determined by the general pattern of social interactions among classmates and with teachers, as well as by teaching instruction. Teachers' instructional behavior is a key component of class climate. In an adequate open classroom climate, students are allowed for equal dialogue, they have opportunities to explain, justify and test the viability of their own and other students' ideas, thus equally negotiate and construct ideas with others. This environment which enables students to feel justly treated by their teachers (Dalbert, 2001) could explain positive class climate perceptions, which construct student efficacy and adaptive patterns of engagement. This raises the need to explore whether different teaching behaviors within class, differentiate their students' perceptions of the classroom environment. This study examines the hypothesis that increased experiences of just and constructive interactions with their teachers will affect the students' positive perceptions of the open classroom climate.

Method

Participants: Six teachers and 83 students studying at four 12th grade classes (mean age=17.6 years; SD=0.36) in four Israeli high schools participated the study.

Data collection

Teachers practice and behavior at class were examined qualitatively using five pre-dominant categories and 13 sub-categories based on content analysis of the guiding principles for open instruction of "Mass Media for High School" curriculum (The Ministry of Education, 1993).

Class Observations: Observations were conducted during one academic year by two judges, aiming at documenting the teacher - student interactions as well as estimate the frequency and intensity rates of the sub-categories during class lessons. Frequency was estimate in a 5-level scale (1= once, 5= five times or more) per lesson. Intensity was estimate by measuring the duration of each sub-category at a specific lesson in a 5-level scale form 1= up to 5 minutes, 5= 35-45 minutes). The final rate was determined by multiplying the frequency and intensity rates. For example: if the teacher encouraged expression of diverse opinions regarding social issue four times during a lesson (=4 points) and dedicated 40 minutes for the total discussions (=5 points) the total score was 20 points (4X5). Finally, the mean score of every sub-category regarding all observations in each school was calculated, and coded by the judges in a 5-point scale from 1=low to 5=high. Reliability was assessed via Cohen's kappa (school A: $k=0.882$; school B: $k=0.889$; school C: $k=0.877$; school D: $k=0.865$). The judges were later asked to classify the teachers practice on two categories: a. "open climate" instructor; b. "close climate" instructor.

Students' perceptions: Two subscales "Classrooms" and "School Curriculum" from the International Study of Civic Education (Torney-Purta et al., 2001) were used to assess students' perception of the open class climate. "Classrooms" subscale contains seven statements ($\alpha=.78$) describing practices that are related to open classroom climate, in which students have ample opportunities to express their views, discuss issues, and become aware of a multiplicity of vantage points to various issues. Students were asked to evaluate in a Likert type scale (1=never to 4=often) how often do practices described in each statement occur in class. "School Curriculum" subscale includes seven statements ($\alpha=.78$) related to pluralism, cooperation and problem solving. Students were asked to indicate in a Likert type scale (1=strongly disagree to 4=strongly agree) their agreement about having acquired these attitudes and skills in the classroom.

Findings

Observations were classified by two independent judges according to the following categories:

- A. Encourage pupil collaboration (included 2 sub-categories)
- B. Encourage freedom of creation (included 3 sub-categories)

Discussion based on the following principles:

- C. Encourage expression of diverse opinions (included 2 sub-categories)
- D. Enable expression of minority opinions (included 2 sub-categories)
- E. Multi-dimensional presentation of current issues (included 4 sub-categories)

Both judges agreed that teachers in schools A and B are "open climate" instructors who extensively used teaching methods that focused on encouraging pupils' negotiation and creation, conducting open discussion about social and political issues, while underscoring the expression of minority opinions and multi-dimensional presentation of current issues. In contrast to teachers in schools A and B, teachers in schools C and D used practices such as frontal teaching, they did not extensively encourage students to form and express their own views, or to take part in collaborative assignments with other students at school.

In order to examine whether teachers' practices inside the classroom differentiate their students' perception of open classroom climate and the curriculum, t-tests between the schools (A and B, C and D) were conducted. The results showed significant differences between the groups in perception of classroom climate as open to discussion about social and political issues ($t(81)=4.62, p<.001$), and in perception of the curriculum as promoting social values ($t(81)=3.75, p<.001$). Students from schools A and B scored higher means in both indices: perception of classroom climate ($M=3.16$ $SD=0.30$), and of the curriculum ($M=2.64$ $SD=0.47$), than their peers in schools C and D, respectively ($M=2.76$ $SD=0.47$), ($M=2.18$ $SD=0.62$).

Discussion

This research investigated whether students' perceptions of their social environment tend to vary due to different conditions created by their teachers' instruction. According to the findings, students' evaluation of their experiences inside the class could depend on their teachers' instructional behavior. This study suggests teachers' social and instructional behavior as key component of students' perceptions of class climate. Since students' perceptions of their class social environment, based upon their feeling of just, could potentially influence their efficacy and adaptive patterns of learning and engagement, this study stresses the need for favorable social classroom climates. This means practicing "open" teaching methods which shape the class as an open, just and equal sphere of interactions.

Children's cognitions of just and unjust experiences in class:

Dimitris Pnevmatikos, University of Western Macedonia, Greece; Ioannis Trikkaliotis, University of Western Macedonia, Greece

Teachers' social and instructional behavior is considered as a key component of class climate. Specifically, children's justice cognitions regarding their teachers' behavior could partly explain whether the children experience a good class climate. The aim of the present study was to investigate specific teachers' behaviors that influence children's cognitions about their teachers' just or unjust behavior, and to explore the role of the experienced emotions. One hundred eighty children from three age groups 8-, 10-, and 12-years-old participated in the study. Three conditions were prepared: (a) teacher behaved consistently to her/his orders, (b) teacher created uncertainty conditions with a positive end, and (c), teacher created uncertainty with negative end. Three groups, equally divided across the age and gender, experienced each experimental condition. Participants were asked to denote their emotional state after each teacher's behavior, their justice cognitions regarding their teachers' behavior, and to judge their teacher as just or unjust. Hierarchical regression analysis has shown that the generated emotions (in parallel to the children's judgments) could explain partially the children's judgments of their teacher as just or unjust. Children construct their justice cognitions regarding their teachers' behavior (consistent, generating uncertainty) based on judgments revealing from their personal experience and to their emotions accompany these experiences. Implications for teacher's behaviors that affect the learning conditions are discussed.

Teachers' social and instructional behavior is considered as a key component of class climate. Specifically, children's justice cognitions regarding their teachers' behavior could partly explain whether the children experience a good class climate (Eder, 1996, 1998; Hearn & Moos, 1978). How these cognitions do constructed? Peter and Dalbert (2010) have shown that students who evaluate their teachers' behavior toward them personally as just, evaluate the class climate more positively. Thus, we could assume that children's evaluation for their teacher's behavior is progressively constructed through a summation of different experiences from small lasted episodes that children are involved and concern them personally.

Most of the studies, studying the influence of teachers' behavior to the class climate, are based on the children's "general feeling" about their teachers' behavior. This methodology, however, is not informative about the specific teachers' behaviors that influence children's final judgments and how they affect children's judgments about their teacher's behavior.

We assume that teacher's behavior is evaluated by their pupils both emotionally and cognitively, and this evaluation contributes to the construction of children's justice cognitions regarding their teachers' behavior. For instance, we know that situational uncertainty generates situational anxiety (Gray & McNaughton, 2000), and when uncertainty disappears, anxiety should give way to satisfaction or joy (if winning) or some negative emotions ranging from sadness to fear (Knyazev, Savostyanov, & Levin, 2005). We could expect that teachers' behavior that generates uncertainty to her/his pupils could be judged differently depending on the final emotions. At the cognitive level, according to the "Relative deprivation theory", individuals judge the procedures according to the results; when they take less than what they expected to take, individuals judge the procedure as unjust (Skitka, 2002). Furthermore, procedures, consistent with the previous known and clear rules, generate emotional stability and are judged as just. On the contrary, inconsistent procedures are judged as unjust (Van den Bos, Vermunt, & Wilke, 1996).

The aim of the present study was to examine whether the emotional (in parallel to the cognitive) states that are generated by specific teacher's behaviors in the class settings, could explain the produced children's judgments for their teacher's behavior. We hypothesized that children's emotional states (in parallel to the judgments) generated from their teacher's behavior (uncertainty with positive vs. uncertainty with negative end, and consistent behavior) could partly explain their judgments about their teacher's behavior.

Method

Participants: One hundred eighty children (including 90 boys) from three age groups 8-year-olds ($M = 8$ years, $SD = .29$, $n = 60$), 10-year-olds ($M = 9.9$, $SD = .27$, $n = 60$) and 12-year-olds ($M = 11.9$, $SD = .28$, $n = 60$) participated in the study. Participants were from middle-class families.

Data Collection: In testing our prediction, we wanted to mimic children's experiences in school settings. Participants were sitting in groups of 10 in front of the computer and the information given by their teacher appeared on the screen. Three experimental groups experienced three teacher's behaviours (consistent, uncertainty with a positive end vs. uncertainty with negative end). In order to examine the emotions in each condition, the children were asked in the three steps of the procedure to denote their emotional state on a scale (1 = 'very sad' to 5 = 'very happy'). Moreover, participants were asked to express their judgments about their teacher's decisions and to judge the overall teacher's behaviour on a scale (1 = 'unjust' to 5 = 'just').

Findings

Hierarchical regression analysis applied to our data with the children's judgments of the overall teachers' behavior as a dependent variable, and the age, gender (block 1), generated emotions after each teacher's behavior (blocks 2 – 4), judgments for the teacher's decision (block 5) and conditions (consistent, uncertainty with positive end, and uncertainty with negative end) (block 6) as independent variables. Analysis revealed that age (at least for children 8- to 12-years-old participated in this study) and gender did not influence significant percentage of the children's judgments about their teachers' behavior ($F(1,177)=1.424$, $p=.243$). The three emotional states that generated after the teachers' behavior explained the 14.9% of the variance (adjusted $R^2=.022$, $R^2=.149$ and $R^2=.145$ respectively for the three teacher's behaviors). The major change on the R^2 ($R^2=.149$) was produced by the emotions produced after the teacher's behavior that generated uncertainty to the participants ($F(1,175)=27.078$, $p<.001$). However, teacher's final decision to give a positive or negative end did not significantly change children's emotional states ($F(1,174)=.257$, $p=.613$). The cognitive aspect (children's judgments) found to be responsible for the 18.6% of the variance ($F(1,173)=9.656$, $p=.002$). Finally, the experience of the three different teacher's behaviors explained another 11.5% of the variance ($F(1,172)=29.385$, $p<.001$).

Discussion

The experimental design of the present study allowed us to create conditions (consistent, uncertainty with a positive end vs. uncertainty with negative end) that partially explain the pupils' cognitions about their teacher behavior. The results confirmed our assumption that children's evaluation for their teacher's behavior is progressively constructed through a summation of different experiences from small lasted episodes that children are involved and concern them personally. Children's overall judgments for their teachers' behavior are partially explained by their personal experiences during the three short lasted experimental conditions. Moreover, experienced emotions (in parallel to cognitive judgments) explain an important part of children's evaluations (as just or unjust) of their teacher's behaviors. Specifically, the generated emotions after the teacher's behavior that characterized as uncertainty explained a significant portion of their cognitions about their teacher's behavior. Contrary, the end (positive or negative) after of an uncertainty did not explain a significant portion of the variance. That is, whenever teacher with his behavior creates uncertainty to his pupils, independently whether the end is positive or negative, is judged as a negative behavior and should be avoided by the teachers. This avoidance could help teachers to be able to establish a positive class climate and, thus, providing a beneficial developmental, learning, and achievement environment.

SYMPOSIUM

Different Perspectives on Understanding Learning in the Workplace

Chairperson: Hans Gruber, University of Regensburg, Germany

Organiser: David Gijbels, University of Antwerp, Belgium

Margje W.J. van de Wiel, Faculty of Psychology and Neuroscience, Maastricht University, Belgium

Discussant: Christian Harteis, Universität Paderborn, Germany

The interest of researchers and organisations in learning in the workplace has been growing over the past years. Effective learning of professionals during work is key to competence development, and hence, to organisational performance. The aim of this symposium is to widen our understanding of the learning that occurs in the workplace and to get more insight in the factors that contribute (or not) to this learning. The three papers in this symposium all show that learning at work occurs during relevant work activities and benefits from the cooperation with colleagues and/or supervisors. Although the research was done in different contexts and situations and focused on different learning behaviours (team learning in diverse organisations; learning in engineering internships; and learning from information and knowledge sharing among physicians) the common goal was to find conditions that foster learning in daily work and to provide suggestions to enhance this learning. A variety of methods was used to investigate the topic including questionnaires, interviews and the analysis of discussions. After the presentation of the papers the similarities and contradictions in the findings, as well as current research gaps and future research opportunities, will be discussed by the discussant and with the audience.

Learning through information and knowledge sharing in patient review meetings

Margje W.J. van de Wiel, Faculty of Psychology and Neuroscience, Maastricht University, Belgium; Carolin Hanssen, Maastricht University, Netherlands; Ruben Hendriks, Maastricht University, Netherlands; Richard Koopmans, Maastricht University, Netherlands

To maintain their expertise physicians have to keep up to date and learn from their experiences in medical practice. This study examined physicians' workplace learning focusing on information and knowledge sharing in patient review meetings that are weekly held with the complete ward team. These meetings were thought to contribute most to professional development in previous research. Eight meetings of different subspecialties of internal medicine were video-recorded and transcribed to examine the knowledge and information sharing processes in the team and how they might contribute to learning. In particular, we looked whether complex cases were more elaborately and deeply discussed than routine cases, as we expected that they have a higher learning potential through their challenging nature. Coding with Atlas-ti of the 98 patient cases discussed revealed that experienced specialists were most active and complex cases triggered longer discussions. Learning, however, was largely implicit, as most of the information and knowledge shared was clearly directed at patient care. Explicit teaching was only observed at four meetings. A short evaluation questionnaire disclosed that only half of the participants mentioned learning as a meeting goal. The results suggest that the meetings' educational function can be increased by more focused learning efforts.

Introduction

The development of professional competence is to a large extent determined by informal learning in the workplace (Eraut, 2004). People learn by doing from the tasks they are involved in, the situations they encounter and the colleagues they work with. This is also the case in medicine where residents learn their profession while doing the job and experienced physicians need to continue learning to provide the best possible patient care. Several studies have provided qualitative evidence that everyday practices in the clinic play a pivotal role in the professional development of physicians (Teunissen et al., 2007; Slotnick, 1999; Van de Wiel et al., 2010). The patient problems encountered and the discussions about these patients with colleagues were thought to contribute most. The more complex cases that require further thinking can be expected to have the highest learning potential.

The present study, therefore, investigated in detail patient review meetings that are held each week to discuss the current status of patients on the ward with a multidisciplinary team including residents and experienced physicians. The research questions were: 1) Are complex cases more elaborately and deeply discussed than routine cases? 2) Who are involved in knowledge and information sharing and in what way? 3) Can explicit teaching be recognized and what might be implicitly learned? 4) Is education perceived as a goal of the meeting?

Methods

We recorded eight patient review meetings, one of each of eight subspecialties at the department of internal medicine at Maastricht University Medical Centre. Team size varied from 7-12. In total there were 74 participants, including 32 internists (11 with 5-10 and 21 with 11-40 years of experience), 19 residents (9 with 0-3 and 11 with 4-5

years of experience), 13 medical students, 7 nurses and 3 other specialists. Overall 98 cases were discussed varying from 5-19 cases per meeting. Case complexity was rated by one or two attending physicians on a scale from 1-5. Participants evaluated the meetings with regard to its perceived purpose and its effectiveness (response rate of 77%). The recordings were transcribed into verbal protocols and Atlas.ti was used for a detailed bottom-up and iterative content analysis. The coding scheme was determined by a team of four researchers. Two of them coded the protocols after an extensive period of training. At least one code was assigned to each turn taken in the discussions. Codes were grouped in coding families including structuring meeting, information and knowledge sharing (with subfamily problem analysis), teaching, and decision making. The number of words per code was used as a unit of analysis to compare the contribution of participant groups and to describe how much attention was paid to certain topics. Percentages were computed per case. Presentation and discussion time per case were recorded.

Results

Usually the meeting was chaired by the head of the department and patients were presented by the attending resident (60 cases) or advanced medical student (22 cases). Regarding case complexity we found that the time and words spent to the cases increased with their complexity. On average the easiest cases were presented and discussed in 302 seconds and 1037 words, and the most difficult cases in 800 seconds and 2034 words. The more complex the cases the more information and knowledge was spontaneously contributed, requested, and provided as an answer. There was also more problem analysis, in the sense that previous contributions in the discussion or actions in patient management were reconsidered, evaluated, and reflected upon.

Analysis of the participation in the discussions showed that the most experienced specialists contributed most. They were particularly active in spontaneously contributing and requesting information and knowledge, as well as in problem analysis. Among them the chairperson played a prominent role. The junior residents engaged most in providing answers to the requests. The medical students played a very limited role.

Explicit teaching was only present in 4 of the 8 meetings covering 3-7% of the discussions. Implicit learning may have occurred throughout the meetings triggered by the way patients presented themselves, the options considered, the decisions made, and the underlying reasons provided (e.g., "And we gave Haldol, because she was rather upset"). The short evaluation questionnaire revealed that all participants regarded discussing patient care as the meeting's main goal. Only half of both the residents and internists mentioned education as an explicit goal. Some indicated that they valued the open atmosphere of discussion.

Discussion

Patient review meetings provide meaningful learning opportunities in medical practice. Different patient cases are discussed considering the subsequent actions that need to be taken. This first study on the topic showed that the more complex cases indeed entailed a higher learning potential as they were more elaborately and deeply discussed. The dominant role of the chairperson and other experienced medical staff point to their function as role models in the learning of residents and medical students. Although they asked residents for knowledge and information about the patient and their approach, more teaching efforts could be put in checking understanding and providing explanations. Implicit learning might be increased by consistently sharing considerations underlying decisions. As only half of the residents and physicians spontaneously mentioned education as a meeting goal, stressing this perspective may make learning more effective. As time seems an important constraint, efficiently structuring the meeting may allow more learning opportunities. In further analyses we will examine these structural meeting aspects, as well as detail the interventions that contribute to implicit and explicit learning.

References

- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26(2), 247-273.
- Slotnick, H.B. (1999). How doctors learn: physicians' self-directed learning episodes. *Acad Med*, 74(10), 1106-1117.
- Teunissen, P.W., et al. (2007). How residents learn: qualitative evidence for the pivotal role of clinical activities. *Medical Education*, 41(8), 763-770.
- Van de Wiel, M.W.J., Van den Bossche, P., Janssen, S., & Jossberger, H. (2010). Exploring deliberate practice in medicine: How do physicians learn in the workplace? *Advances in Health Sciences Education*.

Learning in teams: How do group development phases relate to team-level learning behaviour

Stefan Decuyper, Katholieke Universiteit Leuven, Belgium; Sanne Nijs, University of Leuven, Belgium; Eline Degraeve, University of Leuven, Belgium; Filip Dochy, K.U.Leuven, Belgium

When team members engage in collective team learning behaviours, such as giving feedback and sharing information, the probability that the team will live up to the expectations is increased. Moreover, the importance of team learning has been stressed several times through the demonstration of its effect on individual and organisational learning. Although 'team learning' is described as one of the recently discovered keys to team effectiveness, 'group development' was investigated since many decades. Both research strands start from the premise that teams will not be effective unless they collaboratively learn to overcome barriers such as team dictators, free riding, social loafing, etc.

Currently, there is a lack of empirical research that crosses the gap between these two strands. In this study we answer two important questions at the boundary between team learning and group development research: 'How do different development stages relate to team learning behaviour?' and 'To what extent is group development related to conditions for team learning?' We hypothesise that although each stage of group development is characterised by specific learning tasks, some stages are more favourable for team learning processes than others. Results from multiple regression analyses and ANOVA on a sample of 44 professional teams show that teams learn best in the trust and structure phase and in the work phase due to higher levels of team psychological safety and group potency.

Teamwork does not necessarily work (West, 2004). However, when team members engage in collective team learning behaviours such as giving feedback, sharing information, constructive conflict, etc. they radically increase the probability that the team will live up to the expectations (e.g. Van Woerkom & Croon, 2009.). By engaging in team learning behaviours, teams build shared mental models and gradually become more effective (e. g. Edmondson, 1999;). The positive effects of team learning on team effectiveness are attributed to increased capability of team members to work together, generation of new knowledge, and transformation of the team into a unit that is able to deal with the challenges of tomorrow (Sessa & London, 2008). Also, the importance of team learning has been framed repeatedly by its effect on individual and organisational learning (e.g. Hannah & Lester, 2009).

Although 'team learning' is described as one of the keys to team effectiveness, the concept is relatively new. It was only introduced to a wider audience in the beginning of the nineties. However, research on 'group development', which is conceptually related to team learning research, is traced back to the beginning of the previous century (Bennis & Shephard, 1956). Both strands start from the premise that teams or groups will not be effective, unless they collaboratively learn to overcome barriers such as team dictators , free riding , social loafing, ego-trippers, a lack of team psychological safety, etc. However, although the point of departure for both literatures is the same, they seem to have a different focus. A first obvious difference is the fact that 'group development' literature deals with groups and teams, whereas team learning literature only deals with 'teams'. We further elaborate on that difference below. A second difference is that in contrast to group development, team learning is not often regarded as an unintentional process and/or outcome (London & Sessa, 2007). Consequently, the emphasis in team learning research is on examining and predicting under which circumstances specific team learning processes and outcomes come about. In contrast, group development is more often regarded as a naturally occurring maturation process. Consequently, research on that subject is more concerned with describing how and explaining why groups mature over time.. Despite this different focus of team learning and group development literature, we were surprised by the lack of empirical research that crosses the gap between these two distinct fields (Decuyper, Dochy, & Van den Bossche, 2010). After all, in light of the increasingly changing society and the rising importance of team learning, it is important that we start going beyond the link between group development and teamwork, and start to understand how group development is linked to team learning (Ilgen, Hollenbeck, Johnson, & Jundt, 2005). Kasl, Marsick and Dechant (1997) suggested that group development does not guarantee collective learning, stating that "Teams can work their way through the developmental stages of forming, storming, norming and performing (Tuckman, 1965), yet never challenge dysfunctional assumptions or create new knowledge through strategies such as framing or perspective integration." (p. 231). But, this statement has not been subjected to the empirical test.

In this study we answer two important questions on the boundary between team learning and group development research: 'How do different development stages relate to team learning behaviour?' and 'To what extent is group development related to conditions for team learning?' We hypothesise that, although each stage of group development is characterised by specific learning tasks, some stages are more favourable for team learning processes than others.

We examine these questions by combining the group development model of Wheelan (2005) with the team learning development model of Dechant, Marsick and Kasl (1993). In doing so, we examine to what extent basic team learning behaviour (constructive conflict, sharing information, co-construction) is related to different stages of group development (dependency and inclusion, counter-dependency and fight, trust and structure, work and termination). Moreover, we examine to what extent important conditions for team learning such as 'team psychological safety',

which is the shared conviction that the team is safe for interpersonal risk-taking (Edmondson, 1999), and group potency, which is the collective belief of group members that the group can be effective (Shea & Guzzo, 1987), can serve as 'linking concepts'. As such, we examine to what extent group development phases relate to team learning behaviours because they relate to team psychological safety and group potency. Team psychological safety and group potency were selected as potential 'linking concepts' because they are both important predictors of 'team learning behaviour' (Van den Bossche et al., 2006), and conceptually related to the 'trust' concept, which takes a central part in the description of group development (Edmondson, 2003).

Results from multiple regression analysis and ANOVA on a sample of 44 professional teams show that teams learn best in the trust and structure phase, and in the work phase, due to higher levels of team psychological safety and group potency.

References

- Bennis, W. G., & Shepard, H. A. (1956). A theory of group development. *Human Relations*, 9, 415-437.
- Decuyper, S., Dochy, F., & Van den Bossche, P. (2010). Grasping the dynamic complexity of team learning: An integrative model for effective team learning in organisations. *Educational Research Review*, 5(2), 111-133. doi: 10.1016/j.edurev.2010.02.002.
- Edmondson, A. C. (1999). Psychological Safety and Learning Behaviour in Work Teams. *Administrative Science Quarterly*, 44, 350-383.
- Hannah, S., & Lester, P. (2009). A multilevel approach to building and leading learning organizations. *The Leadership Quarterly*, 20(1), 34-48. Retrieved on 21/02/2010 from
- Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in Organizations: From Input-Process-Output Models to IMOI Models. *Annual review of psychology*, 56, 517-43.
- Kasl, E., Marsick, V. J., & Dechant, K. (1997). Teams as Learners: A Research-Based Model of Team Learning. *The Journal of Applied Behavioural Science*, 33(2), 227-246.
- Sessa, I., & London, M. (2008). *Work Group Learning. Understanding, Improving & Assessing How Groups Learn in Organizations*. Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Shea, G. P., & Guzzo, R. A. (1987). Group Effectiveness: What Really Matters? *Sloan Management Review*, 28(3), 25-31.
- West, M. (2004). Do Teams Work? In M. A. West, *Effective teamwork: Practical lessons from organizational research* (2 ed., pp. 7-26). Oxford: Blackwell Publishing.
- Woerkom, M. V., & Croon, M. (2009). The relationships between team learning activities and team performance. *Personnel Review*, 38(5), 560-577.

Workplace learning during internships: the role of job-characteristics

David Gijbels, University of Antwerp, Belgium; Vincent Donche, University of Antwerp, Belgium; Piet Van den Bossche, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium; Ingrid Ilbroux, Leuven Engineering Collège Groep T, Belgium

It is argued that internships have a distinctive contribution to professional education. It is suggested that the confrontation with the workplace triggers learning. Based on the Demand-Control-Support (DCS) model (Johnson & Hall, 1988; Karasek, 1979; Karasek & Theorell, 1990) the present paper aims to investigate the influence of job-characteristics such as job demands, job control, and social support on the learning in the workplace during internships. We investigated different sources that can guide the learning of interns during work (Oosterheert & Vermunt, 2001). Five such sources are distinguished: (1) external regulation; (2) self-regulation, (3) actively relating theory to practice, (4) collaboration with co-workers; and (5) avoidance behaviour. Moreover, we looked how these relate to the perceived competences reported by both the students and the supervisors. 66 engineering students conducting an internship and their supervisors in the companies participated by completing questionnaires based on existing and validated scales.

Results of regression analyses support Karasek's learning hypotheses indicating that job demands, job control, and social support influence the use of different learning resources in the workplace. In addition, the analyses show that high job demands and support by colleagues contribute to perceived competence. This study provides insight in workplace characteristics that affect learning during internships. Moreover, it disentangles different sources of learning regulation, hereby identifying different ways in which learning is shaped in the workplace. This suggests pathways to promote learning during internships.

Introduction and aims. It is argued that internships have a distinctive contribution to professional education. It is suggested that the confrontation with the workplace triggers learning. Everyday work practice is full of potential learning processes. These learning activities during work can be very effective and necessary for the purposes of becoming more expert in a profession. Despite the theoretical reasoning, research on work-related learning and its antecedents has however remained rather scarce. This paper presents a study that on the one hand questioned antecedents of workplace learning by studying job characteristics, and on the other hand unravelled learning in the workplace during internships.

To investigate the influence of job-characteristics, the present study relied on the Demand-Control-Support (DCS) model (Johnson & Hall, 1988; Karasek, 1979; Karasek & Theorell, 1990). This model stresses the important role of job-characteristics such as job demands, job control, and social support on the learning in the workplace during internships. Job demands refer to stress factors which are present in the work environment. A demanding job thus means that someone has to complete a great deal of work within a limited space of time (De Witte et al., 2005). Job control refers to the opportunities which an employee has to satisfy these job demands. These opportunities are represented by the scope the employee has for taking decisions (De Witte et al., 2005). By social support we mean: the existence of good relations with colleagues, being able to rely on others, obtaining accurate information via others, as well as gaining actual help, understanding and attention when difficulties are encountered (De Jonge et al., 2003).

While earlier studies used self-report of occurrence of work-related learning behaviours as operationalisation of workplace learning (e.g., Gijbels et al. 2010), the present study explores a wider perspective on workplace learning. We investigated different sources that can guide the learning of interns during work (Oosterheert & Vermunt, 2001). Five such sources are distinguished: (1) external regulation; (2) self-regulation, (3) actively relating theory to practice, (4) collaboration with co-workers; and (5) avoidance behaviour. Moreover, we looked how these relate to the perceived competences reported by both the students and the supervisors. 66 engineering students conducting a long term internship and their supervisors in the companies participated by completing questionnaires based on existing and validated scales.

Methodology.

We questioned how individual differences in learning are present among engineering students (N = 66) taking part at a long term internship during engineering education. Hereto, a selection of scales of the ILTP-questionnaire (Oosterheert, Vermunt, & Denessen, 2002) used to map differences in student teacher learning during internships was translated to the specific context of learning during engineering internships. To measure the job-characteristics job demands, job control, and social support we used existing and validated questionnaires that were used in the study by Gijbels, Raemdonck and Vervecken (2010).

Exploratory factor analyses, correlation, and regression analyses were applied to investigate the interrelatedness and predictivity between the constructs under study.

Results.

Results of regression analyses support Karasek's learning hypotheses indicating that job demands, job control, and social support influence the use of different learning resources in the workplace. In addition, the analyses show that high job demands and support by colleagues contribute to (perceived) competence. Results diverged when examining the relation between sources of learning regulation and perceived competence. On the one hand the results indicate that students during internships feel themselves more competent thanks to collaboration with co-workers, while the supervisors label students that integrate theory and practice in the workplace as more competent students.

Theoretical and educational significance. This study provides insight in workplace characteristics that affect learning during internships. Moreover, it disentangles different sources of learning regulation, hereby identifying different ways in which learning is shaped in the workplace. This suggests pathways to promote learning during internships.

References

- Johnsen, J., & Hall, E. (1988). Job Strain, Work Place Social Support, and Cardiovascular Diseases: A Cross- Sectional Study of a Random Sample of the Swedish Working Population. *American Journal of Public Health*, 78(10), 1336-1342.
- Karasek, R.A. (1979). Job demands, job decision latitude, and mental strain: implications for job design. *Administrative Science Quarterly*, 24, 285-308 .
- Karasek, R., & Theorell, T. (1990). *Healthy Work. Stress, Productivity and the Reconstruction of Working Life*. New York: Basic Books.

De Witte, H., Verhofstadt, E., & Omeij, E. (2005). Testing Karasek's learning and strain hypothesis on young workers in their first job. Working paper, Faculty of Economics and Business Studies, Ghent University.

De Jonge, J., Bakker, A. and Schaufeli, W. (2003). Psychosociale theorieën over werkstress. [Psychological theories about work stress]. *Bahn Stafleu van Loghum*, Houten, the Netherlands.

Gijbels, D., Raemdonck, I., & Vervecken, D., (2010). Influencing work-related learning: the role of job characteristics and self-directed learning orientation in part-time vocational education. *Vocations and Learning* (3), 239-255.

Oosterheert, I.E., & Vermunt, J.D. (2001). Individual differences in learning to teach: relating cognition, regulation and affect. *Learning and Instruction*, 11, (2), 133-156.

Oosterheert, I.E., Vermunt, J.D., & Denessen, E. (2002). Assessing orientations to learning to teach. *British Journal of Educational Psychology*, 72, 41-64.

SYMPOSIUM

Environmental learning: content, context and challenges

Chairperson: Cecilia Lundholm, Stockholm University, Sweden

Organiser: Cecilia Lundholm, Stockholm University, Sweden

Discussant: Russell Tytler, Deakin University, Australia

Environmental education (EE) is featured in many countries' formal education systems. In recent years there has been an increase in understanding of the kind of learning needed for meeting environmental and societal challenges both in school settings and in more hybrid school-outdoor settings. Books such as *Sustainable Development and Learning* (Scott and Gough 2003), *Social Learning Towards a Sustainable World* (Wals 2007), *Environmental Learning: Insights from the student experience* (Rickinson, Lundholm and Hopwood, 2009), *Resilience in Social-Ecological Systems: The Role of Learning and Education* (Krasny, Lundholm and Plummer, forthcoming) all reflect the emphasis on learning.

This symposium resonates with the conference theme of a globalized world and education for and within such an outlook. It presents and discusses results from empirical studies investigating learning in both formal and informal contexts. They include i) Chinese secondary students learning about climate change from natural scientific, moral and economic perspectives, ii) Swedish upper secondary students' understanding of price and environmental externalities, and iii) a phenomenological study of Dutch primary school children's' learning in a hybrid outdoor-indoor EE program.

The importance of this symposium lies in an exploration of the kinds of learning processes and learning environments that can strengthen students' thinking about nature and environmental issues and their ability to respond to contemporary environmental and societal challenges. The session seeks to initiate lively debate between scholars in the related fields of environmental education, education for sustainability and environmental learning.

Understanding climate change: conceptions from natural scientific, moral and economic perspectives

Li Sternang, Stockholm University, Sweden; Cecilia Lundholm, Stockholm University, Sweden

The concept of climate change is characterized with increasing complexity. It is not only an environmental issue, but also political and economical, as well as a moral. In this study, we examined students' reasoning of climate change from three aspects: First, a fine-grained analysis of how students make meaning of information related to climate change. Second, since climate change calls for local as well as global actions, it triggers students' moral reasoning: who should do what? Therefore, students' moral reasoning of climate change was investigated. Third, since mitigating climate change is tightly connected with economy, students' reasoning of coping with climate change in relation to economic development was examined.

Climate change is now beyond dispute. China, one of the major carbon emission countries, has compelling obligations to reduce CO₂ emissions and to mitigate climate change. Against this backdrop, we studied how Chinese youngsters, the future decision makers, understand climate change from natural scientific, moral, and economic perspectives.

Aims

Three questions were addressed in our study: How do students understand the phenomenon of climate change, or the enhanced greenhouse effect (EGHE)? What is students' moral reasoning in relation to climate change? How do students conceptualise the tensions between economic development and environmental protection in order to mitigate climate change?

Methodology

The participants of the study were students of 14-16 years of age, studying at three different Green Schools in the Beijing area of China. Green Schools is an international concept, focusing explicitly on environmental education.

Data was obtained through semi-structured interviews. Nine group interviews were conducted, aiming to investigate questions regarding the phenomenon of climate change, the causes and solutions to climate change, and its relationship to economic development.

The transcript data was analyzed from an intentional perspective; an analytical method for interview data. By adopting an intentional perspective, the utterances were seen in the interactional as well as wider institutional and cultural situation. Therefore, students' competences were scrutinized according to a careful investigation of both cognitive competences and context simultaneously.

Findings

As stated, we explored three research questions and the following, we describe briefly our findings.

First, how do students understand the phenomenon of climate change, or the enhanced greenhouse effect (EGHE)?

In explaining the phenomenon of climate change, the students have used and incorporated a lot of information. Some information is related to climate change, some is not, like evaporation and the tilt of the earth, and some is only related to environmental problems such as pollution and the depletion of ozone layers. The students reorganized these diversely different pieces of information into coherent entities. For example, a boy student modelled the EGHE in the following way; there are two "tops" of the earth, which are the polar regions; pollutants rise up to the tops and destroyed the ozone layers; the holes of the ozone layers above the polar regions allow more sunlight to come reach the earth; the sunlight cannot escape because the earth is wrapped in the atmosphere which is like a blanket to the earth; and the spinning of the earth spread the heat from sunlight to other parts of the world.

Second, what is students' moral reasoning in relation to climate change?

The students attributed the causes of climate change to emissions from factories and driving cars, and they dedicated themselves to finding solutions to climate change. The solutions that were suggested by the students mainly concern taking actions by the individuals, where the individual is either "myself" or "someone else". Interestingly, as a consequence this brings forth two different ways of moral reasoning, resulting in different relationships and considerations for nature and society.

When the individual is "myself", a student is likely to be more anthropocentric, which means that her/his personal needs and interests are stressed, and the aspect of nature is not discussed and thus excluded in her/his reasoning. Society gives support to "me" to overcome difficulties. When the individual is "someone else", the students are more concerned with the environment and nature. But society and the government played a role of executing power - and punishment - if the individual is "someone else".

Third, what are students' views of the tensions between economic development and environmental protection in order to mitigate climate change?

The students did not address the linkage between producing and driving cars, using coal for energy supply in the factory, and the problem of climate change. Instead, for them, the focal aspect of the task concerned economic development. With regard to environmental problems, they suggested that environmental problems are inevitable, and even a necessary part of economic development, and that environmental problems can be easily solved by scientific and technological means.

Theoretical and educational significance

The investigation of the first research question shows that students create coherent wholes, even if they are incorrect in relation to scientific understanding of the EGHE, which make sense for the students and have powerful explanatory value for them: they help the students to relate disparate pieces of information together and thus solve a lot of problems at the same time. Modelling coherent wholes of the EGHE, or perhaps solving other learning problems, can be necessary stages in the learning process. In this modelling process, some pieces of information are given up, and new pieces of information incorporated, thus approximating the normative models more and more. Therefore, it is desirable that the focus of teaching shifts from changing what is considered 'wrong' to trying to understand how students actually process their acquired knowledge. Therefore, this results are of significance to current research developing learning theory within the constructivistic tradition (e.g. Vosniadou, 2008).

The investigation of students' moral reasoning can be seen as an example of a social dilemma. This is an important topic worthy of being addressed and explored in environmental and science education. Furthermore, environmental/socioscientific issues are multifaceted but students are often expected to reason in a specific context and to understand "what problem goes where". However, research shows that handling socioscientific problems is challenging, as it requires the development of skills where students come to identify different perspectives or different contexts.

The investigation of students' reasoning of climate change in relation to economic development indicate the importance of giving students opportunities to discuss societal and public aspects since actions solving environmental problems are collective (Gardner & Stern, 2002). Also, the results highlight the importance of addressing economic issues, which includes the consideration of not only social benefits, but also environmental benefits and costs (Lundholm, in press).

References

- Gardner, G. T. & Stern, P. C. (2002). *Environmental Problems and Human Behavior* (2nd ed.). Boston: Pearson Custom Publishing.
- Lundholm, C. (in press). Society's response to environmental challenges: citizenship and the role of knowledge. In *Factis Pax*.
- Vosniadou, S. (Ed.) *International Handbook of Research on Conceptual Change*. New York: Routledge.

Students' understanding of pricing goods and services with negative environmental effect

Caroline Ignell, Stockholm University, Sweden; Peter Davies, University of Birmingham, United Kingdom; Cecilia Lundholm, Stockholm University, Sweden

This paper will report results from the first phase of a longitudinal study on students' systems understanding and focuses on conceptions of price linked to negative environmental externalities.

There is a need of research, conducted with respect to students' understanding of environmental problems, within the field of social sciences as modern times demand that students not only develop scientific understanding of environmental problems, but societal and economical understanding as well. Data were collected using a questionnaire with open-ended questions, distributed to students in Swedish upper secondary schools, followed by individual interviews. Preliminary results show that student tend to give explanations of why a particular good, e.g. a hamburger, a pair of jeans or a travel ticket, has a particular price by referring to the demand side or to the supply side but seldom combine them in a system, which interrelate and create price equilibrium. Also, students reasoning on what should be priced when considering environmental consequences of flight travels, reveals an interesting opposite view from pricing external effects in general today.

The results are discussed in relation to previous studies on students' understanding of pricing, which have focussed on early years, up to 14, and undergraduate students, thus leaving students of 16-19 aside.

Aims

This paper will present results from the first phase of a longitudinal study that aims to explore students' systems understanding and in particular in conceptions of price and negative environmental externalities. Earlier research on learning economics mainly focuses on children's progressive understanding of different concepts as money and price (Berti & Bombi 1981; Davies & Lundholm, 2008). It is also shown how economic understanding is qualitatively different, mainly depending on how children understand indirect and direct causal and proportional relations of demand and supply (Siegler & Thompson, 1998; Thompson & Siegler, 2000). This raises the question of how causal and proportional relations, seen as qualitative differences in system understanding, are developed by students in the age of pre-university and this is the overall interest of the study.

Methodology

To increase the possibility of finding slowly developing processes of understanding, a longitudinal study approach is chosen. A second and more specific argument for conducting a longitudinal study relates to research on conceptual development that sees understanding and learning as a gradual shift towards scientific explanations of a concept, rather than replacement of one conception with another (Caravita & Hallden, 1994; Hallden, Scheja & Haglund, 2008.) In general, there are few longitudinal studies concerning students' understanding of social science concepts as the existing research is focused on concepts of science (Hellden, 2005). To reach variation in students understanding of price and systems, a pilot study followed by a main study is set up. The pilot study, reported here, includes interviews

of a sample of 30 students, generated through the use of a questionnaire with open-ended questions, distributed to 90 students. The questions concern pricing everyday goods and services such as travel tickets (flight versus train), hamburgers, bottled water, computers and a pair of socks and jeans. Findings reported here, will allow for designing the main inquiry which will be distributed to students in year 2, and followed-up, in year 3 of upper secondary schools where students attend a three-year educational program of Social Science and Economic.

Findings

Preliminary results show that students' economical reasoning about pricing goods and services, with regard to environmental effect from production or consumption, mostly concern the area of demand or supply. Students seldom combine the two in a system, which interrelate and create price equilibrium, to explain the price of a particular good. The price of a hamburger is for example decided by the restaurant's geographical location or the quality of primary products or wages for employees at the restaurant. Similar reasoning is found regarding the price of a flight ticket from Stockholm to London compared to a train ticket for the same destination where the price determinants lie within the service itself. A train ticket is more expensive because the journey lasts longer and the train passes through several countries.

This can be compared to earlier research that notes how younger children in the age of preschool see the physical characteristics of a good, as determining price. A diamond does not cost much "because it is so tiny", while the price is higher for a book than a wristwatch because "it is bigger" (Burris, 1983). When asked how the flight should be priced, most students considered environmental consequences of flights as needed to be paid for and included in the tickets/price. They revealed an interesting view of pricing external effects, as a lot of environmentally friendly products and services in today's society are more expensive than non-environmentally friendly.

Theoretical and educational significance

The results reported are of theoretical significance as they contribute to the sparse evidence base of upper secondary students' system understanding and pricing related to environmental externalities. It will also, in a broader sense, contribute to the knowledge of how students develop conceptions and system understanding within social science. From an educational point of view the results also add to discussions on content matter and instruction in economical and environmental education at the pre-universal school level. This project distinguishes earlier work in that it is a longitudinal study and the first of its kind, it focuses on an age group that has received very little attention, and, it considers the wider societal context of price in contrast to earlier work (Webley, 2005) as it addresses understanding of price related to environmental issues as climate change.

References

- Berti, A. E. & Bombi, A. S. (1981) The Development of the Concept of Money and Its Value: A Longitudinal Study, *Child Development*, 52, (pp. 1179-1182)
- Burris, V. (1983) Stages in the Development of Economic Concepts, *Human Relations*, Vol. 36, No. 9 (pp.791-812)
- Caravita, S., & Hallden, O. (1994) Re-framing the problem of conceptual change. *Learning and Instruction*, 4, (pp. 89-111)
- Davies, P. and Lundholm, C. (2008) Students' conceptions of price: some issues in the development of understanding of socio-economic phenomena, Paper presented at the Conceptual Change Special Interest Group of the European Association for Research in Learning and Instruction, Turku, August 23rd-25th 2008.
- Hallden, O., Scheja, M. & Haglund, L. (2008) The contextuality of knowledge: An intentional approach to meaning making and conceptual change. In S. Vosniadou (Ed.) *International Handbook of Research on Conceptual Change* (pp. 509-532). New York: Routledge.
- Hellden, G. (2005) Exploring Understandings and Responses to Science: A Program of Longitudinal Studies, *Research in Science Education*. 35 (pp.99-122)
- Jahoda, M. (1981) The development of thinking about economic institutions: the bank. *Cahiers de Psychologie Cognitive*, 1 (pp. 55-73)
- Siegler, R.S. & Thompson, D. R. (1998) "Hey, Would you Like a Nice Cold Cup of Lemonade on This Hot Day?" Children's Understanding of Economic Causation. *Developmental Psychology*, Volume 34, Issue 1, (pp. 146-160)
- Thompson, D. R. & Siegler, R.S. (2000) Buy Low, Sell High: The Development of an Informal Theory of Economics, *Child Development*, vol. 71, 3, (pp. 660-677)
- Webley, P. (2005) in Barrett, M. & Buchanan-Barrow, (Ed.) *Children's understanding of society* (pp. 43-67) New York: Psychology Press

A phenomenological study of outdoor environmental education for children in the Netherlands

Marlon Van der Waal, Wageningen University, Netherlands; Arjen Wals, Wageningen University, Netherlands

Several studies in the Netherlands and elsewhere indicate that basic knowledge of children about the natural world is declining as a result of many factors including: the decrease in time spent at school for EE, the lack of attention to nature at teacher training colleges, the lack of suitable natural outdoor playgrounds in urban areas, parental fears for the safety of children playing outdoors and the seductive attraction of modern ICTs. Against this backdrop, this paper reports evidence that deep and meaningful engagement in and with nature and the outdoors can have a profound influence on children's future predisposition in adult life towards issues related to nature and environment.

Relevance & significance

Several studies in the Netherlands and elsewhere indicate that basic knowledge of children about the natural world is declining as a result of many factors including: the decrease in time spent at school for EE, the lack of attention to nature at teacher training colleges, the lack of suitable natural outdoor playgrounds in urban areas, parental fears for the safety of children playing outdoors and the seductive attraction of modern ICTs. Against this backdrop there is some evidence, albeit scarce, that deep and meaningful engagement in and with nature and the outdoors can have a profound influence on children's future predisposition in adult life towards issues related to nature and environment.

Aims

In the Netherlands a number of environmental education (EE) programs have been developed in order to (re)connect primary school children with nature and to stimulate their care for nature by taking them outdoors and allowing them to experience, what might be called, nature. These programs usually complement nature-oriented in-class lessons. To add to the evidence-based of the value of such programs and to have a better understanding of the kinds of learning experiences and the conditions allowing for such experiences to unfold in a meaningful and profound way, the Dutch government, the (former) ministry of Agriculture, Nature Food Quality (LNV), commissioned an in-depth study of one program known for its experiential design and its careful linking of outdoor learning and school-based learning: Natuurwijs (NatureWise).

Methodology

A phenomenological study was designed in which children (age 7-12) of eight school classes of six primary schools (with an average of 28 children per class) were followed for two years in order to reach a better understanding of these issues. Using a phenomenological research method, the researchers are not seen as distant observers, but participate fully and personally in the actual 'meeting' of the individual children and create an atmosphere that sets aside taken-for-granted assumptions as it starts from a perspective relatively free from hypotheses or preconceptions. Phenomenological methods can be seen as particularly effective at making explicit the experiences and perceptions of individuals from their personal perspectives and are therefore able to challenge structural or normative assumptions. In the study 'NatuurWijs' is used as case study for each of the urban and countryside schools. The activities of this outdoor program are designed to match the development and the real life experiences of children from the age 7 to 12 and also to match the learning goals of formal education and EE policy. The NatuurWijs program offers schoolclasses the possibility to go outdoors with an official State Forestry ranger for three days. Before these days in which children are allowed to discover relatively undisturbed natural areas by means of their 'head, heart and hands', three preparatory lessons are given and afterwards three reflective lessons. When incorporated in the school curriculum this would mean that children would engage in 9 learning activities on a structural basis. As the NatuurWijs program is longitudinal by character, it is seen as a suitable program for a longitudinal study.

Half of the participating schools are located in urban areas and the other half are located in the countryside, as it is assumed usually that nature experiences will differ considerably as the availability of nature for urban children is reduced. One class in a school participates in the outdoor program while a parallel class from the same school does not follow the outdoor program and is therefore might be regarded as a control group. As not all schools have parallel classes four schools agreed to provide either an 'outdoor group' or a control group.

Data are collected by using 4 research instruments: personal interviews, workbooks, participant observations and 'mind maps' of nature. The interviews are held with teachers and repeatedly with a selected group of 64 children from both the outdoor groups and the control groups throughout the two years. These interviews are about their experience of their daily life: a description of where they live, what they do after school, how the children experience going to school, how they experience EE at school and their relation with animals, plants and natural objects, etc.. In total the selected group of children is interviewed twice before the outdoor groups engage in their outdoor program, twice during the period of the outdoor program and twice after the program.

The use of specially designed workbooks offers a different way of gaining insight in the lives of the children and the importance of nature in their lives. In the first of the three workbooks the children reflect on their memories as very

small children. They write and draw their former favorite places to play, their fears, and their activities at home and outside. The second workbook is dedicated to their experience of their current daily life and the third workbook focuses on their expectations of the future. Again, the workbook assignments give children the opportunity to verbally and graphically reflect on their experiences. Outdoor groups are also observed during their outdoor program in which the researcher fully participates and all groups (outside and control groups) are observed during class and when their teachers engage in EE of science activities. Finally all children make a personal mind map of 'nature' at the start of the research program and at the end of the program.

Results

When having collected all the data the researchers will look for patterns in order to establish categories of experienced meaning of nature in general and the outdoor program in particular that can possibly lead to adaptations to both formal school programs and nature programs. At the moment data of the pretest are being analyzed but the first results will be available in the Spring of 2011 and will be shared at the EARLI conference in August of 2011.

SYMPOSIUM

Professional Development of Experienced and Novice Teachers: Mechanisms for Resistance and Change

Chairperson: Liisa Postareff, University of Helsinki, Finland

Organiser: Liisa Postareff, University of Helsinki, Finland

Discussant: Jan Vermunt, Utrecht University, Netherlands

Research on teacher development has focused on analysing the changes teachers experience in their career, for example through participation in professional development programmes. Resistance to change, although commonplace in professional development efforts, has gained less research attention. The symposium focuses on how individual teachers at different stages in their career confront change or development when faced with new challenges.

Two contributions focus on examining development paths of academics who participate in a professional development course to improve their teaching pedagogies. Both studies identified resistance and withdrawal among experienced teachers, including those who conceived themselves as expert teachers. The third contribution focuses on experienced teachers who take up new roles as teacher-researchers and who exhibit non-learning in response to this professional development endeavor. In all three studies, mechanisms and reasons for resistance and non-learning are identified and discussed. Theories of cognitive dissonance, mental resistance and avoidance, and teacher identity are used to explain the appearance of these responses under investigation.

These studies are particularly relevant in the context of teacher improvement, which is seen by many as the key to any educational innovation. By understanding resistance, withdrawal, and non-learning, teacher educators can more effectively support teachers who are faced with the challenge of learning and development along their own career paths.

Trajectories of Novice and Experienced Teacher Educators in a Professional Development Community

David Brody, Efrata College of Education, Israel; Linor Hadar, University of Haifa , Israel

Stages in career paths have been found to influence the effectiveness of professional development endeavors (Berliner, 2001; Borko, 2004). This study examines professional development trajectories of novice and experienced teacher educators who participated in a Professional Development Community (PDC) focused on infusing thinking into college level teaching. During two yearlong projects for separate groups of teachers, we conducted narrative interviews with ten teacher educators at different points in their careers at the college, seven experienced and three novices. Three times during the year, they were asked to reflect on the PDC's influence on their personal and professional development. Data from these interviews were triangulated with field notes, session recordings and reflective writing of the participants. We identified four stages of professional development in our PDC: anticipation and curiosity, withdrawal, awareness, and change. While all of the teacher educators were found to move predictably from one phase to the next, we found a marked difference in the paths of the novices and experienced teachers who without exception proclaimed their expertise in thinking education, thus they are referred to as experienced experts. The experienced experts entered and often remained in a state of withdrawal, unable to successfully adopt pedagogic changes, while the novices comfortably moved towards awareness and change. Cognitive dissonance theory is used to explain these differences, and implications for designing successful professional development projects are discussed.

Aims

Professional development of teacher educators is a critical element affecting curriculum change which supports higher order thinking (Stes et al, 2010). Our research addresses the effectiveness of the professional development community for teaching improvement, both as a group process (Hadar and Brody, 2010) and individually (Brody and Hadar, 2010). Differences in career paths have been found to influence the teachers' professional development (Berliner, 2001; Borko, 2004; Glaser, 1996). This study explores differences between professional development trajectories of novices and experienced teacher educators who participated in the professional development community (PDC) and to understand the mechanisms by which this development occurs by group. The terms novice and experienced expert are drawn from self definitions of teacher educators relating specifically to thinking education. The correlation between years of teaching and self definition as expert varies considerably and is based on teachers' views of levels of experience and expertise in thinking education.

Methodology and data analysis

Two separate yearlong PDC projects involved twenty faculty members committed to exploring thinking education in their work. A variety of qualitative methods included narrative and group interviews, audio recordings of group sessions, reflective writing, and field notes. Differences between professional development processes and outcomes between novices and experienced experts were identified using the form based mode which explores structure of narrative material (Lieblich et al, 2004). This analysis enabled monitoring of both progression and regression in personal professional development of the participants (Gergen and Gergen, 2000). Grounded theory analysis identified preliminary categories, and narratives were examined again for similarities and differences between individuals. Triangulation was achieved by corroborating these themes with other data sources revealing changes in teacher beliefs and attitudes over time, thereby generating distinct trajectories of development between novices and experts.

Findings

Teacher educators were found to progress through four stages which began with curiosity and anticipation and quickly evolved into a significant withdrawal period. Participants who emerged from withdrawal moved to a stage of awareness of possibilities for implementing new pedagogies, enabling change, which is marked by a positive disposition toward infusing thinking into practice. This examination of novice and experienced expert trajectories revealed distinct patterns. Both groups began with curiosity and anticipation; however, as they moved into withdrawal, the experts regressed to a defensive position of satisfaction with current practice and rejection of new methods. Some remained in stasis at this phase, exhibiting apathy towards change. Others moved onto awareness, and then change. In contrast, novices withdrew into a passive moratorium of observation and delayed implementation, followed by awareness of possibilities for change and actively adopting new methodologies.

Theoretical and Educational Significance

This study points to the decisive role of individual trajectories in the effectiveness of professional development endeavors. Our findings differ from Berliner's (2001) perspective regarding responses of expert and novice teachers in the face of curricular or pedagogical innovations. While he characterized experienced experts as flexible and autonomous, we found that them to experience deep withdrawal, inhibiting implementation of new methods and hindering their professional development. Furthermore, Berliner describes the novice teacher as rigid when dealing with unfamiliar situations, while our data show willingness to applying new methodologies to their practice. Differences between experienced experts and novices are explained by understanding how the PDC affects professional identities of each group.

Changes in identity significantly affect the ability of teacher educators to advance professionally. Borko (2004) claimed that the teaching role is contextual, and teachers often find themselves to be expert in one domain and novice in another. In the context of the PDS, experienced expert teachers see themselves in the novice role, experiencing cognitive dissonance between their identity as expert and their lack of knowledge in the proposed innovative pedagogy. Uncomfortable with this situation, they reframe their current practice, claiming expertise in thinking education, thereby obviating pedagogic change. Withdrawal into this self declared status of expert resolves the dissonance created by the PDC. Novices, on the other hand, find no such dissonance. Accustomed to lack of familiarity with new pedagogies, they are more willing than their experienced colleagues to attempt new practice without a threat to their identity. The absence of cognitive dissonance enables them to move comfortably from withdrawal to awareness and then to change.

This study suggests reconsidering the professional development needs of novice and experienced expert teacher educators. Because the stage of withdrawal is inevitable, professional development initiators might consider developing strategies which support experienced expert teachers to move out of this stage towards change.

Moreover, effective professional development must take into account how personal and professional identity changes in the context of these endeavors and how they affect efforts to improve teaching.

References

- Berliner, D. C. (2001) Learning about and learning from expert teachers. *International Journal of Educational Research*, 35(5), 463-482.
- Borko, H. (2004). Professional development and teacher learning: mapping the terrain. *Educational Researcher*, 33 (8), pp. 3-15.
- Brody, D., and Hadar, L. (2010). "I speak prose and I now know it." Personal development trajectories among teacher educators in a professional development community. Paper presented at SIG 10, EARLI, Helsinki, Finland, June, 2010.
- Gergen, M.M., & Gergen K.J. (2000) Qualitative inquiry: Tensions and transformations. In N.K. Denzin & Y.S Lincoln (Eds.), *Handbook of qualitative research* (2nd ed.) Thousand Oaks: Sage. pp. 1025-1046
- Glaser, R. (1996) Changing the agency for learning: acquiring expert performance, in: K. A. Ericsson (Ed.) *The road to excellence: the acquisition of expert performance in the arts and sciences, sports and games*. Mahwah, NJ: Lawrence Erlbaum Associates. Pp. 303-311.
- Hadar, L. & Brody, D. (2010). From isolation to symphonic harmony: building a professional development community, among teacher educators, *Teaching and Teacher Education*, 26(8), 1641-1651.
- Lieblich, A., Tuval-Mashiach, R. & Zilber, T. (2004) Narrative research. Reading analysis and interpretation. *Applied Social Research Methods Series*, vol 47. Thousand Oaks: Sage.
- Perkins, D., Jay, E. & Tishman, S. (1993). New conceptions of thinking from ontology to education. *Educational psychologist*, 28(1), 67-85.
- Stes, A., Min-Leliveld, M., Gijbels, D., and Van Petegem, P. (2010). The impact of instructional development in higher education: The state-of-the-art of the research, *Educational Research Review*, 5 (1), 25-49.

Development paths of university teachers during a pedagogical development course

Liisa Postareff, University of Helsinki, Finland; Anne Nevgi, University of Helsinki, Finland

Research on development of university teachers followed by participation in pedagogical development courses has focused on analysing changes at group level. Individual development paths and a possible resistance to change have gained little attention. The present study analyses reflection diaries of 18 academics who has participated in a 10 credit (European Credit Transfer System) pedagogical development course. The diaries were content analysed, and the teachers were grouped into five different categories depending on what kind of development paths they represented. Most teachers described different types of changes followed by participation in the course, but four teachers' descriptions were characterized by a resistance to change. The results suggest resistance to change is found among teachers who hold a very strong teacher identity or a strong view of an ideal university teacher.

Background and aims

Previous research has shown contradictory results of the effectiveness of pedagogical courses organised for university teachers. Some research has shown positive effects of such courses (e.g. Gibbs & Coffey, 2004; Postareff et al., 2007) while other research has found changes only in some aspects of teachers' approach to teaching (Stes et al. 2007) or no evidence for changes in teachers' behavior or conceptions (e.g. Ho et al., 2001). Most of the previous studies have analysed and reported changes at group level, while analysis focusing on individual teachers and possible resistance to change has gained less attention. One study which has dealt with resistance to change among academics suggests that the resistance may be related to the identity formation as an academic (Winberg, 2008). University teachers' professional is usually strongly based on being a researcher (e.g. Knight, 2002). Participating in pedagogical development course offers teachers both challenges and possibilities to construct their teacher identities besides researcher identity. According to Guskey (2002), resistance might occur if teachers do not have possibilities to experience how changes in teaching practices affect student learning.

The aim of this study is to analyse teachers' development paths during a pedagogical course. The aim is to capture variation in how teachers describe and experience the courses and in how they describe their development as teachers and development of their teacher identity during the course.

Methodology

The study analyses reflection diaries of 18 academics which were written during a five-month, 10 credit pedagogical basic course at the University of Helsinki. The 18 teachers (10 female, 8 male) represented a range of different

disciplines, and their teaching experience varied from 0 to 25 years. The teachers were aged between 29 and 50 years. Teachers' academic positions at the university varied from doctoral student to senior lecturer and professor. The reflection diaries were content analysed by both authors independently. According to the instructions of the diaries the teachers received, the analysis focused on the teachers' descriptions concerning their motivation to participate in the course, their teacher identity and the changes they experienced during the course. It was noticed that there were similarities among certain teachers in how they described their development and changes. Both authors reanalysed the data from this perspective and identified teachers who described the development paths in a similar way. High consistency between the categorizations of similar paths was found and unclear cases were discussed in depth.

Findings

First, the analyses focused on identifying what kind of changes the teachers described. The changes were sorted into three categories: 1) changes in conceptual level, 2) changes in practical level, and 3) changes in teacher identity. However, it was noticed that there was variation in the depth of descriptions concerning change, and that change or development was not described in all diaries. Furthermore, there was variation in how teachers described their motivation to participate in the course and their teacher identity. When analysing teachers' motivation, teacher identity and the changes they described, five different types of development paths were identified from the reflection diaries.

- 1) Motivated teachers with a discrete profession and weak teacher identity who described lots of changes
- 2) Young and unexperienced teachers with a weak teacher identity who learned more than they expected
- 3) Young and unexperienced teachers holding a practical orientation who learned new teaching practices
- 4) Unexperienced teachers with a weak teacher identity who described resistance at some point, but eventually described changes
- 5) Experienced and un-experienced teachers who conceive themselves as expert teachers, who were resistant to change

There was no variation in teaching experience between the teachers who were open to change and those who were resisted. Thus, the results imply that the amount of prior teaching experience does not explain variation in how teachers experience pedagogical courses or in how they develop as teachers. The results suggest, however, that if the teacher conceives him/herself as an expert teacher, or holds a very strong conception of an expert university teacher, the conceptions they hold and practices they apply are likely to be resistant to change.

Theoretical and educational significance

Previous studies have reported on changes teachers experience as a result of participating in pedagogical courses (e.g. Gibbs & Coffey, 2004; Postareff et al., 2007; Stes et al., 2007). Shifting the focus towards individual development paths makes it possible to analyse reactions and descriptions of those teachers who do not exhibit change. From a more practical perspective, it is important to recognize teachers who are resistant to change and analyse factors causing resistance. Furthermore, it is important to consider how these teachers' learning could be supported in pedagogical courses.

When a university teacher participates in a pedagogical development course, his/her identity as an academic and as a researcher becomes challenged and negotiated with the new concepts and theories of teaching and learning (Winberg, 2008). If a teacher has no possibility to experiment new teaching methods in teaching during the pedagogical course, as proposed by Guskey (2002), it may be that the teacher rejects the theories as unnecessary and his/her identity as an academic remains unchallenged. In pedagogical development programmes, the value of new pedagogies should be addressed to minimize the possible resistance to change.

References

- Gibbs, G., & Coffey, M. (2004). The impact of training of university teachers on their teaching skills, their approach to teaching and the approach to learning of their students. *Active Learning in Higher Education*, 5, 87-100.
- Guskey, T. R. (2002). Professional Development and Teacher Change. *Teachers and Teaching: theory and practice*, 8(3/4), 381-391.
- Ho, A., Watkins, D. & Kelly, M. (2001). The conceptual change approach to improving teaching and learning: An evaluation of a Hong Kong staff development programme. *Higher Education*, 42, 143-169.
- Knight, P. T. (2002). *Being a Teacher in Higher Education*. Buckingham: The Society for Research into Higher Education & Open University Press.
- Postareff, L., Lindblom-Ylänne, S. & Nevgi, A. (2007). The effect of pedagogical training on teaching in higher education. *Teaching and Teacher Education*, 23, 557-571.
- Stes, A., Gijbels, D. & van Petegem, P. (2007). Student-focused approaches to teaching in relation to context and teacher characteristics. *Higher Education*, 55 (3), 255-267.

Winberg, C. (2008). Teaching engineering/engineering teaching: interdisciplinary collaboration and the construction of academic identities. *Teaching in Higher Education*, 13(3), 353-367.

Experienced teachers' non-learning: mechanisms of mental resistance and avoidance

Paulien Meijer, Utrecht University, Netherlands; Helma Oolbekkink-Marchand, Radboud University, Netherlands

This paper focuses on experienced teachers who volunteered to take up a new role as researchers but did not learn in relation to this new role and even seemed to resist such learning. This adds to studies about experienced teacher learning that mainly focus on the teachers who do learn what is expected. Three case studies were performed to examine processes of such non-learning among novice teacher-researchers. The results were interpreted using theories of, among others, Illeris (2007). He described similar processes in terms of mental resistance and avoidance, which he sees as two of the main barriers to learning. Although small-scale, the study provides some interesting insights into the processes that take place when the intended teacher learning does not occur. This has several types of consequences for both research on teacher learning and initiatives regarding teacher professionalization.

Experienced teacher learning is studied by many scholars and from various perspectives. There is general agreement that teachers should continue to learn throughout their career, because of continuous changes in society, in subject matter knowledge, and in knowledge about pupil and student learning. Yet, studies show that experienced teachers find it difficult to keep on learning and to go on developing their knowledge, skills, and attitudes. In addition, many teacher trainers are confronted with teachers who are unwilling to learn or develop themselves, a phenomenon also noted by policy makers who expect teachers to change according to mandatory innovations. Teachers' willingness to learn appears to be an issue of considerable importance (Vermunt & Endedijk, in press), particularly what happens when this willingness is absent.

This paper focuses on teachers who fail to learn or change and who even seem to resist learning. We focus on teachers who are faced with new roles, which they assume voluntarily. In the Netherlands, many experienced teachers take on a new role as a teacher-researcher, which requires of them that they systematically examine their own practice, or more generally practices at their own school. This is consistent with international trends in which teachers are increasingly seen as agents in their schools, and in which schools are increasingly seen as owners and generators of knowledge about education (Cochran-Smith & Demers, 2008). Many studies have been done in which the benefits are described of this type of role-change of teachers, for themselves, for schools, and for education in general (e.g., Zeichner, 2003). In this paper we in no way doubt these benefits. But we do want to shed more light on what happens in the not-so-successful stories, when no benefits are reported by the teachers involved. These stories are hardly described in literature, but they illuminate important aspects of experienced teacher learning and help explain what happens when this learning does not take place. Such insights provide clues about how to proceed with the desired innovations or changes, or how to coach these specific teachers.

Three case studies were performed involving experienced teachers who had indicated that they had learned hardly anything as a result of their new role, even when adopting a broad view on learning that includes acquiring research skills and developing a critical stance towards their own teaching practice or school policies. These teachers were part of a larger study, in which most teachers indicated to have learned or changed as a result of their new role (Meijer et al., 2010). Interviews were conducted to understand the reasons and processes behind the non-learning. Contents of the interviews were first analyzed using a grounded-theory approach, in which categories were formulated that reflected the reasons and underlying processes for the teachers' non-learning. After that, these categories were related to theories about this topic. Results showed that the three teachers had different reasons for non-learning, but in general the processes they described matched Illeris' (2007) ideas about barriers to learning, specifically mental resistance to learning, ambivalence, and avoidance. Examples from the data that illustrate these concepts and how they work are provided in the paper.

In the conclusion section of the paper, the results are related to other studies about teacher learning that also provided some clues about the teachers who did not learn (e.g., Vermunt & Endedijk, in press). Also, links were found in a broad range of literature, for example, literature about student teacher learning and their identity development (e.g., Hong, 2010), and literature about change resistance, in which processes are described that prevent people in general from changing throughout their lives. Indications are provided about how to signal non-learning in an early phase, and how to deal with teachers when such processes occur. Also, with respect to research about teacher learning, a case is made for dealing with non-learning as a process of identity defence rather than unwillingness of a person.

References

- Cochran-Smith, M., & Demers, K. E. (2008). How do we know what we know? Research and teacher education. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of research on teacher education* (pp. 1009- 1016). New York: Routledge.
- Hong, J.Y. (2010). Pre-service and beginning teachers' professional identity and its relation to dropping out of the profession. *Teaching and Teacher Education*, 26(8), 1530-1543
- Illeris, K. (2007). *How we learn. Learning and non-learning in school and beyond*. New York: Routledge.
- Meijer, P., Meirink, J., Lockhorst, D., & Oolbekkink-Marchand, H. (2010). (Leren) onderzoeken door docenten in het voortgezet onderwijs [Teachers (learn to) do research in Dutch secondary education]. *Pedagogische Studiën*, 87, 232-252.
- Vermunt, J.D. & Endedijk, M. (in press). Patterns in teacher learning in different phases of the professional career. *Learning and Individual Differences*.
- Zeichner, K. M. (2003). Teacher research as professional development for P-12 educators in the USA. *Educational Action Research*, 11(2), 301-326.

SYMPOSIUM

Identifying key learning activities in strategy instruction in various ill defined do-mains.

Chairperson: Wilfried Admiraal, University of Amsterdam, Netherlands

Organiser: Gert Rijlaarsdam, University of Amsterdam, Netherlands

Discussant: Patricia A. Alexander, University of Maryland, United States

The symposium aims at the identification of effective instructional strategies in various domains of learning, in ill structured tasks. General idea is to bring together and to analyze intervention studies that focus on strategy development. The symposium will address the question 'What works in strategy instruction and why?' with variations in content (the strategy learned), the learning activity and the content domain. Therefore, we selected studies that were set up as componential analysis of instructional components (e.g. Fidalgo et al. in this symposium), studies that analyzed data from complex interventions with multi-components to isolate the contributions of each component to the total effect (for instance Glaser et al. in this symposium), and experiments that aimed at studying the effect of a single learning activity (Groenendijk et al., focusing on observation as learning activity). In three sessions, the symposium will deal with various domains (visual arts: divergent thinking; history: historical thinking and language arts: writing and reading literary texts). The domains have in common that they aim at thinking skills, and are seen as ill-structured

How do self-regulated writing strategies improve students' composition skills?

Joachim Brunstein, Justus-Liebig-University, Germany; Cornelia Glaser, Psychology, Germany

One of the most promising approaches to promote students' writing and self-regulation skills is Graham and Harris's Self-regulated Strategies Development (SRSD) model. Meta-analytic studies have found that SRSD is quite effective in promoting writing skills not only of struggling writers but also of normally achieving students. Yet, only little is known about how self-regulated writing programs help students become better writers and which processes transmit the associated treatment effects on measures of writing performance. In our research, we therefore sought to identify potential causal mechanisms through which procedures of self-regulated learning increase the efficaciousness of teaching young students strategies for writing stories. In general, we found that the addition of self-regulation elements to writing strategies trainings produced incremental effects on students' writing achievements, strategy-related skills, and subjective writing competence. Specifically, path analytic findings indicated that relative to teaching writing strategies alone, teaching strategies in tandem with self-regulation procedures improved students' skills of planning and revising stories and thereby led to superior achievements as reflected in the quality of compositions. Self-regulation procedures also augmented effects of the strategies training on students' knowledge and self-efficacy beliefs, both of which had a positive effect on the use of the learned strategies while planning narratives.

A considerable body of evidence suggests that teaching strategies for planning, writing, and revising text produces strong and lasting effects on the quality of compositions (Graham, 2006; Graham & Perin, 2007). There is also evidence that self-regulated learning methods are particularly effective in helping students acquire a strategic

approach towards writing (Glaser & Brunstein, 2007; Zimmerman & Risemberg, 1997). One of the most promising approaches to promote students' mastery of writing is Harris and Graham's (2009) Self-regulated Strategies Development (SRSD) model. SRSD combines teaching of strategies for planning and revising compositions with self-regulated learning methods, such as monitoring of strategy use, goal setting, and self-recording of learning progress. However, only little is known about the mechanisms that transmit the effects self-regulated writing strategies interventions have on writing performance. Accordingly, the purpose of this paper is twofold. We wanted (1) to demonstrate that teaching writing strategies in tandem with self-regulation procedures is more effective in promoting the quality of compositions than teaching strategies alone, and (2) to identify a chain of putative mediators explaining how self-regulated learning of cognitive strategies produces superior effects on writing achievements. We contrasted fourth graders who were taught strategies for planning and revising narratives in conjunction with self-regulation procedures such as self-assessment of one's writing performance, setting of outcome-related and procedural learning goals, and self-monitoring of strategy use ($n = 58$) with students who were taught the same strategies without instruction in self-regulation procedures ($n = 59$). Students in both conditions were taught by instructional assistants in mixed-ability groups of 4 to 6 students. Both programs were delivered in five sessions (one session per week) each consisting of two consecutive 45-min lessons. In accord with Harris and Graham's (2009) literature review, we hypothesized a set of four writing-related variables to transmit the proposed effects of self-regulated writing strategies on the quality of children's writing: writing knowledge, writing self-efficacy, prewriting planning, and text revisions. We postulated four direct effects from treatment condition (strategies instruction with and without self-regulation) to each of the target variables hypothesized to transmit the effects of writing interventions on students' writing products. We further expected both strategy-related planning and revising to have a direct effect on the quality of students' stories. In addition, we predicted two indirect effects: First, we expected planning to have an indirect effect on students' writing performance, through its influence on the quality of strategy-related text revisions with better plans predicting better revisions. Second, we postulated treatment condition to have an indirect effect on story plans via its influence on students' writing knowledge and self-efficacy beliefs. In our analyses of treatment effects and mediation relationships, we controlled for the clustering of students within instructional groups (intra-class correlations). For this purpose, we analyzed our data with the Mplus software package using the "Type is complex" command to account for the non-independence of data (Muthen & Muthen, 1998-2009). In each analysis we also controlled for individual differences in pretest measures. Results indicated that, both at posttest and at maintenance (6 weeks after intervention), students in the self-regulated writing strategies condition (a) received higher knowledge scores, (b) felt more self-efficacious about their skills of writing narratives, (c) created more complete plans, (d) made a greater number of strategy-related revisions, and (e) wrote qualitatively better stories than students who had been taught strategies alone. To determine the validity of our model, we followed Hu and Bentler's (1999) recommendation and used two fit indexes: the comparative fit index with a cutoff value of .95 and the standardized root mean residual with a cutoff value of .09. Pretest differences were statistically controlled by computing for each variable included in the model residual scores with pretest scores partialled out. We found the predicted model to fit the data quite well both at posttest and at maintenance. As predicted, treatment condition had a direct effect on each of the four writing variables. Further, the direct effects from planning to story quality and from revision to story quality were significant. Furthermore, the mediational chains from (a) treatment condition to self-efficacy, to planning, to story quality and (b) treatment condition to knowledge, to planning, to story quality were significant both at posttest and maintenance. The chain from treatment condition to planning to text revisions to story quality also turned out to be significant at both points of measurement (posttest and maintenance). Taken together, these results suggest (1) that an intervention that combines the instruction of writing strategies with self-regulation skills exerts a strong, coherent, and sustainable influence on procedural (planning and revising), declarative (writing knowledge) and self-related (writing self-efficacy) aspects of writing. (2) that the self-regulated writing program produced its incremental effects (relative to teaching strategies alone) on students' writing performance consistent with theories of self-regulated learning. Writing knowledge, self-efficacy beliefs, planning skills, and revision activities do not act in isolation but work together within a structured pattern of mediational relations to jointly transmit the beneficial influence the self-regulated writing strategies training has on students' task performance. However, strategic planning constitutes the central linkage point in our path-analytic mediation model, a finding consistent with the view that prewriting planning is an essential ingredient in the development of writing competence.

- Glaser, C., & Brunstein, J. C. (2007). Improving fourth-grade students' composition skills: Effects of strategy instruction and self-regulation procedures. *Journal of Educational Psychology*, 99, 297-310.
- Graham, S. (2006a). Strategy instruction and teaching of writing: A meta-analysis. In C. A. Mac Arthur, S. Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 187-2007). New York: Guilford.
- Graham, S., & Perin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology*, 99, 445-476.

Harris, K. R., & Graham, S. (2009). Self-regulated strategy development in writing: Premises, evolution, and the future. *British Journal of Educational Psychology Monograph Series II*, (6), 113-135.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1-55.

Muthéén, L. K., & Muthéén, B. O. (1998-2009). *Mplus User's Guide* (5th ed.). Los Angeles, CA:

Muthéén & Muthéén Zimmerman, B. J., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary Educational Psychology*, 22, 73-101.

Instruction in revising by means of guided discussion

Olga Arias, University of Leon, Spain; Jesus-Nicasio Garcia-Sanchez, University of Leon, Spain

Writers may have difficulty revising due to limited knowledge or skills at any stage in the process and their overall metacognitive control of the complex revising process may be limited. Children's revisions often have little or no impact on the quality of their writing, so we would redirect the student's attention in the revision process, in order to teach the judgmental skills need both to detect the problem in the text, to recognize opportunities for improving the text and to improve it. The purpose of this study is to test whether guided discussion can be as beneficial in revising as in other domains. The sample of this study comprised 88 students, ranging from 13 to 15 years old and studying in 2nd grade of Spanish Secondary Compulsory Education. They were distributed over three experimental groups and a control group. In the experimental groups, the instruction was carried out by means of guided discussion and individual practice in re-writing the task. The control group received an extra class of ordinary curriculum. The revising procedure emphasized was the following: a) careful reading of the text provided, b) to detect errors and problems in this text, c) to think of and/or suggest improvements, d) re-writing the text, and e) to repeat steps a, b, c and d with your own text. The strategies used during individual practice were self-questions, guides and direct choices.

Writers may have difficulty revising due to limited knowledge or skills at any stage in the process, and their overall metacognitive control of the complex revising process may be limited (MacArthur, Graham & Harris, 2004). Children's revisions have little or no impact on the quality of their text, so we would redirect the student's attention in revision the process, in order to teach the judgmental skills need both to detect the problem in the text, to recognize opportunities for improving the text and to improve it. Revising is a complex process and it has a reflective nature, so that students at primary and secondary school level seem to adopt a least-effort strategy when revising, that is, they generally confine their revisions to local problems changing first what is easiest to change such as small word and phrase substitutions, followed by elaborations (Saddler & Asaro, 2007). Considering that the revision conducted by expert writers includes the overall structure, coherence, and meaning of the text as well as smaller issues of wording and errors (Midgette, Maraia, & MacArthur, 2008), we would like all students to internalize the strategies to realize a differential use of the various components of the revising procedure in all levels of the revision process. There is much evidence that demonstrates the effectiveness of instructional strategies to improve the quality of the texts written by students from various educational levels (Graham & Perin, 2007).

In this study we wanted to check whether guided discussion can be as beneficial in revising as in other domains like mathematics (Horner & Gaither, 2004), health (Williams & Binnie, 2002) and science (Hogan, Nastasi & Pressley, 2000). Guided discussion is a strategy that requires the student to engage actively in the teaching-learning process, because they discover the information they need to build their knowledge through brainstorming and critical thinking, which they secure with individual practice. This strategy stimulates reasoning, critical thinking skills, communication skills, group work and understanding. The sample of this study comprised 88 students, ranging from 13 to 15 years old and studying in 2nd grade of Spanish Secondary Compulsory Education. They were distributed over three experimental groups and a control group. The difference between the three experimental groups was the level of revision: one group worked on surface aspects of revision, the second group emphasized deep aspects and the third group emphasized both aspects of revision. The control group received an extra class of ordinary curriculum. The instruction was carried out by means of guided discussion and individual practice in re-writing the task during eight sessions. All sessions had the same structure. The first part of the session was focused on guided discussion, the teacher presented the topic and the first challenge was to encourage students' participation and reflection. After the guided discussion, a summary was made of the conclusions reached. To keep students' attention throughout the activity, they received a copy of the theoretical aspects that they had worked on, to incorporate into their personal files. The topics were: the revision process, revision categories, and the differences between editing and re-writing text to improve its quality. During the second part of the session, students had to practice the revising procedure. The revising procedure emphasized was the following: a) careful reading of the text proposed, b) to detect errors and problems in the text proposed, c) to think of and/or suggest improvements, d) re-writing the text, and e) to repeat steps a, b, c and d with their own text. In the second part of the session the students had to re-write a text. They

always had to follow the same procedure for each topic of the guided discussion. To facilitate the internalization of the process, students had to practice making use of self-questions, guides and direct choices, according to their needs. By means of IRCE (Instrument of Revision of Written Composition), quality, productivity, and revising measures were taken before and after completion of the instruction (GR: unclear). Results reveal that guided discussion is also effective in the domain of textual revision. Both the text quality as the detection and correction of errors are affected. It also affects the kind of writing activity carried out by the students.

Graham, S., & Perin, D. (2007). A Meta-analysis of writing instruction for adolescents students. *Journal of Educational Psychology*, 99, 445-476.

Hogan, K., Nastasi, B. K., & Pressley, M. (2000). Discourse patterns and collaborative scientific reasoning in peer and teacher-guided discussions. *Cognition and Instruction*, 17 (4), 379-432.

Horner, S. L. & Gaither, S. M. (2004). Attribution retraining instruction with second-grade class. *Early Childhood Education Journal*, 31 (3), 165-170.

MacArthur, C. A., Graham, S., & Harris, K. R. (2004). Insights from instructional research on revision with struggling writers. En L. Allal, L. Chanquoy, & P. Largy (Eds.), *Revision cognitive and instructional processes* (pp. 125-137). New York: Kluwer Academic Publishers.

Midgette, E., Haria, P., & MacArthur, Ch. (2008). The effects of content and audience awareness goals for revision on the persuasive essays of fifth- and eighth-grade students. *Reading and Writing*, 21, 131-151.

Saddler, B., & Asaro, K. (2007). Increasing story quality through planning and revising: effects on young writers with learning disabilities. *Learning Disabilities Quarterly*, 30, 223-234.

Williams, J. M. & Binnie, L. M. (2002). Children's concepts of illness: An intervention to improve knowledge. *British Journal of Health Psychology*, 7, 129-147.

Observational learning in argumentative writing

Martine Anne H. Braaksma, University of Amsterdam, Netherlands; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Huub Van den Bergh, Utrecht University, Netherlands

Observational learning has shown to be an effective instructional strategy in various domains of learning, including writing. Several experimental studies in secondary education provided us insight in the strength of this instructional method in argumentative writing. We address three issues: (1) key processes in the observational process itself, (2) the effect of observational learning on the mediating variable 'writing processes', and (3) the role of learners' characteristics on the effects of observational learning.

Observers are strongly involved in metacognitive activities (observation of the writing of the models, identifying and conceptualizing the models' writing strategies, and evaluating and reflecting on the performance of the models). The performance of these activities suggests that observers have developed, applied, and internalized criteria for effective writing. Observational showed clear effects on the orchestration of the writing processes: writers who learned by observation performed relatively more metacognitive activities at the start and relatively more executional activities in the second part of the writing process than writers who learned by doing. They also showed for some activities a changing execution over time, whereas writers in doing-writing condition performed these activities at a constant rate during the writing process (i.e., a monotonous process). Learners' characteristics were found to play an important role in observational learning: model-observer similarity in competence facilitated learning. Weak learners learned more from focusing their observations on weak models, whereas better learners learned more from focusing on good models.

Learning by observing others who execute tasks has shown to be effective in various school subjects, including writing (e.g., Braaksma et al., 2001, 2002, 2004, 2006; Graham & Perin, 2007; Raedts, et al, 2008; Zimmerman & Kitsantas, 2002). From several experiments (students grade eight – grade eleven), we got insight in the strength of observational learning in argumentative writing. In our presentation we focus on three issues: (1) key processes in the observational process itself, (2) the effect of observational learning on the mediating variable 'writing processes', and (3) the role of learners' characteristics on the effects of observational learning. Key processes in observational learning From analyses of the learning materials and from an observation study, we found that observers are strongly involved in metacognitive activities. They observe the writing of the models, identify and conceptualize the models' writing strategies, evaluate the performance of the models and reflect explicitly on the observed performances. The performance of these activities suggests that observers have developed, applied, and internalized criteria for effective writing. Two of these activities were found to be crucial for the effectiveness of observational learning: evaluation and elaboration. Effects on writing processes

We examined the effects of observational learning on the orchestration of writing processes. We found that observational learning had an effect on the writing processes. Compared with writers who learned by doing/practising, writers who learned by observation 1. performed relatively more metacognitive activities (Goal-orientation and Analysis) at the start and relatively more executional

activities (Writing and Re-reading) in the second part of the writing process than writers who learned by doing; 2. showed more Planning activities over the whole writing process; 3. performed increasingly more Meta-analyzing activities, indicating monitoring and regulating processes, than writers who learned by doing; 4. showed for some activities a changing execution over time, whereas writers in doing-writing condition performed these activities at a constant rate during the writing process (i.e., a monotonous process). Finally, we found that the orchestration of writing processes performed by the students who learned by observation was positively related to the quality of the writing product. Effects of learners' characteristics on the effects of instructions We established that the same instructional method is not the most effective for every learner. Moreover, task familiarity seemed to play an important role. When a task is new, (1) weak students benefited more from observational learning (focusing on weak models) than from performing writing tasks as they are less likely to use metacognitive strategies such as monitoring, evaluating and reflecting. Moreover, they profited from observational learning because their cognitive effort is shifted from executing writing tasks to learning from writing processes of others. They can thus focus on the learning task, providing themselves with a learning opportunity to acquire new understanding about writing. However, weak learners benefited only from observational learning when they reflect on weak models, they did not profit from reflecting on good models. Our explanation of this finding is that it is easier to evaluate the weak model because the performance of the better model provides a frame of reference. Besides, the performance of the observed weak model probably matches the cognitive processes of a weak learner better. (2) better learners benefited not only from observational learning (focusing on good models) but also from performing writing tasks. They are probably able to divide their attention between writing task and learning task, and thus generate enough input for their learning by evaluating and reflecting on their own performance. However, good learners benefited only from observational learning when they reflect on good models, they did not profit from reflecting on weak models. Probably, the performance of a good model is more matched with the cognitive processes of a good learner. Moreover, good learners are able to identify and comment on the qualities of the good model, because they already have their own internal set of evaluation criteria available. When a task is familiar, (1) weak students benefited from performing writing tasks as much as they profited from focusing their observations on weak models' writing. Because the learners had already experienced successes with the tasks, they had a chance to construct knowledge about good writing, and thus were better equipped to learn from doing the writing task themselves. Reflecting on the performance of the better model however, was still not effective for these weak students. (2) good students profited only from observational learning with the focus on good models, not from focusing on weak models or from performing tasks themselves. Maybe, they need the challenge of explaining why the better model performed well. These results contribute to the research about the role that model-observer similarity plays in children's behavioural change (see Schunk, 1987).

- Braaksma, M.A.H., Van den Bergh, H., Rijlaarsdam, G., & Couzijn, M. (2001). Effective learning activities in observation tasks when learning to write and read argumentative texts. *European Journal of Psychology of Education*, 1, 33-48.
- Braaksma, M.A.H., Rijlaarsdam, G., & Van den Bergh, H. (2002). Observational learning and the effects of model-observer similarity. *Journal of Educational Psychology*, 94, 405-415.
- Braaksma, M.A.H., Rijlaarsdam, G., Van den Bergh, H., & Van Hout Wolters, B.H.A.M. (2004). Observational learning and its effects on the orchestration of writing processes. *Cognition and Instruction*, 22(1), 1-36.
- Braaksma, M.A.H., Rijlaarsdam, G., Van den Bergh, H., & Van Hout Wolters, B.H.A.M. (2006). What observational learning entails: A case study. *L1-Educational Studies in Language & Literature*, 6(1), 31-62.
- Graham, S., & Perin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology*, 99(3), 445-476.
- Raedts, M., Rijlaarsdam, G., Van Waes, L., Daems, F. (2008). Observational learning through video-based models: Impact on students' accuracy of self-efficacy beliefs, task knowledge and writing performance. In Boscolo, P., Hidi, S. (Eds.), *Studies in Writing, Volume 19, Writing and motivation* (pp.219-238). Oxford: Elsevier Science and Technology.
- Schunk, D.H. (1987). Peer models and children's behavioral change. *Review of Educational Research*, 57, 149-174.
- Zimmerman, B.J., & Kitsantas, A. (2002). Acquiring writing revision and self-regulatory skill through observation and emulation. *Journal of Educational Psychology*, 94, 660-667.

SYMPOSIUM

Understanding and use of the inverse relation between addition and subtraction

Chairperson: Greet Peters, K.U.Leuven, Belgium

Organiser: Ineke Imbo, Department Experimental Psychology, Belgium

Joke Torbeyns, K.U.Leuven & GROUP T - Leuven University College, Belgium

Discussant: Michael Schneider, ETH Zurich, Switzerland

This symposium brings together three empirical contributions focusing on children's knowledge and use of the inverse relation between addition and subtraction. Because a good understanding of this principle is of fundamental importance in children's arithmetic knowledge, it is of great interest to those who study cognitive development and mathematics education. Furthermore, an efficient implementation of this principle also facilitates the solution process by eliminating computational effort. Indeed, a child who understands the inverse principle can immediately recognize that the outcome of $57+48-48$ is 57 because adding 48 is canceled by subtracting 48, or that $61-59$ can be solved flexibly by counting or computing how much has to be added to 59 to get at 61 (i.e., by using the indirect addition strategy). Two studies in this symposium show the impact of intervention on children's understanding and flexible use of the inversion principle. Using regression analyses, the third study provides a more detailed view on children's strategy choice process when solving simple subtraction problems. In sum, this symposium does not only increase our understanding of the developmental changes in children's understanding and use of the inversion principle but also offers building blocks to improve mathematics teaching on this topic.

Teaching children how to include inversion principle in their reasoning about quantitative relations

Peter Bryant, Oxford University, United Kingdom; Terezinha Nunes, University of Oxford, United Kingdom;
Deborah Evans, Oxford University, United Kingdom; Rossana Barros, Oxford University, United Kingdom

The basis of this intervention study is a distinction between numerical calculus and relational calculus. The former refers to numerical calculations and the latter to the analysis of the quantitative relations in mathematical problems. The inverse relation between addition and subtraction is relevant to both kinds of calculus, but so far research on improving children's understanding and use of the principle of inversion through interventions has only been applied to the solving of $a+b-b=?$ sums. The aim of the intervention described in this presentation was to study the effects of teaching children about the explicit use of inversion as part of the relational calculus needed to solve missing addend and missing minuend problems (inverse problems) using a calculator. The study showed that children taught about relational calculus improved their ability to indicate how to work out the solution to these problems more than those who were taught numerical procedures. They also showed a significantly better performance in change-unknown problems, which were not included in the training. The effects of the intervention were stronger when children were taught about relational calculus with mixtures of direct and inverse word problems than when these two types of problem were given to them in separate blocks. The success of this intervention study points the way to how children can learn to use formal expressions to represent quantitative relations, which is crucial for modeling and algebra.

Background

The basis of this intervention study is a distinction between numerical calculus and relational calculus. The former refers to numerical calculations and the latter to the analysis of the quantitative relations in mathematical problems. In a result-unknown problem, such as "Peter had 8 marbles; he played a game and won 3; how many does he have now?", the children are told about a quantity that someone had and a change to this quantity, and asked about the resulting quantity. In such problems, children need to implement a numerical calculation ($8+3=?$) but there is no need for a relational calculation. In contrast, in a start-unknown problem, such as "Peter had some marbles; he played a game and lost 3; now he still has 8; how many did he have before the game?", children must implement a numerical calculation ($8+3=?$) but they must also reason about the relations between the quantities: if he lost 3 marbles, he must have had 3 more before the game. Finally, some change-unknown problems, such as "Peter had 8 marbles; he won some in a game and he now has 11; how many marbles did he win in the game?" also require relational calculations. The inverse relation between addition and subtraction is relevant to both kinds of calculus, but so far research on improving children's understanding and use of the principle of inversion through interventions has only been applied to the solving of $a+b-b=?$ sums – i.e. to numerical calculus.

Aims

The aim of the intervention described in this presentation was to study the effects of teaching children about the explicit use of inversion as part of the relational calculus needed to solve start-unknown and change-unknown addition and subtraction problems (inverse problems) using a calculator. The motivation to use a calculator to solve the problems was created by presenting the children with problems in which the computations were beyond the limits of their calculation skills. This helped them realize the advantage of knowing how to work out the solution with a calculator and, therefore, to learn how to represent the solution using formal numerical expressions. Primary school children often solve missing addend problems using an adding-on procedure rather than subtraction. Although adding on is an efficient computation strategy, it must be distinguished from the formal numerical expression that models the solution through subtraction.

Method

The children (N=60) were recruited from two grade levels (2nd, mean age 7.13 years, and 3rd, mean age 8.02 years) in state supported schools in the UK and randomly allocated to one of three groups. They all participated in a pre-test, two training sessions, an immediate post-test, and a delayed post-test, given about 8 weeks later. The pre- and post-tests included three types of addition and subtraction story problem: result-unknown (direct), change-unknown and start-unknown (inverse). The children in the intervention group were only taught about the start-unknown problems; the change-unknown problems were used to assess whether they could apply their relational calculation skills to a different problem type. Two intervention groups were taught how to use the inverse relation between addition and subtraction in relational calculus in order to solve story problems with the help of a calculator. The control group was taught different ways of solving addition and subtraction computations using a number line, including the use of indirect addition to solve subtractions (i.e. counting up) and the use of compensation to solve additions (i.e. instead of adding 9, add 10 and then subtract 1). Thus the control group was taught about the inverse relation in the context of numerical calculus. The two intervention groups differed in one aspect: the block group solved all the direct (result-unknown) problems in the first session and all the inverse (start-unknown) problems in the second session whereas the mixed group solved a mixture of the two types of problem in both sessions. The control group solve the same computations that were required in the problems solved by the intervention groups during the two sessions. The procedure was as similar as possible during the sessions; children in all three groups worked individually with an experimenter; the problems and feedback were presented with the support of a computer.

Results

The groups did not differ at pre-test. At both the immediate and the delayed post-tests, the mixed group performed significantly better than the control group in start-unknown and change-unknown problems; the block group only performed better than the control group in the change-unknown problems. The effect sizes were moderate (Cohen's $d=0.6$) to high (Cohen's $d=0.9$) in these comparisons.

Conclusions and educational implications We conclude that children can be taught about relational calculus and improve their ability to indicate how to work out the solution to inverse problems in the first years in primary school. They performed significantly better than those only taught numerical procedures. This intervention study points the way to how children can learn to use formal expressions to represent quantitative relations, which is crucial for modeling and algebra. It has been suggested in the literature that children's informal methods of computation, such as the use of adding-on to solve subtraction problems, interferes with their learning of how to use numerical expressions that shows how problems can be worked out. It has also been suggested that this is a stumbling block to their learning of algebra. This study shows that it is possible to help children understand the difference between numerical and relational calculus by showing them how the latter are required to solve problems with calculators. Future research should investigate whether children can remain aware of this distinction and continue to use flexible computation strategies when they are not using a calculator but realize the significance of knowing how to work our solutions using formal numerical expressions.

Adaptive strategy use and recognition of tasks characteristics of German 3rd-graders

Aiso Heinze, Leibniz Institute for Science and Mathematics Education, Germany; Franziska Marschick, Leibniz Institute for Science and Mathematics Education, Germany

The indirect addition strategy based on the inversion principle is regarded as an efficient strategy to solve subtraction problems like $304-297$ with a small difference between the minuend and subtrahend. However, empirical results show that only a minority of primary school students use this specific strategy. We assume that the recognition of task characteristics like "small difference between numbers" is important for choosing indirect addition as an efficient strategy for a subtraction task. Analyzing task characteristics can support the interpretation of subtraction by a difference model instead of a take away model and, therefore, promotes the consideration of indirect addition instead of the straightforward application of a direct subtraction strategy. In a three-lesson intervention study with 54 3rd-grade students we addressed the recognition of task characteristics as a criterion for strategy choice, in particular for the indirect addition strategy. In a pre-test with items suggesting indirect addition or simplifying as efficient strategies, the students showed a low adaptive strategy use. In interviews, they referred to task specific criteria for their strategy choice only for 11% of their solutions for tasks suggesting indirect addition. After the intervention, this percentage of strategy choices based on tasks specific criteria increased to 35% and the adaptive strategy use increased significantly. Moreover, the references to task specific criteria were highly correlated with the efficiency of the chosen strategy. Referring to these results, we hypothesize that the analysis of task characteristics is an important element in teaching students the efficient use of the indirect addition strategy.

Aims and theoretical framework

There is a consensus among mathematics educators about the importance of adaptive strategy use in arithmetic, i.e., solving computation tasks efficiently by flexibly choosing a strategy which is advantageous with respect to task characteristics. An important role plays the specific strategy indirect addition based on the inversion principle. It is efficient for solving subtraction tasks like $304 - 297$ where the difference between minuend and subtrahend is small. However, empirical results show that only a minority of primary school students uses the indirect addition strategy for these specific subtraction problems (e.g., Selter, 2001; Torbeyns et al., 2009). A possible reason for these findings might be the fact that students' strategy choice is not based on task specific criteria rather it relies on subject specific criteria (e.g., "I know this strategy best.") or socio-mathematical norms (e.g., "Our teacher said we should do it this way."). We assume that recognizing task characteristics supports the interpretation of subtraction in these specific problems by a difference model instead of a take away model and, therefore, promotes the consideration of the indirect addition strategy instead of the straightforward application of a direct subtraction strategy. Accordingly, the question arises whether students' adaptive use of the indirect addition strategy can be fostered by teaching the analysis of task characteristics. More specifically, in an intervention study with grade 3 students we addressed the following questions: Is there a change in students' criteria for strategy choice? Is there a significant rise in students' adaptive use of the indirect addition strategy? Is the students' ability to solve the computation tasks correctly influenced by the intervention?

Methodology/ Research Design

The sample comprises 54 third graders from three different schools. According to their teachers, all students learned a variety of strategies before and show good mathematics achievement. The intervention took place once a week in groups of 7-10 students, parallel to regular mathematics lessons. It encompassed three sessions (each 45 minutes) which were administered by research assistants. The aims of these sessions were (1) repetition of different strategies, (2) recognizing task characteristics as criterion for strategy efficiency and (3) analyzing and rating the efficiency of different strategies for given tasks. In all sessions, different strategies were addressed but the indirect addition strategy was emphasized. In additional introductory and closing sessions, tests and interviews were administered. Pre- and post-test were identical and consisted of ten three-digit addition and subtraction tasks suggesting indirect addition or simplifying as efficient strategies. Each item was rated dichotomously regarding accuracy and adaptivity. Using the individual test booklet, each student was asked for her/his criteria of strategy choice for four of the test items immediately after completing the test. The answers were classified into five categories: task specific criteria, subject specific criteria, socio-mathematical norms, mixed criteria or no classification (= no or other criteria).

Findings

Figure 1 shows the results concerning the criteria for strategy choices for the two interviews tasks suggesting the indirect addition strategy. From pre- to post-test there is a substantial increase in the reference to task specific criteria for strategy choice. Moreover, the student responses which could not be classified decrease drastically. As expected, in the pre-test, students showed a low adaptivity in their strategy choice ($M = 2.19$, $SD = 3.11$; max. 10 points). Most of the students used the standard algorithms or the stepwise strategy to solve the items. About half of the students did not use any efficient strategy in the test. In the post-test, students showed a significant higher adaptivity in their strategy choice ($M = 3.56$, $SD = 3.60$; max. 10 points; Wilcoxon test: $Z = 2.693$, $p = .007$; effect size: $r = .37$). Nevertheless, about one third of the students still did not solve any item adaptively. For the five test items suggesting indirect addition as efficient strategy, only 5 of all 270 students' solutions (= 1.8%) based on this strategy in the pre-test. In the post-test, this increased to 47 solutions (= 17.4%). Regarding the relation between the frequency of reference to task specific criteria and the frequency of adaptive strategy choice, a significant correlation could be observed within the post-test data for the two items suggesting indirect addition as efficient strategy ($r = .51$, $p < .05$). For the accuracy of students' solutions, a small increase could be observed which was not significant (pre-test: $M = 7.65$, $SD = 2.23$; post-test: $M = 7.96$, $SD = 2.15$; max. 10 points for each test). So, there was no influence of the intervention on students' accuracy.

Discussion

In the pre-test, students showed a low adaptivity in their strategy use which increased significantly during the three lesson intervention. This increase of adaptivity did not change the accuracy which remains on a high level. Overall, the post-test results for adaptivity were still on a moderate level. For the five items suggesting indirect addition, only 17.4% of the solutions based on this strategy, though this strategy was emphasized in the intervention. After the short intervention, the percentage of strategy choices based on task specific criteria strongly increased for the indirect addition tasks and the reference to task specific criteria significantly correlates with the adaptivity of the chosen strategy. Based on these results, we hypothesize that the analysis of task characteristics is an important element in teaching students an adaptive use of the indirect addition strategy. However, this result is limited by the fact that we chose students with good mathematics achievement for our sample, i.e. students knowing various strategies. It is unclear which effects can be expected for students with a restricted strategy repertoire.

Children's use of the indirect addition strategy

Greet Peters, K.U.Leuven, Belgium; Bert De Smedt, University of Leuven, Belgium; Joke Torbeyns, K.U.Leuven & GROUP T - Leuven University College, Belgium; Pol Ghesquiere, Katholieke Universiteit Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Subtraction problems of the type $a - b = ?$ can be solved by means of various strategies. For the present contribution, we investigated third- to sixth-grade children's use of indirect addition on two-digit subtractions. We first examined regression models in which different problem characteristics predicted reaction times. Second, we compared performance on two-digit subtractions presented in 2 presentation formats, i.e., the standard subtraction format ($81 - 37 = .$) and an addition format ($37 + . = 81$). Both methods lead to the conclusion that children switched between direct subtraction and indirect addition depending on the relative size of the subtrahend: If the subtrahend was smaller than the difference, direct subtraction was used; if the subtrahend was larger than the difference, indirect addition was the dominant strategy. This strategy choice pattern was very clear when the distance between the subtrahend and the difference was large (e.g., $71 - 2$ and $71 - 69$). In contrast, when these two numbers were close to each other (e.g., $75 - 36$ and $75 - 39$), there was only a subtrahend-dependent strategy selection when the subtrahend was smaller than the difference: those problems were mainly solved by means of direct subtraction, whereas both strategies were used when the subtrahend was larger than the difference. This performance pattern was the same in each grade. These findings are of great relevance for mathematics education as they might challenge classroom practices that only focus on the routine mastery of direct subtraction.

Subtraction problems of the type $a - b = ?$ can be flexibly solved by means of various strategies. One way to solve them is by relying on the inverse principle between addition and subtraction (i.e., if $a - b = c$, then $b + c = a$) and asking yourself how much needs to be added to b to get to a . A rational task analysis indicates that this indirect addition strategy is particularly efficient on subtractions with relatively large subtrahends, such as $81 - 79$. This strategy can be clearly distinguished from the more common strategy of direct subtraction, in which the smaller number is directly subtracted from the larger one (e.g., $81 - 79 = .$ via $81 - 70 = 11$ and $11 - 9 = 2$). Previous work on children's and adults' use of indirect addition in the domain of elementary subtraction indicated that children hardly apply this strategy spontaneously, whereas adults solve subtractions efficiently and flexibly by means of indirect addition (see Verschaffel et al., 2010 for an overview). For the present study, we started from some intriguing results of post-hoc analyses of the study by De Smedt et al. (2010), in which third-grade children almost only reported the use of direct subtraction. If this was indeed the case, an increase in reaction times should have been observed from items with relatively small subtrahends ($81 - 7 = .$) over items with medium-sized subtrahends ($81 - 43 = .$) to items with relatively large subtrahends ($81 - 79 = .$), since subtracting a larger subtrahend requires more and/or larger calculation steps (Peters et al., in press). This reaction time pattern was not found: Problems with a relatively large subtrahend were solved significantly faster than problems with a medium-sized subtrahend, which indicates that the actual use of indirect addition might be greater than suggested by the verbal protocols. Therefore, these results justify the application of other (non-verbal) methods of inferring strategy use, which have already been successfully applied in the past, such as the regression-based approach (Groen & Poll, 1973; Woods et al., 1975) and the manipulation of presentation formats (Campbell, 2008; Peters et al., 2010). We presented 99 third- to sixth-grade children with 32 two-digit subtractions in 2 presentation formats, i.e., the standard subtraction format ($81 - 37 = .$) and an addition format ($37 + . = 81$). We first fitted children's reaction times to 3 regression models, which modelled the use of direct subtraction, indirect addition, and the switching between both based on the relative size of the subtrahend (see Groen & Poll, 1973; Peters et al., in press; Woods et al., 1975). For all four grades and for both formats, the model representing the switching between direct subtraction and indirect addition provided the best fit. In order to learn more about the characteristics that influence this strategy choice, we also compared performances between the two formats (see Campbell, 2008; Peters et al., 2010). We expected that the relative size of the subtrahend would only affect strategy choice when the distance between subtrahend and difference was rather large (as in $71 - 2 = .$ and $71 - 69 = .$) and not when these two integers were close to each other (as in $75 - 36 = .$ or $75 - 39 = .$), because in the latter case the computational advantage of one strategy over the other is not clear. However, a repeated measures ANOVA showed that small-distance problems with the subtrahend smaller than the difference (such as $75 - 36$) were solved preferably by means of direct subtraction, whereas both strategies were used to solve problems with the subtrahend larger than the difference (such as $75 - 39$). For the large-distance problems, strategies were chosen based on the relative size of the subtrahend, as expected: problems such as $71 - 2$ were solved by means of direct subtraction, whereas problems such as $71 - 69$ were solved with indirect addition. This performance pattern was the same in each grade. The only significant effect related to grade was a main effect on response times, showing that third-graders needed more time to solve the two-digit subtraction problems than the older children. To conclude, these results

reveal that primary school children from third grade on spontaneously and efficiently apply indirect addition on two-digit subtractions presented in the $a - b = \dots$ format. These results are thus in contrast with previous work on the use of this strategy, where verbal self-reports were used. Our findings can be of great relevance for mathematics education as they might challenge classroom practices that only focus on the routine mastery of direct subtraction.

SYMPOSIUM

Informing CSCL participants about their collaboration to promote collective and individual learning

Chairperson: Rupert Wegerif, University of Exeter, United Kingdom

Organiser: Alfonso Bustos, University of Barcelona, Spain

Manoli Pifarre Turmo, University of Lleida, Spain

Discussant: Paul A. Kirschner, Open Universiteit, Netherlands

Informing CSCL participants about their collaboration to promote collective and individual learning: Awareness tools to support collaboration Using research methods and tools along with a process-oriented approach is now common for achieving deeper understanding of learning processes in electronic environments (Gress, Fior, Hadwin, & Winne, 2010; Stahl, Koschmann, & Suthers, 2006; Suthers, Dwyer, Medina & Vatrappu, 2009). Three relevant aspects here are related to: How to capture the complexity of learning processes in CSCL; How to overcome the restrictions of analyzing the extremely complex CSCL environments by resorting to only one source of information or one single data analysis method (Dennen, 2008; Naidu & Jarvela, 2006), and How to inform CSCL participants about the whole process and their own individual implication to promote achievement of the desired objectives. This symposium will present and discuss several theoretical approaches and empirical results related to the importance of awareness in relation to CSCL. The symposium will contribute on research about the organizational aspects of CSCL activities and the possibilities and constraints of designing awareness tools to support different forms of collaboration among participants to encourage the collective and individual learning. The proposal has an important scientific and educational relevance in that it will help guide the design of more effective, efficient and satisfactory computer support scenarios for collaborative learning and discuss the uses and effects of awareness tools.

Incidence of group awareness information on students' perception about their CSCL processes

Manoli Pifarre Turmo, University of Lleida, Spain; Ruth Cobos, Universidad Autonoma de Madrid, Spain; Esther Argelagos, University of Lleida, Spain

For researchers in the fields of CSCW, it is of interest to establish how group awareness can be designed and implemented in such a way as to foster collaboration within computer-supported teams. User performance, user perception and satisfaction should be used as indicators of usefulness and usability of awareness features for a better group task resolution and in order to foster collaborative learning processes. This paper studies how the awareness services in the Knowledge Management system called KnowCat might enhance students' group processes to solve a collaborative learning task. The study focuses in knowing students' perception about the utility and the impact of the different awareness services used in their group learning processes. A questionnaire was used to assess seventeen university students' opinion and perception about how, when and for what they used the awareness services. Over 80% of students reported high levels of frequency of use of the different awareness information provided by the KnowCat system. Most of students agreed that the awareness information increased their perception of working collaboratively with other classmates. Moreover, the awareness information provided to the students seemed to help them to orientate, monitor and regulate their collaborative processes. In this line of argument, the widgets most used by students were those that gave graphical information about others users' contribution. Students revealed that knowing what, where and how many their classmates were contributing acted as a positive feedback which encouraged their participation and orientated their own cooperation behaviour and their contribution to the collaborative work.

Theoretical and educational significance

It is well known that members of work groups need information about one another, about shared artefacts and about the group processes. This information is often referred to as group awareness (Briggs, 2006). When this information is provided to the different group members and individuals receive feedback about highly cooperative co-workers individuals increase their rate of cooperation. For researchers in the fields of Computer-Supported Collaborative Work, it is of interest to establish how group awareness can be designed and implemented in such a way as to foster collaboration within computer-supported teams.

However, previous research has shown that the type of information presented and the design of presentation formats can influence people's experiences, perceptions and individuals' contribution behaviour (Ware, 2000). Four types of awareness that are relevant in computer-supported collaborative work are highlighted, named as informal awareness, social awareness, group-structural awareness and workspace awareness. Besides, many researchers highlighted the necessity to shift the focus to human-centred perspective on awareness in which features enabling mutual awareness of group members should be empirically tested with respect to their individual utility and group support. User performance, user perception and satisfaction should be used as indicators of usefulness and usability of awareness features for a better group task resolution and in order to foster collaborative learning processes (Gross, Stary & Totter, 2005).

In this vein, this paper studies how the incorporation of awareness services in the Knowledge Management system called KnowCat (Cobos, 2003), which supports collaborative knowledge construction can improve the students' group processes to solve a collaborative learning task. The study is centered in knowing students' perception about the utility and the impact of the different awareness services used in their group learning processes.

The proposed prototype of awareness services appears in a console in the bottom part of KnowCat. The Awareness console is composed by the following six awareness widgets: Registered Users. It provides brief information about the registered users in KnowCat. On-line Users. It provides relevant information of the on-line users in KnowCat: contact data and the current location of a selected user. Radar View. It provides the locations of the on-line users through a replicate knowledge tree of the KnowCat site. Moreover, in each topic of the replicated knowledge tree the number of the on-line users, who are interacting in each topic, is shown. History View. It provides chronically and graphically information about the realised tasks of a selected user. Participation view. It provides in a table information about the rates of users' participation in the different activities and knowledge spaces of the system. Notes View. It provides graphically information about interaction among users in the annotating task. Users can know which document was annotated, who annotated it and what was annotated. With this widget the users can see graphically how the annotation process is going on among the different group members.

Methodology

Participants

Seventeen university students participated in the study (Universitat de Lleida, Spain). They used KnowCat during a one-term period of one regular university course in the Psychopedagogy degree.

Procedure

Students used KnowCat to solve in groups two problems or case-study. Students had to design an educational intervention to attend two children with learning difficulties.

At the end of the semester students were asked to answer a questionnaire in relation to their collaborative work with the system. In the questionnaire there were eight groups of questions related to the students' use of the different elements of the KnowCat system, one of these groups referred to the awareness console.

Findings and Discussion

Over 80% of students reported high levels of frequency of use of the different awareness information provided by the KnowCat system. Most of students agreed that the awareness information increased their perception of working collaboratively with other classmates because the awareness services informed them efficiently about when and who has contributed with what and where.

The awareness widget most used by the students was the "participation view". This result is in line of previous research that confirms individuals orientate their own behaviour toward that of the other members of the group (Kimmerle & Cress, 2009). Students revealed that knowing what and how many their classmates were contributing acted as a positive feedback which encouraged their participation.

The awareness information catalogued by the students as the most useful were the "History view" and "Notes view", both widgets gave graphical information about users' contribution. Especially the "Notes view" gave graphical information about the annotation task. This task was relevant in the instructional use of the KnowCat system, students were strongly encouraged to use the annotation element as a way to scaffold and help a classmate to improve his/her work. As it is argued in previous research (Kimmerle & Cress, 2009) students highlighted that knowing graphically which documents were annotated most, who annotated and what was annotated orientated their own cooperation behaviour and their contribution to the collaborative work.

To sum up, the awareness information provided to the students during their collaborative work using the KnowCat system seemed to help them to orientate, monitor and regulate their collaborative processes. In future work we will intent to confirm this exploratory result with a larger number of students and assessing in more detail students' work using the system and how it is evolving during time as students gain experience in using the awareness information reported by the KnowCat system.

References

- Briggs, R. O. (2006). On theory-driven design and deployment of collaboration systems. *International Journal of Human-Computer Studies*, 64, 573-582.
- Cobos, R. (2003). Mechanisms for the Crystallisation of Knowledge, a proposal using a collaborative system. Doctoral dissertation. Universidad Autónoma de Madrid.
- To sum up, the students have declared that the information about how the classmates
- Gross, T., Stary, C. & Totter. User-Centered Awareness in Computer-Supported Cooperative Work-Systems: Structured Embedding of Findings from Social Sciences. *International Journal of Human-Computer Interaction*, 18 (3), 323-360
- Kimmerle, J. & Cress, U. (2009). Visualization of group members' participation. *Social Sciences Computer Review*, 27 (2), 243-261
- Ware, C. (2000). *Information Visualization: Perception for design*. San Diego, C.A: Academic Press.

The collaborative learning activity reflect on the Computer Learning Environment and its impact on

Margarida Romero, Esade, Spain

The collaborative learning activity reflect on the Computer Learning Environment and its impact on the students' organizational and knowledge awareness. In distance Computer Supported Collaborative Learning (CSCL) tasks, the learners' activity is not always reflected through the Computer Learning Environment (CLE). The lack of reflection of the learners' activity hinders the development of a correct intersubjective perception of the teammates' activity (group awareness) within the group members. A low level of reflection of the collaborative learning activity could lead the learners' to underestimate their teammates' engagement in the CSCL task and develop a more negative group awareness of their teammates' organization and knowledge. Aiming to promote a better group awareness, we studied the impact of a reflective learning tool providing the students with a collaborative representation of the teammates' status and activity during the duration of the CSCL task. We analyze the impact of the Collaboration Awareness Tool EuroCAT both in terms of organizational awareness (perception of the teammates' organization and contribution) and knowledge awareness (perception of the teammates' knowledge on each of the learning objectives of the task). We analyze then the differences of this tool impact in the evolution of the students' organizational awareness and the evolution of the knowledge awareness within the task duration.

Theoretical and educational significance

Learners enrolled in Virtual Campus (VC) programs may have temporal or location constraints for attending the traditional university. For them, the VC spatiotemporal flexibility is both a necessity and a challenge for the regulation of their learning process on an individual and collective level. In collective learning situations in the VC, students not only face the difficulties of their own constraints, but they should consider their teammates' constraints for organizing the Computer Supported Collaborative Learning (CSCL) task. Nevertheless, in distance learning, the learners' activity is not always reflected through the Computer Learning Environment (CLE). The findings suggest that a lack of reflection of the teammates' activity and status through the CLE could hinder the group awareness development process. In CSCL, group-awareness refers to the understanding of the activities of others, which provides the background of one's own activity (Dourish & Bellotti, 1992). This intersubjective perception consider the knowledge of who is working and what has happened and how (Dix, 1997). For the last years, group awareness has been an emerging topic in research on CSCL, considering the study of group awareness typologies (Gross, Stary & Totter, 2005) and its development and its impact on the knowledge construction and convergence process, the social relations within the group and the performance impact of organizational and knowledge awareness (Bodemer & Dehler, 2010).

Aims and methodology

This study is focused on the impact of the mirroring capabilities of the CLE on the group awareness development difficulties during long term collaborative tasks. The findings suggest that the lack of reflection of the learners' activity hinders the development of a correct intersubjective perception of the teammates' activity (group awareness) within the group members. A low level of reflection of the collaborative learning activity could lead the learners' to underestimate their teammates' engagement in the CSCL task and develop a more negative group awareness of their teammates' organization and knowledge (Romero, Demeure & Lambropoulos, 2010).

Aiming to promote a better group awareness, we studied the impact of a reflective learning tool providing the students with a collaborative representation of the teammates' status and activity during the duration of the CSCL task. We analyze the impact of the Collaboration Awareness Tool EuroCAT both in terms of organizational awareness (perception of the teammates' organization and contribution) and knowledge awareness (perception of the teammates' knowledge on each of the learning objectives of the task). We analyze then the differences of this tool impact in the evolution of the students' organizational awareness and the evolution of the knowledge awareness within the task duration. We analyze the impact of the tool creating a quasi-experimental study including groups using the Collaboration Awareness Tool EuroCAT and control groups.

We considered some individual traits of the students and the group characteristics, such the group size and the degree of previous activity within the group members that we considered as the group history.

Findings and discussion

Results of the study indicate that not only the reflection capabilities of the CLE (use of the Collaboration Awareness Tool EuroCAT) but also the group history are important factors in the development of the organizational group awareness in long term CSCL tasks. Considering the group awareness as a perception of the teammates' status and activity, we could consider that the group will increase this group awareness throughout all their previous interactions before the task (group history) and duration of their collaboration.

References

- Bodemer, D., & Dehler, J. (in press). Group Awareness in CSCL Environments. *Computers in Human Behavior*. doi:10.1016/j.chb.2010.07.014.
- Dix, A. (1997). Challenges for Cooperative Work on the Web: An analytical approach. *Computer-Supported Cooperative Work: The Journal of Collaborative Computing*, 6 pp. 135-156.
- Dourish, P. & Bellotti, V. (1992). Awareness and Coordination in Shared Workspaces. *Proceedings of the ACM Conference on Computer-Supported Cooperative Work CSCW'92* (Toronto, Ontario), 107-114. New York: ACM.
- Gross, T., Stary, C., Totter, A. (2005). User-Centered Awareness in Computer-Supported Cooperative Work Systems: Structured Embedding of Findings from Social Sciences. *International Journal of Human-Computer Interaction*, 18, 323-360.
- Romero, M., Demeure, V. & Lambropoulos, N. (2010). Group awareness in time-on-task regulation in CSCL. *Self-regulated Learning in Technology Enhanced Learning Environments: Challenges and Promises*. EC-TEL. Barcelona, 1 October, 2010.

Supporting Online Learning with Distributed Teaching Presence indicators

Alfonso Bustos, University of Barcelona, Spain; Cesar Coll, University of Barcelona, Spain; Anna Engel, University of Barcelona, Spain

Recent years have seen the development of a particular interest in the presentation of the output of Interaction Analysis (IA) in real-time (usually in a visualized form) to the participants in online learning environments to support learning and collaboration processes. However, there is a clear lack of proposals that incorporate a set of theoretically grounded IA indicators with a high level of interpretative capacity. This paper focuses on a number of potentially useful IA indicators concerning Distributed Teaching Presence and how the delivery of information related to these structural indicators has an impact on the level of the distribution of teaching presence between participants and on the learning process and the results. Three different conditions of information delivery were probed (no-information, personal and private information, and public personal and group information) with three different groups working in the same task in a Moodle forum. The results show that the groups that received information about DTP indicators (groups 2 & 3) exhibit the highest level of distribution and the highest diversity of profiles associated with the exertion of teaching presence. Finally, we will discuss some issues related with providing users with activity information in relation to the applied pedagogical methodology, the need to present information more efficiently, and the need to study the impact of previous information and training in using cues related to access, participation and connectivity in online learning environments.

Theoretical and educational significance

Interaction Analysis, IA, in computer mediated activities is usually based on the aggregation of interaction data from logfiles in a set of indicators, which are presented to the participants (usually in a visualized form and in real-time) in order to increase the effectiveness of learning and collaboration processes in online learning environments. According

to Dimitracopoulos (2008), one of the main challenges is to define theoretically grounded IA indicators with a high level of interpretative capacity, that is to say, indicators related with the quality of collaboration.

This contribution focuses on a number of potentially useful IA indicators concerning Distributed Teaching Presence, DTP. From our theoretical viewpoint, the concept of Teaching Presence (Anderson, Rourke, Garrison & Archer, 2001) has some similarities with the concepts of support adjustment and educational influence (Coll, Onrubia & Mauri, 2008). Seen from this perspective, progress in students' learning is mainly related to the educational influence of others, that is to say, the support and help provided through the students' and teachers' joint activity. Sometimes the support is mainly provided by the teacher, but other times it is highly distributed between participants. In this latter case, we talk of DTP. Collaborative learning, especially CSCL, requires a high level of DTP.

Our previous research, based on a multi-method approach to the study of the DTP, combining structural analysis of the participants' activity with content analysis of the participants' contributions (Coll, Bustos & Engel; in press; Coll, Engel & Bustos, 2009), has demonstrated the usefulness of a set of indicators of structural activity for the construction of participants' profiles in relation to the exertion of the Teaching Presence. Our model of structural analysis includes eight indicators. Five of them concern participants' presence (access and participation). The other three deal with the connectivity between the participants (reciprocity and responsiveness). The information provided by our model of structural analysis could be useful for students' regulation of group learning processes and the self-regulation of individual learning processes.

Aims and methodology

The objective of the present work is to analyze whether the delivery of information related to these structural indicators to the participants has an impact on the level of the distribution of teaching presence between participants and on the learning process and results.

The analyzed data come from a course included in a postgraduate program in Educational Psychology at the University of Barcelona. The participants consisted of three groups of students (6 members per group) who carried out the same learning task – the elaboration of a synthesis of the core content – through an online forum in the Moodle platform during four weeks. Group 1 was used as control group and its members did not receive any information about their activity. The other two groups were provided with information about their activity (access, participation and connectivity) on three occasions. In case of group 2, the members were personally and privately informed only about their own values of the indicators and their own profile. In case of group 3, the report was carried out collectively and all the members had access to their own values of the indicators and their own profiles as well as to the values of indicators and profiles of the other members in the group.

The values of the indicators were calculated on the basis of the logfiles that were provided by the system and were delivered by an adapted version of the GISMO system. The primary body of data used in the analysis of manifestations of teaching presence consists of all participants' contributions. This analysis applied a system of categories that considers three dimensions: the management of the social participation, the management of the academic task and the management of the meanings (Coll, Bustos & Engel, in press).

Findings and discussion

The results show a clear difference between the three groups with regard to the level of the distribution of the teaching presence between the participants, the dynamics of the collaborative work during the activity, and the learning results. Group 1 shows the lowest level of DTP, while group 3 exhibits the highest level; group 2 is at an intermediate level. Concerning the dynamics of the interaction and the collaboration, the most significant difference between the groups has to do with the occurrence of the noticeably differentiated activity profiles. The number and the diversity of profiles are higher in groups 2 and 3. These profiles reflect different modalities in the exertion of teaching presence and can be interpreted in terms of the assumption of roles within the framework of the online collaborative work. The evaluation that the teacher makes of the synthesis shows better results in groups 2 and 3, in contrast to group 1.

This work leaves some important questions unresolved, such as the issue of providing users with activity information relevant and adjusted to the applied pedagogical methodology, the need to examine alternative methods in order to present information more efficiently, or the need to study the impact of previous information and training in using cues related to access, participation and connectivity in online learning environments.

References

Anderson, T., Rourke, L., Garrison, R. & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, 5(2), 1-18.

Coll, C., Bustos, A. & Engel, A. (in press). Perfiles de participación y presencia docente distribuida en redes asíncronas de aprendizaje: la articulación del análisis estructural y de contenido. *Revista de Educación*, (accepted).

Coll, C., Engel, A. & Bustos, A. (2009). Distributed Teaching Presence and Participants' activity profiles: a theoretical approach to the structural analysis of Asynchronous Learning Networks. *European Journal of Education*, 44(4), 521-538.

Coll, C., Onrubia, J. & Mauri, T. (2008). Ayudar a aprender en contextos educativos: el ejercicio de la influencia educativa y el análisis de la enseñanza. *Revista de Educación*, 346, 33-70.

Dimitracopoulou A. (2008). Computer based Interaction Analysis Supporting Self-regulation: Achievements and Prospects of an Emerging Research Direction. *Technology, Instruction, Cognition and Learning (TICL)*, 6(4), 291-314.

SYMPOSIUM

Learning from Multiple Documents: Individual Differences and conditions that foster comprehension

Chairperson: Marc Stadtler, University of Muenster, Germany

Organiser: Jean-Francois Rouet, Universite de Poitiers, France

Marc Stadtler, University of Muenster, Germany

Discussant: Rainer Bromme, Universitat Muenster, Germany

With the advent of the Internet in educational settings, research has gained in influence that examines how readers of different age levels comprehend multiple documents, which revolve around a shared topic. Indeed, there is growing evidence that having students read multiple texts can lead to deeper understanding of complex topics, compared to situations where they learn from a single source. There are, however, concerns that not all teenage readers readily possess the cognitive and language skills needed to face the specific requirements of reading and comprehending information across multiple and possibly heterogeneous documents. Therefore, researchers have tried to identify those cognitive processes and underlying belief systems, which differentiate between good and poor comprehenders of Multiple Documents. Within this line of research, variables such as prior knowledge, Epistemological Beliefs, Need for Cognitive Closure and the ability to accurately monitor one's comprehension have emerged as highly influential determinants of Multiple Documents comprehension. At the same time, research is burgeoning, which examines the instructional conditions that may promote effective reading, comprehension, evaluation and integration of multiple documents. The phrase "Instructional conditions" as we use it encompasses techniques such as preinstructions, guidelines, cueing, or more elaborated training curricula. The purpose of the symposium is to shed some light on what works, for what students and why. Presentations will be grounded into recent theories of document comprehension and present original empirical data regarding individual differences and the effectiveness of one or several of the aforementioned techniques with populations ranging from primary school to college students.

Comprehending multiple documents: Do readers benefit from linguistic markers of conflict?

Marc Stadtler, University of Muenster, Germany; Lisa Scharrer, University of Muenster, Germany

Our study examined whether rhetorical connectors (RC) in multiple science documents facilitate lay readers' acquisition of controversial information. This effect should be moderated by the goal readers pursue: Goals emphasizing argumentative differences between documents should amplify the beneficial effect of RC compared to goals requiring readers to focus on facts. We investigated this assumption with 121 undergraduate readers in a 2 (reading goals: "Summary" vs. "Argument Analysis Instruction") * 2 (presence of RC preceding claims) between-subjects design. Participants read nine medical web sites containing conflicting information under time pressure. Logfiles were recorded during reading. After reading, knowledge of intertextual conflicts and its application in a written communication situation were measured. Results revealed a beneficial effect of RC in terms of knowledge about conflicting information. Also, readers receiving texts with RC included more explicit references to the conflicting nature of information when communicating their knowledge to a fictitious friend. Navigational data supported the results by showing that participants receiving RC accessed texts that contained pairs of conflicting claims more often directly after one another. The expected interaction between reading instruction and RC was not supported by our data. Summarizing, lay readers benefitted significantly from the presence of RC when dealing with multiple documents. This result was obtained regardless of reading goal. Currently, we extend the picture by examining reading goals that involve less focus on macro-structure formation. On an educational level our study underlines the importance of metatextual knowledge when accessing large information resources, which require fast and efficient text processing.

Perspective and source effects when high-school students read multiple contradictory documents

Raquel Cerdan, Faculty of Psychology. University of Valencia, Spain; M^o del Carmen Marin Perez, Catholic University of Valencia, Spain; Eduardo Vidal-Abarca, Universidad de Valencia, Spain

This proposal aims to test the effects of perspective when high-school students read conflicting information from multiple documents to perform a specific task, as well as study if the trustworthiness of a source exerts any kind of influence on students' decision to read and use information from a particular document. We complementarily analyze students' ability to judge sources in terms of trustworthiness and how the interaction with the information may significantly modify students' judgments. Results seem to indicate that high-school students are able to correctly identify sources as untrustworthy without accessing the contents. However, for more trustworthy sources an interaction with the contents seems to be necessary. Results also indicate that perspective instructions can help students focus on trustworthy sources and, in general, having a perspective, irrespective of which kind, seems to focus students on the use of perspective-related contents from trustworthy sources, in contrast to a neutral condition.

Aims

McCrudden & Schraw (2007) show how that the way students interact with a text is mediated by the instructions they are presented with, which significantly modifies the reading process. Specifically, perspective instructions prompt readers to use background knowledge to evaluate text from an assigned point of view. Research on perspective in single texts demonstrated that readers confer relevance on text segments that are consistent with the assigned perspective (Pichert & Anderson, 1977). This proposal will test the effects of perspective when high-school students read conflicting information from multiple documents to perform a specific task, as well as study if the trustworthiness of a source exerts any influence on students' decision to read and use information from a particular document.

Method

Participants. They were 59 high-school school students, with a mean age of 16 years old. **Materials.** We selected six texts of approximately 300 words each on the topic of transgenic food (see table 1 in the appendix). They varied as regards trustworthiness, with three more and the other three less trustworthy (ranking task by expert biology teachers). The texts also varied as regards level of agreement towards the topic: 2 in favor of transgenic food, 2 in opposition and 2 neutral. We created three conditions that varied according to the perspective assigned to students. The task consisted on providing an answer to the convenience of using transgenic foods, from the perspective of a green activist (against condition), from the perspective of a businessman who owns a company of transgenic food (in favor condition) and finally to generally justify if it is convenient or not to use transgenic food (neutral condition). We developed a trustworthiness ranking task to be filled in before and after the experiment. Students were presented with a list of the six sources that they would read in the experiment. These sources contained source cues and content cues that indicated their trustworthiness and content type. They were asked to order them according to how trustworthy they considered them. Those ranked in position 1 to 3 were classified as trustworthy, whereas those classified from 4 to 6 were classified as untrustworthy.

Procedure. The experiment lasted three sessions. In session 1 students performed the trustworthiness ranking task. Session 2 was dedicated to the actual experiment. It was conducted using Read&Answer, software that presents the texts and task on the computer screen using a masking procedure that allows the registration of the reading behavior. Participants were presented with an instructions page where they read the task according to the assigned perspective. The six documents were listed below in a google-like display, and students were told to read the sources that helped them answer their question. Afterwards, students could access the documents and a task screen to answer the assigned question. In session 3, participants performed the same trustworthiness ranking task as the one in session 1.

Analysis and Results

Trustworthiness analysis. We checked whether the experts' classification matched students' classification of sources. We performed chi-square tests, with students' rankings to each of the source (trust, 1; untrustworthy, 0) before and after the experiment (moments 1 and 2). We found significant differences for the following sources: Blog moment 1, p We also found significant differences for the sources: OMS in moment 2 and Ministerio in moment 2. These two trustworthy sources were not significantly differentiated by students before the experiment. It was only after the interaction with the contents that students could correctly classified them. Please note that this did not happen for the untrustworthy sources. **On-line and task analysis.** We analyzed how perspective affected the type of texts read and from which sources students extracted the information. We considered the percentage of perspective-related texts and percentage of trustworthy and untrustworthy texts. We performed Anovas, with independent measure Perspective and dependent measures the above variables. Results were significant for Percentage of trustworthy texts, $F(2, 50) = 15.03$, p Favor, p Neutral, p Against, p We analyzed from which sources students extracted the information. First, we considered the number of ideas from perspective-related texts. We also counted the number of ideas from trustworthy and untrustworthy documents. Results were significant for the three dependent measures.

Students in the in favor condition included more perspective-related ideas than those in the neutral condition $F(2, 50) = 7.25, p$. Discussion Our results indicate that high-school students are able to identify sources as untrustworthy without accessing the contents. However, for more trustworthy sources an interaction with the contents is required. On the other hand, it seems that perspective instructions helped students focus on trustworthy sources and induced the use of perspective-related contents from trustworthy sources. The educational implications will be discussed.

References

- McCrudden, M. T., & Schraw, G. (2007). Relevance and goal-focusing in text processing. *Educational Psychology Review*, 19, 113-139.
- Pichert, J.W. & Anderson, R.C. (1977). Taking different perspectives on a story. *Journal of Educational Psychology*, 69 (4), 309-315.

Teaching fourth and fifth graders to evaluate the authority of information sources

Monica Macedo-Rouet, @4 Teleport 1, France; Jean-Francois Rouet, Universite de Poitiers, France

The present study investigated the effects of instruction about multiple sources on students' ability to evaluate content information based on the cognitive authority of the sources. Participants were 96 students from 4th and 5th grades (mean age = 10.3 years). They received 30-minutes instruction on the authority of information sources and completed a comprehension test with questions on sources and authority one week later. A significant effect of instruction was found, as well as a significant instruction by comprehension level interaction. Poor comprehenders in the instruction group showed higher performance as compared to the control group. The number of students who were able to correctly identify source authority was higher in the instruction group than in the control group. The results are encouraging because effects could be found with one only instruction session. There are reasons to believe that this type of intervention can be easily adapted to school organization. However, other requirements, among which teacher training and adaptation to students' initial comprehension level, must be attained before this instruction can be implemented in school classes.

Recent studies show that elementary school students have a hard time evaluating information sources on the Internet, because they do not clearly distinguish advertisement from content and are misled by the complexity of information display in Web documents (Eastin, 2006; Valcke et al., 2007). Nevertheless, there is evidence that students possess selective criteria to judge the authority of people who give commands to them (e.g. the teacher, other children, etc.; Laupa, 1994). Thus, students possess selective authority criteria, but they are not necessarily efficient in evaluating sources when they are reading and searching for information.

Before they enter middle school, students have relatively few opportunities to learn how to evaluate multiple sources. Access to information sources at school has grown exponentially, but topics such as drawing pupils' attention to authors and publishers of a text, their affiliations, and the context of publication are not regularly taught in the elementary grades (Goldman et al., 2009). Dealing with multiple sources is a complex activity that requires a number of comprehension and documentary skills. Therefore, training is needed to improve students' ability in critically learning from sources (Britt & Angliskas, 2002; Rouet, 2006).

Some researchers have implemented and tested information skills training programs at the elementary school level (Gerjets & Hellenthal-Schorr, 2008; Kuiper et al., 2008; Vries et al., 2008). These studies have obtained a moderate success in enhancing students' evaluation skills. Results suggest that training programs should focus more on content than on technical issues of information search, and that students should be encouraged to reflect on their searches in order to improve their understanding of information found on the Internet.

We conducted a quasi-experimental study using a specific intervention that delivers instruction on the authority of sources and encourages students to establish links between sources and content. Our hypothesis was that instruction would have a positive effect on student's comprehension of "who said what" in the text, and on students' recognition of authority, defined as "the most knowledgeable" source. We also expected that poor comprehenders would benefit from the instruction more than good comprehenders, because of the results from prior studies (Raphael & Wonnacott, 1985).

Method

Participants were 96 students (59 male, 37 female) from 4th and 5th grade classrooms of two French elementary schools. Students' age ranged from 9 to 11 years ($M = 10.3, SD = 0.68$). Prior to instruction, students' completed a

standardized comprehension pre-test (Aubret & Blanchard, 1991) and were categorized as "good" or "poor" comprehenders.

Four argumentative texts dealing with familiar topics were developed for the purposes of the study. Each text presented a controversy between two sources of information, represented by characters in the text. We used simple texts instead of multiple documents in order to limit the quantity of information to be read and allow children to complete the exercise in a 30 minutes session. Each text was accompanied by 4-5 multiple choice questions. There were two types of question: (a) source-content comprehension ("according to the nutritionist..."), (b) recognition of authority ("who is the most knowledgeable character about [subject]?").

The instruction consisted of five steps of mediated discussion in small groups. The general goal of this approach was to encourage students to identify the multiple sources presented in the texts, to establish links between sources and content ("who said what"), and to identify cognitive authorities. Inspiration was sought in effective comprehension instruction practices, such as "reciprocal teaching" (Palincsar & Brown, 1984), from which we borrowed the techniques of asking/answering questions and making predictions.

The experiment was run in two sessions of 30 minutes each. The first session was dedicated to instruction, the second session to the post-test. Students worked in groups of eight, with one computer per pupil. Prior to the experiment, students received specific instruction (approximately 40 minutes) on how to use the online software.

Results

The mean scores for good and poor comprehenders were respectively: 83% and 70% (instruction group), and 82% and 54% (controls). A main effect of instruction was found ($F(1,91) = 3.97$, $p < .042$), as well as a main effect of comprehension level ($F(1,91) = 12.58$, $p < .021$). Additionally, there was a significant interaction between comprehension level and instruction ($F(1,91) = 4.20$, $p < .044$). Students in the instruction group outperformed controls, only if they were poor comprehenders.

Concerning the recognition of authority, 87% of the answers in the instruction group corresponded to the most knowledgeable source with a correct argument, against 74% in the control group. More interestingly, the non expert represented only 2.2% of the answers in the instruction condition and 10% of the answers in the control condition. The distribution of authority scores was analyzed with chi-square statistics. The results ($\chi^2(2) = 3.64$, p

Conclusions

The results of this study are encouraging because significant effects could be observed within a short period of time. With only two sessions (training + test) students showed progress in comprehending the perspectives of multiple sources in argumentative texts. Anecdotal data shows (a) that students adapt very easily to the instructional context because they are used to work in small groups (b) that they engage in lively discussions, especially when texts deal with subjects familiar or interesting to them. Thus, it is reasonable to think that this instruction can be easily implemented in elementary school classes, although other requirements exist in terms of teacher training and class organization. In the long run, the instruction could be adapted to the online system to allow for group discussions with automatic feedback from the system. This adaptation would require further development and observations in class, but the current system can already be used to archive texts and questions that can be used by the teacher in his regular class.

SYMPOSIUM

Causes and effects of biased teacher judgments

Chairperson: Detlef Urhahne, University of Munich, Germany

Organiser: Christian Lorenz, University of Bamberg, Germany

Detlef Urhahne, University of Munich, Germany

Discussant: Pascal Bressoux, Université Pierre Mendès-France, France

Teachers' judgments about student achievement should be as fair and objective as possible. However, there are often cases where teachers misjudge student performance or have erroneous expectations about student achievement. Among the different factors that might impact teacher judgments, characteristics of the teacher, the student, the test, and the teacher ratings have been identified. In the symposium, we will focus on some of these characteristics and examine which of them appear to be meaningful and which do not. Thereby, indications of stereotyping by teachers can be revealed and recommendations about how to overcome them can be made. Furthermore, it is well established

that erroneous teacher expectations can influence student achievement as shown by the seminal work of Rosenthal. However, whether an expectation effect can also be detected at the whole class level and if contrasting teacher expectations positively or negatively influence the achievement of whole classes is an underexplored area. Moreover, whether biased teacher judgments influence the motivation and emotions of students and to what extent the impact of erroneous teacher judgments is mediated by causal attributions has been infrequently investigated. Knowledge about the effects of biased teacher judgments has implications for how negative effects could be counteracted and how positive effects could be exploited. In this sense, the symposium contributes to strengthen the sensibility about biased teacher judgments, to reflect on the causes and effects, to elucidate the advantages and disadvantages, and to derive practical conclusions.

Teacher Judgment, Student Motivation, and the Mediating Effect of Attributions

Detlef Urhahne, University of Munich, Germany; Ji Zhou, University of Munich, Germany; Mingjing Zhu, University of Munich, Germany; Jiannong Shi, Chinese Academy of Sciences, Beijing, China

Based on Weiner's attributional theory of intrapersonal motivation, the mediating effect of attributions on teacher judgment and student motivation was investigated. In two studies, 144 German and 272 Chinese fourth grade elementary school students were tested on their mathematical achievement, causal ascriptions for success and failure, expectancy for success, self-concept, and test anxiety. Mathematics teachers were asked to estimate students' performances on the applied mathematics test, which led to either an accurate judgment, underestimation, or overestimation of students' actual performances. One year later, Chinese students were retested on their mathematical achievement. Results show that the attributional pattern of underestimated students was maladaptive compared to overestimated students. Attributions mediated the effect of teacher judgment on students' expectancy for success, self-concept, test anxiety, and, in case of the Chinese sample, mathematics achievement of the next year. The results indicate the important role of student attributions as a function of teacher judgment and imply attribution retraining as a possible intervention.

Teachers' judgments have a decisive influence on students' motivation to learn and their willingness to put effort into tasks. However, there is no simple, direct relation between teacher judgment and student motivation. Each student perceives teacher judgment differently, and students' explanations vary for why a teacher has judged a performance in a certain way (Weiner, 1986). The differences in students' causal attributions have an impact on motivational consequences such as expectancy for success, self-efficacy perceptions, and affective reactions (Weiner, 1992). Accordingly, it can be assumed that students' attributions might work as mediators between teacher judgment and student motivation.

Meta-analytic studies reveal that teachers are relatively accurate in ranking students according to their actual achievement (Hoge & Coladarci, 1989; Sudkamp, Kaiser & Moller, submitted), however, they show a general tendency to overestimate students' test performances. There is generally a larger group of overestimated students and a smaller group of underestimated students. In an investigation of fourth grade elementary students in Austria, a group of underestimated students was contrasted with a group of accurately estimated and overestimated students (Urhahne, Chao, Luttenberger, Florineth, & Paechter, in press). Research results revealed that underestimated students had the same test performance as non-underestimated students but showed lower expectancy for success, displayed lower academic self-concept, and felt more test anxiety. Two other investigations, in which underestimated and overestimated students were compared on their motivational-affective traits, confirmed these findings (Urhahne et al., 2010). Again, the pattern emerged that underestimated students had lower expectancy for success, a lower self-concept, and more test anxiety than overestimated students.

Research Hypotheses

According to Weiner's model of interpersonal motivation, it is assumed that student attributions will work as mediators between the relationship of teacher judgment and student motivation. The research hypotheses of the two studies are the following:

1. Underestimated students show different attribution patterns for success and failure in comparison to overestimated students.
2. Students' attributions work as mediators between teacher judgment of student performance and psychological and behavioral consequences for the students.
3. The mediation model can be equally supported for a German and a Chinese sample.

Method

Participants were 144 German and 272 Chinese fourth grade elementary school students who were tested with a standardized mathematics achievement test. In addition, students indicated their causal ascriptions for success and failure, expectancy for success, self-concept of ability, and test anxiety by ratings on a self-description questionnaire.

Their mathematics teachers were asked to estimate students' performances on the applied mathematics test, which led to either an accurate judgment, underestimation, or overestimation of students' actual performances. One year later, Chinese students were retested on their mathematical performance by another standardized mathematics achievement test for fifth graders. Students' retesting could only be done in China as in Germany students change after the fourth grade from primary school to different secondary schools.

Results

In Germany, underestimated students attributed success more on variable causes like chance but less to stable causes like ability. They also attributed success less on positive emotions but blamed failure more on negative emotions. In China, underestimated students attributed success more to chance and failure more to emotions, task difficulty, and effort than overestimated students. This pattern could be regarded as maladaptive as underestimated students attributed success to a variable and external cause and failure to a stable or internal cause.

Hierarchical regression analyses for the dependent variables expectancy for success, test anxiety, and academic self-concept were conducted to test the mediating effect of causal attributions. In the first step, teacher judgment was entered into the regression models. In the second step, possible attributional mediators indicated by significant correlations with teacher judgment and student motivation, were added to the regression models. In the German sample, the effect of teacher judgment on students' expectancy for success, test anxiety, and academic self-concept was mediated by students' causal ascriptions. In the Chinese sample, the effect of teacher judgment on student motivation in all three cases was largely reduced after introducing causal ascriptions into the regression models.

In a final analysis, Chinese teachers' judgments were regressed on mathematics achievement of the next school year. An initial significant beta coefficient revealed that underestimated students showed weaker performance in the follow-up test than overestimated students. In the second step of the regression analysis, causal attributions were introduced into the model and chance attribution of success and ability attribution of failure emerged as mediators. In the third step, when also psychological consequences were taken into account, the effect of teacher judgment on mathematics achievement completely disappeared. Teacher judgment was fully mediated by chance attribution of success, expectancy for success, and mathematical self-concept.

Discussion

In two studies in elementary schools, the effects of teacher judgment on student motivation were closely examined, and the assumption that the relationship is mediated by student attributions was tested. Underestimated students attributed success more to external causes and failure more to internal causes in comparison to overestimated students. In both studies and for most of the psychological consequences, ability and emotion attributions have worked as mediators.

As attributional patterns are malleable and can be changed by attribution retraining (e.g., Carr & Borkowski, 1989), underestimated students can be encouraged to reconsider maladaptive attributions and to adopt more adaptive attributions instead. Another suggestion derived from the research results is that teachers can support students' motivation by persuading them to adopt a more positive attribution style. The support can be given immediately after test results are informed to the students and can even be a part of the explanation of grades. Teachers might inform students that abilities are malleable or that emotional reactions depend upon cognitive evaluations and are under personal control. Changing students' perceptions of the controllability of the causes could prevent a decrease of motivation and performance in view of unfavorable teacher judgments.

Direct vs. indirect teacher judgments: Differences regarding students' social status and gender

Christian Lorenz, University of Bamberg, Germany; Cordula Artelt, Bamberg University, Germany

Teachers' diagnostic competence is regarded as a core competence in school settings. Nevertheless, there seem to be differences in the accuracy of teacher judgments depending on students' gender and socio-economic status as well as on the information the teacher has about the underlying tasks. In the current study it was explored to which extent teacher judgments are biased by the mentioned student attributes and assessment methods. For this sake, students from two subsamples of the Bamberg BiKS study attending grade one ($N = 385$) and five ($N = 482$) were tested in vocabulary and text comprehension, while their teachers estimated their individual achievement both directly (task specific) and indirectly (without reference to the particular tasks) by means of a questionnaire. The results for both grade levels show that there are barely significant biases depending on students' gender and socio-economic status, neither for direct nor for indirect judgments. However, direct judgments were even more objective and less biased than indirect judgments. These findings implicate that stereotypes play only a subordinated role in teacher judgments.

Teachers' diagnostic competence is sometimes claimed to be a core competence for high quality teaching. It is necessary that teachers judge their students fairly and objectively. In general, two methods of assessing teacher judgments are applied in the research field on teachers' diagnostic competence: Teachers' judgments on students' performance are either based on specific tasks that are known to the teachers and that are in fact administered to the respective students (direct or specific judgments), or these judgments refer to students' general abilities in a more or less defined area, mostly without knowing concrete tasks that are used to assess these abilities (indirect judgments). In both cases the judgments usually are compared with students' achievement in standardized tests, whereupon the extent of congruence between student performance and teacher judgment is regarded as an indicator of teachers' diagnostic competence. Studies comparing these two approaches generally found that the diagnostic competence is somewhat higher when being based on direct judgments (e.g. Feinberg & Shapiro, 2003). Nevertheless, researchers more often use indirect judgments in their studies because they are much easier to gather and teachers are less burdened when filling in the questionnaire.

Regardless of these described methodological differences many studies found that some students' attributes influence teachers' judgments, especially their social status or gender. However, the findings are heterogeneous in this regard. For instance, it was repeatedly shown that students' socio-economic background can bias teachers' judgments and especially their school recommendations after primary school (Stahl, 2007; Ditton, 1992, 1995, 2010). While many (German) studies pointed out that students with lower socio-economic status are often judged too bad in relation to their actual achievement, some other studies found no influence of the social status at all (e.g. Wigfield, Galper, Denton & Seefeldt, 1999). A similar situation holds true for students' gender. As predominantly older research findings suggest, students' gender has no influence on teachers' ratings (e.g. Hoge & Coladarci, 1989; Jussim & Eccles, 1995; Demaray & Elliott, 1998). In contrast, a series of recent studies showed, that reading competence of girls is often overestimated, while boys are often underestimated in the same performance (Hinnant, O'Brien & Ghazarian, 2009) or that girls receive better marks in German than boys with the same competence level (Bos et al., 2005). It appears that stereotypes can play an important role in teachers' judging process.

Research Hypotheses

Based on the mentioned inconsistency of findings, the current study explored the following hypotheses:

1. Does the accuracy of teachers' judgments on students' vocabulary and text comprehension vary depending on students' socio-economic background and their gender?
2. Are these variations bigger for indirect judgments than for direct judgments?
3. Do these effects appear independently of grade level?

Method

The data basis for the analyses stems from two different subsamples of the Bamberg BiKS project (BiKS is the German acronym for "educational processes, competence development and selection decisions in pre- and primary school age"). In grade level one N = 385 students (from 61 classes in primary school) and in grade level five N = 482 (from 85 classes in secondary school) students from Bavaria and Hesse participated. Students' competences in different fields (e.g. vocabulary, text comprehension, arithmetic) were measured with standardized tests, their socio-economic background (ISEI) was derived from interviews with their parents. At the same time teachers were asked to rate these competences level for each individual student, either specifically (directly) by having all the information about the underlying test items available, as well as indirectly by only giving an estimation of the general competence.

Results

In order to examine the relevance of 1) students' attributes and 2) the assessment method for measuring accuracy of the teachers' judgments, the mean discrepancy between teachers' judgments and students' achievement were calculated for each of the groups (boys/girls and high/low social status) and compared via t-tests. The results indicate that there are barely significant differences in the teachers' judgment accuracy depending on students' socio-economic background or gender, even though students' social status has a strong influence on their achievement. Nevertheless, in most competence domains and for both grade levels there are marginal but observable differences related to judgment accuracy depending on students' attributes which are consistently more pronounced for indirect than for direct judgments, as effect sizes approve.

Discussion

These findings indicate - at least for the two competence domains under study - that teacher judgments are basically accurate in that way that they are not biased by the students' gender or social status. Even if the differences are not substantial, it appears that indirect judgments that are often used in research but rarely in classes are slightly less fair, whereas direct judgments which are relevant for the regular assessment in the classes, for testimonials or school

recommendations do not favor or disadvantage special groups of students. Altogether the current study suggests that stereotypes seem to be less relevant than suspected.

Expecting the best: Teacher expectations and student academic and social outcomes

Christine Rubie-Davies, University of Auckland, New Zealand

The conception that some teachers have high or low expectations for all students has been little explored. This is despite Brophy's (1985) assertion that expectations for a whole class would have more effects on student outcomes than the oft reported expectations of teachers for individual students. The current study examined changes in student achievement and academic self-perceptions across one year conditional on whether students had a high or low expectation teacher. The teachers were identified depending on their expectations for all students. Students' academic achievement and self-perceptions were measured at the beginning and end of the year. Teacher instructional practices were observed. The academic achievement and self-perceptions of students with high expectation teachers increased substantially across one year. Contrasting findings were noted for students with low expectation teachers. Observations of teachers revealed contrasting pedagogical practices for the two teacher groups. The results indicate the importance of considering teacher factors when examining relationships between teacher expectations and student outcomes.

The teacher expectation literature has a history spanning almost five decades. Some researchers consider teacher expectations to be accurate and to have only small effects on student outcomes (Jussim, Robustelli, & Cain, 2009). However, the conception of the self-fulfilling prophecy provides an acknowledgement that teacher expectations can be inaccurate. It is an erroneous judgement of student performance that leads to the teacher interacting with students in particular ways, resulting in the fulfilment of the initially inaccurate belief (Rosenthal & Jacobson, 1968). Research that has investigated the self-fulfilling prophecy effect has focused almost exclusively on teacher expectations for individual students. Differential behaviours of teachers towards those for whom they have high or low expectations have been identified (Brophy, 1983, 1985) but a meta-analysis showed that the behaviours that most affected student outcomes (e.g., those related to the class climate) were those concerning the whole class (Harris & Rosenthal, 1985). Nevertheless, despite this finding and an assertion by Brophy (1985) that teacher expectations for the whole class were likely to be of more consequence for student outcomes than expectations held for individuals, this conception remains largely untested in the literature.

Research by Weinstein (2002) has indicated that teacher beliefs moderate their expectations. In turn, the differing beliefs result in contrasting teacher pedagogical behaviours and so the teacher expectation effects are mediated by the differential behaviours of teachers. This notion reflects Weinstein's stance that contrasting teacher beliefs should be considered when examining teacher expectation effects. When teacher beliefs are accounted for in the expectation sequence from initial formation to student achievement, there are large differential outcomes for students (McKown & Weinstein, 2008). Similarly, Babad (2009) has shown that biased teachers have far more negative teacher expectation effects on students than do non-biased teachers. However, Rubie-Davies (2008) is the only author located who has tested the idea that teachers may have high or low expectations for all students, i.e. that there are high and low expectation teachers. This perspective was examined in the current study.

Research Hypotheses

Based on Brophy's notion that class-level expectations were likely to have more substantial effects on student outcomes than those for individuals, the current study explored the following hypotheses:

1. Teachers who had very high or very low expectations for their students could be identified.
2. Student academic and social outcomes would vary depending on whether they were with a high or low expectation teacher
3. Differing teacher beliefs would lead to contrasting teacher instructional practices possibly mediating the effects of teachers' expectations.

Method

Participants were 191 primary school students (either in Year 2 or in Year 5/6), 132 of who had high expectation teachers and 59 who had lows. Student achievement and academic self-perception were measured at the beginning and end of the academic year. Teacher expectation was measured by asking 21 teachers to estimate student end-of-year reading achievement (n = 540 students) on a 1-7 Likert scale from very much below average to very much above. Only the students of teachers whose expectations were significantly above or below class-level beginning-year achievement were included in the study. Analyses verified that expectations were contrastingly high or low for all students in each respective class.

Results

Student reading achievement was measured beginning and end of one academic year. Overall, students with low expectation teachers had higher achievement beginning the year than did students with high expectation teachers. However, markedly different results were documented by year's end. Those with high expectation teachers made very large academic gains ($d = 1.05$) while those with low expectation teachers made fewer gains ($d = .05$). Similarly, there was no difference in students' self-perceptions in reading and maths at the beginning of the year. However, at year's end, the academic self-perceptions of students with high expectation teachers had risen but there was a substantial drop in the self-perceptions of students with low expectation teachers. Further, a sub-scale used to determine student perceptions of their teachers' expectations showed no difference between the two student groups at the beginning of the year. Nevertheless, student perceptions of teacher opinion for those with low expectation teachers had fallen by year's-end in contrast to the perceptions of students with high expectation teachers.

Teacher instructional behaviours were observed to determine if these might mediate between teacher expectations and student outcomes. Large differences were found between high and low expectation teachers' practices. In summary, high expectation teachers took a facilitative approach to student learning: using mixed ability grouping; spending considerable time introducing new concepts, linking to prior knowledge and establishing student understanding; providing students with choices in activities, setting clear learning goals; using questions requiring higher level thinking; and positively approaching classroom management. In contrast, low expectation teachers used a more directive approach: they emphasised procedural directions; used ability groupings for reading; asked few questions of students; frequently admonished students for behaviour; and made all decisions about whom students were to work with, when and how.

Discussion

The conception that teachers could have high or low expectations for all students was examined in this study. Academic and social outcomes were investigated for students whose teachers had contrasting expectations. Compared to students with low expectation teachers, those with high expectation teachers made large academic gains and enhanced their academic self-perceptions. Observations of teacher instructional behaviours suggested that differing pedagogical practices may have mediated the effects of teacher expectations on student outcomes.

Few studies have considered teacher beliefs (i.e. teacher factors) in the expectation literature as contributing to differential expectation effects. The current study as well those by Weinstein (2002) and Babad (2009) suggest that teacher factors are related to large differential outcomes for students and therefore should be more closely considered in teacher expectation studies. Further, considering the large gains in academic outcomes found for students with high expectation teachers, it would be prudent to consider an intervention designed to raised teachers' expectations and change beliefs and practices such that they reflect those of high expectation teachers. Thus it may be that the outcomes for all students could be enhanced.

SYMPOSIUM

An international perspective on stimulating excellence in higher education

Chairperson: Fritz Oser, Universitat Freiburg, Switzerland

Organiser: Lyndsay Drayer, Hanze University of Applied Sciences, Groningen, Netherlands

Ingrid Schutte, Hanzehogeschool Groningen University of Applied Sciences, Netherlands

Discussant: Lynn McAlpine, University of Oxford, United Kingdom

This symposium on evoking excellent achievement in higher education focuses on international comparison of research data. Research on high ability in higher education is a new field in Europe. Institutions in Finland, Germany and the Netherlands share the results of their collaboration in research. We wish to discuss empirical research findings and their implications on the institutional level, the level of teacher strategies and the level of students and programs. Presentation 1. The comparison of plans of Dutch and German universities on their aims and goals with gifted education is the central theme of the first presentation. Students are stimulated to achieve more and a higher level in different ways, leading to different learning outcomes. Presentation 2. Effective teachers' strategies to evoke excellence include three concepts; building a community, offering a certain amount of freedom and providing academic challenges. What do teachers themselves say on their strategies and which differences can be found in strategies in a regular curriculum compared to honours education? Presentation 3. Measurements on moral and cultural sensitivities of urban secondary school students favor the high ability students. Is that still the case with higher education students? We discuss the implications to further develop the instruments for cross-cultural

comparisons and to further educate the high ability students' moral sensitivities to combine excellence with ethics and citizenship for the global world.

Evoking excellence with special undergraduate programmes: a German-Dutch comparison

Julia Moeller, University of Erfurt, Germany; Lyndsay Drayer, Hanze University of Applied Sciences, Groningen, Netherlands

This presentation compares the two main gifted education programmes for undergraduate students in the Netherlands and Germany. The programmes were evaluated and will be compared in terms of the institutions involved, the educational objectives pursued, the nature of support provided to the students, and the anticipated effects (Netherlands), respectively the achieved effects (Germany). The Dutch study focuses on the Sirius Program established by the Dutch government which invited universities to submit their own plans for the promotion of student excellence. The successful applications are analysed with respect to the above mentioned criteria. The German study focuses on the ideational support means, which is a varied enrichment programme provided by several national foundations that is supported with money and guidelines by the German government. The scholarship recipients were interviewed in large online surveys (N1 = 2379 and N2 = 1614). Both programmes are endowed with public funding and thus are shaped by political objectives. Also, both programmes are conducted by non-governmental institutions: universities in the Netherlands, and basically political, religious and social foundations in Germany. Thus, the presentation provides insights in theory and practice of gifted undergraduate education in both countries. The discussion will address the impact of political objectives and organizational structures on the reality of gifted education. Strategies for educators to accumulate scientific knowledge about gifted education, about evidence-based goals and about real life limitations will be provided. The different evaluation methods will be discussed in order to find out the best practice for research.

Introduction

The aim of this presentation is the comparison of the main promotion programmes for excellent undergraduate students in the Netherlands and Germany. The programmes are compared in terms of assigned institutions, educational objectives, the nature of support provided to the students and the anticipated effects (Netherlands), respectively achieved effects (Germany). In the Netherlands, most universities now offer special programmes for talented students. The government has stimulated this process through the Sirius Program. Assessment of plans was based on the institution's own views on excellence and the anticipated achievements. This resulted in 37 applications, 19 of which were selected for funding (2008-2010). For this presentation we have analyzed these successful applications focussing on the following points: 1) the nature of the activities chosen by each university to stimulate excellence, 2) the "added value" expected for the participating students, the university and society, and 3) the anticipated effects of the excellence programmes as measured by the individual universities. In Germany, the main programmes for undergraduate gifted education are provided by institutions which are closely related to the bigger political parties, the two main churches, the labour unions, the German economy and the state as such. These institutions receive money and some guidelines from the government in order to provide scholarships and enrichment programmes for excellent and socially committed students in the tertiary sector. The enrichment programmes, called "ideational support", vary widely and are influenced by theoretical assumptions of gifted education as well as political / ideological objectives. The effects of the ideational support were evaluated (2009-2010) in a survey including 2379 present scholarship recipients and 1614 former stipendiaries, as well as other people implicated in the programmes. The evaluation focused on effects of the ideational support, self-reported by the recipients. Psychological issues such as self-regulation, self-efficacy, good work (Gardner, Csikszentmihalyi, Damon, 2002), social competence etc. were assessed as well as "objective" measures such as achievement (indicated by grades and duration of study) and social commitment.

Data and Methods

For the Dutch study, the 19 successful applications published by the institutions are publicly available (www.siriusprogramma.nl). The plans were analysed and categorised according to the nature of the activities, the number of credits awarded, the reasons for developing the activities, the anticipated added value, and the way in which the effects are to be measured. The German study applied a multi-method approach, consisting of large online questionnaires for present and former scholarship recipients, phone interviews with mentoring professors, group interviews with self-organized groups of scholarship recipients and questionnaires in which the implicated institutions reported their specific goals which should be realised in their education programme. Additionally, the main documents published by the institutions to present themselves were analysed and categorised. However, the focus lay on the online questionnaires, which were completed by 2379 present and 1614 former scholarship recipients. According to Kirkpatrick's (1998) evaluation model, reaction (satisfaction, quality of the programme

learning (knowledge, attitude), behaviour (academic and occupational achievement, civic engagement) were assessed. The data of present and former scholarship recipients were compared with each other as well as with results from studies on gifted students (Heller & Vieck, 2000; Lubinski & Benbow, 2006) and representative samples (Fischer, 2006).

Results

Netherlands (Sirius): Historically, the Dutch research universities have more experience with special programmes for talented students (often called Honours programmes) compared to the universities of applied sciences. In the Sirius Program we detect a shift from departmental research programmes for a limited number of students, to more broadly-orientated multidisciplinary Honours programmes for a larger student population. The universities of applied sciences have developed Honours programmes specifically aimed at professional excellence and stimulating applied research within the institutions. Although the contents of the programmes and the European Credits (EC's) awarded vary greatly between the institutions, the anticipated added values and effects to be measured show similarities. The performance indicators mainly focus on short term effects such as academic performance, retention and graduation rates, student satisfaction, time required to obtain the first job and starting salary. Germany (ideational support): The questionnaires revealed showed that the scholarship recipients appreciate the received ideational support much. They report effects of the ideational support in terms of development of achievement, social commitment and personal growth. The more the students participated in the ideational support, the bigger were the reported effects. Also, the effects of the different education programmes were in accordance with the goals of the particular institution.

Theoretical and educational significance

The presentation provides insights into different theoretical assumptions about gifted education found in the implicated institutions and the different political and organizational strategies to accomplish promotion of gifted students. It is of theoretical significance to learn about the assumptions and aims of given institutions in the two countries and to prove if they meet scientific knowledge about best practice in gifted education. Also, the impact of political assumptions and institutional limitations on the reality of gifted education will be discussed. The methodological add on value of the presentations will be the discussion about a best practice in the evaluation of undergraduate gifted programmes, concluding the research of both studies. The educational significance concerns the development of strategies to get together scientific knowledge about best practice as well as theoretical assumptions and the reality of political and structural limitations and guidelines in the institutions concerned with gifted education.

References

- Gardner, H., Csikszentmihalyi, M., Damon, W. (2001). *Good Work. When Excellence and Ethics meet*. New York: Basic Books.
- Heller, K.A. & Vieck, P. (2000). Support for University Students: Individual and Social Factors. In C.F.M. van Lieshout & P.G. Heymans (Eds.), *Developing Talents Across the Life-Span* (pp. 299-321). Hove: Psychology Press.
- Kirkpatrick, D.L. (1998). *Another look at evaluating training programs*. Alexandria, VA: American Society for Training & Development.
- Lubinski, D., & Benbow, C.P. (2006). Study of Mathematically Precocious Youth after 35 years: Uncovering antecedents for the development of math-science expertise. *Perspectives on Psychological Science*, 1, 316-345.
- Fischer, C. (2006). *Lernstrategien in der Begabtenförderung. Eine empirische Untersuchung zu Strategien Selbstgesteuerten Lernens in der individuellen Begabungsförderung*. (Habilitationsschrift). Mönster.

Teaching strategies to elicit excellence in higher education

Marca V.C. Wolfensberger, Hanzehogeschool Groningen, Netherlands; Roeland M. Van der Rijst, ICLON-Leiden University Graduate School of Teaching, Netherlands

Pedagogy for gifted and talented students in higher education is the main topic of this study. Teachers of educational programmes designed for talented or highly motivated students in higher education (here called honours programmes) are challenged to stimulate students to increase the quality of their academic achievements. However, systematically acquired knowledge on effective teaching strategies for motivated and talented students above the age of 18 is limited (Heller, Mönks, Sternberg & Subotnik, 2000). The aim of this study is to augment the existing body of knowledge. Firstly to reflect on this knowledge from different perspectives, secondly by a mix-method research, analysing multi-institutional data collected in the United States and the Netherlands about teachers perception on teaching strategies for gifted and motivated students in higher education. The theoretical perspectives behind this study focus on (1) theories about giftedness, (2) motivational theories and (3) on studies on honours programmes.

Three concepts prove to be of importance when thinking about pedagogies for excellent students: shaping of a community, allowing for (academic) freedom and providing academic challenges. The empirical section of the study is concerned with the question: which strategies teachers say to employ within honours education and regular course in the light of these three concepts. These strategies highlight effective tactics that can be used to elicit excellence. This account addresses a gap in the emerging international body of knowledge on 'honours pedagogies'. Some aspects of the honours context seem quite different from standard teaching practices and necessitate special faculty development.

Introduction

Pedagogy for gifted and talented students in higher education is the main topic of this study. Teachers of educational programmes designed for talented or highly motivated students in higher education (here called honours programmes) are challenged to stimulate gifted and motivated students to increase the quality of their academic achievements. However a systematically acquired knowledge about effective teaching strategies motivated and talented students above the age of 18 is limited (Heller, Mönks, Sternberg & Subotnik, 2000). The aim of this study is to augment the existing body of knowledge. Firstly to reflect on this knowledge from different perspectives, secondly by a mix-method research, analysing multi-institutional data collected in the United States and the Netherlands about teachers perception on teaching strategies for gifted and motivated students in higher education. The theoretical perspectives behind this study focus on (1) theories about giftedness, (2) motivational theories and (3) on studies on honours programmes. Three concepts prove to be of importance when thinking about pedagogies for excellent students: shaping of a community, allowing for (academic) freedom and providing academic challenges. The empirical section of the study is concerned with the question which teaching strategies teacher say to employ within honours education and regular course in the light of these three concepts. This study reveals that teachers employ different teaching strategies for talented and motivated students compared to regular classes.

Methodology

A systematically conducted literature study into research findings published in scientific journals included in the Social Science Citation Index (SSCI) revealed findings on effective teaching strategies for honours students. For further analysis of review studies published in the period 1959-2009 and individual reviews in the period 1999-2009 were included. These studies were complemented by publications on motivational theories and studies into honours programmes. The analysis of the publications revealed that teaching strategies emphasising community, freedom and academic competences highlight effective tactics that can be used to elicit excellence in higher education. Then, we devised a mix-method research design with a questionnaire and an interview protocol for focus groups. The questionnaire focused on specific teaching methods. Multi-institutional data were collected among faculty in the US and the Netherlands in 2006-2007. The analysis has been conducted on the basis of 442 completed questionnaires representing at least 84 higher education institutions. The respondents were experienced teachers across the US and the Netherlands. The questionnaire consisted of 20 multiple choice questions, 47 items with a 5 point Likert scale and three open questions. The focus group interview questions were conducted with teachers (N=48) at the end of each semester in a Dutch university with a relatively long tradition of honours programmes. The teachers were invited to comment on the extent to which strategies employed in honours programmes differ from those in regular educational programmes and whether faculty training was needed.

Results

The search query into reviews from the period 1959-2009 yielded 28 publications covering one or more of the themes concerned with teaching strategies for honours programmes (cf. Fliegler & Bish, 1959; Rogers, 2007) revealing two themes: teaching strategies and teaching objectives. The search query into individual studies from 1999-2009 found 60 relevant publications. Frequently occurring teaching objectives were stimulation of creativity (Heller, 2007), leadership-building and fostering of student motivation (Schick & Phillipson, 2009). Although those findings give account of different age groups, they can provide insight into students in higher education (cf. Colangelo & Davis, 2003). The findings have been embedded in perspectives of motivational theories and honours studies. This resulted in three teaching strategies potentially relevant and effective for teaching excellent and talented students in higher education: building communities, balance between giving freedom and providing structure and developing academic competences.

The results from the questionnaire and focus group suggest that there are similarities between honours and regular education. Nonetheless, significant differences remain. Teachers in honours programmes attach greater value to community building and indicate that they offer students more freedom in terms of planning and selecting of research topics. Interdisciplinarity and undergraduate research are of greater importance in honours programmes. Furthermore teachers give little reference to structural issues when teaching honors, while teachers in regular educational programmes often emphasize the need for a structure and clear explanations. Finally, little or no distinction can be made between regular and honours education in terms of the provision or application of academic

knowledge. The results of this research indicate that greater tailoring of honours programs, within a strong framework of community, would be appropriate.

Theoretical and educational significance of the research

Honours pedagogies within higher education have received little attention in previous research. The spread of programs designed for enhanced educational opportunities and outcomes makes further research critical. This research examines the strategies that teachers in higher education in the United States and the Netherlands reportedly employ in honours courses, in contrast to regular programs. These strategies highlight effective tactics that can be used to elicit excellence. This account addresses a gap in the emerging international body of knowledge on 'honours pedagogies'. Some aspects of the honours context seem quite different from standard teaching practices and necessitate special faculty development. The extent to which teachers in higher education are equipped to facilitate the creation of this kind of learning environment certainly requires further debate and study.

References

- Colangelo, N., & Davis, G. A. (Eds.). (2003). *Handbook of gifted education* (3rd ed.). Boston: Pearson Education.
- Fliegler, L.A., & Bish, C.E. (1959). The gifted and talented. *Review of Educational Research*, 29, 408-450.
- Heller, K. A. (2007). Scientific ability and creativity. *High Ability Studies*, 18(2), 209-234.
- Heller, K. A., Mönks, F. J., Sternberg, R. J., & Subotnik, R. F. (Eds.) (2000). *International handbook of giftedness and talent* (2nd ed.). Oxford, UK: Elsevier.
- Rogers, K. B. (2007). Lessons learned about educating the gifted and talented: A synthesis of the research on educational practice. *Gifted Child Quarterly*, 51, 382-396.
- Schick, H., & Phillipson, S. N. (2009). Learning motivation and performance excellence in adolescents with high intellectual potential: what really matters? *High Ability Studies*, 20, 15-37.

Combining ethics and excellence in education of gifted students

Kirsi Tirri, University of Helsinki, Finland; Ingrid Schutte, Hanzehogeschool Groningen University of Applied Sciences, Netherlands

In this paper we argue that skills in moral judgment and especially in moral sensitivity are necessary in combining excellence with ethics. High ability students have been shown to be superior in moral judgment when compared to average ability students. However, high academic ability does not always predict high moral judgment (Narvaez, 1993). Moreover, morality includes other components as well, such as sensitivity, motivation and character. Social and moral responsibility (Davies et al., 2005) and understanding the world 'from the point of view of the other' (Nussbaum, 1997, as cited by Friedman, 2000) are considered to be aspects of citizenship education for the global world. We present two instruments that have been created to measure moral and cultural sensitivities of urban school students (Tirri & Nokelainen, 2007; Holm, Nokelainen & Tirri, 2009). The instruments with a detailed description of their use and validity will be published in a book (Tirri & Nokelainen, 2011). We show the correlations between academic achievement and moral sensitivities favoring the high ability urban school students. The level of moral judgment is associated with rapid cognitive development of gifted students. The difference in self-estimated ethical and intercultural sensitivity between academically gifted and average ability students might disappear when students get older. At the conference, we will present data on higher education students. We will also discuss the implications of our work to further develop the instruments for cross-cultural comparisons and to further educate the high ability students' moral sensitivities to combine excellence with ethics.

Introduction

In this paper we argue that skills in moral judgment and especially in moral sensitivity are necessary in combining excellence with ethics. High ability students have been shown to be superior in moral judgment when compared to average ability students. However, high academic ability does not always predict high moral judgment (Narvaez, 1993). Moreover, morality includes other components as well, such as sensitivity, motivation and character. Social and moral responsibility (Davies et.al., 2005) and understanding the world 'from the point of view of the other' (Nussbaum, 1997, as cited by Friedman, 2000) are considered to be aspects of citizenship education for the global world. In this paper we present two instruments that have been created to measure moral sensitivities of urban school students (Tirri & Nokelainen, 2007; Holm, Nokelainen & Tirri, 2009). We have gathered empirical data from 4 urban schools in Finland and tested the psychometric qualities of our instruments. The level of moral judgment is associated with rapid cognitive development of gifted students. The difference in self-estimated ethical and intercultural sensitivity between academically gifted and average ability students might disappear when students get older. We examine the ethical and intercultural self-evaluations among older students (17 years and older) in

2010/2011. The instruments with a detailed description of their use and validity will be published in a book (Tirri & Nokelainen, 2011).

Data and Methods

The non-probability sample of urban secondary school students (N=249-549) was collected with the two instruments during the years 2006 and 2007 from the seventh, eighth, and ninth grade students. The non-probability sample of university students (N=500) was collected from two Dutch universities in 2010/2011. The data will be presented at the conference. The ethical sensitivity scale questionnaire (ESSQ) is based on Narvaez's operationalization of ethical sensitivity (2006). Its main purpose is to scale the pupils' orientations on ethical issues. The ESSQ measures following seven dimensions of ethical sensitivity: (1) Reading and expressing emotions, (2) taking the perspectives of others, (3) caring by connecting to others, (4) working with interpersonal and group differences, (5) preventing social bias, (6) generating interpretations and options and (7) identifying the consequences of actions and options. The instrument consists of 28 Likert-scale items with the response options from 1 (totally disagree) to 5 (totally agree). The Intercultural Sensitivity Scale Questionnaire (ICSSQ) is based on Bennett's (1993) Developmental Model of Intercultural Sensitivity (DMIS), which is a conceptual tool to situate certain reactions towards cultural difference. The DMIS consists of six stages, of which three are ethnocentric and three ethnorelative. The ICSSQ is based on the operationalization of the first five stages: (1) Denial, (2) Defense, (3) Minimization, (4) Acceptance, and (5) Adaptation. The instrument consists of 23 Likert-scale items.

Results

Academically gifted students estimated their ethical skills higher than average ability students (Tirri & Nokelainen, 2007). This finding supported other researchers' notion that gifted students hold a privileged position in the maturation of moral thinking because of their precocious intellectual growth (Andreani & Pagnin, 1993; Karnes & Brown, 1981; Terman, 1925). The results concerning cultural sensitivity showed that academically above average students estimated their intercultural sensitivity higher than average ability students. Further, the academic achievement level appeared to be related to intercultural sensitivity: all the above-mentioned variables were negatively correlated with the two lowest ethnocentric stages and positively with the two highest ethnorelative stages of the DMIS (Holm, Nokelainen, Tirri, 2009).

Significance of the research

Our research indicates that gifted secondary school students show higher scores in self-estimated ethical and cultural sensitivities than average-ability students. High ability students show interest to the scientific and research fields that require skills in ethics. Teachers and educators should nurture the moral growth of future scientists by exploring and discussing the ethical aspects of doing scientific studies. Academic work ethic is a specific domain that needs to be discussed with the future scientists (Tirri, 2011). Furthermore, as future scientists and citizens, gifted students might play a part in coming up with solutions for problems of the global society, like climate change and poverty. Future scientists need ethical expertise that includes skills in ethical sensitivity, ethical judgment, ethical motivation and ethical action. Holistic education supports the development of the whole person, rather than merely the cognitive domain. This kind of education acknowledges the importance of social and affective domains in student's development including their moral sensitivities.

References

- Andreani, O., & Pagnin, A. (1993). Nurturing the moral development of the gifted. In K. Heller, F. Mönks, & H. Passow (Eds.), *International handbook of research and development of giftedness and talent* (pp. 539-553). Oxford: Pergamon Press.
- Bennett, M.J. (1993). Towards Ethnorelativism: A Developmental Model of Intercultural Sensitivity. In M.R. Paige (Ed.), *Education for the Intercultural Experience* (pp. 21-71). Yarmouth, ME: Intercultural Press.
- Davies, I., Evans, M. and Reid, A. (2005). Globalizing citizenship education? A critique of 'global education' and 'citizenship education'. *British Journal of Educational Studies*, 53, 66-98.
- Holm, K., Nokelainen, P. & Tirri, K. (2009). Relationship of gender and academic achievement to Finnish students' intercultural sensitivity. *High Ability Studies*, 20 (2), 187-200.
- Friedman, M. (2000). Educating for World Citizenship. *Ethics*, 110, 586-601.
- Narvaez, D. (1993). High achieving students and moral judgment. *Journal for the Education of the Gifted*, 16(3), 268-279.
- Narvaez, D. (2006). Integrative ethical education. In M. Killen & J.G. Smetana (Eds.), *Handbook of Moral Development* (pp. 703-732). Mahwah, N.J.: Lawrence Erlbaum Associates.
- Karnes, F., & Brown, K. (1981) Moral development and the gifted: An initial investigation. *Roper Review*, 3, 8-10.
- Terman, L. (1925). *Genetic studies of genius: Vol. 1. Mental and physical traits of a thousand gifted children*. Stanford, CA: Stanford University Press.

Tirri, K. (2011). Combining excellence and ethics: Implications for moral education for the gifted. *Roeper Review* (in press).

Tirri, K., & Nokelainen, P. (2007). Comparison of Academically Average and Gifted Students' Self-Rated Ethical Sensitivity. *Educational Research and Evaluation*, 13(6), 587-601.

Tirri, K. & Nokelainen, P. (2011). Identifying and measuring multiple intelligences and moral sensitivities in education (in press).

SYMPOSIUM

What makes a successful learner of mathematical proof?

Chairperson: Matthew Inglis, Loughborough University, United Kingdom

Organiser: Matthew Inglis, Loughborough University, United Kingdom

Stefan Ufer, University of Munich, Germany

Discussant: Jon Star, Harvard University, United States

This symposium will present three empirically validated accounts of factors that influence how successfully students engage with mathematical proof. Such accounts are important because proof is at the heart of mathematical knowledge construction, so successful engagement with proof is one major goal of mathematics education. Although important, such accounts are rare: it has been known for decades that students struggle to comprehend and construct proofs, but we do not yet know how to design instruction to help them overcome these struggles. By presenting three such accounts together, we aim to link different strands of empirical research on the cognitive processes involved in proof comprehension and construction.

The contributions to the symposium are similar in their focus on individual acquisition of cognitive skills related to proving, and complementary in their educational levels and their research methods. At the secondary school level, Ufer, Heinze and Reiss use a correlational survey to highlight commonalities and differences in the cognitive demands of calculation and proof problems. At the university level, Inglis and Alcock use eye-tracking to identify attentional differences as experts and novices read proofs, and Mejia-Ramos and Weber use an intervention study to investigate how presentation format proof affects proof comprehension. The authors of all three contributions will discuss their findings with a focus on implications for the learning and teaching of proof across the educational levels.

Expert/Novice Differences in the Reading of Mathematical Proofs

Matthew Inglis, Loughborough University, United Kingdom; Lara Alcock, Loughborough University, United Kingdom

Learning by reading mathematical proofs is central to the study of advanced mathematics. Indeed, some philosophers have argued that professional mathematicians learn the majority of their new mathematics by reading the proofs of others. However, many educational research studies have shown that students find mathematical proofs difficult to engage with. Here we report a study in which professional research mathematicians and first year undergraduate students were asked to read, and then determine the validity of, several purported mathematical proofs. Participants' eye-movements were recorded as they read. We analysed the order in which participants attended to different components of the purported proofs. Our findings suggest that a major difference between expert and novice behaviour when reading mathematics is that experts expend considerably larger effort to looking for logical links between different statements. In addition, we demonstrate that novice readers spend proportionately longer studying formulae (compared to text) than experts. However, contrary to the predictions of earlier researchers, we found no evidence that expert readers read mathematics in a non-linear fashion.

At the heart of mathematics is the notion of proof: logical arguments that justify mathematical claims. Because of the centrality of proof to mathematics, curriculum documents and educational theorists have argued that it should be central to mathematics education at all levels of schooling. In particular, a key goal of mathematics education is to develop students' abilities to read and critique mathematical arguments (e.g., NCTM, 2000). However, even students at the undergraduate level find engaging with proof difficult, and struggle to determine whether or not a proof is valid, i.e. whether it contains any logical errors or gaps which that prevent it being accepted by the mathematical community (Selden & Selden, 2003). Consequently, researchers have suggested that deepening our understanding of how expert mathematicians read proofs could productively inform the design of effective educational interventions (e.g. Weber, 2008).

Our study was informed by theoretical analyses of what is required to effectively read mathematics (e.g. Selden & Selden, 2003; Weber, 2008; Weber & Alcock, 2005). Specifically, we tested two hypotheses: (i) novices focus more on

surface features such as algebraic manipulation, and less on logical relations than do experts; (ii) experts devote more effort than novices to finding and evaluating the logical links between different statements in proofs.

We asked 12 research-active mathematicians ('experts') and 18 first year undergraduate mathematics students ('novices') to read six number theory proofs. Participants' eye-movements were recorded by a Tobii T120 Eye-Tracker. After participants had read each argument they were asked to state whether the proof was valid, and how confident they were in their judgement. Participants were encouraged to take as long as they needed to make an informed judgement. In this contribution we focus on the eye-movement data recorded in the study.

To test Hypothesis (i) we classified each part of the proofs as being 'formulae' or 'non-formulae'. We then calculated participants' mean dwell times each area. These data were subjected to an ANOVA with one between-subjects factor (group: expert/novice) and one within-subjects factor (type: formulae/non-formulae). A significant interaction was found, $F(1,28)=8.81$, $p=.006$, a consequence of the novices (as predicted) spending proportionately longer than the experts fixating on the formulae within the proofs. These data suggest that the novices do not devote a similar level of effort as the experts to comprehending those parts of the arguments which were written in text: often the part where logical structure is explicitly discussed.

Hypothesis (ii) was tested by calculating line transition matrices (i.e. the number of saccades each participant made between different lines of the proofs). We calculated the number of saccades of distances 1, 2 and >3 (i.e. a saccade between line n and line $n+1$ has distance one, whereas a saccade between line n and line $n-3$ has distance three). These data were subjected to an ANOVA with one within-subjects factor (distance: 1, 2, >3) and one between-subjects factor (group: expert, novice). There was a significant interaction, $F(1.02,28.7)=5.22$, $p=.029$: the experts made significantly more saccades between consecutive lines than the undergraduates, $t(28)=2.24$, $p=.033$, but the differences for the other distances considered did not approach significance, all $ps>.2$. Hypothesis (ii) accounts for these additional consecutive between-line saccades by suggesting that experts more frequently conduct searches for between-line justifications. To test this prediction more explicitly we calculated the number of eye-movements made of the form Line $x+1$ to Line x to Line $x+1$. Under the assumption that such movements could be associated with attempts to find the logical link between lines x and $x+1$, Hypothesis (ii) predicts that the experts would make more of such moves than the novices where Line $x+1$ requires a justification, but not when it does not (e.g. when Line $x+1$ introduces a novel definition). This prediction was confirmed (we found a significant transition-type by group interaction on these frequency data, $F(1, 27)=4.38$, $p=.046$).

To summarise, many educational research studies have shown that students of all ages struggle with proof, and in particular with reading proofs. Here we reported the first direct comparison of expert and novice in-line proof reading behaviour. We found that novices get 'hung up' with surface features of arguments and do not devote as much effort as experts to searching for the logical links between statements. Further research is required to determine whether expert reading strategies can be explained and modelled during instruction, and whether such instruction would be sufficient to raise the efficacy of novice reading behaviour.

References

- NCTM. (2000). Principles and standards for school mathematics. Reston, VA: NCTM.
- Selden, A., & Selden, J. (2003). Validations of proofs considered as texts: can undergraduates tell whether an argument proves a theorem? *Journal for Research in Mathematics Education*, 34, 4-36.
- Weber, K. (2008). How mathematicians determine if an argument is a valid proof. *Journal for Research in Mathematics Education*, 39, 431-459.
- Weber, K., & Alcock, L. (2005). Using warranted implications to understand and validate proofs. *For the Learning of Mathematics*, 25(1), 34-38.

Cognitive predictors of problem solving in geometry – a comparison of complex calculation and proof

Stefan Ufer, University of Munich, Germany; Aiso Heinze, Leibniz Institute for Science and Mathematics Education, Germany; Kristina Reiss, Technische Universität München, Germany

Mathematics competence as described in educational standards worldwide encompasses the abilities to perform mathematical reasoning and proof and to apply mathematical rules and procedures to perform calculations. Both aspects of mathematical competence are commonly viewed as aims of secondary level instruction. Nevertheless, the relation between the cognitive processes which are necessary to construct proofs and perform complex calculations in geometry is quite unclear. In particular, it is unknown if the underlying problem solving processes require the same cognitive prerequisites or if there are specific differences. Mathematics education research tends to focus on

epistemological specifics of proof problems, but from a problem solving perspective, both task types seem to be quite similar. This research builds on theoretical ideas from dual-process theories of deductive reasoning (Evans, 2008). They typically describe a fast, intuitive and experience-based system 1 and a slow, analytic system 2 which is e.g. based on mental simulations. In a correlational study with N=230 German 10th grade students from Germany (Gymnasium), we find that abilities related to system 1 are almost equally related to performance in both task types, whereas abilities related to system 2 are primarily related to the ability to construct geometry proofs. The results cast light on two different aspects of geometric content knowledge and their role in mathematical problem solving. We will also discuss instructional ideas that might potentially foster conceptual knowledge that can be applied flexibly to solve proof problems as well as calculation problems.

Context

Mathematics competence as described in educational standards worldwide encompasses the abilities to perform mathematical reasoning and proof, on the one hand, and to apply mathematical rules and procedures to perform calculations, on the other hand. Both aspects of mathematical competence are commonly viewed as aims of secondary level instruction, and are typically treated in the context of secondary level geometry. Nevertheless, simple one-step geometric calculation tasks tend to dominate classroom activities.

Mathematics education research often focuses on the specific epistemological complexity of proof problems (Duval, 2002). Nevertheless, from a problem solving perspective, many cognitive processes seem to be common to both tasks types. Hsu (2010), for example, found no significant differences between 9th graders' ability to construct geometry proofs and to solve (parallelized) geometric calculation problems.

Both task types involve deductive reasoning processes. Dual-process theories (e.g. Evans, 2008) propose two cognitive systems for deductive reasoning. System 1 is described as fast, intuitive, and based on experience. System 2 is considered as slow, analytic, and based for example on mental simulations. Computation tasks are presumably based on system 1: Here, only one specific geometric configuration is involved. Thus, recognizing a prototypical subfigure linked to a certain mathematical property may already trigger an inference. In a proof process on the contrary, in principle, every argument has to be checked against all possible instantiations of a given geometric configuration. The latter involves the ability to manipulate the geometric configuration mentally within the constraints imposed by the proposition to be proved (mental simulations, system 2). From this perspective, the success in proof tasks can be expected to rely strongly on cognitive processes associated with system 2, in contrast to the performance in complex calculation tasks.

Aim

In our study, we aim at testing the hypothesis that mental processes related to system 1 are connected to performance in both task types, whereas processes related to system 2 are only connected to performance in proof tasks.

Methodology

We conducted a correlation study with 230 German grade 10 students (Gymnasium) and surveyed their abilities to solve complex calculation tasks (8 open items) and to construct geometry proofs (7 open items). As predictors, we used a geometric knowledge test consisting of mathematical propositions (grouped into 6 multiple-choice items) that had to be judged as true or false and, additionally, a scale of simple single-step geometric calculation problems (4 open items) to survey procedural knowledge. The tests were administered by trained assistants in two 45-minute sessions.

We assume different cognitive processes required to judge true and false propositions in the geometry knowledge test. To evaluate a true proposition (e.g. in each isosceles triangle two angles are congruent), it is sufficient to recall the corresponding theorem or, alternatively, one or more prototypes of isosceles triangles from memory to see that the proposition is correct. This is a typical application of system 1. When evaluating a false proposition (e.g. in each isosceles triangle, the bisector of each angle bisects the side opposite to the angle), a prototype might lead to a wrong conclusion, since it might represent a special case for which the proposition is true. Several possible configurations of isosceles triangles, and different angles have to be considered to see that the proposition is false. This involves cognitive processes typically associated with system 2 (e.g. mental simulations). Accordingly, we split the knowledge scale into two subscales.

The relation between the predictors and the performance in the two task types were analyzed by using regression analyses.

Findings

The scales showed sufficient to good reliabilities and distributions. The performance in single-step calculation items had no significant influence on the performance in neither proof nor complex calculation tasks. The ability to judge true propositions showed a significant relationship with both task types ($t(226)=5.79$; $pb=0.35$ for proofs, $t(226)=5.31$; $pb=0.35$ for complex calculations). In our context, this means that abilities related to system 1 are indeed connected to performance in both task types.

The ability to judge false propositions showed a significant relation with proof performance ($t(226)=4.85$; $pb=0.30$). Moreover, we found a weakly significant relation with complex calculations ($t(226)=2.07$; $pb=0.14$) which disappears when controlling for proof performance.

To sum up, we found a predictor pattern which is consistent with our theoretic assumptions about cognitive processes which are relevant for complex calculation tasks and proof tasks within elementary geometry. First, the ability to solve single-step calculation tasks does not seem to be relevant for success in both task types. Secondly, the results support the assumption that success in proof tasks relies on abilities associated with both systems of deductive reasoning. System 2 does not seem to be equally relevant for complex calculation tasks. It requires flexible mental representations of geometric concepts and the ability to manipulate them in working memory.

Discussion

If these results can be sustained, at least there are two educational implications: First, if the ability to solve single-step calculation problems is not predictive for the success in higher-order tasks, the current role of this task type in classrooms should be reconsidered carefully. They tend to make up the majority of practice problems. Secondly, existing ideas that can potentially lead to a better development of mental representations and abilities associated with system 2 should be considered as possible interventions to foster conceptual development and performance in both task types. Examples are so-called "conjecturing tasks", demanding students to explore geometric configurations and come up with a reasonable conjecture about a geometric configuration, or tasks involving the evaluation of (potentially false) mathematical propositions.

References

- Duval, R. (2002). Proof understanding in mathematics. What way for students? Plenary paper, "International Conference on Mathematics: Understanding proving and proving to understand". Taipei, 2002.
- Hsu, H.-Y. (2010). Conceptualization of the relation between geometric proof and geometric calculation. In Pinto, M.F. & Kawasaki, T.F. (Eds.). *Proceedings of the 34th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 3, 105-112. Belo Horizonte, Brazil:PME.
- Evans, J. (2008). Dual-Processing Accounts of Reasoning, Judgement, and Social Cognition. *Annual Review of Psychology* 59, 255-278.

The effect of proof format on proof comprehension: are structured proofs easier to understand?

Juan Pablo Mejia-Ramos, Rutgers University, United States; Keith Weber, Rutgers University, United States

In undergraduate mathematics courses, proofs are regularly employed to convey mathematics to students. However, research has shown that students find proofs to be difficult to comprehend. Some mathematicians and mathematics educators attribute this confusion to the formal and linear style in which proofs are generally written. To address this difficulty, Leron (1983) suggested an alternative format for presenting proofs, namely structured proofs, designed to enable students to perceive the main ideas of the proof without getting lost in its logical details. However, we are not aware of any empirical evidence that such format actually helps students comprehend proofs.

Here we report preliminary results of a study that employs a recent model of proof comprehension to assess the extent to which Leron's format helps students understand proofs. This model comprises six different dimensions of proof comprehension and suggests ways in which each dimension can be assessed. Using this model we designed proof comprehension tests for two proofs, one in calculus and one in number theory. We compare the performance of twelve undergraduate mathematics students who took these tests after reading two different versions of these proofs: the traditional linear presentation and Leron's structured presentation. This study did not find evidence that structured proofs improved students' comprehension of proofs, suggesting the need for more research on the conditions under which this format may improve comprehension.

Introduction

In advanced mathematics courses, proofs are a primary way that teachers and textbooks communicate mathematics to students. However, researchers note that students find proofs to be confusing or pointless. Some mathematicians and mathematics educators attribute students' difficulties in understanding proofs to the formal and linear style in which proofs are written (e.g. Rowland, 2001).

To address this difficulty, Leron (1983) suggested an alternative format for presenting proofs: the structural method. Leron suggested that linear proofs limit students' understanding because this format masks the overarching structure of the proof. He recommended instead organizing a proof into levels with Level 1 providing a summary of the main ideas of the proof, Level 2 giving a summary of how each of the main ideas is implemented, and successively lower levels filling in more of the details of the proof. Leron claimed this format helped students comprehend proofs.

This suggestion has an obvious appeal; if changing the format of a proof can increase students' understanding of its content, then this alternative proof format provides a practical way to improve the effectiveness of lectures and textbooks in advanced mathematics courses. However, although several researchers cite Leron's structured proofs as a possible way to improve proof presentation (e.g., Alibert & Thomas, 1991), we are not aware of any empirical evidence that such proofs will help students. Indeed, in an exploratory study, Cairns and Gow (2003) present theoretical difficulties that students may encounter with a structure proof and illustrate how three students experienced these difficulties. The goal of this study is to further examine the extent to which Leron's (1983) structured proofs improve student understanding.

Methods

For this study, we interviewed twelve third-year undergraduate mathematics students. Participants were asked to study a proof and told they would be asked a series of questions about it. After they studied the proof to their satisfaction, they returned it to the interviewer. Participants were then asked to rate how well they understood the proof on a 5-point scale (with 5 indicating they understood the proof completely) and asked both open-ended and multiple-choice questions about the proof. These questions were designed employing Mejia-Ramos et al.'s (2010) model for proof comprehension at the undergraduate level (according to this model students' proof comprehension can be assessed along six dimensions including the ability to cite justifications for statements in the proof and identify the logical structure of the proof and its high-level ideas). After participants answered all questions, the proof was returned to them and they were permitted to change their answers. This process was repeated with a second proof. Participants in one group first studied a linear presentation of a proof in calculus and then studied a structured proof of a statement in number theory. Participants in the second group studied a structured version of the calculus proof and a linear version of the number theory proof. The structured and linear versions of the proof in number theory were taken with minor modifications from Leron (1983). Participants were also asked about their opinions of the structured proof, what (if anything) they found positive or negative about it.

Our analysis focuses on: (a) how well participants felt they understood the given proofs, (b) participants' performance on the proof comprehension test, and (c) their comments on the benefits and drawbacks of structured proofs. Results Combining across proofs, participants studying the linear proofs reported a mean understanding of 4.00 and answered an average of 7 of the 15 assessment questions correctly (47%), while students studying structured proofs reported a mean understanding of 3.13 and answered 4.83 out of 15 assessment questions correctly (32%).

Among the twelve participants, two reacted positively to the structured proof format, citing that it made explicit the goals of the proof and the relationships between its different parts. The remaining ten participants cited drawbacks with the approach, with some claiming they found it generally confusing.

Discussion

In summary, this study did not find evidence that structured proofs improved students' comprehension of proofs. When participants read a structured proof as opposed to a linear proof, they reported less understanding and performed worse on the assessment questions. Only two participants cited more benefits of structured proofs than drawbacks, with the remaining participants citing that the difficulties in following the structured proofs hindered their understanding.

We note that our results about students' difficulties with structured proofs are consistent with the findings of Cairns and Gow (2003). We also note there are no empirical studies that offer any evidence that structured proofs do improve understanding. We are not arguing such studies cannot be done, but we believe they would take careful thought to design, maybe including instruction for students on how structured proofs should be read. We contend such studies are necessary if alternative formats for presenting proofs are to continue to be proposed as a means of increasing students' proof comprehension, both because claims of this type in mathematics education should require

empirical support and because a study of this type can offer practical pedagogical direction for teachers who wish to incorporate proofs in their own classrooms.

References

- Alibert, D. and Thomas, M. (1991). Research on mathematical proof. In D. Tall (Ed.) *Advanced Mathematical Thinking*. Dordrecht: Kluwer.
- Cairns, P. and Gow, J. (2003). A theoretical analysis of hierarchical proofs. In A. Asperti, B. Buchberger & J.H. Davenport (Eds.) *Mathematical knowledge management. Proceedings of MKM 2003*. LNCS 2594. Springer.
- Harel, G. (1998). Two dual assertions: The first on learning and the second on teaching (or vice versa). *American Mathematical Monthly*, 105, 497-507.
- Leron, U. (1983). Structuring mathematical proofs. *American Mathematical Monthly*, 90(3), 174-184.
- Mejia-Ramos, J.P., Weber, K., Fuller, E., Samkoff, A., Rhoads, K., and Search, R. (2010). Modeling the comprehension of proofs in undergraduate mathematics. In *Proceedings of the 13th Conference for Research in Undergraduate Mathematics Education*.
- Rowland, T. (2001). Generic proofs in number theory. In S. Campbell & R. Zazkis (eds.) *Learning and teaching number theory: Research in cognition and instruction*. Westport, CT: Ablex Publishing.

SYMPOSIUM

Perspectives of competence measurement in VET

Chairperson: Frank Achtenhagen, Institute for Business and Human Resource Education, Germany

Organiser: Esther Winther, University of Paderborn, Germany

Frank Achtenhagen, Institute for Business and Human Resource Education, Germany

Discussant: Franz Eberle, University of Zurich, Institut fuer Gymnasial- und Berufspädagogik, Switzerland

Competence measurement in the fields of vocational education and training do actually not exist in Germany and other European countries (cf. Baethge, Achtenhagen, Arends, Babic, Baethge-Kinsky & Weber, 2006). Major problems are given by the fact that competence measurement in VET has mainly to cope with the effective and efficient fulfilment of actions at the workplaces. This leads to a multitude of measurement problems of which central perspectives shall be discussed.

The symposium treats three perspectives: First, an approach to constructing educational assessments in terms of modeling actions and conceptual understanding for mastering real-life tasks at the worksite. This also includes the analyses of test fairness with respect to both the individual characteristics of the students and the companies' properties. Second, perspectives of recent developments in modeling a complex sample of abilities and its high-dimensional structures as well as advantages and disadvantages of diagnostic models will be discussed. Third, competence measurement for VET has to be integrated into a comprehensive, general measurement model of competence. The link between a complex ability construct and the performance in real-life situations can be modelled using sophisticated statistical methods like generalizability theory.

The contributions to this symposium bring together decisive perspectives of competence measurement in the fields of VET. A central aim is to present and discuss research standards which support performance studies in these fields that are comparable to those of PISA studies in compulsory education.

Competence-oriented assessments in VET

Esther Winther, University of Paderborn, Germany; Frank Achtenhagen, Institute for Business and Human Resource Education, Germany

Performance studies in vocational and professional education and training, comparable with the PISA studies on scholastic education, do not yet exist in Germany and other European countries. Therefore, the proposal aims to transfer the methods and evaluation standards applied in the PISA studies to the area of VET and professional development. For this purpose, approximately 1,800 final examinations for industrial clerks (after 3 years of apprenticeship) are analyzed. Based on that analysis scientifically founded evaluation models are developed. Simultaneously, there is a need to learn more about complex situations and its descriptive components to design competence-oriented assessment. This also includes a deep insight into the modeling and scaling approach, but also a constructive discussion about theoretical assumptions regarding the competence construct that is measured. Two aspects of interests will be discussed: A reconstruction of the item development under a pedagogical content knowledge (or subject didactic) perspective, and based on DIF analyses aspects of fairness in formative and

summative testing as well as for the use in instructional processes to foster learning and teaching in the specific domain of economic sciences. The DIF analyses are done in different ways: comparing individual characteristics as well as comparing companies' properties.

(1) Aims and methodology

According to the „Standards for educational and psychological testing“ (AERA, APA & NCME, 1999) the development of tests is based on four different phases: „(1) delineation of the purpose(s) of the test and the scope of the domain (content and skills) to be measured; (2) development and evaluation of the test specifications; (3) development, field testing, evaluation, and selection of items and scoring guides and procedures, and (4) assembly and evaluation of the test for operational use“ (ebd., p. 37). Compared to the PISA studies for the compulsory school system, measurement of competencies in VET has to take into account not only relevant knowledge, but also abilities to fulfill work-related actions in an effective and efficient way. To control this precondition it is necessary to reconstruct (and revise) the theoretical assumptions, which led from the training program to competence measurement under aspects of pedagogical content knowledge as well as under psychometrical aspects. This includes the control (and revision) of the developmental chain with regard to concept map, construct map, item development, outcome space, and measurement procedure (four building blocks, Wilson, 2005). Results of such analyses will be presented. They can be used for the interpretation of test results of different test takers and for the construction of revised test versions. In addition to that there are a number of person-related principles, which should apply: Respect for the students/examinees, responsibility, fairness, reliability, validity and collaboration among the parties involved. In other words, a test developer has to ask: What efforts are made to ensure that the assessment results are accurate and fair? Professionals in learning and instruction should provide and use tests that are fair to all test takers regardless of personal characteristics. Therefore, fairness is a primary consideration in all aspects of testing. Fairness concerns are often framed in terms of both test and item bias favoring or disadvantaging groups of test takers. Two approaches to examining potential measurement bias are identified: (a) judgmental, and (b) statistical. Judgment methods rely solely on one or more expert judges' opinions to select potentially biased items. Clearly, this is more a heuristic methodology. Instead of the sole reliance on expert (i.e., content area) judges, the recommendation to rely on statistical techniques for investigating generates potential bias because this method's defensibility is given. The statistical technique then flags potentially biased items (e.g. Clauser & Mazor, 1998; Zumbo, 1999).

(2) Findings

Primarily results of analyses of test items under the pedagogical content knowledge perspective will be presented (e.g. neglect of process aspects of actions). This is the starting point for the discussion of fairness which is relevant for both the formative as well as the summative use of assessments. Based on the analysis of 1,776 final examinations of industrial clerks the continuum of variation of students' professional competence is discussed. The continuum of variation is an essential part of modern test theory and it not only helps define Differential Item Functioning (DIF) but it also helps us interpret DIF results and their use in learning and instruction. DIF refers to the different statistical properties of an item between groups. DIF analyses here are done in three ways using the Rasch model for DIF: pre-orientation in economic courses vs. no formal trainings, male vs. female, large-scale enterprises vs. smaller companies.

Rasch model for DIF: (Appendix 1)

Competence measurement in VET is not considered fair if it advantages or disadvantages groups of test-takers. Winther (2010) considers that a major concern in the design and development of competence measurement in the domain of VET and professional development is to minimize the effects of the factors that are not part of the actual professional ability to understand and to act in complex professional situations. Some of these factors are described by the test-takers characteristics; some of them are addicted to companies' properties. For example, there is substantial bias comparing the solving of economic problems by naive individuals (with no formal trainings in economics) and novice individuals (with pre-orientation in economic courses). The bias is – surprisingly – in that direction that the groups of novice individuals are less likely to answer an everyday economic item correctly than examinees of the other group (mean DIF-effect .438 logits). The results suggest that classroom instruction in economics does not necessarily lead to superior performance in everyday economic tasks. The examinees from those two groups show differing probabilities of success on the everyday economic items after matching on the underlying ability that the items are intended to measure even after three years of learning and working together. With respect to companies' properties trainees of large-scale enterprises have higher probabilities of responding correctly to an economic item than those trainees working in smaller companies (mean DIF-effect .529 logits). Both effects mentioned have meaningful impact on both the design of tests in the economic domain as well as on the learning and instructional processes.

(3) Theoretical and educational significance

With respect to the design of tests to measure competence in the domain of economics a fundamental issue is that DIF is a necessary, but not sufficient condition for item bias. Therefore, a very important decision is whether to consider items exhibiting DIF as biased items until proven valid or unbiased items until proven biased (Schumacker, 2005). Item bias differs in terms of whether group differences are based on relevant or irrelevant characteristics (respectively) of the test. DIF requires that members of the groups be matched on the relevant underlying ability before determining whether members of the two groups differ in their probability for success. And finally, adverse impact simply describes disproportionate workplace decisions based on test performance, for instance (e.g. Zumbo, 1999). Using the empirical results of DIF for discussing implication on learning and instruction (as a formative use of assessments) it has to be considered that first of all under the pedagogical content knowledge perspective an adjustment of students' prior knowledge, of the skills and strategies students' are using in learning and performing, and of the understanding of underlying economic concepts is necessary.

Do diagnostic models hold more promise than they deliver?

Matthias von Davier, Educational Testing Service, United States

Recent developments in modeling complex student response data utilize multidimensional discrete skill variables. These variables represent latent mastery/non-mastery levels that need to be inferred by observed responses to a series of items. Models of this type have been developed as extensions of latent class approaches, and are often referred to as models for cognitive diagnosis, or diagnostic classification models. The class of models presented here is suitable for binary and ordinal observed response data, and allows modeling the latent structure as a combination of quantitative and qualitative latent variables. Applications of this general diagnostic modeling framework to analysis of test and questionnaire data from areas such as cognitive skills assessments, large scale surveys, longitudinal analysis, and the analysis of multidimensional personality tests (Big 5) will be discussed. The presentation will give an overview of the field, and will talk about promised advantages of using these models as well as limitations of the utility of these models.

(1) Introduction

The presentation will give an overview of latent variable models for cognitive diagnosis. von Davier, DiBello and Yamamoto (2006) provided a selective review of these models tracing the history of diagnostic models from Tatsuo's Rule Space Methodology (RSM) to the General Diagnostic Model (GDM, von Davier & Yamamoto, 2004, von Davier, 2005) As Rupp & Templin (2008) point out, the roots of the currently discussed or rediscovered models go back three decades or more. I chose the term general diagnostic model for my developments, which are no exception here. A new name for a family of models may help to distinguish the approach, but may also be counterproductive in helping to understand relationships to existing approaches. Other names used in the field are aside from cognitive diagnosis models terms such as skill profile models, cognitively diagnostic models, and other variations and for more specific models such as NIDA, DINA, NIDO, etc. All these new terms cannot hide the fact that latent structure analysis (Goodman, 1974; Haberman, 1979; Lazarsfeld & Henry, 1968) is the foundation of all these approaches. This can be easily expressed in terms of a slight variation of the latent class model equation. Some well known properties are preserved, for example, many approaches assume local independence of response variables given the latent class. In addition, one may assume that the latent variable takes on a specific form. In the vast majority of diagnostic models, the latent structure is broken down into a product space of several mastery/non-mastery variables. In this case, we speak of the latent structure as representing binary latent skills, each of which can take on two states. Haberman & von Davier (2007) discuss limitations of these models for the use on item response data based on test instrument that were not designed for the identification of multiple skills.

(2) Modeling high-dimensional structures

However, if highly multidimensional tests are subjected to analysis with diagnostic models, the multidimensional skills-space used in these models may need to be constrained in order to maintain the ability to estimate these models without excessively large sample sizes. DeLaTorre & Douglas (2004) design a higher-order diagnostic model, in which the skill space distribution depends on a higher order latent trait, which makes the binary skills into unobserved 'super-items' and relates in consequence all responses, the observed and the unobserved binary 'skill responses' to a uni-dimensional IRT model. von Davier & Yamamoto (2004) suggested a model that was used by Xu and von Davier (2006) to parameterize the high-dimensional skill space more parsimoniously utilizing log-linear models for multidimensional binary and ordinal data. This model allows for interactions and higher order marginal moments, while reducing the burden on estimated quantities necessary for these models by a large extent, and has proven to be more flexible in fitting the data than, for example, discrete-ized multidimensional normal ability variables.

(3) Utility for factorial and typological theories

Subsequent research (Haberman, von Davier & Lee, 2008) has shown that diagnostic models and multidimensional IRT (MIRT) models can hardly be told apart when looking at the fit of these models to real data. This implies that the multidimensional quantitative skill variable used in MIRT models can very often be successfully approximated by a discrete skill variable with very few (2 or 3 are often sufficient) skill levels per dimension. This finding corresponds with conceptual discussions of the DIMCAT framework (DeBoeck, Wilson & Acton, 2005), as well as with findings reported by Lindsay, Clogg & Grego (1991) as well as de Leeuw & Verhelst (1986) and Formann (1985, 2003). The consequence is that the GDM can be viewed as a general latent variable modeling framework that covers binary, ordinal, and continuous latent variables.

The talk will elaborate on these findings and will give examples of applications of the GDM, and will present research-grade software that is publicly available for non-commercial purposes.

On a General Competency Measurement Model

Richard Shavelson, Stanford University, United States

Across multiple societal sectors, demand is growing to measure individual and group competencies. This paper unpacks Hartig et al.'s (2008) competency definition as a complex ability construct closely related to real-life-situation performance to make it amenable to measurement. Unpacked following the assessment triangle (construct, observation, inference), competency measurement is exemplified by vocational and educational research from business, military and education sectors. Generalizability theory, a statistical theory for modeling and evaluating the dependability of competency scores, is applied to several of these examples. The paper then pulls together the threads into a general competency measurement model.

(1) Aims and Methodology

This talk provides one possible vision, or more formally, model of what the measurement of competencies—be they in education, work, or everyday life—might look like and how such a measurement might be developed and evaluated. It addresses, in part, the challenge posed by Hartig, Klieme and Leutner (2008, p. v): The theoretical modeling of competencies, their assessment, and the usage of assessment results in practice present new challenges for psychological and educational research. The paper is conceptual. It draws on a variety of statistical methods, especially Generalizability Theory (Cronbach et al., 1972).

(2) Findings

The presentation is organized along the lines of the assessment triangle (Figure 1; National Research Council, 2001): Construct—Observation—Interpretation. What is measured, indirectly, is typically called a construct—in our case, the construct is competence or competency. Competence is a "... complex ability ... [construct] that ... [is] closely related to performance in real-life situations" (Hartig, Klieme, & Leutner, 2008, p. v). Note that the construct, competency, is an idea, a construction created by Western societies. It is hypothetical and cannot be observed directly. It can only be inferred from a person's behavior.

Figure 1. The Assessment Triangle. (Appendix 1)

Competencies may be simple (e.g., fastening a bolt) or complex (e.g., troubleshooting a malfunctioning engine). Underlying performance and competence are a complex set of abilities. These abilities are cobbled together when a person attempts to meet task and response demands. The ability complex changes over the duration of task performance as sub-goals are met and new goals are set. These complexes are inextricably intertwined and while psychologists untangle them, analyze them separately, and add them up to provide a measure the whole, this is not the case of competency measurement. Rather, competency measurement focuses on real-world tasks and responses to them recognizing a multitude of abilities are involved in performance and pulling them apart distorts the performance of greatest interest (e.g., McClelland, 19973; Shavelson, Roeser et al., 2002).

From this construct, a task, or problem or stimulus can be identified that is thought to evoke the construct. By engaging in the task, a person's behavior—her response—can be observed. Either the presence or absence of the construct can be observed, or the person's level of performance can be observed. The universe of possible tasks and responses for observing competency performance, then, logically follow from the definition of the construct. For the purpose of building an assessment, a sample of the tasks/responses is drawn from this universe.

Having created an assessment and observed behavior on the sample of tasks and responses, the question remains: Do the scores actually measure—reliably and validly—the construct? That is, can one reliably and validly interpret (infer) from a person's behavior on the assessment the presence or absence of the construct, or the level of performance on the construct? Evidence is presented in Table 1.

Table 1. Generalizability Analysis of Scores from the Navy Machinist Mates Hands-on Assessment (data from Webb, Shavelson, Kim, & Chan, 1989). (Appendix 2)

The talk presents one possible definition of the construct, competence, in a preliminary way. From that definition, concrete examples of how that definition might be put into practice are provided. These examples are drawn from business, military and education. From this characterization, a statistical theory for modeling performance on competence measurements is briefly described. It is then applied to several of the example assessments and some general findings of competency measurement are summarized. The entire package is put together in a final concrete example of an operational assessment of college students' learning. The talk concludes with one possible synoptic model for developing measures of competency.

(3) Theoretical and educational significance

Research and development activities directed at the measurement of competence need to be based on one or several models of competency measurement. The model presented in this paper (or some other model) serves as a beginning of a conversation as to the nature of competency measurement. If adopted across research and development groups involved in measuring competency, there is a chance that our findings and experiences can accumulate and progress over time. In this way, a center of gravity will be created and new advances in one domain will most likely inform measurement in another competency domain. The goal, in the end, is to create continuous improvement in both our measurement methods and our theories of competency.

SYMPOSIUM

On the Design of Visualizations for Learning

Chairperson: Marije van Amelsvoort, Tilburg University, Netherlands

Organiser: Marije van Amelsvoort, Tilburg University, Netherlands

Discussant: Mireille Betrancourt, University of de Geneva, Switzerland

A great deal of educational research aims at a better understanding of learning with and from visualizations, for example by comparing text and pictures, or static and dynamic graphics. Visualizations refer to static and animated visual displays that depict conditions, situations, processes, places or events as they appear in maps, diagrams, graphs, pictures, schematics, data-based spatial or linear renditions, and immersive virtual environments. Although visualizations are widespread in education, the results of learning with visualizations are often mixed, arguably because learning scientists have mostly ignored the importance of informed design of visualizations. Despite much work in graphics design, we know surprisingly little about what a good visualization for learning should look like or what makes a visualization more effective than another. This symposium aims at an inventory of principles, functionality, and aesthetics in the design of visualizations for learning. Three studies are reported that investigate different kinds of visualizations (metaphorical depictions, physics and geography graphics, and argument diagrams). Schwartz et al. investigate whether a decorative picture increases learners' understanding when the graphic is designed to convey a metaphorical message. De Vries and Ashraf solicit teachers' expertise in determining the existence of different categories of visualizations and their function across cultures and domains. Van Amelsvoort and Maes investigate learners' spontaneous construction and understanding of argument visualizations. Through the presentation of these studies, as well as through energetic debate with the discussant, the symposium will give rise to a list of research-based guidelines for the design of visualizations for learning.

Metaphorical Visualizations: Their Influence on the Emotional Intensity of Expository Text Themes

Neil Schwartz, California State University, United States; Robert Danielson, California State University, United States; Sevil Gonen, California State University, United States; William Vallado, California State University, United States; Maryam Falahi, California State University, United States

A series of four experiments across three investigations are reported which describe the influence of decorative graphics on learners' ability to extract the underlying themes of narrative and expository text. When decorative graphics are metaphorical depictions of textual themes, learners use the graphics to guide their interpretation of text at a level deeper than literal passage facts. However, text themes are not equally salient in the emotional arousal they

evoke in learners, and the graphics influence thematic text comprehension differently relative to that arousal. Specifically, the more a graphic is capable of metaphorically depicting text theme, the better the passage will be learned. However, the effect is most predominant well after learning and depends on the emotional salience of the thematic concept.

Background to the Investigation When graphics are paired with text, text comprehension is reliably improved. The finding is robust and well documented across a wide variety of visualization graphics (Schnotz & Bannert, 2003; Mayer, Hagerty & Mayer, 2005; Schwartz & Collins, 2008). However, not all visualization graphics function in the same way, particularly when the graphics are intended to decorate a page. In a meta-analytic review, Levin, Anglin, and Carney (1987) found moderate to strong effect sizes for graphics used to inform text by representing all or part of text content, but weak to non-existent effect sizes for graphics used for decoration. Elia, Gagatsis, and Demetriou (2007) found that graphics used principally for adornment fail to increase learners' understanding of related tasks or deepen their comprehension of instructional material. And yet, decorative graphics are common in educational materials, and publishers still persist in incorporating them. The presumption is that publishers believe that learners will be more drawn to text if it is visually interesting and attractive. The problem is that instructional designers need to know if decorative graphics actually make a difference beyond the aesthetics of text, and what features of the graphics influence comprehension. In the present paper, we discuss four experiments demonstrating that when decorative graphics are metaphorical depictions of underlying text themes, learners use the graphics to guide their interpretation of text at a level deeper than surface processing. (Danielson, Schwartz, Krause & Lippman, 2010; Mortensen & Schwartz, 2009; Schwartz, Battinich, Lieb & Mortensen, 2008; Schwartz, Lieb, Battinich & Kuinke, 2007; Schwartz & Collins, 2008). Schwartz and Collins (2008) demonstrated that learners summoned personally relevant prior knowledge based on the theme of the text made salient by a decorative graphic. Mortensen and Schwartz (2009) found that learners' comprehension of both literal details and deeper-level text themes were increased when decorative graphics were visual metaphors of the underlying themes of a narrative text. Danielson et al. (2010) revealed that learners remembered more neutral passage material in the presence of a decorative graphic when the graphic was a metaphorical depiction of the text theme—significantly more than a graphic showing the geographic region in which the text information took place, or no graphic at all. The Danielson et al. investigation was designed to replicate Mortensen and Schwartz (2009) with expository, as opposed to narrative text, since expository text is more commonly found in textbooks and mainstream media. Two types of text themes (Genocide vs. Civil War) were crossed with four types of metaphorical graphics (Genocide vs. Civil War vs. Geographic Location vs. None) to demonstrate that thematically-consistent metaphorical graphics influence what is remembered from text. The experimental passage was an 839-word expository text describing the current conflict in Darfur, written to reveal two socio-political themes—civil war and genocide. The civil war theme described how Darfurian factions fight for territory and influence. The genocide theme described actions centering around ethnic cleansing. The passage contained 40 neutral, 20 civil war, and 20 genocide idea units. Neutral idea units provided the reader with contextual background of the conflict, geographic information, and a historical timeline. Civil war idea units consisted of rebel groups uniting against a corrupt government for representation. Genocide idea units consisted of a planned extermination or removal of a group of individuals. The graphics depicting genocide, civil war, and geographic location were visual metaphors of the theme and are shown in Figure 1. Metaphorical depiction was defined as a visual representation of an object in action (the target) capable of being understood in terms of another object (the source—in this case the concept underlying the text theme) (Van Weelden, Cozijn, Maes, & Schilperoord, 2010). The analysis yielded significant differences in memory for the genocide theme relative to the theme of civil war, but only in the no graphic condition, with the genocide theme significantly better remembered. Thus, the themes inherent in the text were not equivalent in their salience (Figure 2).

The Present Investigation In the present investigation, we designed two experiments—one a test of the theme of genocide, and the other as a test of the theme of civil war—since the themes were determined to be nonequivalent emotionally. The experimental passage constructed for both experiments was 431 words in length and comprised of 24 sentences, three rated high for the genocide or civil war theme, respectively, in the context of the Darfur conflict. The passage with the genocide sentences was used for experiment 1; the passage with the civil war sentences for experiment 2. The graphics were the same as Danielson et al. (2010) but re-normed for their metaphorical depiction of the genocide or civil war theme, respectively. Only the genocide graphic required modification to reach a statistically significant level of metaphorical depiction. Participants were randomly assigned to one of four graphics (civil war; genocide; geographic location; none) in each experiment. In experiment 1, learners read the passage with the salient genocide theme; in experiment 2, the passage with the salient civil war theme was used. Learners in both experiments were directed to write an essay immediately following reading and a second essay one week later. Results from both experiments suggest that graphics, when they are metaphorical depictions of theme, make text material more memorable when the material can be associated with the theme. However, text themes are not always equivalent, evoking different levels of emotion that mediate the extent to which the graphics influence learners' ability to extract themes for comprehension. The graphics with metaphorical depiction of theme also exert their greatest effect some time after learning. Taken together, the findings reveal that graphic

visualizations, when they are carefully-constructed metaphorical depictions of underlying text themes, influence what learners learn from text. The graphics may appear decorative, but they are interpreted by learners at a level deeper than their literal appearance. Learners attempt to make meaning of the graphics they see by drawing metaphorical associations between the underlying meaning of the text and the underlying meaning of the graphic.

Unpacking Visualisations: A Study of Teacher Conceptions

Erica de Vries, Université Pierre-Mendes-France, France; Muhammad Ashraf, University of Grenoble, France

Visualisations gain more and more importance in pedagogical material, in text books and in computer programs. Despite the co-existence of many different types of visualisations or graphical genres, learning research only has taken into account the distinction between text and pictures. The current study aims at unpacking what, at least in learning research, seems to be one single holistic indivisible category of visualisations. The presented approach focuses on teacher conceptions on the existence of different types of visualisations and their presumed function in teaching and learning. Twenty teachers from two different countries (France and Pakistan) and of two different subject matters (physics and geography) were interviewed. Amongst others, results showed that teachers are confident about student comprehension for generic categories such as tables, line graphs, and maps. However, the transparent nature of hybrid visualisations was called into question. This is an important finding given the fact that technological means have considerably enlarged the spectrum of visualisation possibilities. The design of educational graphics therefore involves reasoned use of advanced visualisation techniques.

Introduction

Visualisations gain more and more importance in pedagogical material, in text books and in computer programs. Despite the co-existence of many different graphical genres, learning research only has taken into account the distinction between text and pictures by studying their spatial and temporal arrangement. Thus, much less attention has been devoted to the educational efficacy of different types of visualisations (or texts!). Thus, the verbal and the visual presentation modes appear as two holistic indivisible categories. To begin with, very diverse systematic taxonomies of visualisations would be possible depending on the particular classification criteria adopted: graphical form, content domain, pedagogical function, signification mode, or nature of the projection of world to visualisation. Bertin (1983) for example distinguishes diagrams (bar charts, histograms, and scatter plots), maps (geographical maps and diagrams with projected topological relations), networks (trees, path, node-and-link), and symbols (signs, icons, pictograms). A more pedagogically oriented categorisation distinguishes representational, organisational, interpretational and transformational pictures (Carney & Levin, 1998). Such distinctions have not gained much importance either in educational research or in teacher training as part of the body of professional knowledge of teachers. The current study aims at an inventory of existing knowledge on visualisation types through an exploration of teacher conceptions on the pedagogical use of visualisations.

Theoretical background

Visualisations are widely used in everyday life, in professional practice, in science and technology, as well as in teaching and learning. Thus, just like reading and writing for texts, interpreting and constructing visualisations seem to be important skills. Roth, Pozzer-Ardenghi, and Han (2005) even argue for the necessity of developing "critical graphicacy", i.e. the ability of constructing and deconstructing inscriptions, in other words to disentangle form, content, and purpose of representations (see also MRC, diSessa, 1995). Such skills clearly go beyond the objectivist functions of visualisations of recording, communicating and processing information (Bertin, 1983). On the other hand, compared to text, visualisations are acclaimed for their transparency, their concreteness, and their support for perceptual inferences (Larkin & Simon, 1987). In short, today's citizens are thought to be able to spontaneously and intuitively read off information because visualisations rely on analogy, on resemblance relations, on iconic as opposed to symbolic representation (Schnotz, 2001). However, educational settings may be considered as a special case of communication characterized by a knowledge disparity between participants. In particular, teachers and learners differ in prior experience with representational conventions (de Vries, 2010), which coins the question of the nature of such representational knowledge especially in teachers. Within the iconic presentation mode, are teachers aware of different types of visualisations? Are teacher conceptions domain-dependent? For example, graphical representations are traditionally widely used in geography (Bertin, 1983) and in physics but for essentially different reasons. Furthermore, teacher conceptions are likely to be culture-dependant. For example, French teachers select, organize and construct their own teaching material, whereas Pakistani teachers use textbooks which contain mostly text, some tables, and very few maps (geography) and diagrams (physics). The aim of the interview was to extract teacher conceptions on visualisation genres, their function in teaching, and on student comprehension.

Method

The study involved an inventory of teacher conceptions through a detailed, semi open-ended interview of ten French and ten Pakistani secondary school teachers in geography and physics. The sample was selected through snowball sampling method and teachers were interviewed in their home country. The interview consisted of seven questions for each of a set of eight different visualisations from geography and physics text books from Pakistan and France. Transcripts of the interviews were scored with the help of an analysis grid.

Summary of the results

Labelling graphics All eight visualisations received more than one category name in the set of teachers. The most clear-cut categories were "table", "map" and "line graph", but even visualisations within these categories were sometimes called "illustration" or "diagram". Only physics teachers used the category name "illustration".

Function of graphics The most important function of graphics, as indicated by teachers, is to present specific information on a topic. Furthermore, graphics are used in order to compare between text and graphics, and for students to be able to study subject matter. Teachers in both disciplines and from both countries did not feel that the presented graphics would motivate or attract students. All teachers stated that they use generic categories such as line graphs, tables, and pictures (such as an image of the solar system). Pictograms are not much used.

Student comprehension All teachers were confident on student comprehension of visualisations like the ones presented with the exception of a map-histogram hybrid that only the better students would understand. All students are thought to be able to understand line graphs and tables. Pictures and pictograms received mixed results. Some teachers think only good students will understand those, whereas others think any student will understand them.

Conclusions and future work In this study, the idea of visualisations as an opaque category was questioned and teachers were interviewed in order to extract their expert knowledge on visualisation types and functions in teaching. The results show that no clear cut categories can be identified. Category names such as "line graph", "diagram", "map" and "illustration" were not univocally attributed and no clear indication as to their function was established. Furthermore, although teachers were confident about student comprehension for generic categories such as tables, line graphs, and maps, there is also reason to doubt the transparent nature of hybrid visualisations, i.e. combinations of different types. This is an important finding given the fact that technological means have considerably enlarged the spectrum of visualisation possibilities. The design of visualisations of learning therefore involves finding the balance between full exploitation of new visualisation techniques and the anticipation of their pedagogical appropriateness. Future research should inquire into the nature of representational knowledge in general and for pedagogical purposes. Furthermore, future work should tackle the question of proper teaching of representational knowledge in teacher training and in school curricula.

Spontaneous Visualization of Argumentation

Marije van Amelsvoort, Tilburg University, Netherlands; Alfons Maes, Faculty of Humanities Tilburg University, Netherlands

Argument diagrams show argument in a non-linear way. They may help students to see relevant relations and to communicate their argumentative positions. However, research on learning with argument diagrams has shown mixed results. We argue that studies thus far did not take into account enough the design quality of argument diagrams. In two studies, we aimed to find design principles for argument visualization. In the first study, twenty participants had to visualize their position (either pro or contra) of an issue on a whiteboard with color pens. Then they were shown the drawing of another participant and asked to explain whether it was created by a proponent or opponent. All participants used textual, spatial and graphical features to visualize their standpoint, and all correctly identified the other's standpoint. Although participants created different types of visualizations, design principles seem to exist that are recognized by others. In the second study, we wanted to find out to what extent the graphical features support understanding of the argumentation. Four versions of the visualizations (1 original, 3 manipulated to contain text only, blurred text only, or graphics with blurred text) were exposed to 120 participants, twice very shortly, a third time for a longer period. Participants had to answer questions on sign, quality, attractiveness and clarity of the visualizations. We found that learners spontaneously use graphical features when creating argument visualizations. The meaning of these features is recognized by others, and strengthens the message. Our studies can help improve computer tools for argument visualization.

Students are sometimes asked to visualize argumentation in diagrams to help them learn about a topic. Researchers have argued that visualizing argumentation in diagrams helps for overview, shows relations, illustrates the structure of argumentation, and promotes reflection of alternative perspectives (e.g., Baker, 2003; Suthers & Hundhausen, 2003). However, visualizing argumentation is hard. Students are taught for years how to read and write, but hardly any attention is paid to how to read and draw visualizations. Asking students to visualize argumentation is therefore

oftentimes not helpful in remembering or understanding the argument. We actually don't know much about how students produce and interpret argument visualizations, and so far, there are hardly any shared conventions in visualizing argumentation (Buckingham Shum & Okada, 2008). Several software tools have been created to visualize (collaborative) argumentation, such as Reason!Able (Van Gelder, 2000), and Drew (Corbel et al., 2003). These tools make argumentation visible, but constrain learners at the same time. In Drew for example, learners must use rectangles to put arguments in and cannot use colors. We asked participants to create a visualization on a whiteboard in any way they liked in order to find spontaneous designs. The goal of our studies is to (1) investigate how students spontaneously create visualizations, and (2) how different graphical features of visualizations contribute to the understanding of argument visualizations.

In our first study, twenty participants were assigned a position (for or against) and asked to make a drawing of twelve given arguments to convince someone else of their standpoint. They could design the drawing in any way they liked, as long as they used all arguments for and against. Results show that all visualizations were different, though seventy percent could be defined as web-like or table-like (Figures 1 and 2). All participants used textual, spatial and graphical elements to visualize their standpoint. The visual language matrix (adapted from Kostelnick & Roberts, 1998) was used to identify what and how many elements were used. In this matrix, 15 graphical, textual and spatial features are distinguished on a local level (i.e., small-scale, such as size for important words) and global level (i.e., large-scale, overall level such as general shape of the visualization). Two researchers independently analyzed 285 features, rating 4% differently. All features were used in more than one visualization, but not in all visualizations. For example, the visualizations contained on average 4.81 arrows ($SD = 5.53$), and 3.21 different colors ($SD = 0.79$) at a local level. The number and type of graphical features inform us of what participants spontaneously use, but do not explain what the features mean. Therefore, we have asked the twenty participants to read the visualization of another participant and decide whether it was made by a proponent or opponent. Table 1 displays perceptual features (space, graphics, and text manipulations) that were used in more than half of the visualizations to meet their argumentative goal. For example, colors were used consistently to show pro and contra arguments.

Participants all correctly identified the standpoint in visualizations created by others. We also compared explanations readers gave for how they decided upon the standpoint to answers the designers gave on how they visualized the argument. For example, one designer explained that she circled her most important argument and put an exclamation mark in front of it. The reader said: "I think the designer was against, because this counter argument is in a red square with an exclamation mark in front of it" (see Figure 2). Study 1 showed that participants use perceptual features in visualizations (space, graphics and text manipulations) consistently to a large extent, and that these are recognized by others, even though very different types of visualizations were created.

In study 2, we investigate to what extent these perceptual features are responsible for understanding argument diagrams, as well as evaluating their attractiveness and persuasiveness. For the experiment, we constructed four versions of each of the visualizations produced in study 1; (a) the original version, (b) graphics with blurred text, (c) text only, and (d) blurred text only. 120 participants were asked to carry out three tasks, twice (task 1 and task 2) looking at the visualizations one by one for only 4 seconds on screen, a third time by looking at the visualizations all together without time limit. In task 1, they had to decide whether the visualization was from a proponent or opponent. In task 2, they rated the attractiveness and clarity of the visualization. In task 3, they answered more in-depth questions about the quality of the visualizations using a selection task. We expected that the graphical features help participants in deciding pro or contra when they have only four seconds to decide, and that participants evaluate visualizations with graphical features more positively. The graphical features of each visualization in study 1 were correlated to participants' evaluations in study 2, in order to find those features that are important for understanding argument visualizations. Preliminary results indicate that graphical features help learners identify arguments faster, but not understand them better. In sum, learners spontaneously use textual, graphical, and spatial features when creating argument diagrams. The meaning of these features is not only recognized by others, but also strengthens the message. Design principles are derived from learners' own use of graphical features to improve tools for argument visualization. Future research should take into account how people create and interpret specific aspects of argument visualizations to gain insight into how representations guide learning.

SYMPOSIUM

Learning by means of comparing and contrasting

Chairperson: Lennart Schalk, ETH Zurich, Switzerland

Organiser: Elsbeth Stern, ETH Zurich Institute for Behavioral Sciences, Switzerland

Discussant: Alexander Renkl, University of Freiburg, Germany

Encouraging students to compare different examples of problems and/or solution methods has recently gained attention because it has proven to be a powerful mechanism for meaningful learning particularly in formal areas such

as science and mathematics. Systematic comparisons involve processes of structural alignment and mapping that support learning by abstraction, inference-projection, or difference-detection. As a consequence, comparisons can support the extraction of a common relational scheme inherent in different examples. Another possibility is that comparisons do help to contrast important features that should not be confused. In this symposium, three different experimental studies will be reported that investigated learning by means of comparing and contrasting. The first study by Schalk and Saalbach demonstrated that a broad transfer performance can be achieved by comparing multiple examples in the domain of propositional logic. The second study by Ziegler revealed that contrasting superficially similar problems in the domain of basic algebra helps to highlight the differences which prevents from confusing the underlying concepts. The third study by Durkin and Rittle-Johnson showed that comparing correct and incorrect solution methods helps to learn key concepts and correct procedures about decimal fractions. Overall, the studies demonstrated that initiating comparison and contrasting activities foster the acquisition of conceptual and procedural knowledge and their transferability. The discussion will integrate these new empirical findings and provide critical reflections on how the findings can be used to develop learning material.

Designing learning material to foster transfer: Which route to take?

Lennart Schalk, ETH Zurich, Switzerland; Henrik Saalbach, ETH Zurich, Switzerland

We evaluated different ways of how to design learning materials to foster the flexible use of general principles. One possibility is to directly present the abstract representation of a principle; another is to present concrete examples which instantiate the principle and prompt comparison of them. Both the use of worked examples and the prompting of comparison processes have been shown to support learning and transfer. In contrast to previous studies, we evaluated the transfer potential of a variety of learning materials with multiple transfer tasks. In Experiment 1, four different ways of learning the principles of propositional logic were tested against each other: (1) learning the abstract representation, (2) comparing the abstract representation with one worked example, (3) comparing two worked examples, (4) learning two worked examples without comparison. We found that students learning material (3) showed better transfer performance than students using (1), (2), or (4). Surprisingly, students comparing the abstract representation with one worked example (3) were least successful. Given the importance of mapping abstract representations onto concrete examples in school learning, we explored a way of supporting this mapping. In Experiment 2, we therefore tested whether comparing the abstract representation with two worked examples (5) instead of one would result in a better transfer performance. We found that learning with (5) resulted in the best transfer performance. We suggest that this kind of comparison should be considered when designing learning materials to foster transfer of general principles.

A major aim of education is to enable learners to apply their content knowledge to solve a large variety of problems. Knowledge acquired in educational contexts often consists of general principles applicable to superficially dissimilar phenomena. For example, principles of propositional logic should be considered when evaluating the validity of a philosophical argument, but also when comprehending the functions of logic gates in digital circuits. Teaching thus requires that the principles taught in school are transferable to new problems and do not remain tied to specific characteristics of the learning situation.

Different approaches have been proposed to achieve this aim. One approach to foster transfer of general principles suggests directly teaching the abstract representation of the principle (e.g., a formula). It is argued that abstract representations are likely to emphasize non-perceptual relations among entities while containing no (distracting) extraneous information (e.g., Kaminski, Sloutsky, & Heckler, 2008). Another approach emphasizes the self-construction of the principle by comparing concrete examples (e.g., worked examples). Comparing examples is said to promote the generation of a more general and complete relational schema (e.g., Gentner, Loewenstein, & Thompson, 2003). Finally, a third approach suggests learning simultaneously from different representational formats (e.g., a formula and a worked example). Here it is argued that integrating multiple representations supports conceptual understanding by active translation between representations (e.g., Ainsworth, 1999). However, results of research investigating these different approaches are difficult to compare.

A comprehensive evaluation is difficult due to two reasons. First, conceptualizations of transfer differ between researchers. Mainly, dichotomies such as near versus far transfer have been used without explicitly specifying the conceptual distance between learning and transfer task. This becomes even more problematic because, second, transfer is commonly measured only with a single task. Hence, the advantage of the learning material used in previous studies may be restricted to the specific kind of transfer tested. The aim of the present research was therefore to evaluate the transferability of general principles taught by different materials by means of a wide range of transfer tasks with different representational formats.

Experiment 1

In Experiment 1, we developed materials presenting the principles of propositional logic in four different ways. Groups of students learned the principles either by (1) directly learning the abstract representation of the principles, (2) comparing the abstract representation with one worked example, (3) comparing two worked examples, or (4) learning two worked examples without comparison. (4) served as the baseline group, which should be outperformed by the other groups. Group (3) might be provided with the most effective learning material since learners are trained on the translation between different representations and the different transfer tasks are based on various representational formats.

Method:

Undergraduates (N=114) were randomly assigned to learning materials. Students worked through the materials individually. To engage students in active processing they were instructed to write short self-explanations. Learning lasted one hour. One week later, students were given a transfer test consisting of seven types of tasks.

Results

Students comparing two worked examples gained the highest transfer score (65%). This score was significantly higher than the score of students comparing the abstract representation with one worked example (54%, $d = .72$) and the score of the baseline group (58%, $d = .46$). Directly learning the abstract representation resulted in the second best transfer score (61%). This group was significantly superior to the group comparing the abstract representation with one worked example ($d = .51$), however, they did not outperform the baseline group.

Discussion

Comparing worked examples resulted in the best transfer performance. Although students learning the abstract representation did not perform significantly worse than students comparing two worked examples, they failed to perform better than the baseline group. The results thus suggest that learning principles by the means of comparing worked examples has the highest transfer potential.

Surprisingly, however, comparing the abstract representation with one worked example resulted in the least successful transfer performance. Given the importance of mapping abstract representations onto concrete examples in school learning, we explored a way of supporting this mapping in the second experiment.

Experiment 2

We tested whether comparing the abstract representation with two worked examples (5) instead of one would result in a better transfer performance. We compared performance of this group to groups (1), (2), and (3) of Experiment 1.

Method

Twenty-seven undergraduates learned the principles of propositional logic by comparing the abstract representation with two worked examples. The students were tested on the same transfer test used in Experiment 1. The procedure was the same as in Experiment 1.

Results and Discussion

Learners of material (5) gained the highest transfer score (66%). This group significantly outperformed students who (1) learned only the abstract representation ($d = .31$) and students who (2) compared the abstract representation with one worked example ($d = .82$). No differences between learners of material (5) and students who (3) compared two worked examples were found. Our results suggest that using multiple representations when learning general principles is only efficient when the abstract representation needs to be aligned with multiple worked examples.

General Discussion

Overall, we found that comparing worked examples (3, 5) is more effective than merely learning an abstract representation (1) or aligning two different representational formats (2) with respect to transferring general principles such as propositional logic to a broad range of tasks. Our results therefore suggest that a specific advantage of learning environments with multiple representations can only be reached when they incorporate multiple worked examples (5) instead of a single one. This allows for deep abstraction from superficial features of the learning materials. Because learning principles is common in mathematics and science instruction the present findings have implications on developing learning materials.

References

- Ainsworth, S. (1999). The function of multiple representations. *Computers & Education*, 33(2-3), 131-153.
- Gentner, D., Loewenstein, J., & Thompson, L. (2003). Learning and transfer: A general role for analogical encoding. *Journal of Educational Psychology*, 95(2), 393-408.
- Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2008). The advantage of abstract examples in learning math. *Science*, 320, 454-455.

Learning similar concepts in mathematics: Contrasting as a way to make differences more salient

Esther Ziegler, ETH Zurich, Switzerland

Numerous studies have shown the positive effect of comparisons on concept learning. Comparisons seem to affect a deeper processing of learning materials. Previous studies used comparing examples with dissimilar surfaces to abstract a principle that subsequently can be applied to solve a novel problem. However, to understand closely-related concepts, it may be helpful to compare objects with similar surfaces to make differences more salient, in the sense of a contrasting. The aim of this study was to explore whether comparisons used as contrasts can help to better understand the difference between superficially similar concepts. A training study was conducted with a self-learning program for the introduction of two mathematical concepts: addition and multiplication in algebra. A total of 157 sixth-graders (mean-age= 12.4) were randomly assigned to two conditions: (1) in the contrast condition they were presented addition and multiplication tasks simultaneously with the instructions to compare them, (2) in the sequential condition they practiced addition examples for two days, followed by two days of multiplication training. In both conditions, exactly the same learning material was used. In accordance with our hypotheses, all three post-tests (one day, one week, ten weeks later) showed a significant effect of contrasted learning compared to sequenced learning, although students in the contrast condition performed worse in the immediate learning tests. Thus, this study demonstrated that contrasting is a promising learning method to differentiate superficially similar concepts in the domain of algebra in a school setting, although such learning leads to more errors at the beginning.

Many students have substantial difficulties in learning algebra. The main problem seems to be the uncertainty in handling the rule system which may be responsible for prevalent confusion of similar concepts ($ab+ab=2ab$ and $ab \cdot ab=a^2b^2$). Two reasons for confusion errors are discussed: procedure memorizing without understanding underlying concepts (Stephens, 2008) and the misleading focus on surface features instead of paying attention to structural characteristics of concepts (Chi et al., 1981). Comparisons seem to affect a deeper processing which help to overcome this focus on the surface and to gain insight into causal structures of concepts. The benefit of comparison has been shown in numerous studies with comparisons to learn complex concepts (Kurtz et al., 2001; Loewenstein et al., 2003). Therefore, comparing examples with dissimilar surfaces helps to abstract a common principle which subsequently can be used to solve novel problems. However, to understand closely-related concepts, it may be helpful to compare objects with similar surfaces to make differences more salient, in the sense of a contrasting. Concepts are frequently built on precedents and therefore often differ only in a few aspects, which may also be the reason why concepts are usually introduced gradually. But there is no research that investigated a simultaneous and contrasted introduction of concepts. Hence, the aim of this study was to examine whether such contrasting helps to distinguish between superficially similar concepts. On this account, we have chosen the two concepts addition and multiplication in algebra. We expected to find learning benefits of the contrasted introduction compared to the sequential introduction. In addition, we were interested in whether contrasting can be established as a general instruction principle in school settings.

Method

We constructed a self-learning program for the introduction of the two concepts: addition and multiplication in algebra. The programs were processed in 2-hour learning sessions on four successive days where students had to work through 9 work sheets. These sheets consisted of worked examples and a self-study part. After every sheet, students did a test as an indicator for immediate learning. A total of 157 sixth-graders (mean-age= 12.4, 54.5% girls) participated and were randomly assigned to one of two conditions. In the contrast condition, students were presented worked addition and multiplication tasks simultaneously with the instruction to compare them. In the sequential condition, students practiced addition examples for two days, followed by two days of multiplication training. In both conditions, exactly the same learning material was used only presented in another order.

All students participated in three post-tests (one day, one week, ten weeks later), where procedural and conceptual knowledge, including misconceptions, were assessed as indicators for long-term learning. Conceptual knowledge was further analyzed for the number of defining features students reported in their written explanations. In addition, we assessed the passive learning of the alphabetical-ordering convention which was not explicitly taught.

We conducted two successive experiments with different participants and with an adapted post-test instruction: "control all tasks after finishing the test".

Results

As the main effect of group was similar in both experiments, we merged the two experiments into one evaluation. We used repeated measurement ANOVAs with the factor Group (contrast versus sequential) x Time (T1: one-day, T2: one-

week, T3: ten-weeks) for all the post-test measures. A multivariate ANOVA was conducted for the immediate learning measures.

There was a main effect of group for all post-test measures in favor of the contrast group: for procedural knowledge ($p = .094$) and for conceptual knowledge ($p = .077$) both with significant post-hoc tests at all points of measurement and for misconceptions ($p = .102$) with significant post-hoc tests at T2 and T3. These results indicate that contrast learning improves long-term memorization. The sub-analyses of conceptual knowledge showed only significant differences in reporting defining concept features, but not in reporting secondary features.

Surprisingly, the contrast group performed worse in immediate learning (p

There was a main effect of time for most of the post-test measures (p

Discussion

Our findings support contrasting as a promising learning method to differentiate superficially similar concepts in the domain of algebra in a school setting. The contrast group performed better in most of the post-test measures, mainly in the one- and ten-weeks post-tests, indicating a clear long-term learning gain.

In immediate learning, however, the sequential learners showed better results which may mislead one to conclude they learned better. However, knowledge acquisition needs to be considered on a long-term basis. An implication may be that some errors must be done in concept learning to differentiate between concepts. Furthermore, the fact that contrast students scored higher in the defining features of conceptual knowledge indicates that contrasting instruction leads to a focus on the essential aspects of concepts that need to be learned. This focus on defining features may be the key to manage distinction between similar concepts. Together with the worse performance of contrast learners in not explicitly taught conventions it may indicate that sequential processing of material requires less cognitive load. Thus, this reduced cognitive load may promote the perception of secondary concept features, but seems to distract from the more central defining features.

Chi, M.T.H., Feltovich, P.J., & Glaser, R. (1981). Categorization and Representation of Physics Problems by Experts and Novices. *Cognitive Science*, 5(2), 121-152.

Kurtz, K.J., Miao, C.H., & Gentner, D. (2001). Learning by analogical bootstrapping. *Journal of the Learning Sciences*, 10(4), 417-446.

Loewenstein, J., Thompson, L., & Gentner, D. (2003). Analogical Learning in Negotiation Teams: Comparing Cases Promotes Learning and Transfer. *Academy of Management Learning and Education*, 2(2), 119-127.

Stephens, A.C. (2008). What "counts" as algebra in the eyes of preservice elementary teachers? *Journal of Mathematical Behavior*, 27, 33-47.

The effectiveness of comparing incorrect and correct examples

Kelley Durkin, Vanderbilt University, United States; Bethany Rittle-Johnson, Vanderbilt University, United States

Many studies have examined the benefits of comparison when learning mathematics. Comparing common mathematical errors to correct examples may be one type of comparison that prevents such errors from being made in the future. In two experiments, we examined whether comparing correct and incorrect solution methods was more effective than comparing two correct solution methods when learning about decimal magnitude. In Experiment 1, students ($N=74$) in Grade 4 and 5 were randomly assigned to one of two conditions: 1) incorrect and correct examples or 2) correct examples only. Comparing incorrect and correct examples helped students learn correct procedures and remember key concepts more than comparing correct examples. Students' explanations during the intervention revealed that those in the incorrect and correct condition more frequently discussed correct concepts (e.g., the magnitude of a decimal; identifying a misconception). In Experiment 2, students ($N=54$) in Grade 4 and 5 were provided with instructional explanations or additional practice to evaluate the different benefits of each when learning from incorrect examples. Students were randomly assigned to one of three conditions: 1) incorrect and correct examples with explanations, 2) incorrect and correct examples with additional practice, or 3) correct examples only with additional practice. Preliminary analyses suggested that exposing students to incorrect and correct examples was more effective than studying only correct examples when learning about decimal magnitude. Also, additional practice seemed to be more beneficial than instructional explanations. Overall, having students compare incorrect and correct examples seems beneficial for learning, especially when paired with procedural practice.

Intuition suggests that exposure to incorrect examples reinforces an incorrect response. However, the learning of science literature has robustly shown that misconceptions in science persist even in older students, and discussing these misconceptions is an important step towards correcting them (e.g., Eryilmaz, 2002). In a similar fashion, comparing common mathematical errors to correct examples may prevent such errors from being made in the future.

It may improve students' ability to use and transfer effective solution methods (procedural knowledge) and to understand key concepts (conceptual knowledge). In particular, this type of comparison emphasizes the critical attributes of correct examples (Grope & Renkl, 2007) and helps students correctly update their schemas for important decimal concepts (VanLehn, 1999).

Students have common and persistent misconceptions in the domain of decimal fractions (Irwin, 2001; Resnick et al., 1989), so we examined incorrect examples in this domain. Students often treat decimals as if they are whole numbers (e.g., they think 0.25 is greater than 0.7) or do not understand how a zero affects the magnitude of a decimal (e.g., 0.08 and 0.250). We used a number line task to teach students about decimals. This was a relevant but novel task for most students, and the National Math Panel Report (2008) suggests using number lines for supporting understanding of decimals.

In Experiment 1, we investigated whether comparing incorrect and correct examples (incorrect condition) promoted greater learning than comparing two correct examples (correct condition). We randomly assigned students ($N = 74$) in Grade 4 and 5 to a condition. All students completed a pretest that focused on students' knowledge of decimal procedures and concepts. The procedural knowledge assessment included number line problems in a variety of formats. The conceptual knowledge assessment focused on students' understanding of decimal magnitude (e.g., which is bigger?). Students then worked individually on a 25-minute intervention during which they studied 12 worked example pairs and answered questions about the examples. During the intervention, students in both conditions also solved four practice problems. After the intervention, students completed an immediate posttest. About two weeks later, students completed a retention test.

Comparing incorrect and correct examples led to greater procedural knowledge at posttest and greater conceptual knowledge on the retention test. This was partially due to these students making fewer whole number misconception errors on the retention test. Thus, comparing incorrect and correct examples does help students learn correct procedures and remember key concepts above and beyond the general benefits of comparison. During the intervention, comparing incorrect and correct examples encouraged students to more frequently discuss misconceptions and mention correct concepts. These findings suggest that exposure to incorrect and correct examples may cause students to notice salient, correct concepts more so than comparing only correct examples.

Even with the learning gains in Experiment 1, students were still making errors on 40% of the problems. When students are learning in a domain with many misconceptions, such as decimal magnitude, they are faced with competing concepts (Huang, Liu, & Shiu, 2008). Instructional explanations emphasize important conceptual structures, which may be a way to eliminate this competition (Renkl, 2002). Also, when a correct procedure is learned, the incorrect procedure remains, and this results in competing procedures (Siegler, 2002). Giving students sufficient procedural practice may decrease competition and improve selection of correct procedures (Siegler, 2002). Consequently, more instructional explanations and more opportunities for procedural practice throughout the intervention might be beneficial for reconciling these competing concepts and procedures, which we wanted to investigate in Experiment 2.

In Experiment 2, we examined three conditions: (1) learning from comparing an incorrect and a correct example with instructional explanations (incorrect-explanation), (2) comparing an incorrect and a correct example with additional practice problems (incorrect-practice), and (3) comparing two correct examples with additional practice problems (correct-practice). We slightly modified the assessment and used the same pretest-intervention-posttest-retention test design as in Experiment 1. During the intervention, students ($N = 54$) studied 12 worked example pairs and answered questions about the examples. Students in the incorrect-explanation condition received an instructional explanation for each worked example pair and solved 4 practice problems. Students in the incorrect-practice and correct-practice conditions completed 28 practice problems, in an effort to control for time on task.

After preliminary analyses, it seems that comparing incorrect and correct examples led to greater procedural knowledge at posttest and greater conceptual knowledge at posttest and retention test. In addition, spending time on practice problems led to greater retention of procedural and conceptual knowledge than spending time on instructional explanations. Comparing incorrect and correct examples appears to be a promising instructional tool, and providing opportunities for practice may help students benefit most from such comparisons.

References

- Eryilmaz, A. (2002). Effects of conceptual assignments and conceptual change discussions on students' misconceptions and achievement regarding force and motion. *Journal of Research in Science Teaching*, 39(10), 1001-1015.
- Grope, C. S., & Renkl, A. (2007). Finding and fixing errors in worked examples: Can this foster learning outcomes? *Learning and Instruction*, 17(6), 612-634.

- Huang, T.-H., Liu, Y.-C., & Shiu, C.-Y. (2008). Construction of an online learning system for decimal numbers through the use of cognitive conflict strategy. *Computers & Education*, 50, 61-76.
- Irwin, K. C. (2001). Using everyday knowledge of decimals to enhance understanding. *Journal for Research in Mathematics Education*, 32(4), 399-420.
- National Mathematics Advisory Panel. (2008). *Foundations of Success: The Final Report of the National Mathematics Advisory Panel*. Washington, DC: U.S. Department of Education.
- Renkl, A. (2002). Worked-out examples: Instructional explanations support learning by self-explanations. *Learning and Instruction*, 12(5), 529-556.
- Resnick, L. B., Nesher, P., Leonard, F., Magone, M., Omanson, S., & Peled, I. (1989). Conceptual bases of arithmetic errors: The case of decimal fractions. *Journal for Research in Mathematics Education*, 20, 8-27.
- Siegler, R. S. (2002). Microgenetic studies of self-explanation. In N. Garnott & J. Parziale (Eds.), *Microdevelopment: A process-oriented perspective for studying development and learning* (pp. 31-58). Cambridge, MA: Cambridge University Press.
- VanLehn, K. (1999). Rule-learning events in the acquisition of a complex skill: An evaluation of cascade. *The Journal of the Learning Sciences*, 8(1), 71-125.

SYMPOSIUM

Effects of home environment and early child care on social development of young children

Chairperson: Andrea G. Eckhardt, German Youth Institute, Germany

Organiser: Andrea G. Eckhardt, German Youth Institute, Germany

Discussant: Hans Guenther Rossbach, University of Bamberg, Germany

A major topic in early childhood education is the social development of young children. However, the findings of the effects of home environment and center based care are inconsistent. New insights in influences of social development in early childhood are presented from multiple perspectives. In the first paper, Melhuish et al. present new findings from the EPPE-Project focusing on long term influences of demographic characteristics, early years home learning environment, and pre-school experience on social development of children at age 11. While this paper looks at individual and combined influences of the developmental context of children, the following presentations provide insight on the effect of institutional care on the social development of children. In the second paper Leseman, de Haan & Elbers examine social-emotional development in targeted and mixed culturally diverse preschools for disadvantaged children, with special interest in the effects of classroom ethnic-cultural composition and degree of interethnic peer interaction on extraversion, work attitude, sociability and emotional stability. Finally, results from a systematic review by Eckhardt & Egert present the effectiveness of early childhood programs on social development of children. The symposium contributes to existing knowledge in confirming the long term consequences of family environment and quality of center based care on positive aspects of social development. At the same time, it provides new insights from research on the effects of institutional care that result from groups with children from diverse cultural backgrounds. Additionally, it highlights differential effects depending on individual characteristics of children, care settings or program features.

The effects of early experiences at home and pre-school on social/behavioural development at age 11

Pamela Sammons, University of Oxford, United Kingdom; Edward Melhuish, University of London, United Kingdom;

Kathy Sylva, University of Oxford, United Kingdom; Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Brenda Taggart, University of London, United Kingdom

This paper explores the contribution of the demographic characteristics, early years home learning environment and pre-school to children's social/behavioural development. While much existing research relates aspects of children's environments or experiences to social development, there has been little work that is with a large enough longitudinal sample, with sufficiently detailed data, to delineate the independent long-term effects of demographics, home and pre-school. This paper contributes to the literature by presenting findings from the Effective Pre-school and Primary Education (EPPE) Project, a longitudinal study on a representative sample of 3000 children in the UK. While the study has extensive longitudinal information on cognitive, educational and social/behavioural development, this paper will focus on the predictors of social/behavioural development at age 11. The home learning environment and pre-school are important predictors of social/behavioural development and the interaction of these effects is also explored.

Aims:

This paper aims to explore the contribution of the demographic characteristics, early years home learning environment and pre-school to children's social/behavioural development. While much existing research relates aspects of children's environments or experiences to social development, there has been little work that is with a

large enough longitudinal sample, with sufficiently detailed data, to delineate the independent long-term effects of demographics, home and pre-school. This paper uses findings from a longitudinal study on a representative sample of 3,000 children in the UK. While the study has extensive longitudinal information on cognitive, educational and social/behavioural development, this paper will focus on the predictors of social/behavioural development at age 11.

Methodology:

The EPPE project is Europe's largest longitudinal investigation into the effects of pre-school and primary education on children's developmental outcomes, and uses mixed methods. Using multilevel modelling, the authors examined the contribution of child, family, home environment, and school characteristics to children's social/behavioural development at age 11 years. Research questionsThe research questions addressed in this paper are as follows: a. Does the early years home learning environment (HLE) have an independent effect on children's social behavioural development?

b. Does pre-school have an independent effect on children's social/behavioural development?

c. Does pre-school quality influence children's social/behavioural development?

d. Do the effects of home and pre-school on children's social/behavioural development remain until age 11 years?

e. How do pre-school effects and home learning environment effects interact to shape children's social/behavioural development?

Sample

Five regions in the U.K were strategically selected to include urban, suburban and rural areas, some including social and ethnic diversity. A total of 141 centres were randomly selected from different types of provisions (e.g., playgroups, nursery schools, private day nurseries). Over 2,800 children were recruited at age 3 and followed until school entry (age 5), when they were joined by an additional 310 'home' children with no pre-school experience. Approximately 2,700 of these children were then followed for a further six years until the end of Primary school (age 11). Child assessmentsSocial/behavioural development was measured at several ages through standardized questionnaires completed by a teacher (or other staff) who were familiar with the child in pre-school or school environments. When children were aged 11 we used the Strengths and Difficulties Questionnaire (Goodman, 1997) plus additional items from other questionnaires to measure different features of children's social/behavioural development. The social/behavioural child profile was completed by a teacher who knew the EPPE 3-11 child well. Principal component analysis and confirmatory factor analysis were used to identify the main underlying dimensions of social behaviour at age 11. The main four dimensions of social behaviour were self-regulation, pro-social behaviour, hyperactivity and anti-social behaviour. Home Learning Environment measureBased on data collected from parental interviews, an index of the Early Years Home Learning Environment (HLE) was constructed, consisting of the following items rated on an 8-point scale (anonymous, 2001):

Reading to child	Painting and drawing with child
Playing/teaching numbers/shapes to child	Library visits with child
Playing with letters/numbers with child	Playing/teaching alphabet/letters
	Playing/teaching of songs/nursery rhymes etc.

Pre-school quality measure: Early Childhood Environment Rating Scale-Revised (ECERS-R) (Harms, Clifford,& Cryer, 1998) Early Childhood Environment Rating Scale-Extension (ECERS-E) (Sylva, Siraj-Blatchford & Taggart, 2003). Co-variables: Child and family variablesParental interviews and questionnaires were conducted at ages 3 and 7. Information was collected on parental characteristics (socio-economic status, educational level, employment and age), family characteristics (lone parent family and number of children), and child characteristics (ethnicity, birth weight, perinatal difficulties, child's first language, early developmental problems). Analytic strategyIn order to take account of the clustering of children within the same pre-school centre or school multi-level models (Goldstein, 2003) were used to investigate children's development as a function of home, pre-school and school factors as well as a wide range of EPPE 3-11 and family characteristics.

Findings:

The positive benefits of pre-school education have largely persisted through to age 11. Attending a pre-school compared with not attending (the 'home' group) showed a positive effect on children's pro-social behaviour at the end of Year 6, but there were no statistically significant differences for other aspects of social behaviour. Also the quality of the pre-school had a statistically significant impact on all four social/behavioural outcomes at age 11. The findings suggest that attending a high or medium quality pre-school has a lasting effect in promoting or sustaining better social/behavioural outcomes, in terms of increased 'Self-regulation', higher 'Pro-social' behaviour and lower 'Anti-social' behaviour levels at age 11. There was a continuing strong influence of the Early years Home Learning Environment. After controlling for child and family characteristics, Early years HLE had a significant net effect on children's self-regulation, pro-social behaviour and hyperactivity at age 11. Only self-regulation had significant interactions between early years HLE and pre-school quality. Controlling for other background characteristics, a combination of high Early years HLE and attendance at a medium or high quality pre-school is a strong predictor of higher self-regulation. In addition, high Early years HLE seems to act as a protective factor for children who do not

attend pre-school helping them achieve higher levels of self-regulation. Similarly, high quality pre-school seems to protect against the disadvantage of a low Early years HLE and promotes children's later self-regulation. Theoretical and educational significance: This study has shown that children who have more beneficial experiences in the home and in pre-school before they enter school have better social/behavioural development and these effects are still apparent at the end of primary school. These beneficial effects upon social/behavioural development contribute to the child's overall well-being and are likely to promote social and educational success in later years. The benefits of early experiences are long-lasting and fundamentally change children's longer-term development. These findings add further weight to arguments for: (1) pre-school education for all 3 and 4 year old children (2) ensuring good quality of pre-school education, and (3) supporting parents in providing a high quality HLE.

Social-emotional development in culturally diverse preschool and kindergarten classrooms

Paul Leseman, Utrecht University, Netherlands; Annika de Haan, Utrecht University, Netherlands; Ed Elbers, Utrecht University, Netherlands

A major issue in early educational intervention policy for low income and ethnic-minority children concerns the pros and cons of targeted versus mixed and universal programs. Whereas recent evidence indicates that mixed and universal programs are more effective in the domains of cognitive and language development compared to targeted approaches, less is known about similar differential effects on social-emotional development. The question is especially relevant for social-emotional skills that relate to interethnic interaction and to the establishment of enduring interethnic relationships, because a major criticism on targeted approaches is that they tend to reinforce segregation between majority and minority communities. The present study examined the effects of targeted versus mixed early childhood education programs on interethnic interaction and social-emotional development in a sample of 116 3-6-year old children. The results show, as was expected, that mixed (i.e., heterogeneous) classrooms have a higher the degree of interethnic interaction. Furthermore, the results indicated a positive effect of targeted (i.e., homogenous) classrooms on social-emotional development: a lower level of extraversion and impulsivity, a higher level of positive play-work attitude in more targeted, homogenous classrooms, and negative effects of peer interethnic interaction: a higher level of extraversion and impulsivity, a lower level of positive work attitude in classrooms with a relatively high degree of interethnic peer interaction. The findings together suggest that interethnic interaction may present difficult social contexts for young children from various ethnic-cultural backgrounds. The difficulties may arise from communication problems and conflicting norms and expectations about interaction and communication.

Aims

In the face of the persistent education gap, most industrialized countries provide pre-school education programs targeted at low income and ethnic minority groups. Two main types of intervention can be distinguished: universal versus targeted. Universal interventions provide care and education for all children. Targeted interventions, in contrast, are specifically provided to eligible groups only, such as particular ethnic and sociolinguistic minority groups. Targeted interventions seem most cost-effective, but tend to reinforce societal segregation tendencies with at least two possible negative consequences. First, the educational effectiveness of the preschools serving mainly disadvantaged children with an immigrant background may be reduced (Lee & Loeb, 1995; Schechter & Bye, 2007). Second, due to the lack of contact between members of minority and majority communities, mutual prejudices and discrimination may increase (Allport, 1954). First (indirect) evidence suggests that a mixed classroom composition promotes inter-ethnic interaction and that positive inter-ethnic interaction promotes social skill development (Johnson et al., 2000), positive inter-ethnic peer relations (Hamre & Pianta, 2001), positive attitudes towards minority communities (Henry & Rickman, 2007), and multicultural sensitivity and positive intergroup attitudes (Aberson et al, 2004). However more evidence is needed. The present study will contribute to this by examining the effects of ethnic-culturally targeted versus mixed-universal preschools on interethnic interaction and on social-emotional development among 3- to 6-year-old immigrant and low income native children.

Method

The participants in this study, 116 in all, were selected from a larger sample of children participating in a longitudinal study on the effects of mixed preschools in the city of Utrecht, The Netherlands. At the first measurement wave the sample consisted of 52 children (28 boys) from 8 preschool classrooms and 64 (31 boys) children from 8 kindergarten classrooms. The mean age of the preschool children was 2.8 years ($SD = .30$); 53.7% had a native-Dutch ethnic background and 72.6% came from low SES families. The mean age of kindergarten children was 4.3 years ($SD = .23$); 63.9% was native Dutch and 58.5% came from low SES families. A norm-referenced structured questionnaire, filled out by the teacher, was used to assess children's extraversion, play-work attitude, sociability, and emotional stability. Furthermore, teachers were asked to report the size and ethnic cultural composition of the class. Based on school

records, children whose parents were born and raised in the Netherlands were considered native-Dutch. Children with one or two parents born in another country were considered ethnic-minorities. Classroom processes were observed on four half days using a cyclic-interval-coding approach. In each classroom a representative subsample of six children were selected as targets for the observation study. For each observation interval, inter-ethnic interaction was coded if the target child was native-Dutch and verbally interacted with at least one ethnic minority child during that interval or if the target child was an ethnic-minority and verbally interacted with at least one native Dutch child in that interval. The scores of the six target children were averaged over intervals and aggregated to the class level as percentage interethnic interaction of the total classroom time.

Preliminary findings

Preliminary statistical analyses were conducted using MANOVA with classroom composition (two levels: > 50% ethnic minorities), interethnic interaction (two levels based on median split: > 10 % of the total time) and age-cohort as factors, and the social-emotional measures as dependents. The results indicate a statistically significant main effect of classroom composition, a borderline significant main effect of interethnic interaction, and significant interaction effects with cohort on extraversion and work attitude. The mean level of extraversion is lower and the mean level of positive play-work attitude is higher in classrooms with comparatively more ethnic minority children. The mean level of extraversion is higher and the mean level of positive work attitude is lower in classrooms with a comparatively high level of interethnic interaction. The main effects are stronger in the younger cohort than in the older cohort.

Summary and significance

The present results suggest that more homogenous targeted classrooms provide a better basis for social-emotional development in young children attending early childhood education programs than (deliberately) mixed classrooms. The fact that, in addition to the main effect of classroom composition, interethnic interaction was negatively related to social-emotional outcomes, suggests that interethnic interaction may present difficult social contexts for young children from various ethnic-cultural backgrounds. The difficulties may arise from communication problems and conflicting norms and expectations about interaction and communication. Although mixed programs may have a positive influence on language and cognitive development, the same may not hold for social-emotional development. The results pertain to an important issue of current education policy regarding the contribution of targeted and universal early childhood education to the integration of ethnic-cultural minorities.

References

- Aberson, C. L., Shoemaker, C., & Tomolillo, C. (2004). Implicit bias and contact: the role of inter-ethnic friendships. *The Journal of Social Psychology*, 144, 335-347.
- Allport, G. (1954). *The Nature of Prejudice*. Cambridge, Massachusetts: Addison-Wesley.
- Hamre, B.K., & Pianta, R.C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development*, 72, 625-638.
- Henry, G. T., & Rickman, D. K. (2007). Do peers influence children's skill development in preschool? *Economics of Education Review*, 26, 100-112.
- Lee, V. E., Loeb, S., & Lubeck, S. (1998). Contextual effects of prekindergarten classrooms for disadvantaged children on cognitive development. *Child Development*, 69, 479-494.
- Schechter, C. & Bye, B. (2007). Preliminary evidence for the impact of mixed-income preschools on low-income children's language growth. *Early Childhood Research Quarterly*, 22, 137-146.

Differential effects of early childhood education programs on social development of young children

Andrea G. Eckhardt, German Youth Institute, Germany; Franziska Egert, German Youth Institute, Germany

Over the last decade, several studies investigated the effects of early childhood education programs on the cognitive and social development of young children. In general, there is a strong evidence for positive effects of early education programs on the cognitive and academic domain, whereas the findings on the social development are less conclusive. Results suggest positive effects in some studies and no or negative effects in others. Although, some systematic reviews have been conducted recently, more research is needed providing information on differential effects on the social development of children. To understand the inconsistent effects of program effectiveness on social development, a systematic review was conducted. Approximately 70 articles were identified that report studies with (quasi-)experimental designs and aim at the social development of children from 0-6 years. Of all identified articles, the full text was coded by two independent reviewers using an extensive coding schema.

Aims

Research on the impact of early childhood education on the social development of children has yielded inconsistent findings. Systematic reviews on this topic indicate overall small positive effects of participation in early child care/intervention programs on social development. However, less is known on differential effects on social development depending on child characteristics, program features or setting characteristics. For a better understanding of the effectiveness of early child care/intervention programs, a systematic review was conducted to examine effects of child, program and setting characteristics. This paper investigates the differential effects of early child care/intervention programs on social development. The purpose of this presentation is to (1) illustrate the search process and (2) to present findings from this systematic review.

Methodology

To understand the inconsistent effects of program effectiveness on social development, a systematic review of existing studies was conducted that investigates child characteristics and program features due to program impact. Therefore, an electronic search in relevant databases such as ERIC, PsycINFO, Francis, ProQuest Dissertations and Theses and, additionally, a hand search of publications were conducted and approximately 3.000 relevant citations found. Titles and abstracts were reviewed from all references and about 700 articles were identified that provide information on the development of children up to 6 years of age. Using a short screening form, approximately 70 articles were identified that a) report studies with (quasi-)experimental designs, b) aim at the social development of children from 0-6 years, and c) met the selection criteria for research quality (e.g. sample size, assignment, outcome measurements). These studies are included in the systematic review. Of all identified articles, the full text was coded using an extensive coding schema extracting information on the following aspects: intervention program, target population, types of study, outcome measures, sample, characteristic of settings and personnel. The coding process at all stages was completed by two independent reviewers. Disagreements between the two reviewers in the coding process were resolved through discussion. Effect size estimations were conducted using the statistical software Comprehensive Meta-Analysis 2.0 by Borenstein, Hedges, Higgins, and Rothstein (2005). Results are based on the calculation of random-effect models.

Findings

At time of submission only preliminary results are available. The final results presented at the symposium will be based on the complete sample. Preliminary results were calculated on the basis of 19 studies, containing 25 group comparisons. The overall effect of child care on the development of children below seven years is $ES = 0.199$ with a 95% confidence interval of $0.109 \leq CI \leq 0.29$. To test the influence of individual studies on the combined effect size, an analysis was conducted with each study removed. The results confirm the overall effect size. Depending on the study removed, the overall effect size varies between $ES = 0.177$ and $ES = 0.217$ indicating only small changes. In sum, early child care/intervention programs have a small positive effect on the social development of children below seven years. Some studies contained mixed age groups ($N = 9$) and others homogenous groups ($N = 10$). Random-effect models were conducted to test for differences depending on the groups of children. Children classified in settings with mixed age groups had a lower increase in social development ($ES = 0.129$; $0.019 \leq CI \leq 0.239$) compared to children classified in homogenous age groups ($ES = 0.272$; $0.152 \leq CI \leq 0.392$). Finally, it was tested if children at risk profited more from child care/intervention programs compared to children without being at risk. This analysis identified a positive effect in social development of children independent of their at risk status. However, children without being at risk seem to benefit more from their participation in child care/programs ($ES = 0.213$ vs. $ES = 0.183$; $0.109 \leq CI \leq 0.317$ vs. $0.029 \leq CI \leq 0.338$).

Summary and Significance of Research

Preliminary findings of small effect sizes are consistent with recent systematic reviews on the overall effect of early child care/programs on social development (e.g. Anderson et al. 2003; Camilli, Vargas, Ryan, & Barnett, 2010; Nelson, Westhues, & MacLeod, 2003). In addition, results reveal some differential effects depending on individual characteristics of children, care settings or program features. The analysis of the complete sample is expected to provide an even more detailed understanding of the effect of social development on children in early child care/programs. The systematic review offers new insights on social development of small children depending on child characteristics, program features and setting characteristics. Knowledge of differential effects for specific groups of children or children in care with certain setting characteristics are relevant for policy makers who develop early intervention programs.

Literature

Anderson, L. M., Shinn, C., Fullilove, M. T., Scrimshaw, S. C., Fielding, J. E., Normand, J., et al. (2003). The effectiveness of early childhood development programs. A systematic review. *American Journal of Preventive Medicine*, 24(32-46).
Borenstein M, Hedges L, Higgins J, Rothstein H. (2005). *Comprehensive Meta-analysis Version 2*, Biostat, Englewood NJ.

Camilli, G., Vargas, S., Ryan, S., & Barnett, W. S. (2010). Meta-Analysis of the effects of early education interventions on cognitive and social development. *Teachers College Record* 112(3), ID Number 15440.

Nelson, G., Westhues, A., & MacLeod, J. (2003). A meta-analysis of longitudinal research on preschool prevention programs for children. *Prevention and Treatment*, 6(1), 1-34.

SYMPOSIUM

Causal Effects in Educational Research

Chairperson: Michael Becker, Potsdam University, Germany

Organiser: Michael Becker, Potsdam University, Germany

Discussant: Olaf Koeller, Leibniz Institute for Science and Mathematics Education, Germany

Causal inference is of central importance for educational and developmental scientists: For example, programs for school improvement or the elimination of risk factors for maladaptive scholastic development require that researchers identify causal factors and mechanisms which determine educational outcomes and estimate their impact on normal, optimal, or pathological development. In most areas of educational research experimental manipulation, often considered as the gold standard of causal research, is practically and/or ethically not feasible. Instead, observational data has to be used to estimate causal effects. Recently, the question how to appropriately address causality in non-experimental research has drawn substantial attention in educational and developmental research (e.g., Foster, 2010; Schneider et al., 2007), picking up ideas and techniques from other disciplines such as econometrics. In the symposium, leading scientists in the field present promising approaches for causal effect estimation, e.g. regression discontinuity, instrumental variables, and elaborate their potential and limitations, both from a theoretical and applied perspective. The major goal is to emphasize the utility (and benefit) educational research can (and should) expect from modern design and data analysis techniques.

References:

Foster, E. M. (2010). Causal Inference and Developmental Psychology. *Developmental Psychology*. Advance online publication. doi: 10.1037/a0020204.

Schneider, B., Carnoy, M., Kilpatrick, J., Schmidt, W. H., & Shavelson, R. J. (2007). Estimating causal effects using experimental and observational designs. Washington, DC: American Educational Research Association.

A comparison of quasi-experimental analysis methods for causal inference in large-scale assessment

Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany; Ulf Kroehne, DIPF, Germany; Johannes Hartig, German Institute for International Educational Research (DIPF), Germany

Bilingual education understood as teaching academic content in a secondary language is implemented as an educational program in many educational systems. Compared to students with similar initial baseline conditions bilingual instruction is expected to gain English competence, especially for German grammar schools and high schools. The aim of the paper is twofold: Firstly, we discuss the identification of a causal effect of bilingual instruction on the theoretical level and introduce the definition of a treatment effect which can be estimated drawing on the data available from a German large-scale assessment of students' language competencies, named DESI (German English Student Assessment International, Beck & Klieme, 2007). Secondly, we present a methodological comparison of different quasi-experimental analysis methods applied to the estimation of a treatment effect at the school level. In particular, we compare different propensity score based adjustment procedures (propensity score matching, propensity score weighting and propensity score sub-classification) with generalized analysis of covariance for estimating the causal effect of bilingual instruction. We highlight why the different approaches, even when applied to same data and based on an identical set of covariates, are expected to yield different treatment effect estimators. A positive adjusted treatment effect for bilingual instruction at the school-level is found consistently for all measured outcomes. It is concluded that the bilingual instruction is an effective treatment at the school-level, even if the competence is averaged across students. In the closing discussion the methodological limitations of the presented analysis and further research questions are discussed.

For the investigation of causal effects large-scale assessments are not well-suited because usually they are observational studies with cross-sectional designs. However, results from large scale assessments often attract a great deal of attention and findings from large-scale assessments, for instance, observed differences between groups of students, are often discussed in a causal manner. Accordingly, there is a gap between the large scale assessments' important contributions to educational research at the one hand and the traditional approaches to causal inference and program evaluation at the other.

In this presentation we discuss the identification and the estimation of the causal effect of bilingual instruction on students' English competence based on empirical data from a German large-scale assessment of students' language competencies, named DESI (German English Student Assessment International, Beck & Klieme, 2007). Bilingual education - understood as teaching academic content in a secondary language - is implemented as an educational program in many educational systems. Compared to students with similar initial baseline conditions bilingual instruction is expected to gain English competence, especially for German grammar schools and high schools. For the evaluation of bilingual instruction the unadjusted difference between students with and without bilingual instruction has no causal interpretation because the assignment of individual students to the bilingual instruction was not randomized. Therefore, additional assumptions are needed for identifying a causal effect of bilingual instruction, i.e. in order to adjust for existing baseline differences between treated and untreated students. However, in case important and pre-ordered covariates are not measured or if further assumptions of the quasi-experimental adjustment methods are violated, the treatment effect cannot be identified at all. Moreover, even if a causal effect can be identified, the estimated treatment effect might be sensitive to additional assumptions of the analysis method used to estimate the adjusted treatment effect.

Therefore the aim of the paper is twofold. Firstly, we discuss the identification of a causal effect of bilingual instruction on the theoretical level and introduce the definition of a treatment effect which can be estimated based on the data available from the DESI large-scale assessment under more reasonable assumptions. For this purpose we re-define the treatment variable and consider the bilingual instruction as a treatment implemented at the school-level. In addition we discuss the substantial interpretation of the resulting average treatment effect and highlight the appropriateness of this treatment definition with respect to typical violations of the Rubin Causal Model in educational research, such as the violated stable unit-treatment value assumption (Stuart, 2007). Secondly, we present a methodological comparison of different quasi-experimental analysis methods applied to the estimation of a treatment effect at the school level. In particular, we compare different propensity score based adjustment procedures (propensity score matching, propensity score weighting and propensity score sub-classification) with generalized analysis of covariance for estimating the causal effect of bilingual instruction. We highlight why the different approaches, although applied to the same data and based on an identical set of covariates, are expected to yield different treatment effect estimators. The resulting differences between the estimated treatment effects are discussed as a region of uncertainty, i.e. a measure of the treatment effect estimator's robustness with respect to the utilization of a particular adjustment method.

For the re-defined treatment effect at the school-level we present the suggested region of uncertainty for the different outcomes and compare the estimated treatment effects for the different discussed adjustment methods. A positively adjusted treatment effect for bilingual instructions at the school-level is found consistently for all measured outcomes. It is concluded that the bilingual instruction is an effective treatment at the school-level, even if the competence is averaged across students. In the closing discussion the methodological limitations of the presented analysis and further research questions are discussed.

References

- Beck, B., & Klieme, E. (Eds.) (2007). Sprachliche Kompetenzen. Konzepte und Messung [Language competencies: concepts and measurement]. Weinheim: Beltz.
- Klieme, E., Eichler, W., Helmke, A., Lehmann, R. H., Nold, G., Rolff, H.-G., et al. (2008). Unterricht und Kompetenzerwerb in Deutsch und Englisch: Ergebnisse der DESI-Studie [Instruction and development of competence in German and English: results of the DESI study]. Weinheim: Beltz.
- Stuart, E. A. (2007) Estimating causal effects using school-level datasets. *Educational Researcher*, 36, 187-198.

Generalizing Causal Inferences: Test Validity and Meta-Analysis

Derek Briggs, University of Colorado, United States

Estimating the causal effect of program X on outcome Y is a challenging task, but it is a task that is, in principle, solvable through some combination of experimental design and statistical adjustment. In contrast, the generalization of causal inferences is more art than it is science. In this presentation I focus attention on what might be viewed as a precondition for generalizing the effect of an intervention in educational research—the construct validity of a test score when it has been used as an outcome variable. Meta-analysis is often considered the primary "scientific" means by which the effects of educational interventions across different outcomes can be synthesized. Yet this activity hinges upon the assumption that the outcome variables for which effects have been estimated can be compared on a common scale once effect size statistics have been computed. Such an assumption is only plausible if test scores represent interval measures of a common underlying latent variable. Because this is only assumed and never

evaluated, it may well raise some difficult questions about the meaningfulness of causal generalizations that result from meta-analytic research.

Estimating the causal effect of program X on outcome Y is a challenging task, but it is a task that is, in principle, solvable through some combination of experimental design and statistical adjustment. In contrast, the generalization of causal inferences is more art than it is science. In this presentation I focus attention on what might be viewed as a precondition for generalizing the effect of an intervention in educational research—the construct validity of a test score when it has been used as an outcome variable. Meta-analysis is often considered the primary "scientific" means by which the effects of educational interventions across different outcomes can be synthesized. Yet this activity hinges upon the assumption that the outcome variables for which effects have been estimated can be compared on a common scale once effect size statistics have been computed. Such an assumption is only plausible if test scores represent interval measures of a common underlying latent variable. Because this is only assumed and never evaluated, it may well raise some difficult questions about the meaningfulness of causal generalizations that result from meta-analytic research.

This point is illustrated in this paper using test score data gathered between the Fall of 2008 and the Fall of 2009 by visiting the web sites for 22 states reported to have developmental score scales in the annual "Quality Counts" issue produced by American publication Education Week in 2008. For 9 of these states, it was possible to locate both the mean scale scores and standard deviations on the state's large-scale math and reading assessments for the grades 3 and 8. In all of these cases item response theory methodology was used to create and maintain a "developmental" scale such that the scores of the same student in a higher or lower grade could be compared in absolute sense. Over the past 30 years, the quality of developmental score scales in the United States have been evaluated on an operational basis, consistent with the scaling theory that makes no presumption that the resulting scale has interval properties. What this means in practice is that one examines the empirical patterns of grade by grade means and standard deviations (SDs) after tests have been calibrated onto a common scale. In order to compare observed growth patterns across multiple states, it is customary to place each state's test scores onto a common scale using an effect size metric (cf. appendix A). With grade to grade growth in an effect size metric nested within each state, it becomes possible to conceptualize the task of comparing growth patterns within and across states as one of meta-analysis. Table 1 (cf. appendix B) summarizes the descriptive results from taking such an approach with the data described above.

What stands out in Table 1 is the variability in these estimates of growth across scales within each of the four adjacent grade combinations (e.g., grade 3 to 4, 4 to 5, etc). Mean growth in student performance for any pair of adjacent grades ranges from a low of .30 SDs (grade 3 to 4 Reading) to a high of .65 SDs (grades 5 to 6 Reading). This variability is much larger for tests of reading than tests of math. With respect to the reading vertical scales, it is also clear that there is greater variability among the four states with scales created by one testing company (Harcourt) than there is among the five states with scales created by another (CTB). For math tests, one sees a trend from grades 3 through 8 consistent with that of decelerating growth—in general, effect sizes decrease in magnitude with increasing grade. There is no such discernible trend for the reading tests.

As is typical in application of meta-analytic techniques, as a next step one would be inclined to look for other factors germane to the creation of each state's test that could help to explain the variability in growth from state to state. For example, perhaps the answer can be found in differences in the triangulation of content standards, curricular emphasis, and test design from state to state? Can differences in growth be explained by something schools within a given state are doing to effect learning? One might ask certainly ask these questions, but if the test score scales being synthesized in each state only contain ordinal information, will the results be meaningful? In this presentation I raise this question and suggest that there is good reason to believe that the answer will, unfortunately, be "no."

Instrumental variable regression techniques to estimate effects of schooling and age on achievement

Jan-Eric Gustafsson, University of Goteborg, Sweden; Christina Cliffordson, University West, Sweden

The main purpose of the paper is to examine the relative effects of schooling and age on achievement in mathematics and science by the use of a regression discontinuity design, augmented with an instrumental variable (IV) approach. The regression discontinuity design relies on the assumption that there is a sharp age-based decision rule for grade assignment of students, but this assumption is typically violated, which in turn causes biased estimates. A previous study based on the Swedish TIMSS 1995 data showed that an IV regression approach, using formal school start-age as an instrument, can be used to obtain unbiased estimates of the grade and age effects when the assumption of a sharp age-based decision rule is violated, thereby creating a fuzzy RD design. In the present study, the applicability of this IV-

approach is investigated for all the countries participating in the TIMSS 1995 study. All together, around 40 countries investigated science and mathematics achievement in 7th and 8th grades, and around 20 countries also participated with 3rd and 4th grade. The rules for school start and grade repetition vary greatly between countries, so in a first step it is investigated for which countries an age-based decision rule leading to a fuzzy RD design is used, and in the next step the IV regression analysis is conducted for the countries for which this is possible.

Issues of causal inference have not been a strong focus of interest in educational research since the 1980s. However, lately there are signs of a growing interest, such as an increasing use of experimental designs and an increasing interest in methods for causal inference from observational data (see, e.g., Schneider, et al., 2007). Given that other disciplines within the field of social and behavioral research have kept a focus on issues of causality, it also is possible to take advantage of developments made in disciplines such as economics, sociology, and statistics. Within econometrics, in particular, there has been a strong development of methods for establishing causal relations in observational data (e.g., Blundell & Costa Dias, 2009).

One of these methods is instrumental variables (IV) regression, which is commonly used to deal with two of the main threats to causal inference in observational data, namely reversed causality (or more broadly, endogeneity) and errors of measurement. The idea is to find a variable (an 'instrument') that is related to an endogenous variable X , but not to the dependent variable Y apart from the indirect effect via X . The treatment effect can then be identified through the part of the variation in X that is triggered by the instrument. Estimation is typically done with two-stage least squares, where the first step involves predicting X from the instrument, and the second step involves predicting Y from the variation in X due to the instrument.

IV regression has only rarely been applied in educational research, but given the frequent need to address problems of reverse causality in educational research there should be a great potential for application of this method. The current paper uses IV regression to deal with reverse causality in regression discontinuity designs used to separate the effects of age and schooling on achievement.

It can easily be observed that students in a higher grade have a higher level of achievement than students in the adjacent lower grade, with an effect size typically around $d = .40-.50$. This effect is due to the combined effect of another year of schooling and another chronological year, and it is of great theoretical and practical interest to separate the effects due to schooling and age. Given that these factors tend to be completely confounded, this is no easy task, but it has been demonstrated that under certain circumstances this can be done with the between-grade regression discontinuity (RD) design. In this design, the age effect is estimated through the age variation within grades, and the schooling effect through the grade effect, controlling for age (e.g., Cahan & Cohen, 1989).

However, for this approach to give correct results grade assignment must be strictly based on age, for example through the rule that school starts during the year the child becomes 7 years old. However, this rule is typically not strictly followed, because certain children are allowed to start school a year early, while others have their school start delayed by a year. Furthermore, in certain school systems there is grade repetition for poorly achieving students. Such deviations from the strict decision rule required by the RD design turns the design into a so called "fuzzy RD design" and these deviations tend to cause severe bias in the estimates of the effects of schooling and age. The reason for this is that the fuzziness is due to reverse causality, the actual grade that a student attends being determined by level of achievement. One approach to deal with this problem is to exclude students who are not of normal age for their grade. When the frequency of such cases is low, this approach works well (Cliffordson, 2010), but such an ad hoc approach is not optimal. However, Cliffordson and Gustafsson (2010) demonstrated on Swedish data from the TIMSS 1995 study that an IV regression approach used on all cases yielded reasonable estimates. In these analyses, the instrument was taken to be the age the student was expected to have if normal-aged for the grade, so the instrument expresses "intention to treat".

In the paper, the applicability of this IV-approach is investigated for all the countries participating in the TIMSS 1995 study. In this study, around 40 countries investigated science and mathematics achievement in 7th and 8th grades, and around 20 countries also participated with 3rd and 4th grades. The rules for school start and grade repetition vary greatly between countries, so in a first step it is investigated for which countries a fuzzy RD design is applicable. In the next step the IV regression is conducted for the countries in which this is possible, and in the final step the estimates obtained are assembled and evaluated.

References

Blundell, R. & Costa Dias, M. (2009). Alternative Approaches to Evaluation in Empirical Microeconomics. *Journal of Human Resources*, 44(3), 565-640.

- Cahan, S., & Cohen, N. (1989). Age versus schooling effects on intelligence development. *Child Development*, 60, 1239-1249.
- Cliffordson, C. (2010). Methodological Issues in Investigations of the Relative Effects of Schooling and Age on School Performance: The Between-Grade Regression Discontinuity Design Applied to Swedish TIMSS 1995 Data. *Educational Research and Evaluation*, 16(1), 39-52.
- Cliffordson, C., & Gustafsson, J.-E. (2010). Effects of schooling and age on performance in mathematics and science: A between-grade regression discontinuity design with instrumental variables applied to Swedish TIMSS 1995 data. Paper presented at the 4th IEA International Research Conference, Gothenburg, July 1-3, 2010.
- Schneider, B., Carnoy, M., Kilpatrick, J., Schmidt, W. H., & Shavelson, R. J. (2007). Estimating causal effects using experimental and observational designs. Washington, DC: American Educational Research Association.

SYMPOSIUM

Discursive practice and knowledge construction in mathematics classrooms in different cultures

Chairperson: Fritjof Sahlstrom, University of Helsinki, Finland

Organiser: David Clarke, University of Melbourne, Australia

Discussant: Oskar Lindwall, University of Gothenburg, Sweden

The three papers in this symposium employ different analytical approaches to the study of classroom discourse and knowledge construction in particular Asian and Western mathematics classrooms. Comparison across such culturally-disparate sites poses powerful questions regarding the nature of social interaction and the social processes whereby knowledge is constructed and performed. The symposium combines a focus on classroom patterns of participation with fine-grained analyses of associated patterns of communicative exchange and negotiation of meaning. Each paper sees mathematics learning in terms of participation in forms of social practice. In the first paper, analysis of classrooms in eight culturally-diverse settings examines student participation in different forms of discursive practice and their developing capabilities with regard to both discursive practice and mathematical reasoning. The second paper reports a Bakhtinian analysis showing that mathematical activity in one Japanese classroom was characterized by a monologic suppression by authoritarian voice, rather than by a dialogicality of voices. In the third paper, classroom participants are shown to be highly sensitive to nonverbal epistemic claims and their ongoing interaction is shaped by moment-by-moment adjustments in relation to these. The participants are shown to orient to slight changes in the production of discursive tokens in determining whether a shared understanding of the learning task at hand is arrived at. This in turn is shown to have consequences for the co-construction of knowledge and the constitution of trajectories of learning.

In combination, the three papers address fundamental questions about the social construction of knowledge in mathematics classrooms.

The Cultural-Specificity of Discursive Practice and Learning Outcomes: Connected Contingencies

David Clarke, University of Melbourne, Australia; Lihua Xu, The University of Melbourne, Australia; May Ee Vivien Wan, University of Melbourne, Australia

This paper reports research into the nature and occurrence of mathematical discourse in well-taught classrooms in Berlin, Hong Kong, Melbourne, San Diego, Seoul, Shanghai, Singapore and Tokyo and into the possible associated learning outcomes arising (or likely to arise) from such discursive practices. The paper combines analyses of the relative contributions made by teachers and students to the public classroom discourse, the use of technical mathematical terms by students, both publicly and privately in class and in their post-lesson reflections on their learning. The analysis determined the number of utterances occurring in whole class and teacher-student interactions in a sequence of five lessons from each of the classrooms studied (a total of 110 lessons from twenty-two classrooms), together with the frequency of public statement of mathematical terms and, in a separate analysis, the number of utterances and spoken mathematical terms in the context of student-student (rather than public) interactions. Also analyzed was student use of technical mathematical terms in 191 post-lesson interviews in which they described classroom activities and their mathematics learning.

Student-student spoken interactions were frequent in the classrooms studied in San Diego, Singapore and Melbourne, and non-existent in Shanghai and Seoul, and student use of mathematical terminology varied significantly. Such variations in practice problematise any simplistic characterization of "the Asian classroom." Student spoken facility with the technical language of mathematics can be achieved through either public or private discourse, however student facility with mathematical discourse, in a broader sense, may be enhanced or restricted by cultural contingencies.

In this paper, we summarize analyses of 110 lessons documented in twenty-two classrooms located in Australia (Melbourne), China (Hong Kong and Shanghai), Germany (Berlin), Japan (Tokyo), Korea (Seoul), Singapore and the USA (San Diego). A stratified analysis was conducted in five stages focusing on the significance of the situated use of spoken mathematical language in these classrooms. The results of the first and second analytical stages focused on public oral interactivity (frequency of public utterance) and public mathematical orality (spoken use of key mathematical terms). We distinguish private student-student interactions from whole class or teacher-student interactions, both of which we consider to be public from the point of view of the student. Our major concern in the first four stages of the analysis was to document the opportunity provided to students in the mathematics classroom for the oral articulation of the relatively sophisticated mathematical terms that formed the conceptual content of the lesson and to distinguish one classroom from another according to how such student mathematical orality was afforded or constrained in both public and private classroom contexts. The fifth stage of our analysis examined student use of mathematical terms in post-lesson video-stimulated interviews.

A total of 110 videotaped lessons were analyzed. The 'Asian' data set analyzed included three sequences of five lessons from three mathematics classrooms in Shanghai, three similar sequences from Hong Kong, Tokyo, Seoul and Singapore. 'Western' classroom practice was represented in this analysis by three sequences of five lessons from Melbourne, two sequences from Berlin and two sequences from San Diego. The data from San Diego 3 and from Berlin 3 were excluded because of difficulties in distinguishing "public" and "private" statements in those classrooms.

Spoken Mathematics in the Classroom

The prevalence of spoken mathematics in the twenty-two classrooms studied differed in the following respects:

- the frequency of public utterance
- the relative prominence of the teacher or the students' voices in public discourse
- the frequency of public use of spoken technical terms, most particularly by students
- the differences in the extent to which student use of spoken mathematics was strategically facilitated by teachers
- the extreme differences between classrooms in the occurrence of student-student (private) use of spoken mathematics.

In the fifth stage of our analysis, the transcripts of student post-lesson interviews were examined for the occurrence of the key terms that constituted the instructional focus of the lesson, together with those mathematical terms closely related to the key terms (related terms). In addition, we also coded other terms employed by the student to describe or explain some aspect of their classroom activity.

In conducting the post-lesson interviews, students were asked to comment on what they had learned or felt was important from that day's lesson. Following which, the video for the lesson was played and the student could pause, fast forward or rewind to any parts of the lesson that they felt were important or that they wanted to comment on. After viewing the video, the students were asked if they had any other comments about the lesson before ending the interview session.

Conclusions and Speculations

As a result of this research, we were able to compare the discursive practices of twenty-two mathematics classrooms in eight cities in seven countries. Many hypotheses emerged and these have been variously investigated.

- If student facility with technical mathematical vocabulary is the targeted outcome, then the analysis of the post-lesson interviews suggests that the public scaffolding of student technical fluency (eg Shanghai 1) can be as effective as the encouragement of student-student spoken mathematics (eg San Diego 2) in developing this facility.
- Where the classroom provided students with no opportunity for spoken mathematics (Seoul), there appeared to be little inclination (and possibly capacity) to do so, even in interview situations where the invitation to use spoken mathematics was explicit ("Tell me what the lesson was about").
- Student inclination to employ other mathematical terms ('other terms') in addition to those specific to the lesson could indicate a form of interconnected knowing.
- The level of student participation in the social modelling of particular forms of argumentation could afford or constrain individual's development of particular reasoning capabilities.

Our work suggests that the theories of teaching/learning by which contemporary (largely Western) instructional advocacies are rationalized may themselves be culturally-specific. Fine-grained analysis of the discursive practices of mathematics classrooms in contrasting cultures may hold the key to connecting social discursive practice with specific forms of individual performative capability.

Analysis of “Voice” in a Japanese Mathematics Classroom

Minoru Ohtani, Kanazawa University, Japan

This study investigates how a Japanese mathematics classroom is discursively constituted. The investigation focuses on the ways that teacher and students coordinate their purposes and maintain a predictable sense of the ongoing discourse. The discussion consists of two parts. The first part involves an indication of the theoretical framework and the justification for the methodology used. The theoretical framework, which is grounded on the Bakhtinian perspective, is applied to the study of classroom discourse in which the concept of “voice” and “speech genre” play significant roles. The second part involves description and interpretation of an episode that occurred in the classroom during participant observation. A year-long participant observation was conducted. Utterances which the classroom teacher and students addressed to me are recorded. These utterances give the participant observer an opportunity to have access the under-represented voices in ordinary classroom practice. Analysis of the episodes shows that classroom mathematical activity is characterized by a monologic suppression by authoritarian voice, rather than by a dialogicality of voices. Teacher's utterances suggest that he sends a strong implicit message that homogeneity among students activity should be attained. Students were constrained to limited expression through the monologic speech genre of formal schooling, and this was reflected in their assumption that there is only one true formulation of a mathematical task.

This paper investigates how a Japanese seventh grade mathematics classroom is discursively constituted. The investigation focuses on the ways that teacher and students coordinate their purposes and maintain a predictable sense of the ongoing discourse. The following discussion consists of two parts. The first part involves an indication of theoretical framework and the justification for the methodology used. The second part involves description and interpretation of an episode that occurred in the classroom during participant observation.

Theoretical framework which is grounded on the Bakhtinian perspectives is taken to the study of classroom discourse in which the concept of “voice” and “speech genre” play significant roles.

Bakhtin, contemporarily with Vygotskii, shared the basic idea that communicative practice is situated in social practice (Wertsch, 1991). Unlike many scholars of language, especially contemporary linguists who concern themselves primarily with linguistic form and meaning abstracted from the actual conditions of use, Bakhtin focused on the utterance, the real unit of communication. Speech can exist in reality only in the form of concrete utterance by the individual speaking subject. The speaking subject is called “voice” (Bakhtin, 1982). Voice refers to more than vocal-auditory signal. It involves the much more general phenomenon of “the speaking personality” in particular social practice. Utterance is an activity that enacts different values, perspectives, conceptual horizons, intentions, and world views. Bakhtin stresses the idea that voice reflects “speech genre” (Bakhtin, 1986), which involves particular social and cultural categories.

A year-long participant observation was conducted. Every lesson was audio-video taped for later analysis. “Voices” which the classroom teacher and students addressed to me are essential. According to Bakhtin, any utterance entails the idea of addressivity. An utterance reflects not only the voice producing it but also the voices to which it is addressed. Furthermore, the voices to which an utterance is addressed may be temporally, spatially, and socially distant. Thus, utterances of teacher and students involve their motives, beliefs, situations of definitions, and opinions before, during, and after the lessons. These utterances give the participant observer (voice to be addressed) an opportunity to have access the underrepresented voices in ordinary classroom practice.

Analysis of the episodes shows that classroom mathematical activity is characterized by a monologic suppression by authoritarian voice, rather than by a dialogicality of voices (Wertsch & Rupert, 1993). Teacher's utterances suggests that he sends a strong implicit message that homogeneity among students activity should be attained, even if another form of description or perspective could be used to describe an object or event more appropriately and usefully in their activity settings. Teacher's use of the register of formal instruction surfaces at many points and in many guises in classroom discourse. One of the characteristics of the monologic speech genre of formal schooling is directiveness. Teacher's utterances were directives designed to get the student to participate in formulating the problem in the right way. Another characteristic is a tendency toward a certain kind of rationality. This derives in part from the institutional framework within which formal instruction take place. Formal instruction has to perform a degree of rationalization of what it transmits. Thus, in place of diversity or heterogeneity, it puts explicit, standardized taxonomies, which are expressly inculcated and therefore conserved in the memory as knowledge that can be reproduced in virtually identical form by all the agents subjected to its action. A further characteristic of this speech genre in formal instructional settings is a tendency of homogenization created by such rationality. An underlying assumption of the lesson is that one must not introduce alternative formulations unless specifically invited to do so. This functions as if

an invisible barrier has been placed around the topical space that is eligible for discussion. The title of the worksheet becomes directive of an imperative that he is expected to follow. The title functioned to regulate his mathematical activity in ways that are appropriate for the classroom setting. By responding to the directive, the student engages in a process sanctioned and regulated by the teacher.

The voices of most students can be seen as the internalized voice of the authorized teacher. Through months of classroom practice, students would gain adequate facility and flexibility in the patterns of privileging a particular speech genre deemed appropriate in mathematics lessons. These voices are reflected in the assumption that there is only one true formulation of mathematical task. The mastery of this privileging pattern of the monologic speech genre of formal schooling was clearly revealed in many episodes.

Dialogicality of voices was detected in some students. A student wrote that: "Unlike ordinary lessons, today's lesson was interesting. Because, I can formulate my answer by myself." Kinds of dialogicality that are temporally and spatially distant become apparent in his voice. The voice involves not only positive attitude toward the lesson, but also negative opinion associated with the way the teacher organized preceding lessons.

References

- Bakhtin, M. M. (1982). *The dialogic imagination: Four essays*. Holquist, M. et.al, (Eds). Austin, TX: The University of Texas Press.
- Bakhtin, M. M. (1986). *Speech genres and other late essays*. Translated by V. W. McGee. Austin, TX: The University of Texas Press.
- Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.
- Wertch, J. V. & Rupert, L. J. (1993). The authority of cultural tools in a sociocultural approach to mediated agency. *Cognition and Instruction*, 11 (3 & 4), 227-239.

Embodied epistemic claims in educational settings

Helen Melander, Uppsala University, Sweden; Fritjof Sahlstrom, University of Helsinki, Finland

The focus for this paper is a concern with how people in interaction in educational settings claim to know things, and how these claims, as integrated aspects of learning, can be found to change. Epistemic stances are the primary means by which students and teachers can establish, sustain, and question intersubjectivity in teaching situations. Previous work shows that participants use a variety of resources, including verbal and non-verbal (e.g. prosody, gestures and other embodied displays) epistemic stance markers, for situating their actions within a trajectory of past, concurrent, and projectable change.

Drawing on analyses of video recorded interaction between teachers and students in mathematics education and pilot training, our results show that participants are highly sensitive to nonverbal epistemic claims and the ongoing interaction is shaped by moment-by-moment adjustments in relation to them. This in turn is shown to have consequences for the co-construction of knowledge and the constitution of trajectories of learning.

The identification of evidence of knowing is the basis of, amongst other things, assessment in classrooms. Hence, a more developed understanding of how teachers and students – relying upon non-verbal resources – establish, sustain, challenge, and change epistemic claims is of immediate relevance for the practical activity of teaching.

The focus for this paper is a concern with how people in interaction in educational settings claim to know things, and how these epistemic stances, as an integrated aspect of learning, can be found to change over time. The analysis is situated within recent understandings of learning and development as social and situated (e.g. Enfield & Levinson, 2006; Lave & Wenger, 1991).

Epistemic stances, that is, participants' ways of marking attitudes toward knowledge and how it was obtained, are the primary means by which students and teachers can establish, sustain, and question intersubjectivity in teaching situations. Moreover, they are an important resource for teachers when assessing student's actions. Epistemic stance emerges from interaction between participants in particular dialogic and sequential contexts; it is a public action that is shaped by the talk and stances of other participants in sequentially unfolding turns-at-talk (Karkkainen, 2006). Participants thus socially establish epistemic ecologies of teaching and learning.

Recently completed and on-going work (e.g. Melander, 2009; Sahlstrom, forthcoming) shows that participants use a variety of resources for situating their actions within a trajectory of past, concurrent, and projectable change. These resources include verbal and non-verbal epistemic stance markers, such as syntax and prosody, and gestures and other embodied displays.

Previous research has shown that human action is built through the use of many different kinds of interactional resources. Participants use semantic, syntactic, and prosodic features of talk, gestures, gaze, and body posture, and resources in the surrounding material environment when participating in social interaction (e.g. Goodwin, 2000). Most commonly, analysis of epistemic stance has been focused on verbal aspects of knowledge claims. In this paper, we intend to expand notions of epistemic stance beyond the verbal and lexically oriented analyses and, in line with the above-mentioned research, focus on the role of gesture, prosody, and the use of and interaction with artifacts in the epistemic ecologies of the studied situations (cf. Goodwin, 2007).

Providing empirical ground for the analyses are video recordings of mathematics lessons focusing how teachers and students are working with linear equations. In the analyses we demonstrate how epistemic stance is produced and oriented to and how the student in different ways is positioning himself as knowing some things and as being ignorant of others. This in turn has consequences for how the participants co-construct the content of learning. These results are contrasted with analyses of pilot training where a trajectory of learning is constituted over time through a study of how the student's epistemic claims change over three consecutive lessons, carried out both on the ground and in flight.

The participants are demonstrated to be highly sensitive to nonverbal epistemic claims and the ongoing interaction is shaped by moment-by-moment adjustments in relation to them. The participants have a number of resources available to them, not least prosodic, where they are shown to orient to slight changes in the production of discursive tokens (mhm, yes, etc.) displaying in minimal albeit efficient ways whether a shared understanding of the learning task at hand is arrived at. This in turn is shown to have consequences for the co-construction of knowledge and the constitution of trajectories of learning.

The identification of evidence of knowing is the basis of, amongst other things, assessment in classrooms. Hence, a more developed understanding of how teachers and students – relying upon non-verbal resources – establish, sustain, challenge, and change epistemic claims is of immediate relevance for the practical activity of teaching. This study builds on the substantial cumulative findings of prior studies, to focus on the nature of classroom knowing. It contributes to the empirical resolution of questions on how to identify and analyze successful learning, and how to identify and distinguish accomplished teaching.

SYMPOSIUM

A Cognitive Load Picture Tells a Story about Multimedia Learning

Chairperson: Birgit Karoline Imhof, Knowledge Media Research Center, Germany

Organiser: Gabriele Cierniak, Knowledge Media Research Center, Germany

Discussant: Paul Ayres, University of New South Wales, Australia

Much is known about how to design multimedia materials to optimize learning (see Ainsworth, 2006; Schnotz, 2005). Highly influential has been Sweller's cognitive load theory (CLT; Sweller, 2005) and Mayer's cognitive theory of multimedia learning (Mayer, 2005). Both theories consider the influence of cognitive load. However, there remain a number of unanswered conceptual questions, as well as unidentified conditions, pertaining to the use of multimedia materials. The papers in this symposium investigate some of these issues. The first paper examines the impact of disfluency. Diemand-Yauman, Oppenheimer and Vaughan (in press) found that the inclusion of unintelligible text can facilitate learning, in spite of expected increases in cognitive load. This paradoxical finding is investigated in a multimedia environment that distorts diagrams as well as text. The second paper investigates two plausible explanations for the segmentation effect. CLT argues that segmenting animations is advantageous because the need to process transitory information in working memory is reduced (Ainsworth & van Labeke, 2004; Ayres & Paas, 2007). An alternative explanation is that segmentation acts as a form of temporal cueing, breaking the animations into meaningful units (Arguel & Jamet, 2009; Schwan, Garsoffky, & Hesse, 2000). Few CLT studies have investigated learners with any form of special needs. In the case of learners in pain, working memory capacity can be reduced, consequently multimedia materials may be especially important for this group of learners. The final paper examines the impact of multimedia materials on this population.

Disfluency Research Meets Cognitive Load Theory: When a Bad Layout Leads to Good Performance

Tim Kuhl, Knowledge Media Research Center, Germany; Alexander Eitel, knowledge media research center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

According to Cognitive Load Theory (CLT), instructional material should be designed in a way to decrease unnecessary demands on working memory that, for instance, may be caused by a low legibility. In contrast, recent research on disfluency in educational settings showed that less legible text even leads to better learning outcomes. However, research on disfluency was yet only conducted using texts as stimuli, but not multimedia materials. Therefore, the aim of the current study was to investigate which of these abovementioned two contradicting assumptions would hold true in learning with text and pictures: Would a less legible text also be beneficial when accompanied by pictures, and what would be the role of less legible pictures? To address these questions, participants were randomly assigned to one of four conditions resulting from a 2x2-Design with text layout (legible vs. less legible) and picture layout (legible vs. less legible) as independent variables. Learning outcomes were measured by means of a retention test, a transfer test, and a pictorial test. Extraneous cognitive load (ECL) was assessed by one item referring to task difficulty. Results revealed that a less legible text layout led to better performance on transfer tasks, which is in line with disfluency research. However, a less legible picture layout led to worse performance on pictorial tasks and to higher subjective ratings of ECL, which is in line with CLT. These results stress the importance to take a closer look when and for which purposes legibility may be important.

According to Cognitive Load Theory (CLT; Sweller, van Merriënboer, & Paas, 1998), instructional material should be designed in a way that unnecessary demands on working memory (i.e., extraneous cognitive load, ECL) should be avoided. While in general there is strong empirical support for the CLT, there are certain areas which are rather neglected in this research area, such as the influence of legibility of the instructional material. Nevertheless, following CLT, one would recommend designing the layout of the instructional material in a way that it can easily be perceived. However, this view has recently been challenged by research on “disfluency” in educational settings (Diemand-Yauman, Oppenheimer, & Vaughan, in press). These authors argue that a certain amount of illegibility – which is termed disfluency - leads to a deeper engagement and processing of the text, resulting in better learning. They showed that harder-to-read fonts (e.g., Haettenschweiler) lead to higher learning outcomes compared to easier-to-read fonts (e.g., Arial). However, the current research on disfluency is restricted to text processing, and no study has yet investigated the role of disfluency in learning with multimedia instructional material. Hence, the role of disfluency when learning from text and pictures is yet unclear: Is a disfluent text also beneficial when accompanied by pictures, and do even disfluent pictures foster learning? Or is disfluency harmful and leads to higher ECL, as could be derived from CLT? To address these questions, we manipulated the legibility of text and pictures in the current experiment, and investigated its impact on learning outcomes and cognitive load.

Method

Seventy-two university-students were randomly assigned to one of four conditions which resulted from a 2x2-Design with text layout (legible vs. less legible) and picture layout (legible vs. less legible) as independent variables. The instructional material was adapted from a study by Mayer, Hegarty, Mayer, and Campbell (2005, Exp. 2). It was paper-based (fitting on one page) and consisted of four key pictures depicting the mechanisms of a toilet flush and a text below describing how a toilet flush works. Participants received six minutes to process the instructional material. The experimental variation of the text layout consisted of either a legible text layout or a text layout, which looked like a low quality photocopy of a normal text (less legible; i.e., wavily deformed and blurred). Similarly, the experimental variation of the picture layout consisted of either a legible picture layout or a picture layout, which looked like a low quality photocopy of these pictures (less legible; i.e., wavily deformed and blurred). Learning outcomes were measured by means of a retention test, a transfer test, and a pictorial test. Cognitive load was assessed by one item referring to difficulty (“How difficult was it to learn with the material?”), which was supposed to measure ECL.

Results

Concerning retention, a 2x2-ANCOVA (controlling for prior abilities) revealed neither differences for text layout, nor for picture layout, nor an interaction. With regard to transfer, a 2x2-ANCOVA revealed a main effect for text layout (p With respect to the ECL-item, a 2x2-ANCOVA revealed a main effect for picture layout (p Summary & Discussion). In this study, we investigated whether making instructional text and/or instructional pictures disfluent would decrease learning outcomes, as could be derived from CLT, or improve learning outcomes, as would be predicted from current disfluency research. In line with disfluency research, a worse text layout led to a deeper understanding (as measured by transfer tasks), suggesting that a disfluent text may have led to a deeper processing of the content. However, designing pictures in a disfluent way did not lead to better transfer performance. By contrast, less legible pictures tended to lead learners to a worse pictorial model of the content, as indicated by the lower performance on pictorial tasks. In connection, learners receiving less legible pictures found it more difficult to learn with the material than learners receiving more legible pictures. These latter findings are basically in line with CLT. Taken together, while a less

legible layout of the text led to a better understanding of the content, less legible pictures on the other hand may have led to a worse pictorial mental model. By this first attempt to incorporate disfluency research in multimedia learning scenarios, this study may be considered as – at least partly – a challenge to CLT. However, it has also demonstrated that the global question whether a low quality layout leads to better performance does not seem to be very fruitful. Rather, a more sophisticated differentiation between the legibility of text layout and of picture layout and their impact on different learning outcome measures seems reasonable.

References

- Diemand-Yauman, C., Oppenheimer, D. M., & Vaughan, E. B. (in press). Fortune favors the bold (and the italicized): Effects of disfluency on retention. *Cognition*.
- Mayer, R. E., Hegarty, M., Mayer, S., & Campbell, J. (2005). When static media promote active learning: Annotated illustrations versus narrated animations in multimedia instruction. *Journal of Experimental Psychology: Applied*, 11, 256-265.
- Sweller, J., van Merriënboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10, 251-296.

Explaining the Segmentation Effect in Learning from Animations: The Role of Pausing and Cueing

Ingrid A. E. Spanjers, Maastricht University, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Jeroen van Merriënboer, University of Maastricht, Netherlands; Pieter Wouters, Universiteit Utrecht, Netherlands

Segmentation, that is, showing an animation in pieces rather than continuous, has been shown to improve the effectiveness of animations in terms of cognitive load and learning. Two alternative (but not mutually exclusive) explanations can be given for beneficial effects of segmentation. First, pauses, which are usually inserted between the pieces, provide learners with the possibility to perform necessary cognitive processes on smaller units of information. Secondly, segmentation breaks the animation down in meaningful pieces, which is a form of cueing, and may support learners in perceiving the structure underlying the information. This experiment investigated with a 2 (pauses or no pauses) x 2 (cues or no cues) design which explanation is the most plausible. The participating 161 secondary school students first completed a pretest, then studied animated worked examples on probability calculation, and finally made a posttest. Results showed that studying animated worked examples with pauses led to higher posttest achievement than studying animated examples without pauses. However, studying animated examples segmented by cues required less investment of mental effort during study than examples without cues, without decreasing posttest performance significantly. Thus, results provide some evidence for both explanations.

Animations are increasingly used in education. Information in animations is often transient. Consequently, learners have to process information currently presented, while simultaneously maintaining information presented earlier in working memory to be able to link it with new information (Ayres & Paas, 2007; Lowe, 1999). This may lead to a high cognitive load, which may hinder learning from complex animations. Therefore, it is important to search for guidelines to increase the effectiveness of complex animations by reducing this high cognitive load. One of the guidelines proposed is segmentation, that is showing animations in pieces (e.g., Ayres & Paas, 2007; Wouters, Paas, & Van Merriënboer, 2008). A number of studies have found positive results on learning from segmented animations (e.g., Hasler, Sweller, & Kersten, 2007; Spanjers, Wouters, Van Gog, & Van Merriënboer, in press). Two (alternative, but not mutually exclusive) explanations can be given for these positive effects. First, in previous studies pauses were inserted between the pieces. These pauses provide learners with time to perform necessary cognitive activities and to perform them on smaller units (Mayer, 2009). Secondly, segmentation can be seen as a form of temporal cueing, since it breaks animations into meaningful units (cf. Arguel & Jamet, 2009) which may support people in mentally breaking the events shown into units (see Schwan, Garsoffky, & Hesse, 2000). Since the natural boundaries are made more salient through the segmentation, searching for them may impose less cognitive load and learners may be supported in perceiving the structure underlying the process or procedure shown and stimulated to self-explain the information shown, which enhances learning (cf. Catrambone, 1998). This study investigated which of these processes is the most plausible explanation for the beneficial effects of segmentation. Therefore, learning outcomes and cognitive load with non-segmented animated worked examples and animated examples segmented by pauses, cues or pauses and cues are compared to each other. In addition learning efficiency scores (equal/higher learning outcomes with lower/equal investment of mental effort; see Van Gog & Paas, 2008) was also compared.

Method

The participating 161 secondary education students (51 % females; mean age = 14.79, SD = 0.49) were randomly assigned to one of the conditions (non-segmented (n = 42), segmented by cues (n = 41), segmented by pauses (n = 40),

and segmenting by pauses and cues ($n = 38$)). First, they completed a pretest consisting of probability calculation problems. Subsequently, they studied four animated worked examples, in which it was demonstrated and explained how probability calculation problems can be solved (cf. Spanjers et al., in press). The segmented examples were divided into five or six segments by pauses of 2 seconds and/or cues (i.e., slightly darkening the screen temporarily). Finally, the students completed the posttest consisting of probability calculation problems. After each example and test problem, the participants rated the amount of mental effort invested.

Findings

Two-by-two ANCOVAs with pretest scores as covariate showed that learners who studied animated worked examples with pauses ($M = 6.46$) achieved better than learners who studied examples without pauses ($M = 5.80$), $F(1,156) = 3.96$, $p = .05$. There was no significant main effect of cueing nor a significant interaction between cueing and pausing. For mental effort invested in the posttest no significant main effects nor a significant interaction was found. Analyses on the mental effort data during example study showed that studying examples with cues ($M = 2.19$) required less mental effort investment than studying the examples without cues ($M = 2.73$), $F(1,156) = 5.65$, $p = .02$. There was no significant main effect of pausing nor a significant interaction between pausing and cueing. Conclusion This study replicated the findings of previous studies (Hasler et al., 2007; Spanjers, Wouters et al., in press) that segmentation enhances learning from animations. Furthermore, this study investigated the plausibility of two explanations for the segmentation effect by comparing learning outcomes and cognitive load of four types of animated worked examples. Learners studying animated examples with pauses attained higher posttest scores than learners studying examples without pauses, without differences in investment of mental effort during example study. Thus, pauses influence the efficiency of the learning outcomes positively. On the other hand, studying animated examples with cues required less mental effort than studying examples without cues, without differences in posttest scores. So the insertion of cues also influenced the efficiency of the learning process positively. These results provide evidence for both explanations: pausing between segments enables learners to perform necessary processes on smaller information units, leading to better learning, and providing temporal cueing by making natural event boundaries more salient lowers cognitive load.

References

- Arguel, A., & Jamet, E. (2009). Using video and static pictures to improve learning of procedural contents. *Computers in Human Behavior*, 25, 354-359.
- Ayres, P., & Paas, F. (2007). Making instructional animations more effective: A cognitive load approach. *Applied Cognitive Psychology*, 21, 695-700.
- Catrambone, R. (1998). The subgoal learning model: Creating better examples so that students can solve novel problems. *Journal of Experimental Psychology: General*, 127, 335-376.
- Hasler, B. S., Kersten, B., & Sweller, J. (2007). Learner control, cognitive load and instructional animation. *Applied Cognitive Psychology*, 21, 713-729.
- Lowe, R. K. (1999). Extracting information from an animation during complex visual learning. *European Journal of Psychology of Education*, 14, 225-244.
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press.
- Schwan, S., Garsoffky, B., & Hesse, F. W. (2000). Do film cuts facilitate the perceptual and cognitive organization of activity sequences? *Memory & Cognition*, 28, 214-223.
- Spanjers, I. A. E., Wouters, P., Van Gog, T., & Van Merriënboer, J. J. G. (in press). An expertise reversal effect of segmentation in learning from animations. *Computers in Human Behavior*.
- Van Gog, T. & Paas, F. (2008). Instructional efficiency: Revisiting the original construct in educational research. *Educational Psychologist*, 43, 16-26.
- Wouters, P., Paas, F., & Van Merriënboer, J. J. G. (2008). How to optimize learning from animated models: A review of guidelines based on cognitive load. *Review of Educational Research*, 78, 645-675.

Does the multimedia principle hold true for chronic pain learners?

Angela Smith, University of New South Wales, Australia

Much is known about how pain reduces working memory capacity, but little is known about how instruction can be designed to compensate. Cognitive load theory (Sweller, 2005) and the cognitive theory of multimedia learning (Mayer, 2005) have both shown that a multimedia approach can overcome some working memory limitations. This paper investigated the impact of multimedia learning materials on learners who experience chronic pain. Sixty school teachers (30 with chronic pain, 30 pain-free) were randomly assigned to one of two learning materials written (W) or written with visuals (W+V). Following instruction on how lightning forms, participants completed retention, transfer, and matching tasks. Overall, pain-free learners scored higher than chronic pain learners; and the multimedia combination of W+V was more effective than the single W strategy. However, these results were moderated by the

task and the learner. For pain-free learners there was a consistent advantage to the W+V strategy. However, for chronic pain learners, the advantage of the W+V strategy was only found on one transfer task. Chronic-pain learners demonstrated impaired cognitive performance; and the effectiveness of multimedia materials was moderated by task requirements. This study adds to multimedia learning theory by extending the research into population of learners with special needs. The study may have implications for information representation to individuals with chronic pain in broader contexts.

This paper investigates the impact of multimedia materials on learners with chronic pain. It aims to show that these learners experience impaired cognitive performance compared with pain-free learners, and interact differently with multimedia materials. Learners with chronic pain essentially operate in a dual-task, split-source paradigm. Key areas of the brain involved in attentional resource allocation, modulation of sensory and affective components of pain, and amplification and attenuation of pain response, are associated with widespread activation in the anterior cingulate (ACC) and prefrontal cortices (PFC; Gilbert & Sigman, 2007). Such cortices are also activated during a variety of higher order processes including cognitive control, behavioural flexibility, and performance adaptation (Collette & Van der Linden, 2002). Importantly, the ACC and PFC are sensitive to working memory (WM) load and susceptible to interference when the processing of stimuli is increased. The sum of such conditions suggests that learners with chronic pain are vulnerable to impaired cognitive performance, particularly in contexts that require knowledge acquisition, problem-solving and transference. Although, the influence of pain on WM is well documented, little has been explored to improve cognition through instructional design manipulation. Cognitive load theory (CLT; Sweller, 2005) and cognitive theory of multimedia learning (CTML; Mayer, 2005) have identified various design principles that should be followed to optimize multimedia learning environments. Both theories directly link WM demands to multimedia design, arguing that a dual mode approach (visuals and text) can overcome some WM limitations. The application of these theories has predominantly been conducted with mainstream learners. However, are these design principles effective for a population of learners demonstrating episodes of reduced WM capacity? Do learners with chronic pain require greater access to multimedia materials to maximize understanding? This study investigates if the multimedia principle holds true for a population of learners with chronic pain. Mayer's multimedia principle states: "People learn more deeply from words and pictures than from words alone" (p. 31; Mayer, 2005). Two predictions were made. First, similar to pain-free learners, chronic pain learners would benefit from instruction that integrated visual and textual information. Second, that pain-free learners would learn more effectively than chronic pain learners. To test these predictions, a 2x2 factorial design was used where the first factor was participant pain status (presence vs. absence) and the second factor was instructional strategy (written vs. written + visual).

Method

Participants. 60 academic staff were recruited from a Sydney school. 30 reported that they had chronic pain and 30 reported no form of chronic pain. Each group was randomly assigned to one of the two treatment conditions: written only (W) or written with visuals (W+V). Each of the four cells had 15 participants.

Materials. The materials were a reproduction of those used by Mayer and colleagues that explain lightning formation. In the W group, written instructions were provided; in the W+V group, instructions included written text and diagrams. Following the learning phase, participants were required to take a retention test; a transfer test that included four different types of problem-solving questions, and a matching test that required causal-element identification. Prior to this phase a prior knowledge test was given, that served as a covariate throughout. Demographic data on pain duration, intensity, and depressive symptoms were also collected but are not reported here because of space restrictions.

Procedure. Participants received 8 minutes to process the instructional material before being presented the series of timed tests: retention (6 minutes), transfer (3 minutes each question), and matching task (3 minutes).

Results

An ANCOVA on the retention task indicated a significant strategy effect. The W+V strategy outperformed the W strategy: $F(1,53)=4.09$, p

Conclusion

For pain-free learners, there was a consistent advantage for the dual mode strategy. More learning occurred when both written text and diagrams (W+V) were presented compared with written text (W) alone. For learners with chronic pain the modality effect was moderated by the type of transfer task required. On tasks that required an explanation of the relationships among elements in the scientific system (transfer tasks 1 and 2) no advantage was observed. On a task that required making changes to the scientific system in order to achieve a particular goal (transfer task 3), a large effect was observed. Possible causes of this interaction will be discussed in more detail during the presentation. The findings of this study extends the theory on multimedia learning to a unresearched population of learners. The interaction findings suggest that chronic pain reduces WM capacity and that the effectiveness of

multimedia materials varies according to task requirements. The study may have significant implications for the way in which information is represented to learners with chronic pain in clinical and vocational contexts.

References

- Collette, F., & Van der Linden, M. (2002). Brain imaging of the central executive component of working memory. *Neuroscience and Biobehavioural Reviews*, 26(2), 105-125.
- Gilbert, C. D., & Sigman, M. (2007). Brain states: Top-down influences in sensory processing. *Neuron*, 54(5), 677-696.
- Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed), *The Cambridge Handbook of Multimedia Learning*. New York, NY: Cambridge University Press.
- Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 19-30). New York, NY: Cambridge University Press.

SYMPOSIUM

Facets of teachers' competences and teachers' perceptions

Chairperson: Eveline Wuttke, Goethe-Universitat Frankfurt, Germany

Organiser: Eveline Wuttke, Goethe-Universitat Frankfurt, Germany

Juergen Seifried, Universitaet Konstanz, Germany

Discussant: Monika Waldis, University of Applied Sciences, Switzerland

Aims of the symposium

Current discourse surrounding teacher competence and its development has established that teacher competence is a primary requirement for high level performance in the classroom. It has also established that this competence covers a variety of types of knowledge that a teacher should ideally possess (Shulman, 1987). Bromme (1992, 1997) has taken up and further developed Shulman's classification, which, from his perspective, also contains value systems (philosophy of the school subject, convictions, teachers' perception of learners etc.). In our symposium we focus on three central facets of teachers' competence and perception, namely diagnostic competence of teachers, professional error competence of teachers, and teachers' perception of ability and effort.

Scientific and educational relevance

As students' learning from errors depends on how teachers deal with errors and as diagnosing is an everyday task at school and the demand to foster students individually increases, such concepts prove to be helpful both in further education and earlier in teacher education when implemented in the curriculum. We furthermore need to know more about teachers' perceptions of learners abilities because teachers are among the most significant adults with whom children interact daily at school and we know that children easily assimilate teachers' perceptions as a part of their own self-concept.

Can Diagnostic Competences of Teachers be fostered by Training and the use of Diary?

Julia Klug, TU Darmstadt, Germany; Mara Gerich, Institut fuer Psychologie TU Darmstadt, Germany; Stefanie Jauch, Institut fuer Psychologie TU Darmstadt, Germany; Simone Bruder, DIPF, Germany; Bernhard Schmitz, Technical University of Darmstadt, Germany

Diagnosing is one of teachers' key tasks at school. So far, particularly students' academic achievement has been investigated in prior empirical research on teachers' diagnostic competence. However, there's a request to shift the focus to diagnosing learning behavior and a call for further education programs to foster new facets of teachers' diagnostic competence. The aim of the present study was to develop and evaluate a training program including a standardized diary, which was based on a three-dimensional process model of teachers' diagnostic competence concerning learning behavior. N=47 secondary school teachers participated in the longitudinal training program which combined pre- and posttest measures with time-series data. Results of our study show that the training in fact enhances teachers' diagnostic competence, especially when it comes to the processing while diagnosing and to diagnostic action before the actual judgment is delivered. The standardized diary proved to be a useful instrument to measure diagnosing in everyday work at school and also showed an additional intervention effect for the processing while diagnosing. As diagnosing is an everyday task at school and the demand to foster students individually increases, the training concept proves to be helpful both in further education and earlier in teacher education when implemented in the curriculum.

Theoretical framework and aim of the study

In their daily job, teachers are faced with multitasking and highly complex work (Brante, 2009). Diagnosing is one of their key tasks as they "are challenged to meet diverse learning needs and to adapt their teaching to heterogeneous academic ability as well as to multiple interests and motivations" (Vogt & Rogalla, 2009).

Looking at prior empirical research, students' academic achievement in particular has been investigated, from the 1970s until today. So far, accuracy in teachers' judgments has been measured by correlating judgments with results of standardized tests (e.g. Coladarsi, 1986; McElvany et. al., in press). However, there's an ongoing request in theoretical literature to shift focus from diagnosing achievements to diagnosing learning behavior which allows didactic action afterwards like fostering students individually and adapting class to their needs (e.g. Abs, 2007; Kretschmann, 2009). Klug, Bruder & Schmitz (in preparation) developed and empirically tested a model of teachers' diagnostic competence concerning learning behavior which closes the gap between previous empirical research and recent theoretical demands. It describes diagnosing learning behavior as a three-dimensional process (Jäger, 2007), consisting of a preactional, an actional and a postactional phase (Schmitz & Wiese, 2006). In preactional phase, teachers should intentionally aim at watching individual students learning process and at fostering students due to the diagnosis. Furthermore, teachers' basic diagnostic skills (knowledge about methods for gathering information, knowledge about psychological quality criteria of tests, knowledge about judgment formation) are activated. In actional phase, acting systematically is most important, including making predictions, gathering information from different sources, choosing relevant information, interpreting data and coming to a concluding diagnosis. In postactional phase, pedagogical action that follows out of the diagnosis like giving feedback, writing plans for students' promotion and adapting class by means of teaching appropriate learning strategies shall be implemented. Knowledge, professional identity and reflected experience are responsible for the development of diagnostic competence in the model.

Klieme et al. (2003) call for further education programs to foster new facets of teachers' diagnostic competence. Nevertheless, there are no such programs yet (Laukart, 2004). The aim of the present study was to develop and evaluate a training program including a standardized diary based on the described model to foster diagnostic competence concerning learning behavior.

Methodology

N=47 secondary school teachers with a mean age of 40.4 years and a mean school-teaching experience of 14.76 years (min=1, max=38) participated. 66 % were female and 7 had already taken part in a further education program on diagnostics. The longitudinal training design combined pre- and posttest measures with time-series data. Experimental group 1 (n=15) completed pretest, then got three weekly training sessions and completed posttest afterwards. Experimental group 2 (n=15) additionally worked on a standardized diary, starting one week before the first training session and finishing one week after the last session. The waiting control group (n=17) participated in pre- and posttest and got a shortened training program afterwards.

Pre- and posttest were composed of three instruments which were tested in a former study. First, a scenario-test measured diagnostic competence. It described a case of a pupil with learning difficulties followed by twelve open questions based on the model. Answers were rated each from zero to three points. Interrater-reliabilities were between ICC=.67 and ICC=.95. Of a maximum of 36 points, M=14.28 (SD=4.59) points were reached. Second, a knowledge test in multiple-choice-format with item difficulties between .33 and .82 measured knowledge on diagnostics. Third, a six-point likert-scale-questionnaire measured reflected experience (4 items, α =.75) and professional identity (12 items, α =.77).

The standardized diary contained 12 items on the content of the model, four on professional identity and one item on reflected experience, each formulated as states.

Findings

Multivariate ANOVAS with group as independent and the pre-post difference as dependant variable showed significant differences in case scenario measures for the total score of diagnostic competence ($F=12.43$, $df=2$, p

Theoretical and educational significance

Results of our study show that teacher training in diagnostic competence concerning learning behaviour in fact enhances teachers' diagnostic competence, especially when it comes to preactional and actional diagnosis action. However, postactional content needs to be broadened in later training programs. The standardized diary proved to be a useful instrument to measure processing while diagnosing in everyday work at school even though it did only show an additional intervention effect for actional variables. As diagnosing is an everyday task at school and the demand to foster students individually increases, such training concepts prove to be helpful both in further education and earlier in teacher education when implemented in the curriculum.

How to deal with student errors – Findings from a teacher training study

Juergen Seifried, Universitaet Konstanz, Germany; Eveline Wuttke, Goethe-Universitat Frankfurt, Germany

It is often said that students – or people in general – learn from errors. But we argue that this does not happen automatically, that teachers must support students in learning from errors, and that a teacher needs specific competences to do so. First, teachers need to know what typical errors can be made in a certain domain. Then, after errors have been discovered, teachers need to know how to give constructive and elaborate feedback about more successful ways to solve a problem. Therefore, the objectives of our studies are:

- To find out what teachers know about typical student errors.
- To analyse how teachers handle errors, if they get to the bottom of errors and if they are able to give elaborate feedback in order to support students in learning from errors.

The presentation will report the first findings from a video vignette study.

Ellström, P.-E. (2006). The meaning and role of reflection in informal learning at work. In: Boud, D. J. Cressey, P. & Docherty, P. (Eds.): *Productive reflection at work*. London: Routledge, 43-53.

Gartmeier, M., Bauer, J., Gruber, H., & Heid, H. (2008). Negative knowledge: Understanding professional learning and expertise. *Vocations and Learning*, 1, 87-103.

Klein, T., Neumann, J., Reuter, M., Hennig, J., & von Cramon, D.Y. (2007). Genetically determined differences in learning from errors. *Science*, 318, 1642-1645.

Minsky, M. (1994). Negative expertise. *International Journal of Expert Systems*, 7(1), 13–19.

Parviainen, J. & Eriksson, M. (2006). Negative knowledge, expertise and organisations. *International Journal of Management Concepts and Philosophy*, 2, 140–153.

van Woerkom, M. (2003). *Critical reflection at work. Bridging individual and organisational learning*. Enschede: PrintPartners.

Weimer, H. (1925). *Psychologie der Fehler*. Leipzig: Klinkhardt. Yerushalmi, E. & Polingher, C. (2006). Guiding students to learn from mistakes. In: *Physics Education*, 41, 532-538.

SYMPOSIUM

Understanding mechanisms and quality of students' questions

Chairperson: Albert Logtenberg, University of Amsterdam, Netherlands

Organiser: Albert Logtenberg, University of Amsterdam, Netherlands

Discussant: Baruch Schwarz, Hebrew University, Israel

This symposium brings together three empirical studies that investigate how students ask questions. Research in student questioning faces two problems. Firstly, students in education do not ask many questions and the quality of the questions leaves much to be desired. Secondly, there is more need for empirical knowledge of how questioning processes elapse in different domains. The aim of this symposium is to discuss methodological and empirical issues and contribute to theory on student questioning. In questioning theory variables such as prior knowledge readers' goals play an important role. The first paper discusses the impact of domain-specific prior knowledge on number and quality of students' questions (N=26, aged 21). Students of the experimental group received prior knowledge on the topic 'emotion and learning'. Their questions are compared to the questions of the control group that did not receive prior knowledge. The second paper studies questioning with 33 students (aged 15) that read a historical introductory text. In order to determine the quality of a historical question indicators of questioning ability in History are described. The third paper discusses how readers' goals affect the detection of reading obstacles and the generation of questions on scientific texts. Results show that students in the understanding condition detected more explanation obstacles than the students in the experimenting condition. The discussant will discuss the contribution of these studies to theoretical understanding of questioning processes and how this understanding can help develop learning activities that foster the development of student questioning skills and domain-specific understanding.

The influence of domain-specific prior knowledge on the number and quality of students' questions

Frauke Kammerer, University of Erfurt, Germany; Helmut M. Niegemann, University of Erfurt, Germany

Questioning as a learning technique can improve learning outcomes because it helps the learner to better integrate new knowledge into prior knowledge. However, the influence of domain-specific prior knowledge on the number and quality of questions has not yet been made clear. We aim at empirically based statements about the influence of prior knowledge on the number and quality of questions. We therefore conducted an experiment with two groups: the experimental group (n=13) received prior knowledge on the topic "emotion and learning" (high prior knowledge). The

control group (n=13) did not receive prior knowledge on that topic (low prior knowledge). To judge the number and quality of questions students in both groups read a text on the topic "emotion and learning" and were asked to write down all their questions while reading. The first results indicate that both groups differ significantly in their domain-specific prior knowledge. Further analysis may show if this difference in has an influence on the number and quality of their questions

Aims.

Questioning as a learning technique can contribute to better learning outcomes. Previous studies have shown the positive effects of questioning (e.g., Graesser & Person, 1994). But there are inconsistent results concerning the influence of domain-specific prior knowledge on the number and quality of learner's questions (e. g., Miyake & Norman, 1979; van der Meij, 1990). To contribute to this knowledge gap we designed an experiment with two groups: one group that received prior knowledge on the topic 'emotion and learning' and another group that did not receive any prior knowledge. Firstly, we want to find out if both groups differ in the number they ask on another text about emotion and learning. Secondly, we consider the quality of their questions in relation to their domain-specific prior knowledge.

Theoretical framework

We judge the quality of questions according to the PREG model (Otero & Graesser, 2001). This model predicts the occurrence of questions during text understanding on three different cognitive levels:

Text surface: learners seek to understand the meaning of a certain word, e.g., 'What is the meaning of exam nerves?'

Text base: learners seek to understand the relation of propositions in a text, e.g., 'How are the two components of exam nerves related to each other?'

Situation model: learners seek to construct relations between propositions in a text and their prior knowledge, e.g., 'What is the relation between emotions during learning and the depth of information processing?'

Research question and hypothesis

This paper deals with our research question concerning the number and quality of student questions: How does domain-specific prior knowledge influence the number and quality of students' questions? We expected students with high prior knowledge (experimental group) to ask more questions on a higher cognitive level than students with low prior knowledge (control group) (Hypothesis 1). We expected both groups to differ in the number of questions they ask (Hypothesis 2).

Method

Participants and design.

The participants were 26 students of a German university majoring in education, special education or psychology (2 male, 24 female). The mean age was 21.58 years (SD=2.56). All of the participants studied in the second semester. They were randomly assigned to one of the experimental conditions.

Experimental conditions.

We designed an experiment with one experimental and one control group (1x1 design). The experimental group received prior knowledge to the topic of emotion and learning. The control group did not receive domain-specific prior knowledge on that topic.

Learning materials

As learning materials we used two texts about emotion and learning: one text that explicitly induced prior knowledge on the topic (prior knowledge text) and one text that was read by both groups (main text).

In the first text that was given to the experimental group before reading the main text important concepts of the topic "emotion and learning" were explained (e.g. exam nerves, worry-component of exam nerves). The explanation of certain concepts should reduce the number of questions on text surface. Thus, students in the experimental group should have more cognitive resources to concentrate on questions on higher cognitive levels. Before reading the main text the control group received a text about the oil catastrophe in the Gulf of Mexico (control text). We wanted to make sure that both groups read the same amount of words before turning to the main text.

We took the main text on emotion and learning from an educational psychology textbook. We analysed the text into propositions and manipulated the text on the three levels of understanding according to the PREG model. These manipulations should make the text inconsistent and thus, provoke questions on the three levels of understanding according to the PREG model. Students were told to read this text and try to understand it. If they had difficulties in understanding they should formulate and write down their questions.

Prior knowledge test.

After they had finished reading the first text (prior knowledge text and control text) students of both groups completed a criterion-oriented prior knowledge test.

Dependent variables.

To measure the influence of prior knowledge we gathered the following variables: number of questions, quality of questions and learning outcome.

Results

Manipulation check.

We conducted a t-test for independent samples to check if both groups are different regarding their prior knowledge. The mean score of the experimental group in the prior knowledge test was $M=3.23$ ($SD=1.166$), the mean score of the control group was $M=1.85$ ($SD=1.281$). The t-test showed that both groups differed significantly in their domain-specific prior knowledge ($t(24)=2.882$; $p=.008$). Cohen's $d=1.13$ showed a strong effect in favour of the experimental group.

Number and quality of questions.

The data concerning number and quality of questions have not yet been fully analyzed. To judge the quality of questions we analyzed them into propositions. Two independent raters will judge the quality of questions according to the PREG model. To compare the means of the questions on each level we will conduct t-tests. The results will be presented at the conference.

significance and future work

As stated earlier, we try to contribute to fill in the gaps of previous studies examining the influence of prior knowledge on the number and quality of questions. We also collected data on interest, level of understanding (self-assessment) and invested effort. We should also pay further attention to the influence of these variables on the number and quality of questions.

References

- Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal*, 31(1), 104-137.
- Miyake, N., & Norman, D. A. (1979). To ask a question, one must know enough to know what is not known. *Journal of verbal learning and verbal behaviour*, 18(3), 357-364.
- Otero, J., & Graesser, A. C. (2001). PREG: Elements of a Model of Question Asking. *Cognition and Instruction*, 19(2), 143-175.
- Van der Meij, H. (1990). Effects of prior knowledge on question asking. *Journal of Educational Psychology*, 4(2), 87-96.

Students' questioning in History: indicators of the ability of formulating historical questions

Albert Logtenberg, University of Amsterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Bernadette Van Hout-Wolters, University of Amsterdam, Netherlands

This study aims at deeper insight into students' ability to ask historical questions after reading a historical introductory text and at the identification of possible indicators of this ability. The study draws on domain-specific and more general theories on questioning. We depart from the idea that historical questions are related to historical thinking and reasoning. Furthermore, we use a three-stage model of questioning (onset, formulating and answering) for designing this study. 33 students in secondary education were instructed to underline text segments they found striking. Then, students were instructed to formulate questions and were asked whether they could give an answer. Finally students were interviewed about their most interesting and important questions. We used four indicators for students' questioning ability to analyze the data; the ability to formulate a question out of an experience of perplexity, the quality of the questions asked, students' questioning goals, and the extent to which students have an idea of an answer. Our analysis shows that the four indicators proposed in this study can help to determine students' ability in asking historical questions and the problems students face. The data also support the idea that the model of questioning is not always linear; a question can function as a start but also as a result of historical reasoning. Implications for improving students' ability to ask historical questions are explored.

In History, questioning can be seen as an 'engine' of historical reasoning (Reference removed for review). Interpreting a historical phenomenon implies a search for explanations ('why did it happen?'), differences and communalities ('what changed?') and historical context ('was it common in that time?'). When we want to enhance students' ability to ask historical questions, it is important to investigate how students perform on a questioning task. The aim of this study is to provide an insight into students' questioning ability and to identify indicators of students' ability to ask historical questions.

Yang (2006) argues that research on questioning assumes incorrectly that 'the cognitive process type needed by each question is fixed in itself.' (pp. 198). Most research on questioning disregards the mechanisms of question generation and the domain-specific characteristics of questioning (Otero, 2009). Although researchers in history education state that questioning plays an important role in historical reasoning empirical research is scarce.

Van der Meij (1994) describes three stages that characterize the questioning process : (1) the onset (perplexity), (2) development (formulating) and (3) processing of an answer (answering). The stage of formulating questions knows many difficulties and opportunities (Van der Meij, 1994). Ideally, students should be able to recognize their experience of perplexity (onset) and put this perplexity into the right words. In History, students' perplexity is sometimes the result of considering past events and actions as strange, reasoning from a present-oriented perspective. Having an idea about the answer is considered an important component of questioning ability. The task to formulate questions can be interpreted differently. Questions can function to express interest, to foster text-comprehension or to create a representation of the phenomena the text is about (Chin & Osborne, 2010).

Summarizing, this study focuses on questions asked by students in secondary education. We describe the domain-specific characteristics of student questioning processes in order to be able to do more sophisticated claims about what constitutes students' ability to ask historical questions. Potential indicators are 1) students' ability to formulate the experienced perplexity into a question; 2) the domain-specific quality (historical question types), 3) students' ability to formulate an answer and 4) students' questioning goals.

In order to validate and specify these indicators, we investigated students' questioning after reading an historical introductory text. These questions are addressed to describe possible indicators of students' ability to ask historical questions:

1. To what extent do students' formulate a question out of experiences of perplexity?
2. To what extent do students formulate historical questions and what type of historical questions?
3. To what extent have students an idea of a possible answer?
4. What are students' questioning goals?

Method

Participants

33 students in higher secondary education (mean age = 15.6, 10 boys, 23 girls) are recruited from a sample of 174. Selection criteria were high, medium and low scores on variables prior knowledge and interest in History.

Procedure

The introductory text about the Industrial Revolution (770 words) composed for this study contains narrative and problematizing characteristics. Participants were instructed to read and underline text segments that were striking or unclear to them. After reading students were instructed to ask questions. After each formulated question, students were asked to answer it. Students were interviewed about their most important question.

Analysis

We used the analyses of types of perplexity in terms of prior knowledge, affect and historical reasoning (Reference removed for review) to determine whether students put their perplexity into a question. Secondly, we determined the type of questions (descriptive, comparative, explanative (causal) and evaluative questions). Furthermore we distinguished questions aiming at text comprehension and questions aiming at understanding a historical phenomenon. Finally we analyzed the preliminary answers that students gave and analyzed the explanations they gave for choosing their most important question.

Results & Conclusions

Not every experience of perplexity during reading was formulated into a question after instruction. Spontaneously asked questions during reading were not always (re)formulated after instruction. For example, perplexity that was characterized with emotions, such as indignation, was not always transformed into a question. In some cases students verbalize perplexity, but resolve it by reasoning historically (e.g. contextualize an event or situation) when they are asked to explain their perplexity.

Students formulated 117 (M = 3.5) questions after instruction. Most questions were descriptive (N= 60) and explanative (N = 47) questions and aimed at historical understanding (76%). Many of these questions go beyond the text and seek for more general information about the Industrial Revolution, such as 'How did the Industrial Revolution start?'

On 79 (67.5%) of the questions students tried to formulate an idea of an answer. Ideas contained information from the text, lessons on the topic or world knowledge. In some cases students formulated follow-up questions while

reasoning about a possible answer. Analysis of the explanations for choosing certain question as most important revealed that students think the most important questions are questions that helps them to understand the topic and that focus on the most significant issues of the historical topics. Sometimes, personal interest is also seen as an important motivation for a question.

Summarizing, the indicators proposed in this study help to determine students' ability in asking historical questions and the problems students face. Students' reflection on their questions reveals important aspects of cognitive and affective goals and historical aspects of the ability of questioning. The data also support the idea that the model of questioning is not always linear: a question can function as a start but also as a result of a historical reasoning.

References

- Chin, C., & Osborne, J. (2010). Supporting argumentation through students' questions: Case studies in science classrooms. *Journal of the Learning Sciences*, 19(2), 230 - 284.
- Otero, J. (2009). Question generation and anomaly detection in texts. In D. Hacker, J. Dunlosky & A. Graesser (Eds.) *Handbook of Metacognition in Education*. Routledge.
- Van der Meij, H. (1994). Student questioning: a componential analysis. *Learning and Individual Differences*, 6(2), 137-161.
- Yang, M. (2006). A critical review of research on questioning in education: limitations of its positivistic basis. *Asia Pacific Education Review*, 7(2), 195-204.

Effect of an understanding task versus an experimenting task on detection of obstacles and questions

Paula Fernandes, University of Coimbra, Portugal; Piedade Vaz, University of Coimbra, Portugal; sanjose vicente, University of Valencia, Spain; Jose Otero, Universidad de Alcala, Spain; Maria Morgado, High School of Tomar, Portugal

Question asking may be conceptualized as a request for information in order to overcome an obstacle to achieve a certain goal. This study examined the effect of two reading tasks, and corresponding goals, on the detection of obstacles and question asking on scientific passages. Two types of obstacles and corresponding questions were considered in the study: explanation obstacles and association obstacles. A typical example of the former are difficulties in establishing causal relations, while the latter correspond to difficulties in characterizing the entities described in a text and their features. A sample of secondary school students read passages for understanding or, alternatively, to do an experiment, with instructions to ask questions if necessary. The results showed that students in the understanding condition detected more explanation obstacles, according to the questions asked, than the students in the experimenting condition. The opposite was true for association obstacles and association questions.

Asking an information seeking question may be conceptualized as a request for information in order to overcome an obstacle to achieve a certain goal (Reference removed for review). In this study, we examined how readers' goals affect the detection of reading obstacles and, subsequently, the generation of questions on scientific texts. These three elements, reading goals, obstacle detection and question asking are closely interrelated. Goals influence the type of mental representation attempted by readers. The attempted mental representation, in its turn, is one key element defining the comprehension obstacles found, and these obstacles influence the questions asked. Two types of obstacles and corresponding questions were considered in the study: explanation obstacles and association obstacles (Reference removed for review). A typical example of the former are difficulties in establishing causal relations, while the latter correspond to difficulties in characterizing the entities described in a text and their features. A sample of secondary school students read the same short passages for understanding or, alternatively, to do an experiment, with instructions to ask questions if necessary. Given a particular text and a reading task, the immediate goal of a reader consists in building an internal representation of discourse appropriate for the attempted task.

Therefore, these two tasks were hypothesized to correspond to different mental representations attempted by the students under the two conditions. Reading for understanding involves representations of discourse where explanations and causal relations play an important role. This expectation is supported by models such as the constructionist theory of discourse comprehension of Graesser, Singer and Trabasso (1994), and by many other studies that have demonstrated the importance of causal or goal-based explanations in the mental representation of narratives (Klin, 1995; Suh & Trabasso, 1993; Van den Broek, 1990), and of expository texts (Millis and Graesser, 1994; Singer and Gagnon, 1999; Wiley and Myers, 2003).

A different mental representation and different obstacles would be expected when someone reads a text to perform a procedure. For instance, reading about a physical system in order to carry out an experiment involves attempting a representation where objects and processes are elaborated in enough detail so that the operation of the system could

be predicted (Norman, 1983). In addition, school practical work is frequently considered by students as mainly manipulative and relatively devoid of theoretical content (Abrahams and Millar, 2008). Students focus on manipulative activities with less regard for the ideas providing meaning and relevance to the events taking place in the laboratory. Therefore explanations and causal relations may be regarded less important under this condition. In contrast, knowing the objects and processes involved in a procedure are expected to be central components of the mental representation built. Therefore obstacles in representing these entities, i.e., association obstacles, are expected to be more frequent when reading to perform an experiment than when reading for understanding.

In accordance with this, we hypothesized that less explanation obstacles and less explanation questions should occur in the experimenting condition than in the understanding condition while the opposite should occur for association obstacles and association questions.

One hundred and twenty four 12th grade students, in 6 classes, and 72 9th grade students, in 4 classes, participated in three experiments. The students read 4 different short science passages under understanding or experimenting conditions, with instructions to ask questions if necessary.

The results showed that obstacles and questions depended in a predictable way on the proposed tasks and corresponding reading goals of the students. Students in the understanding condition asked significantly more explanation questions than the students in the experimenting condition - a result replicated across the experiments. In contrast, students in the experimenting condition tended to ask significantly more association questions than the students in the understanding condition. These results suggest that understanding and experimenting tasks give rise to different concerns in science students. The relation between these concerns and deep understanding merits further attention.

References

- Abrahams, I. & Millar, R. (2008). Does Practical Work Really Work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, 30, 1945–1969.
- Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review*, 3, 371-395.
- Klin, C. M. (1995). Causal inferences in reading: From immediate activation to long-term memory. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 21, 1483-1494.
- Millis, K., & Graesser, A. (1994). The time-course of constructing knowledge-based inferences for scientific texts. *Journal of Memory and Language*, 33, 583-599.
- Norman, D.A. (1983). Some Observations on Mental Models. In D. Gentner and A.L. Stevens (Eds.), *Mental Models* (pp. 7-14). Hillsdale, N.J.: Lawrence Erlbaum.
- Singer, M., & Gagnon, N. (1999). Detecting causal inconsistencies in scientific text. In S. R. Goldman, A. Graesser, & P. van den Broek (Eds.), *Narrative comprehension, causality, and coherence: Essays in honor of Tom Trabasso* (pp. 179-194). Mahwah, N.J.: Lawrence Erlbaum Associates.
- Suh, S. Y., & Trabasso, T. (1993). Inferences during reading: Converging evidence from discourse analysis, think-aloud protocols and recognition priming. *Journal of Memory and Language*, 32, 279-300.
- Wiley, J., & Myers, J. L. (2003). Availability and accessibility of information and causal inferences from scientific text. *Discourse Processes*, 36, 109-129.
- Van den Broek, P. (1990). Causal inferences and the comprehension of narrative texts. In A. C. Graesser and G.H. Bower (Eds.), *Inferences and text comprehension*. San Diego: Academic Press

SYMPOSIUM

Developmental dyscalculia interventions and fMRI measures – A combined approach

Chairperson: Dominique Arndt, University of Duisburg-Essen, Germany

Organiser: Dominique Arndt, University of Duisburg-Essen, Germany

Katleen Sahr, University of Duisburg-Essen, Germany

Discussant: Daniel Ansari, University of Western Ontario, Canada

Arithmetic competencies are an important predictor for children's later success in their educational career. Thus, developmental dyscalculia - which is defined as a specific learning disability that affects the acquisition of mathematical skills in children with normal intelligence and age-appropriate school education - needs to be investigated more often especially in young children. The aim of this symposium is to present a combination of

different research methods in the field of developmental dyscalculia, which is quite new. In the research of all presenters the findings of a mathematical training condition for children aged five to ten years were replicated by means of functional magnetic resonance imaging (fMRI). The papers differ in their kind of mathematical training and the sample of children (e.g. formerly preterm children versus children taken from ordinary primary school).

Imaging and behavioral effects of an arithmetic training for young children

Katleen Sahr, University of Duisburg-Essen, Germany; Dominique Arndt, University of Duisburg-Essen, Germany; Maria Opfermann, Duisburg-Essen University, Germany; Annemarie Fritz, University of Duisburg-Essen, Germany; Detlev Leutner, University of Duisburg-Essen, Germany; Helga Krinzinger, RWTH Aachen University Hospital, Germany; Jan Kötter, RWTH Aachen University Hospital, Germany; Kerstin Konrad, RWTH Aachen University Hospital, Germany; Klaus Willmes - von Hinckeldey, Medical Faculty RWTH Aachen University, Germany

Our longitudinal study investigated, whether early arithmetic competencies can be validly and reliably assessed with a screening instrument and fostered by means of an adaptive training. In addition, we aimed at supporting these behavioral findings by investigating whether the changes in arithmetic competencies are accompanied by neurological changes as well, that is, shifts in brain activation patterns. Secondly, children were tested for their arithmetic and cognitive competencies. Based on these results, we classified children into those who showed average arithmetic and cognitive performance, low arithmetic but average cognitive performance or both, low arithmetic and low cognitive performance. The low arithmetic achievers were then assigned to one of three training groups: an individual adaptive training of arithmetic competencies, a computer-based working memory training and a group-based training of social skills, whereby all trainings took place three times a week over seven weeks. It was found that the arithmetic training led to significant increases in arithmetic competencies compared to the other two training groups and that such effects remain stable over several months, but not after a year. This implies that, although the seven-week-training was obviously effective, continuous support is needed to keep low achieving children's arithmetical competencies on a level that allows them not to fall behind their age-related peers. This was also supported by the finding that brain activation patterns changed with increasing and decreasing arithmetic competencies.

Early arithmetic competencies are an important predictor for children's later success in school. (Krajewski & Schneider, 2009). Detecting missing competencies and correcting them as early as possible might thus be considered one of the main goals of education. In this regard, our longitudinal study focused on three main questions: (a) How do arithmetic competencies develop in early childhood and how can this be tested? (b) Can missing competencies be overcome by means of an adaptive training? (c) Are there indicators other than pure performance improvements that show children's arithmetic development, e.g., shifts in brain activation patterns?

When looking at the arithmetic development of children, it can be seen that even toddlers are already able to deal with amounts and numbers and that such abilities become more sophisticated the older the children get, even without specific training. The model of arithmetic development by Fritz, Ricken and Balzer (2009) proposes five levels that children aged about four to eight years naturally run through when building up their arithmetic skills. For instance, during the first level, children are able to distinguish small sets (that is, they do not count but can decide which of two sets is bigger), while during the fifth level, they already have a relational understanding of numbers (for instance, they can solve tasks like "What number is 5 less than 9?").

Based on this model, we tested 1363 children aged 4 to 8 years with a screening instrument the tasks of which correspond to the skills that Fritz et al. (2009) propose to be developed within the respective levels. In addition, cognitive abilities (CPM) were assessed. Out of this sample, 256 children were selected, who either showed average arithmetic and cognitive performance (Group A), low (PR

Repeated measures ANOVAs revealed - in comparison to the working memory and social training groups - a stronger impact of the arithmetic training on arithmetic performance (interactions of time and type of training), which referred to retention (p

Over the course of a year we tested and scanned 40 first- to third graders showing low arithmetic performance (PR. These 40 children as well as 16 age-matched controls completed four different numerical tasks in the scanner (Siemens Trio; voxel size: 3.5mm; TR: 1.6 sec; block design): a symbolic magnitude comparison task, a non-symbolic magnitude comparison task, a symbolic exact addition task ("Add these two numbers up to 7, yes or no?"), and a non-symbolic exact addition task. For all four tasks, the same stimulus combinations (stimuli ranging from 2 to 5) were used comprising 24 items per task.

Brain activation differences between low-achieving children and controls as well as specific and unspecific training effects on brain activation patterns will be presented and discussed.

Our behavioral results from both studies indicate that an adaptive training of arithmetic competencies can strongly improve children's immediate retention and transfer skills and such effects even last for a certain amount of time. However, since these effects were only found for the first, but not the second follow-up, a continuous training of children, whose arithmetic skills are below age-related expectations, seems more advisable than a one-time intensive push.

Literature:

Fritz, A., Ricken, G. & Balzer, L. (2009). Warum fällt manchen Schýlerinnen und Schýlern das Rechnen schwer? – Entwicklung arithmetischer Kompetenzen im Vor- und frýhen Grundschulalter [Why do some students have difficulties with calculating? – Development of arithmetical skills in pre- and primary school ages]. In A. Fritz & S. Schmidt, Fßrdernder Mathematikunterricht in der Sekundarstufe I. Rechenschwierigkeiten erkennen und ýberwinden (pp. 12-28). Weinheim: Beltz.

Kaufmann, L., Nuerk, H.-C., Graf, M., Krinzing, H., Delazer, M. & Willmes, K. (2009). TEDI-MATH: Test zur Erfassung numerisch-rechnerischer Fertigkeiten vom Kindergarten bis zur 3. Klasse [TEDI-MATH: Test for assessing numerical and arithmetic skills from Kindergarten to third grade]. Bern: Huber.

Krajewski, K. & Schneider, W. (2009). Early development of quantity to number-word linkage as a precursor of mathematical school achievement and mathematical difficulties: Findings from a four-year longitudinal study. *Learning and Instruction*, 19, 513-526.

Training in Children with Developmental Dyscalculia

Karin Kucian, University Children's Hospital, Switzerland; Ursina Grond, University Children's Hospital, Switzerland; Claudia Schonmann, University Children's Hospital, Switzerland; Barbara Henzi, University Children's Hospital, Switzerland; Stephanie Rotzer, University Children's Hospital, Switzerland; Markus Galli, Methods in Action GmbH, Switzerland; Michael von aster, german red cross hospitals Berlin; neuroscience center zurich, Germany; Ernst Martin, University Children's Hospital, Switzerland

Recent studies in human neurosciences indicate that developmental dyscalculia is linked to a deficient development of spatial number representation, i.e. the mental number line. This study evaluated a computer based training program of this basic number representation with neuropsychological as well as imaging (fMRI) basis. It was shown, that children benefited from the training regarding to their representation and arithmetic ability. Different activation patterns between dyscalculics and control children could be shown, as well as a main effect of training in decreased frontal lobe activation. Furthermore there is indication for a differential training effect on dyscalculic children, who showed an increase in parietal activity. This is a clear indication of a remedy to deficient brain activation patterns by the means of a custom-designed training program.

Background

Developmental dyscalculia is a specific learning disability that affects the acquisition of mathematical skills in children with normal intelligence and age-appropriate school education. Estimated prevalence rates range from 3 to 6%. One essential step in the development of mathematical understanding is the formation and automated access to a spatial representation of numbers. Many children with Developmental dyscalculia show a deficient development of such a mental number line.

Aim

The present study aimed to develop and evaluate a computer-based training program to improve the construction and access to the mental number line. The efficiency of the training was evaluated by means of neuropsychological tests and functional magnetic resonance imaging (fMRI).

Methods

Sixteen children with Developmental dyscalculia aged 8-10 years and 16 matched control children completed a 5-weeks computer training called 'rescue calcularis'. Main goal of the training was to gear a rocket, on which Arabic numbers, additions, subtractions, or sets of dots were displayed, to a corresponding landing place on a number line from 0 to 100. All children played the game 15 minutes a day on 5 days a week. Different behavioural data related to number processing and other cognitive abilities such as spatial working memory, as well as fMRI during a number line task was measured before and after training. Developmental dyscalculia and control children differed significantly according to standardized measures of number processing and calculation. Differences in verbal IQ were due to differences in the subscore 'arithmetic' and disappeared when comparison was controlled for arithmetic.

Results

In general, children with and without Developmental dyscalculia could benefit from the training indicated by (i) improved spatial representation of numbers and (ii) the number of correctly solved arithmetical problems.

Regarding the initial pattern of brain activation control children activated the typical fronto-parietal network associated with number processing (Figure 1.A). In contrast, dyscalculics showed main activation in medial frontal areas (Figure 1.A). Statistical group comparison corroborated that children with Developmental dyscalculia showed less activation in bilateral parietal regions (Figure 1.B). The main effect from pre-post training comparison was a decrease of frontal lobe activity after training in both groups (Figure 1.C). An increase of parietal activity in Developmental dyscalculia children was evident after a second follow-up 4 weeks after training was completed.

Conclusions

In general, children with and without Developmental dyscalculia showed a benefit from the training indicated by (a) improved spatial representation of numbers and (b) the number of correctly solved arithmetical problems. Regarding initial group differences in brain activation, children with Developmental dyscalculia showed less activation in bilateral parietal regions which might reflect neurophysiological deficits in pivotal regions for number processing. Both groups showed a clear reduction in the recruitment of relevant frontal brain regions after the training which can be attributed to automatization of cognitive processes necessary for mathematical reasoning and may indicate reduced demands on executive functions. Moreover, results point to a parietal remediation of deficient brain activation in dyscalculic children after consolidation of acquired and refined number representation. To conclude, the present study represents the first attempt to evaluate a custom-designed training program in a group of dyscalculic children and results indicate that the training leads to an improved spatial representation of the mental number line, which facilitates processing of numerical tasks, and a modulation of neural networks.

Literature

- von Aster, M. & Shalev, R. (2007). Number development and developmental dyscalculia. *Developmental Medicine & Child Neurology*, 49:11, 868-873.
- Dehaene, S., Piazza, M., Pinel, P. & Cohen, L. (2003). Three parietal circuits for number processing. *Cognitive Neuropsychology*, 20, 487–506.
- Kucian, K., von Aster, M., Loenneker, T., Dietrich, T. & Martin, E. (2008) Development of neural networks for exact and approximate calculation: A fMRI study. *Developmental Neuropsychology*, 33:4, 447-473.
- Feigenson, L., Dehaene, S. & Spelke, E. (2004). Core systems of number. *Trends in Cognitive Sciences*, 8, 307–314.

Brain-imaging guided intervention of numeracy skills in primary school children born prematurely

Liane Kaufmann, UMIT-Private University for Health Sciences, Medical Informatics and Technology, Austria; Marc Starke, Innsbruck Medical University, Department of Pediatrics IV, Austria; Silvia Pixner, UMIT-Private University of Health Sciences, Medical Informatics and Technology, Austria; Christian Kremser, Innsbruck Medical University, Department of Radiology I, Austria; Thomas Trieb, Innsbruck Medical University, Department of Radiology I, Austria; Ursula Kiechl-Kohlendorfer, Innsbruck Medical University, Department of Pediatrics IV, Austria

The term developmental dyscalculia denotes severe calculation difficulties despite average intellectual abilities and good schooling. Prematurely born children are known to be at high risk to develop learning disorders including dyscalculia and thus are an ideal population to study developmental pathways of numerical cognition. Main aim of the present study is to investigate training-induced changes as regards behavioral performance and functional imaging (i.e., blood-oxygenation-level-dependent/BOLD response) in 6 to 7 year-old children born prematurely. Neuropsychological assessments (including a standardized calculation test) are conducted prior training and after termination of training. The experimental training condition comprises specific training of basic number skills and consists of eight training sessions, each lasting 30 minutes. A control training focusing on phonological skills is offered to participants in a waiting group design. Both training programs are comparable with respect to duration, materials and sensory modality. To the present, data collection is still ongoing. Data analyses will be as follows: Calculation skills will be used as a covariable. Beyond quantifying behavioral training effects, training-induced changes in neurofunctional response patterns (i.e., fMRI signal strength) upon processing number tasks will be measured.

Aims

Individuals with significant calculation difficulties have a considerable disadvantage in both academic and occupational activities. The term developmental dyscalculia (DD) denotes severe calculation difficulties despite average intellectual abilities and good schooling. According to influential authors, impaired number magnitude (i.e., numerosity) processing should be considered a key cognitive deficit of affected children. Most studies on developmental dyscalculia are based upon adult calculation models which may not provide an adequate theoretical framework for

understanding and investigating developing calculation systems. Moreover, despite the fact that recent technological advances enable us to visualize the neurofunctional correlates of numerical cognition, many researchers are skeptical as regards the educational implications of neuroscience research. Recently, an increasing effort to bridge the gap between neuroscience and education can be observed, as reflected in scientific journals devoted to this subject (i.e., *Mind, Brain and Education*; first compiled in 2007). In particular, it has been stressed that neuroscientific endeavors might be potentially fruitful for educational sciences by going beyond behavioral analyses (and thus contributing to a better understanding of the brain-behavior relationship of the cognitive function of interest).

The present study is among the first to systematically investigate the effects of number skill training in young children. Our research efforts are targeted at prematurely born children because the latter are at high risk to develop learning disorders including developmental dyscalculia. Consequently, by recruiting prematurely born children aged 6 to 7 (first graders), we may ensure to have both average and poor math performers in our sample. Thus, beyond investigating training effects at both the behavioural and neuroimaging level, our design will allow us to investigate whether mastery (i.e., average versus poor performers) modulates training extents (by looking at the behavioural, at the neural and at both levels).

Methodology

Study participants are 6 to 7 year-old, formerly preterm children with a gestational age of

The experimental training condition comprises specific training of basic number skills and consists of eight training sessions, each lasting 30 minutes. A control training focusing on phonological skills will be offered to participants in a waiting group design. Both training programs are comparable with respect to duration, materials and sensory modality. Training effects will be measured behaviorally (i.e., calculation test administered prior and after training; as well as behavioral data of the experimental task employed in the scanner) and by means of neuroimaging (i.e., fMRI responses in number-relevant brain regions).

The experimental task to be employed in the scanner is a physical Stroop task requiring children to classify the physically larger (font-size) of two to-be-compared one-digit numbers by button press. Generally, incongruent items (physical and numerical size interferes) are more difficult than congruent ones, as reflected in higher error rates and slower response times. However, the so-called congruency effect may be less pronounced or even absent in children who have imprecise number magnitude representations (as expected in poor math performers). The task is presented in box-car fashion (5 stimuli per block; stimulus duration will be 3000 msec; inter-stimulus-interval varying between 1000 and 3000 msec). Experimental blocks are interspersed with rest blocks (18000 msec each) and preceded by an instruction picture (4000 msec). The instruction picture is defined as predictor of no interest. Within blocks, stimuli are presented in randomized order. Data analyses are performed using SPM5 (<http://www.fil.ion.ucl.ac.uk/spm/software/spm5/>) and are hypotheses driven: fronto-parietal areas being the regions of interest. A whole-brain regression analysis will be performed to examine which brain regions correlate significantly with behavioral performance during scanning. Finally, correlation and regression analysis will be conducted to assess the association between neurocognitive (i.e., behavioral training effects) and brain imaging measures (i.e., neurofunctional training effects).

Findings

Please note that currently, we are still in the stage of data collection. Our working hypotheses are as follows. First, behavioural training effects are specific (i.e., larger gains in number knowledge observable in children participating in the number skill training compared with children attending the non-numerical training). Second, beyond behavioural training effects, training effects are expected to arise at a neural level (preferentially in number-relevant fronto-parietal brain regions). Third, skill level (i.e., mastery of number knowledge) may modulate the extent of training effects (possibly at both the behavioural and the neural level). In particular, poor math performers (i.e., experimental group consisting of preterm children with poor calculation skills) are expected to show larger training effects compared to average performing peers (i.e., control group consisting of preterm children with average calculation skills).

Theoretical and educational significance of the research

Our findings will be taken as an example to discuss how neuroscience findings may impact on educational sciences and classroom interventions. In particular, we expect that the findings of our intervention study will enhance our current understanding of the link between skill level and training extents on the one hand and will aid in characterizing the interplay between behavioural and neurofunctional training effects on the other hand. In particular, knowledge about the close interlink between behavioural performance and neural responsiveness may inspire pedagogical practice to go beyond well-established teaching methods, encouraging the development and evaluation of novel teaching attempts that take into account the brains' responsiveness to training.

SYMPOSIUM

The assessment of reading literacy: new measurements and technological developments

Chairperson: Helge Stromso, University of Oslo, Norway

Organiser: Eduardo Vidal-Abarca, Universidad de Valencia, Spain

Danielle McNamara, University of Memphis, United States

Discussant: Johannes Naumann, German Institute for International Educational Research, Germany

The concept of reading literacy has expanded in the last decade. It now includes competencies to use very different documents that combine verbal and pictorial information covering very different contents with very different purposes (e.g., accessing, retrieving or integrating information). These competencies can take advantage of technological developments that allow automated analysis of document information as well as the reader's behavior when reading documents. The aim of this symposium is to show recent studies that have explored how these competencies can be assessed, and how technological developments can be used for the assessment. Thus, two contributions explore the measurement of two important reader's competencies, that is, text-picture integration and the use of document within a task-oriented reading approach, whereas the third one measures text difficulty, an important component of any assessment procedure. Regarding technological developments, two contributions explore the use of information technology to analyze: (a) text difficulty with Coh-Metrix, and (b) the reader's competencies to use documents with CompLEC, whereas the third one provides a theoretical and empirical basis to analyze text-picture integration with an automated tool. The ultimate goal of this symposium is to build bridges between research advances in reading and document literacy and practical solutions for education and assessment.

CompLEC: A computed-based test to assess task-oriented reading competencies of high-school students

Eduardo Vidal-Abarca, Universidad de Valencia, Spain; Tomas Martinez, Universidad de Valencia, Spain; LADISLAO SALMERON, UNIVERSITY OF VALENCIA, Spain; Ramiro Gilabert, Universidad de Valencia, Spain; Ana .C. Llorens, Universidad de Valencia, Spain; Amelia Mana, University of Valencia, Spain

CompLEC is a computer-based test that assesses students' ability to use complex documents to solve a series of questions, which correspond to the skills promoted by PISA and PIAAC, two recent international reading literacy assessment programs. CompLEC presents the information with a masking procedure, so that it can evaluate students' reading and search behavior. The test has adequate psychometric properties, as revealed by data from 794 students collected in 7 different Spanish regions. Preliminary analyses with hierarchical linear equations based on on-line data suggest that students' initial reading and search efficiency are strong predictors of performance. From a practitioner's perspective, CompLEC provides information not only of students' question success, but also of critical reading and search behavior, which allows for a more fine-grained intervention in task-oriented reading.

Two recent international reading literacy assessment programs, i. e., PISA (Program for International Students Assessment, OECD, 2009) and PIAAC (Program for International Adult Assessment Competencies, OECD, 2010), have been implemented to assess reading comprehension with a task-oriented reading approach. The emphasis in this approach is on the use of different documents (i. e., continuous texts, like a novel or an expository text, and non-continuous, like a graph or a table) to answer different kind of questions to prompt different types of cognitive processes (e.g., retrieving and integrating information) having the document available.

Two characteristics of task-oriented reading are essential. First, only information that is pertinent to the task is relevant to the reader. Second, the reader interacts with the text in a particular way, going back and forth from the text to the task, and vice versa, until she determines that the task has been achieved. Therefore, task-oriented reading places specific self-regulatory demands on readers (e. g., how to read a text according to the question, when and where to reference a document, what piece of text to read, and when to stop searching to answer a question). This interaction between the reader and the text can be recorded on-line, which gives information to make inferences about the reader's skills and strategies.

Vidal-Abarca and colleagues have developed a technological tool to record this interaction called Read&Answer (Vidal-Abarca et al., 2010). They also have conducted different studies using this tool to analyze the impact of different kind of questions on comprehension (Cerdan, Vidal-Abarca, 2008; Cerdan, Vidal-Abarca, Martinez, Gilabert & Gil, 2009), or the difference between skilled and less-skilled readers (Vidal-Abarca, et al., 2010), which contribute to explain the readers' performance in task-oriented reading.

Features of CompLEC

CompLEC, the tool we present in this symposium, is based on Read&Answer technology and the main results of the above-mentioned studies. It follows PISA and PIAAC framework regarding text materials and type of questions. CompLEC is a test to assess reading literacy competencies at the individual level. It provides practitioners with information about the product of reading (i. e., performance) and the processes and strategies the readers follow when reading a document. An important advantage of CompLEC is that it provides all this information automatically. Next, we explain the main characteristics of CompLEC and the main results of a first application to a large population of high-school students.

CompLEC is composed of five short documents (~400 words) and 20 questions (5 retrieve, 10 interpret, 5 reflect questions). Documents represent different structures (3 continuous and 2 non-continuous documents) and deal with several topics (Climate change, nuclear energy, language of the bees, traffic accidents and good chairs). Students are given one hour to use the documents to answer the questions. They can read either the text or the questions first.

The tool presents information following a masking procedure, so that students have to click on text segments to make them readable. This procedure allows to record students' on-line behavior. CompLEC automatically derives a series of indexes based on those data, such as reading speed, number of searches, search regulation, search efficiency, and global reading strategy.

Psychometric and on-line analyses

We collected data from 794 7th to 9th grade students, from schools or 7 Spanish regions, which allowed us to analyze the test's psychometric properties and the relationships between on-line reading behavior and performance.

Psychometric properties of the test were obtained after data from 794 students from 7th to 9th grade, from schools located in 7 Spanish regions. Reliability of the text was fair, as revealed by a Cronbach alpha of .80. Construct validity was assessed by comparing students' scores with CompLEC with those obtained in a standardized comprehension skills test (TEC). Correlation between tests' scores was high: $r = .52$, $p < .001$. Finally, predictive validity was considered by predicting students' class scores through students' scores in CompLEC. Correlations were moderate to high: mathematics $r = .32$, $p < .001$, natural sciences $r = .44$, $p < .001$.

In addition, we are currently testing a series of hierarchical linear equations using on-line indices as predictors of final test scores. Preliminary results suggest that initial reading time had a positive relation with performance. In addition, students' decisions to search were associated to lower performance. This suggests that students regulate their search initiatives, so that they would not search when they are positively confident on a question response (Vidal-Abarca et al., 2010). Once students decided to search, time on task had a differential effect. Time searching text segments that include relevant information for a question had a positive relation with performance, whereas the opposite relationship was found for inefficient search time. Finally, the results seemed to be modulated by question difficulty and comprehension skill.

Conclusions

CompLEC is a test to assess high-school students' reading literacy competencies similar to those measured by PISA and PIAAC. It is based on well-grounded research studies on how students deal with task-oriented reading. CompLEC provides practitioners with automatic information about the product and processes when readers reading complex documents to answer different types of questions. This information can be used to improve the student's strategies when using complex documents.

Coh-Metrix Measures of Text Difficulty: Moving Towards Improving Comprehension Assessment

Danielle McNamara, University of Memphis, United States; Arthur Graesser, University of Memphis, United States; Jonna Kulikowich, Penn State, United States

We focus on the importance of considering the nature of the text in comprehension assessment, and discuss a new methodology for doing so that is currently being considered for adoption by the Common Core State Standards in the United States. Traditional readability measures such as Flesch-Kincaid, Lexile, and Degrees of Reading Power measure text difficulty at the word and sentence levels. These measures assume that when words are less frequent in language and when sentences are more syntactically complex, the text is more difficult to process. However, discourse psychologists have identified multiple levels of language and discourse differentiating the surface code (words and syntax), explicit textbase, situation model, genre and rhetorical structure, and pragmatic communication. We developed Coh-Metrix, which automatically analyzes text on measures associated with these levels, except for pragmatic communication. This study examined 53 Coh-Metrix measures for 37,520 texts in a corpus representing

what typical students have read. A principal components analysis revealed that the components were closely aligned with the theoretical levels, accounting for 67.3% of the variance: word concreteness, syntactic simplicity, referential cohesion (textbase), situation model cohesion, and narrativity (genre). The results support the claim that there is an objective and theoretical foundation for scaling texts on difficulty, one of the major goals in literacy research. The presentation will discuss how these components can be used to characterize the complexity of particular passages that students encounter in K-12 classrooms and how these components might be used to enhance our ability to more accurately gauge reading proficiency.

There is a heightened awareness in text comprehension assessment concerning the need to consider the nature of the text, and particularly the difficulty of the text. Whereas there has been a good deal of focus on the nature of the assessment questions, there has been little on characterizing and controlling the difficulty of the text beyond the use of traditional readability formulas. The purpose of this project is to explore the use of advanced measures of linguistic characteristics of text and discourse provided by an automated tool called Coh-Metrix in order to assess text difficulty (cohmetrix.memphis.edu; see csep.psyc.memphis.edu/vita.htm for publications). The scaling of texts on difficulty has enormous practical value in education in addition to advancing scientific theories of reading and comprehension. There are times when students need to be challenged by assigning them texts on difficulty levels that push the envelope on what they can handle. There also are times when students need a self-confidence boost by receiving easy texts that they can readily comprehend. In most situations, however, the texts should not be too difficult or too easy for students, but rather at an intermediate zone of difficulty. The appropriateness of a text is a particularly important factor in the assessment of comprehension ability. A widespread assumption is that the texts or tests should be sensitive to the individual students' proficiency profiles. This study explores the potential of going beyond traditional measures of text readability for this purpose by incorporating linguistic indices inspired by theories of text and discourse comprehension.

Advances in psycholinguistics, discourse processes, and cognitive science provide a theoretical foundation for scaling texts on multiple levels. Multilevel theoretical frameworks have identified the representations, structures, strategies, and processes at multiple levels of language and discourse. These multilevel frameworks have typically included the following levels: words, syntax, the explicit textbase, the referential situation model (sometimes called the mental model), the discourse genre and rhetorical structure (the type of discourse and its composition), and the pragmatic communication level (between speaker and listener, or writer and reader). Coh-Metrix was developed to analyze and measure text on the first five levels of discourse.

In order to discover what aspects of texts account for text complexity, a principal components analysis assuming an orthogonal loading of components with Varimax rotation was conducted on Coh-Metrix indices for 37,520 texts in a corpus provided by Touchstone Applied Science Associates (TASA). Because there was a large number of texts and Coh-Metrix measures, a high Kaiser criterion of 2.0 was adopted to determine the number of principal components. This analysis converged on 53 measures of linguistic features of text.

The texts were single paragraphs with a mean length of 288.6 words ($SD = 25.4$). The TASA corpus represents the texts that a typical senior in high school would have encountered kindergarten through 12th grade in the United States. The texts are scaled on Degrees of Reading Power, which can approximately be translated into grade. Most of the text genres were classified by the TASA researchers as being in language arts, science, and social studies/history, but other categories were business, health, home economics, and industrial arts.

The principal components analysis of the corpus revealed that the following 8 dimensions (in order of percentage of the variance explained) accounted for 67% of the variability among texts.

1. Narrativity. Narrative text tells a story, with characters, events, places, and things that are familiar to the reader. Narrative is closely affiliated with everyday oral conversation. Informational texts on unfamiliar topics would lie at the opposite end of the continuum.
2. Referential cohesion. High cohesion text contains words and ideas that overlap across sentences and the entire text, forming threads that connect the explicit text together for the reader.
3. Syntactic complexity. This component reflects the degree to which the sentences in the text use complex, unfamiliar syntactic structures, which are more challenging to process and understand.
4. Word abstractness. Abstract words represent concepts that cannot be visually represented. Text that contains more abstract words is more challenging to understand.
5. Situation model cohesion. Causal, intentional, and temporal connectives help the reader to form a more coherent and deeper understanding of the text.

6. Verb cohesion. This component reflects the degree to which there are overlapping verbs in the text. When there are repeated verbs, the text likely includes a more coherent event structure that will facilitate and enhance situation model understanding.
7. Logical cohesion. This component reflects the degree to which the text contains explicit additive and comparative connectives to express relations in the text. This component is related to the reader's deeper understanding of the relations in the text.
8. Temporal cohesion. Texts that contain more cues about temporality and that have more consistent temporality (i.e., tense, aspect) are easier to process and understand. In addition, temporal cohesion contributes to the reader's situation model level understanding of the events in the text.

We consider the first five of these components to be most highly associated with text difficulty (and they were the most robust components, accounting for 54% of the variance). Using the results of the analysis, we can compute percentile scores on text complexity for individual texts based on the five components. A percentile score varies from 0 to 100%, with higher scores meaning the text is likely to be more challenging to read than other texts in the corpus. For example, a percentile score of 80% means that 20% of the texts are more difficult and 80% are easier. Four such texts including two narrative texts and two science texts are presented in Figure 1.

The presentation will further discuss how these components can be used to characterize the complexity of particular passages that students encounter in K-12 classrooms and how these components might be used to enhance our ability to more accurately gauge reading proficiency. These results support the claim that there is an objective and theoretical foundation for scaling texts on difficulty, one of the major goals in literacy research.

Assessment of Text-Picture Integration Difficulties in Reading Comprehension

Wolfgang Schnotz, University of Landau, Germany; Mark Ullrich, University of Koblenz-Landau, Germany; Holger Horz, Goethe-University Frankfurt, Institute of Psychology, Germany; Thorsten Rasch, University of Koblenz-Landau, Germany; Nele McElvany, Max Planck Institute for Human Development, Germany; Katrin Lintorf, Technical University of Dortmund, Germany; Jurgen Baumert, Max Planck Institute for Human Development, Germany

Reading comprehension frequently requires integrating text and picture information into coherent knowledge structures. To investigate how students' competencies for text-picture integration develop, a representative sample of integration tasks was selected from German schoolbooks and used for the construction of items, which were presented to 1060 students from grades 5 to 8 attending different types of German schools. Based on item-response theory, 186 items requiring integration at different hierarchical levels were selected according to a 1-parameter logistic test model. The increase of competencies across grades was significant, but nevertheless relatively low given the large differences between school types. Cognitive item analysis revealed that text-picture integration can be performed based on a limited set of cognitive operations. Further analysis showed that combining structural task characteristics and procedural item characteristics allowed relatively successful predictions of item difficulties according to item-response theory, explaining about half of the variance associated with item difficulty.

Textbooks often combine written text with schematic diagrams or various kinds of graphs that visualize and explain complex and more abstract subject matter. When learning from such materials, students are expected to integrate verbal and pictorial information for the construction of mental representations of the learning content (Ainsworth, 1999; Mayer, 2005).

The model of integrated text and picture comprehension (Schnotz, 2005) was used for the analysis of integration requirements in textbooks. This model assumes that text and picture integration takes place in a working memory, which has a limited capacity (Baddeley, 1986) and includes different channels for processing verbal and pictorial information (Paivio, 1986). Integrating verbal and pictorial information requires mappings between corresponding elements in the text and the picture. Surface structure mappings include interrelations between words and graphical elements based on cohesive devices such as color coding, common numbers, symbols or labels. Deep structure mappings include interrelations between conceptual structures and mental models of the learning content. Within deep structure mapping, a distinction can be made between different levels of extracting information from text and pictures: Level 1 refers to extracting detail-level information, level 2 refers to extracting simple relations, and level 3 refers to extracting complex relations.

Assessment of Students' Competencies

We randomly selected 48 text-picture integration units from a representative sample of biology and geography textbooks in Germany in grades 5 to 8. Text length per task unit varied from 38 to 160 words. The number of pictures

per task unit varied from 1 to 3. For each unit we created 6 multiple-choice test items: Two items on level 1, two items on level 2, and two items on level 3. This resulted in a total of 288 test items. The items were presented via a multiple matrix design to 1060 students from 48 classes in Germany from grade 5 to grade 8. The three tracks of the German schooling system (Hauptschule: low, Realschule: medium, Gymnasium: high) were represented by the same number of classes.

The correlation between the theoretical hierarchy level of items and their empirical difficulty revealed a significant Kendall's Tau of .55. This value can be considered as satisfactory because the need for the stochastic independency of each item had to be taken from a different local hierarchy, and the different local hierarchies cannot be expected to have the same difficulty levels. Accordingly, the distinction between the three theoretical hierarchy levels was sufficiently supported by the empirical data. Students' item responses were then analyzed with regard to the dimensionality of text-picture integration competency. Although a 2-dimensional model had the lowest Bayes Information Criterion (BIC) value and thus the best model fit, the two latent variables ('extracting details' and 'extracting relations') had an extremely high correlation of $r=.95$. Thus, we decided for pragmatic reasons to proceed with a 1-dimensional model.

Assessment of Item Difficulties

In order to find out what makes some items more difficult than others, we performed a rational task analysis of all selected items. On the one hand, this analysis included a structural analysis of the text, a structural analysis of the pictures, and a description of the text-picture cohesion per unit. On the other hand, we performed a procedural analysis of the required cognitive operations per item.

The structural analysis of the text included text length and number of content concepts. The structural analysis of the pictures included number and type of pictures, number of graphical entities and number of variables within pictures. Furthermore, we measured text-picture cohesion in terms of number of overlaps between color codes, labels, symbols and numerical values. For the procedural analysis of the required cognitive operations, we identified based on experts' judgments a set of operators for integrating text and picture information:

- IDPICT = identification of relevant picture
- EMap = element-mapping (name, symbol, color, numerical value)
- IDENT-AT (candidates, attributes, results) = identification of sets of entities based on attributes
- READ = reading of attributes
- IDENT-IT = identification of sets of entities based on item response alternatives
- IT-MATCH = complexity of pattern-matching with item response alternatives

For the procedural analysis of the required cognitive operations per item, we determined the frequency of applications for each operator within the rational task analysis, which resulted in an operator-application profile for each item.

Regarding the structural features of text-pictures units, item difficulty correlated highly significantly only with text length ($r=.37$; $p=.003$), whereas the other features did not uniquely add to the explained variance of item difficulty. Item difficulty also correlated significantly with the cognitive hierarchy level of the items ($r=.50$; $p<.001$). Combining text length and cognitive hierarchy level as predictors for item difficulty resulted in a multiple correlation of .63, which was also highly significant ($p<.001$). To get a more detailed view of the procedural requirements associated with the different cognitive hierarchy levels, we computed multiple regressions between the application frequency of each operator according to the rational task analysis as predictors and the cognitive hierarchy level as dependent variable. The combination of the number of element mappings (EMap), the number of identifications of sets of entities based on attributes (IDENT-AT), the reading of attributes (READ), and the complexity of pattern-matching with item response alternatives (IT-MATCH) resulted in a multiple correlation of .70 ($p<.001$) with the hierarchy level of items.

Theoretical and Practical Relevance

Challenges associated with text-picture integration seem to be closely related to structural and procedural item characteristics. This result is promising, because it suggests that it is possible to build 'bridges' between measurement theories and cognitive research on comprehension processes. Such bridges are relevant for assessment, because they could allow in the long run an automated assessment of item difficulties. They are also relevant for the fostering of students' competencies, because they provide us with a better understanding of what makes some items more difficult than others, what kinds of cognitive procedures are required, and how adequate strategies of integrating text and picture information can be taught.

Children's agency in research — across settings and as co-investigators

Chairperson: Kristiina Kumpulainen, National Board of Education, Finland

Organiser: Kristiina Kumpulainen, National Board of Education, Finland

Ola Erstad, University of Oslo, Norway

Discussant: Roger Saljo, Goteborg University, Sweden

The dominant discourse of most educational and psychological research on children, learning and development conceives of children as subjects of study, done by adults studying children, as a process of measuring and normalising childhood (e.g., Marr & Malone, 2007). However, developments in recent years focus more on positioning children as active co-producers of meaning (Fleer & Hedegaard, 2010; Fleer, Hedegaard, Bang & Hviid 2008) and the formation of identities across different settings and contexts (Moje & Luke, 2009; Wortham, 2006). As a consequence, several researchers are involving children as active agents in the research itself and as co-investigators. Building on a situative and socio-cultural framework on human agency (Greeno, 2006; Holland, Lachicotte, Skinner & Cain, 1998; Martin, Sugarman & Thompson, 2003), we maintain that validating and making use of this aspect of participation in research is a crucial factor in building more ecologically valid educational and psychological research.

The aim of this symposium is to present different ways of researching with children in family practices and across different contexts of learning. Moreover, it presents a specific methodological investigation of the use of video cameras when researching with children, along with reflections on ethical considerations, challenges and possibilities in involving children more actively in research. Specifically, the aims of the different presentations are to contribute different experiences and approaches from research.

Learner video, learner voice: reflections on self-directed research by younger learners

John Potter, Institute of Education, University of London, United Kingdom

This presentation reflects on two completed studies which positioned children of primary school age (between 7 and 11) as researchers of their own experiences using self-authored video as a central tool for reflection. In the first project (Potter, 2010) fieldwork was carried out in two schools among children taking part in video projects on themes of self-representation and identity. The findings in this study suggested that this new media literacy practice can be metaphorically conceived as a form of "curatorship" in the organisation of digital media assets and that this connects to an important set of dispositions and skills in lived culture. In the second case study (Selwyn, Potter & Cranmer, 2010), video recording under the control of younger learners was used as part of a set of mixed methods to explore the differences between children's experience of new media technology at school and at home. The findings in this study suggested that the desire to engage with the "learner voice" approach in their video research was representative of a deeper need to see their experience of lived culture reflected and acknowledged within pedagogy. Self-authored video in the project provided some of the participants with the means to present their learning lives.

The third and last presentation puts the emphasis on how children (age between 6 and 11) as learners relate to other people and objects, drawing on deeper trajectories or narratives of the self as it exists within and outside the immediate learning contexts. Using a mix of methods and drawing on cultural studies and identity theory, Potter examines how personal histories and future orientations are used to create "narratives of the self". And it is these selves (or their narrativisations) which are central to productive learning.

This presentation reflects on two completed studies which positioned children of primary school age (between 7 and 11) as researchers of their own experiences using self-authored video as a central tool for reflection.

In the two UK projects (Potter, 2010), fieldwork was carried out among children in two primary schools taking part in video projects on themes of self-representation and identity. The findings from the first case study suggest that this literacy practice can be metaphorically conceived as a form of curatorship in the organisation of digital media assets and that this connects to an important set of dispositions and skills in lived culture (Williams, 1979). In the second case study (Selwyn, Potter & Cranmer, 2010), video recording under the control of younger learners was used as part of a set of mixed methods to explore the differences between children's experience of new media technology at school and at home. The findings in this study suggested that the desire to engage with the learner voice approach in their video research was representative of a deeper need to see their experience of lived culture reflected and acknowledged within pedagogy. Self-authored video in the project provided some of the participants with the means to present their learning lives.

The presentation reflects on how a future research agenda might be constructed in the light of the findings. With these lenses on interactional data, as well as video clips and photographs made by the children themselves, the intention in this presentation is to put an emphasis on learning as the capacity to adapt to changing roles within

different contexts. With data from these three case studies as a point of departure, we hope to contribute to broader discussions of how children initiate and perform their agency and identity as learners across different settings. Altogether, these different lenses and perspectives explore how children perform their agency and identity across different settings.

References

- Christensen, P. & James, A. (Eds.) (2008). *Research with Children: Perspectives and Practices*. New York: Routledge.
- Erstad, O., Gilje, Ø., Sefton-Green, J. & Vasbø, K. (2009). Exploring 'learning lives': Community, identity, literacy and meaning. *Literacy*, 43(2), 100–106.
- Goldman-Segall, R. (1998). *Points of Viewing Children's Thinking: A Digital Ethnographer's Journey*. NJ, Lawrence Erlbaum Publishers.
- Greeno, J. (2006). Authoritative, Accountable Positioning and Connected, General Knowing: Progressive Themes in Understanding Transfer. *Journal of the Learning Sciences*, 15, 537–547.
- Holland, D., Lachicotte, W., Skinner, D. & Cain, C. (1998). *Identity and Agency in Cultural Worlds*. Cambridge, MA: Harvard University Press.
- Hull, G. & Schultz, K. (2002). Literacy and learning out of school: A review of theory and research. *Review of Educational Research*, 71(4), 575.
- Kellet, M. (2005). Children as active researchers: A new research paradigm for the 21st century? NCRM Methods Review Papers NCRM/003. Retrieved on 29.10.2010 from: <http://www.ncrm.ac.uk/publications/methodsreview/MethodsReviewPaperNCRM-003.pdf>
- Macoby, E. E. (1994). The role of parents in the socialisation of children: An overview (pp. 589–615). In R. D. Parke, P.A. Ornsteing, J. J. Rieser & C. Z. Waxler (Eds.), *A century of development psychology*. Washington, DC: American Psychological Association.
- Marr, P. & Malone, K. (2007, November). What about me? Children as co-researchers. Paper presented at the Australian Association for Research in Education, International Educational Research Conference.
- Martin, J., Sugarman, J. & Thompson, J. (2003). *Psychology and the Question of Agency*. Albany, NY: State University of New York Press.
- Moje, E. & Luke, A. (2009). Review of Research: Literacy and Identity: Examining the Metaphors in History and Contemporary Research. *Reading Research Quarterly*, 44(4), 415–437.
- Potter, J (2010) Embodied memory and curatorship in children's digital video production, *English Teaching: Practice and Critique*, 9(1), 22–35.
- Selwyn, N., Potter, J. & Cranmer, S. (2010). *Primary Schools and ICT: Learning from Learner Perspectives*, London: Continuum.
- Stratton, P. (2003). Contemporary families as context for development. In J. Valsiner & K. Conolly (Eds.), *Handbook of Developmental Psychology*. London, Sage.
- Williams, R. (1979). "The analysis of culture", in Storey, J. (2009), *Cultural Theory and Popular Culture: A Reader*, 4th edition, Harlow: Pearson.

AGENTS – Children as video researchers

Jaakko Hilppo, University of Helsinki, Finland; Kristiina Kumpulainen, National Board of Education, Finland; Lasse Lipponen, University of Helsinki, Finland

This project explores the potential of video research in promoting children's agency in the formal and informal contexts of childhood. The idea of "efficacious agency" is that children are not merely reactive, passive and controlled by either environmental or biological forces but they can make themselves more efficacious, proactive and self-regulating. Within the "children as researchers" approach video research is used as means of eliciting the voice of the child, but not pursued or developed as a participatory method in its own right. This implies that Kumpulainen et al pays attention to innovative and new methods for collecting data from the children's perspective, by digital video compositions, written annotations and other data produced by the children.

This presentation explores the potential of video research in promoting children's agency in the formal and informal contexts of childhood. The idea of "efficacious agency" is that children are not merely reactive, passive and controlled by either environmental or biological forces but they can make themselves more efficacious, proactive and self-regulating. Further, we argue that through co-produced video stimulations it is possible for the children to learn to control their actions from outside, express their own perspectives on efficacious agency and hence also participate in the research process.

Building on a situative and socio-cultural framework on human agency (Greeno, 2006; Holland, Lachicotte, Skinner, & Cain, 1998; Martin, Sugarman, Thompson, 2003; Vygotsky, 1978), we maintain that validating and making use of this aspect of participation in research is a crucial factor in building more ecologically valid educational and psychological research.

Within the "children as researchers" approach (e.g., Kellet, 2005; Christensen & James, 2008), video research is used as means of eliciting the voice of the child, but not pursued or developed as a participatory method in its own right. Our objective is to develop and refine video research methods that recognise children as active research partners. In this, we draw on the work of Goldman-Segall (1998), who has shown that children can take part in video research as competent actors and stakeholders. In this approach, children have not only an epistemological, but also a strong ontological position.

Our method consists of a cycle of six steps (1–6). The first three steps (1–3) are researcher driven and the focus is on the identification and joint group reflection of efficacious agency in context. In steps 4–6, with the use of mobile phones and other hand-held video devices, children create video episodes of their authentic life in diverse contexts (e.g., episodes from school, playground or museum). As in steps 1–3, children observe and discuss video data in peer groups and develop and design ideas to be further used with parents in home settings. Steps 4–6 will focus on empowering children's own views and voices of efficacious agency in their worlds.

As data, we will present and discuss the preliminary findings from two ongoing empirical cases from elementary school and daycare contexts in the Helsinki Metropolitan area. Participants of each empirical case formed focus groups of three to five children, comprising four to six groups per case and, in all, fifty children. Our focus in the presentation will be on questions of engaging children as co-researchers in designing, producing and interpreting video episodes from their authentic life in diverse contexts. We will also look into whether implementing our method has had any effect on the children's efficacious agency.

References

- Christensen, P. & James, A. (Eds.) (2008). *Research with Children: Perspectives and Practices*. New York: Routledge.
- Erstad, O., Gilje, Ø., Sefton-Green, J. & Vasbø, K. (2009). Exploring 'learning lives': Community, identity, literacy and meaning. *Literacy*, 43(2), 100–106.
- Kellet, M. (2005). Children as active researchers: A new research paradigm for the 21st century? NCRM Methods Review Papers NCRM/003. Retrieved on 29.10.2010 from: <http://www.ncrm.ac.uk/publications/methodsreview/MethodsReviewPaperNCRM-003.pdf>
- Macoby, E. E. (1994). The role of parents in the socialisation of children: An overview (pp. 589–615). In R. D. Parke, P.A. Ornsteing, J. J. Rieser & C. Z. Waxler (Eds.), *A century of development psychology*. Washington, DC: American Psychological Association.
- Marr, P. & Malone, K. (2007, November). What about me? Children as co-researchers. Paper presented at the Australian Association for Research in Education, International Educational Research Conference.
- Martin, J., Sugarman, J. & Thompson, J. (2003). *Psychology and the Question of Agency*. Albany, NY: State University of New York Press.
- Stratton, P. (2003). Contemporary families as context for development. In J. Valsiner & K. Conolly (Eds.), *Handbook of Developmental Psychology*. London, Sage.

Learning identities and pathways: Using video to study children across settings

John Potter, Institute of Education, University of London, United Kingdom; Oystein Gilje, Department of Educational Research, Norway; Ola Erstad, University of Oslo, Norway

This presentation elaborates on issues related to children as co-researchers. The data was gathered as part of the ongoing Learning Lives project which focuses on three transitions (cohorts) within the educational system in one community in the eastern part of Oslo, Norway. The transitions are in the age-groups 5-6 years (1), 15-16 years (2) and 18-19 years (3), and all of the informants will be followed for at least one year. The data presented here stem from cohort 1, which put an emphasis on preschool children's learning identity in the transition from kindergarten to first grade in primary school. The overall aim in the project is two-folded. First, we aim to make explicit the mobilization of resources or affordances within specific contexts at the same time as focusing on an approach which characteristics learning as the capacity to adapt to changing roles within different contexts (Holland et al., 1998; Hull and Shultz, 2002). And secondly, our emphasis is on how the individual learner relates to other persons and objects, in order to grasp processes occurring between people, which we find significant for young people's identity and learning. With this perspective, the presentation here aims at describing learning among preschool children within and across

different learning sites exploring the positioning and re-positioning of the learner identity across these different contexts.

Gilje, Erstad and Potter elaborate in their presentation the overall theme in the symposium by drawing upon data from three case studies. This presentation reflects on two completed studies and one ongoing study. These three studies put an emphasis on the children's use of video cameras as a tool for making narratives about themselves across different settings like the kindergarten, the primary school and the home.

We study children in kindergarten and primary school (ages between 6 and 11) and ways of involving them as researchers of their own experiences using self-authored video as a central tool for reflection. The presentation puts the emphasis on how children as learners relate to other people and objects, drawing on deeper trajectories or narratives of the self as it exists within and outside the immediate learning contexts. Using three different case studies, we examine how personal histories and future orientations are used to create "narratives of the self", and it is these selves (or their narrativisations) which, we suggest, are central to productive learning.

Using three different case studies, we examine how personal histories and future orientations are used to create "narratives of the self", and it is these selves (or their narrativisations) which, we suggest, are central to productive learning.

In the two UK projects (Potter, 2010), fieldwork was carried out among children in two primary schools taking part in video projects on themes of self-representation and identity. The findings from the first case study suggest that this literacy practice can be metaphorically conceived as a form of "curatorship" in the organisation of digital media assets and that this connects to an important set of dispositions and skills in lived culture (Williams, 1979). In the second case study (Selwyn, Potter & Cranmer, 2010), video recording under the control of younger learners was used as part of a set of mixed methods to explore the differences between children's experience of new media technology at school and at home. The findings in this study suggested that the desire to engage with the "learner voice" approach in their video research was representative of a deeper need to see their experience of lived culture reflected and acknowledged within pedagogy. Self-authored video in the project provided some of the participants with the means to present their learning lives.

The Learning Lives project in Norway elaborates further on this perspective, describing learning among preschool children within and across different learning sites exploring the positioning and re-positioning of the learner identity across these different "locations" (Erstad, Gilje, Sefton-Green & Vasbø, 2009). The data reported on in this case study is part of an ongoing project studying three different cohorts in one community in the eastern part of Oslo.

The data presented here stem from cohort 1, which consist of video data and the observations of a small number of children followed during the last six months in kindergarten. The data consist of observations during different settings at kindergarten, in their community and at home. In addition, the children are supposed to make short video clips about places in their local environment.

With these lenses on interactional data, as well as video clips and photographs made by the children themselves, the intention in this presentation is to put an emphasis on learning as the capacity to adapt to changing roles within different contexts. With data from these three case studies as a point of departure, we hope to contribute to broader discussions of how children initiate and perform their agency and identity as learners across different settings.

References

- Erstad, O., Gilje, Ø., Sefton-Green, J. & Vasbø, K. (2009). Exploring 'learning lives': Community, identity, literacy and meaning. *Literacy*, 43(2), 100–106.
- Potter, J (2010) Embodied memory and curatorship in children's digital video production, *English Teaching: Practice and Critique*, 9(1), 22–35.
- Selwyn, N., Potter, J. & Cranmer, S. (2010). *Primary Schools and ICT: Learning from Learner Perspectives*, London: Continuum.
- Williams, R. (1979). "The analysis of culture", in Storey, J. (2009), *Cultural Theory and Popular Culture: A Reader*, 4th edition, Harlow: Pearson.

SYMPOSIUM

Understanding the social, situated and dynamic transactions among teachers and students

Chairperson: Nancy Perry, University of British Columbia, Canada

Organiser: Julianne Turner, U. of Notre Dame, United States
Discussant: Susan Nolen, University of Washington, United States

Although psychological and educational research has acknowledged the social, situated, and dynamic aspects of learning and engagement, researchers have mostly focused on individual differences in cognitions and beliefs. Partly, this situation results from a dearth of theory and methods to examine such complex processes. In this symposium, presenters investigate the socially situated and dynamic nature of teacher-student and student-student transactions using theoretical and methodological tools that capture interaction. Theoretical constructs include 1) situated learning (Greeno & Gresalfi, 2008; 2) co- and shared regulation (Volet, Vauras, & Salonen, 2009); and 3) dynamic systems theory (Thelen & Smith, 1994). Methods include using the activity as unit of analysis and the State Space Grid (SSG) (Hollenstein, 2007) technique. SSG uncovers (mis)matches in participants' behavior patterns and their (in)stability over time. Presentations will examine interpersonal coordination in three educational settings: small group of students, small group with teacher, and whole class instruction. Scientific relevance includes the use of theory and methods to analyze bidirectional and reciprocal regulatory processes, flexible shifts of agency, and sharing and transfer of responsibility between the participants in shared learning contexts. Analyses uncover how matches and mismatches develop and settle into patterns. Educational relevance involves insight into more or less optimal interpersonal transactions. Discussions will address how suboptimal transactions might be disrupted or redirected through examination of patterns and professional development.

Elementary School Students' Regulation of Science Learning While Solving a Fictional Murder Mystery

Nancy Perry, University of British Columbia, Canada; Carolyn Thauberger, University of British Columbia, Canada; Lynda Hutchinson, University of British Columbia, Canada; Cansel Kadioglu, Gaziosmanpasa University, Turkey; Cindy Lau, University of British Columbia, Canada; Ahmed Rahim, University of British Columbia, Canada

Research on the regulation of learning has mainly focused on individuals and independent activity, but learning in elementary school classrooms is rarely a solo event. In fact, evidence suggests children develop self-regulation through a process of co-regulation and effective co-regulation enhances both self and shared regulation of learning. Hence research about inter-individual forms of regulation is needed. We examined students' co and shared regulation as they worked collaboratively to solve a fictional crime. Primarily, we focused on what instrumental supports students provided one another for regulating learning, how co and shared regulation developed across time, and how regulation supported understandings about forensic science. Initially, students' interactions were characterized as "knowledge sharing/reporting." Co-regulation was limited to one student keeping the group on track, self-regulation occurred outside the group, and shared regulation was not observed at all. Over time, however, students began to "regulate in unison," and co-regulation became more instrumental to individual and group goals. Our findings indicate collaborative tasks that prompt dynamic, coordinated, and interdependent work afford opportunities for regulation of learning to occur. However, our findings also indicate students may struggle to interact productively in collaborative contexts, highlighting the need for more research about how features of tasks, instructional practices, and interpersonal processes afford and constrain all forms of regulation

Aims. We examined student-student interactions during collaborative work for evidence of self, co and shared regulation. Primarily, we focused on (a) what instrumental supports students provided one another for regulating learning, and (b) how students' co and shared regulation developed across time and supported understandings about forensic science.

Theoretical framework. Research involving elementary school children supports the view that self-regulated learning (SRL) develops in contexts where children gradually gain control over learning through co-regulation (Perry, 2004; Perry, Hutchinson & Thauberger, 2007). Models of co-regulation build on Vygotskian and neo-Vygotskian perspectives emphasizing the importance of instrumental interaction and activity in learning and higher psychological processes, such as SRL (McCaslin & Good, 1996; McCaslin, 2009). Co-regulation involves support giving and receiving and presumes at least one party in a transaction has knowledge or skill the other(s) need to learn. The "co-regulator" role can shift across time and tasks, depending on who has expertise in a situation. Shared regulation is "regulation in unison" and describes how participants co-construct understandings about tasks through shared metacognition, motivation and strategic action (Hadwin et al., 2010). Co and shared regulation can illuminate how children collaborate to complete tasks or solve problems. We argue successful collaboration depends not only on (a) self-regulatory skills and strategies that individuals contribute to the group; but also on (b) support members provide that boosts the self-regulatory competence of their peers (co-regulation); and (c) shared or collective regulation of learning that involves metacommunicative awareness and successful coordination of strategies (Winne et al., in press).

Methodology. The data presented here are from a larger study of self, co, and shared regulation among students working collaboratively to solve a fictional crime presented through The Crime Kit, an electronic learning kit constructed in gStudy, now nStudy, software (Winne, Hadwin & Beaudoin, 2010). Eight lessons each presented a blog by Detective Silver describing case developments and scaffolding student navigation to experiments, evidence, forensic information such as fingerprint analyses, and interviews with experts. Groups of three students followed the blog and recorded case observations in "Suspect Notes," summarized learning from experiments in "Summary Notes," evaluated learning and SRL in "Self-Evaluation Notes," and represented predictions about the case in a "Concept Map." gStudy recorded students' on-line actions. Digital recordings captured group discussions. The larger study involved 24 grade 5 students (8 groups; Mean Age = 10.85 years, ethnic minorities = 58%, identified disabilities = 8%) attending a low-SES school in a large sub-urban district near Vancouver, Canada.

Space prevents an in-depth presentation of our data in this proposal. Here we focus on results from one group's discussions of two Summary Notes: Lesson 3, Interviewing Witnesses, and Lesson 5, Leaf Analysis and show changes in the group's regulation over time. Transcripts were divided into four segments, corresponding to the group's interactions about four summary questions that loosely followed Bloom's Taxonomy (Bloom, 1956), with two questions at the levels of knowledge or comprehension and two at higher levels. Table 1 shows whether and where instances of self, co, and shared regulation were observed in the transcripts. Forms of regulation were further refined, so that processes were identified as metacognitive, motivational, and strategic, and related to task understanding, planning, goal setting, monitoring, problem-solving, and evaluating. Data will be discussed at this level of detail at EARLI.

Findings.

Initially, students in Group 2 answered Summary Note questions before meeting to discuss them. Until Lesson 3, their interactions involved mainly knowledge sharing with individuals reporting their answers to the group (e.g., S2: I wrote, "Ask questions about the crime." S3: I wrote ...). Co-regulation was limited to one student keeping the group on track (e.g., "Let's start with question 1 ... Read number 2 ... S2?), self-regulation occurred outside the group and shared regulation was not observed. Then, while discussing question 4 in Lesson 3 a shift occurred. Students stopped reporting, "I wrote ..." and began discussing options and correcting and building on one another's responses to . Eg.:

SX: (asking about options proposed) So what's the right [answer] to be?

S2: ... they need proof to get evidence the person actually committed the crime.

S1: (elaborating) 'Cause you can't just blame one person ... You can't just say, 'She did it.'

By Lesson 5, Group 2's process of shared regulation was seamless. One student led the discussion, another read the questions, and the third recorded answers in the Summary Note template. "Regulation in unison" was evident and co-regulation became more instrumental to individual and group goals. E.g.: Students supported one another to read and understand challenging vocabulary, and to find key information in the Crime Kit ("Just go to Notes? ... And go to browser ... Go all the way up ... Now, go to Information ... let's see. A broad leaf. Where's a broad leaf?). For both lessons, Group 2's actual Summary Notes indicate good understanding of the science needed to solve the crime (e.g., in Lessons 3 and 5, tactics for interviewing witnesses, evidence from analyzing leaves).

Significance. Research on the regulation of learning has mainly focused on individuals and independent activity, but learning in elementary school classrooms is rarely a solo event. Hence understandings about inter-individual forms of regulation are needed. Collaborative tasks present opportunities to study students' co and shared regulation. They can prompt dynamic, coordinated, and interdependent work, and illuminate how collaborative teams leverage individuals' unique and distributed expertise to achieve something that could not be achieved by individuals alone (Winne et al., in press). However, consistent with previous research, our findings indicate students may struggle to interact productively in collaborative contexts (we will provide evidence for this from other groups in our EARLI presentation). Research is needed about how features of tasks, instructional practices, and interpersonal processes afford and constrain all forms of regulation.

How do Teachers Scaffold Low-Achievers in Reading Comprehension?

Anu Kajamies, University of Turku, Finland; Marja Vauras, University of Turku, Finland; Riita Kinnunen, University of Turku, Finland

This paper discusses a study of special needs teachers and their low-achieving students during the implementation of a reading comprehension intervention. The intervention was designed to support matching, growth-promoting instructional discussions between the students and their teacher. We aim to show whether teachers created opportunities for the low-achieving students to reach higher levels of independent functioning, and to illustrate how dynamic instructional match/mismatch can be analyzed with the State Space Grid technique (Hollenstein, 2007;

Vauras et al., 2009b). Low-achieving students were selected from 437 fourth grade, 10-year-old mainstream students on the basis of the pre-test scores in reading comprehension. The quantitative results from the pretest, posttest, and follow-up test indicate significant effects for the intervention students' reading comprehension during the intervention. Detailed analysis of the results shows that the lowest-achieving students progressed the most. We focus on the strategy practice of two teachers, in particular on how they created and took up growth-promoting opportunities. Preliminary analysis shows that teachers had difficulties in finding a dynamic match. Reading comprehension was mainly practiced at low levels and few opportunities were created at higher levels. It was easier for the teachers to create growth-promoting opportunities for the lowest achieving students than for the more skilled low-achievers. Detailed findings and implications for the challenges involved in instructional interaction and teacher training will be discussed in the presentation

Aims and Background

Scaffolding the reading comprehension of motivationally vulnerable low-achievers poses a challenge to teachers (Guthrie et al., 2004; Vauras et al., 1999). Optimal scaffolding presupposes sensitive and flexible teachers, who create a dynamic match between their moment-to-moment support and the students' constantly varying functioning, and growth-promoting opportunities within the students' zones of proximal development (ZPD) (Salonen et al., 2005; Vygotsky, 1978). This paper discusses a study of special needs teachers and their at-risk, low-achieving students during the implementation of a reading comprehension intervention to support growth-promoting instructional discussions. Special needs teachers were assisted in implementing the interventions, aimed to provide intensive, systematic, and explicit teacher scaffolding to promote the growth of cognitive, metacognitive, and motivational activities involved in skilful reading comprehension (Vauras et al., 2009a; Pressley, 2005). This paper aims to show whether teachers succeed in creating opportunities (Gresalfi, 2004) for the low-achieving students to reach higher levels of independent functioning, and to illustrate how dynamic instructional match/mismatch can be systematically detected and analyzed with the aid of State Space Grid (SSG) technique (Hollenstein, 2007; Vauras et al., 2009b). Further, we discuss the implications of instructional (mis)matches in the development of reading comprehension skills in the case of low-achieving students.

Method and Analysis

Experienced special needs teachers ($n = 11$) participated in a half-year-long intervention to foster low-achieving students' reading comprehension skills, self-regulatory and coping skills, and motivational engagement in reading. Training and counseling were provided to advance teacher scaffolding. Low-achieving students ($n = 57$) were selected from the total sample of 437 fourth grade, 10-year-old mainstream students on the basis of the pre-test scores in reading comprehension. This paper concerns the interventions that the teachers carried out in 18 hours in small groups (3 trainees /group) in core comprehension skills (such as, selecting, integrating, transforming, and summarizing information). The intervention was strongly built around a mystery book (Threat in the Desert Island, written for the purposes of the program, and including tasks and problems of increasing difficulty). In all respects, ethical code for scientific research is followed, according to the guidelines of the ethical committee of the University of Turku.

All intervention sessions were videotaped, and this paper illustrates the scaffolding patterns of two teachers, differing in their level of creating opportunities for their students. We applied the dynamic-analytical State Space Grid (SSG) technique (e.g., Granic & Patterson, 2006; Hollenstein, 2007) to analyze (mis)matches and opportunities offered in scaffolding in real-time interaction patterns. SSGs provide a visual aid (temporal scatter plot) to depict the relationship between the activity of a teacher and a student (/group) synchronized in time. The observed data (selected target phases) were transmitted to The Observer XT (Noldus Information Technology), and then, behavioral events were coded and exported from Observer XT to GridWare. The level of creating (teacher) and taking-up (students) growth-promoting opportunities (Gresalfi, 2004) in scaffolding the strategy practice was classified into high and low levels (in creation of categories, the work of Kintsch and Kintsch, 2005; Taylor et al., 2002; Vauras et al., 2009b are used), plotted on a 5 (teacher) x 5 (students) grids (coding ranging from 'none' to 'strong'). At high levels, the teacher creates growth-promoting opportunities within the ZPD, and strategies are practiced by building links between the strategy principles and situational factors (different tasks, prior knowledge and experience). Metacognitive regulation is integrated at the highest level of scaffolding, and if the student take-up is high, they are involved in discussions at the level of how, when and why strategies can be used in various real-life situations. At low levels, teacher scaffolding focuses on mechanical practicing of the strategies, which are treated as isolated elements in the reading activity. No real opportunities for learning and motivation are created when the focus of interaction is on things irrelevant for understanding.

Findings and Significance of the Outcomes The quantitative results from the pretest, posttest, and follow-up test indicate significant effects for the intervention students' reading comprehension during the intervention ($1, 435$) = 8.56 , p Preliminary interaction analysis shows that teachers had difficulties in acting sensitively and flexibly and finding

a dynamic match in spite of the guidance provided to them in implementing scaffolding principles and new materials. Reading comprehension was mainly practiced in low levels and few opportunities were created at the higher levels. Instead of instructional discussions, the interactions were tightly led by the teacher, full of simple question-answer chains, accompanied with disconnected situational or content demands. The teachers typically stayed in secure/comfortable interaction, where students' skills may become consolidated, but further progress is slow (cf., Vauras et al, 2009b). It was easier for the teachers to create growth-promoting opportunities for the lowest achieving students than for the more skilled low-achievers. Further, the teachers had difficulties taking up opportunities provided by the (often the more skilled) students: they neither carefully listened to students' suggestions, nor did they try to understand their thinking or establish links to the discussed topics. Much of the time was spent on incidental matters. Students were over-controlled, under-demanded and unsupported despite these experienced teachers' genuine interest in scaffolding students and expanding their own expertise. The significance of the findings lies in the development of advanced methods in analyzing instructional interactions and in their theoretical and educational impact for implementing special needs interventions. Detailed findings with implications for challenges inherent in instructional interaction and teacher training will be discussed in the presentation.

The Change in Teacher-Student Interactional Patterns in Eight Classrooms over One School Year

Julianne Turner, U. of Notre Dame, United States; Sara Fulmer, University of Notre Dame, United States

We investigated the dynamic nature of teacher-student interaction over one year. In particular, we analyzed patterns of opportunities offered by teachers to make connections among content ideas, and how their students took them up. Instruction was observed and coded 12 times each in 8 middle school classrooms. Teacher opportunities and student uptake (coded as none, weak, moderate, strong) were plotted on a 4x4 grid representing all possible behavioral combinations to show trajectories of interaction during real time. Interactional patterns differed in classrooms of weak vs. strong teachers. All classrooms showed a wide range of teacher-student interaction in the first quarter. By second semester, patterns had stabilized. Weak teachers offered mostly weak opportunities (e.g., practicing procedures) and student uptake was weak. Strong teachers offered mostly moderate to strong opportunities to connect ideas, and students took up the offers. Findings imply that, over time, teachers' and students' behaviors may invite certain kinds of reciprocal behaviors from each other and these sequences may lead to certain forms of stable patterns. Studying classrooms as dynamic systems can provide information about how patterns develop, and how interventions might interrupt stable patterns of low quality interactions. Teachers might study patterns and redesign opportunities such as tasks or questioning practices or study interactions in high quality instruction.

Aims

The goal was to investigate patterns of stability and change in teacher-student interaction about content over the school year in eight middle school classrooms. In particular, we examine the quality of opportunities offered by teachers to make connections among content ideas, how students took up these opportunities, and patterns of interactions.

Theoretical Perspective

We take the theoretical perspective that learning and engagement develop as teachers and students participate together (Turner & Patrick, 2008; Vauras, Salonen, & Kinnunen, 2008). Therefore, classrooms are dynamic systems (Thelen & Smith 1994). Over time, teachers' and students' behaviors may invite certain kinds of reciprocal behaviors from each other and these sequences may lead to certain forms of stable patterns (Gurtman, 2001). Teachers provide opportunities for student participation of different levels of quality. For example, if certain kinds of scaffolding require that students connect ideas (e.g., compare-contrast), then students might be more likely to offer explanations or ask questions that attempt to make connections. Conversely, if teachers focus on isolated facts or procedures alone, students may practice skills, but not relate them to disciplinary content. In another situation, teacher opportunities and student uptake may be unbalanced; students may respond to a weak opportunity with a high quality response, or may not respond to a strong opportunity. In those situations, patterns could be perturbed, opening up the possibility for change in interaction patterns (Thelen & Smith, 1994). These assumptions lead us to take social interaction rather than individual teacher or student behaviors as the unit of analysis (Rogoff, 1997).

Methodology

Teachers participated in a year-long intervention to foster student engagement in middle school. We introduced four theoretical principles that support engagement: supporting students' competence, autonomy, belongingness, and making learning meaningful. Teachers learned instructional strategies (e.g. asking open-ended questions) to enact the four principles and were encouraged to implement them in their daily instruction.

Observations (n=12) were conducted in each of the 8 classrooms during the school year. The observation instrument was designed to capture teacher-student interactions. Instructional interactions were coded by activity segments, which were defined by the intended product in the activity. Activity segments ranged from 1 to 4 during observed classes.

The eight teachers were first classified on one variable, Responsive Assistance in Thinking (RA-T), which indicated teachers' propensity to scaffold instruction, (Rivera & Tharp, 2004). RA-T was coded "present" when the teacher 1) determined students' current level of performance/understanding, and 2) adjusted instruction to enable an advance in learning. The presence or absence (i.e., 1 or 0) of teachers' use of RA-T was separately recorded for each activity segment during the 12 observations, and then were averaged across the 12 observations. Teachers differed significantly on the mean level of RA-T [$t(6) = -3.61, p$

Then interaction patterns for the teacher groups were contrasted on one observation category, the source of opportunities to work on content (adapted from Gresalfi, 2004). This variable is coded for both teacher and student. These ratings were plotted on a 4 x 4 State Space Grid (none, weak, moderate, strong; Hollenstein, 2007) such that teacher offers and student uptake could be plotted together in the same cell (e.g., teacher opportunity might have been moderate, but student uptake was weak). Activity segments for one class were connected by lines with arrows showing the direction of interaction over that class period.

Findings

Weak teachers

In the first quarter of the school year, teacher-student interaction was in the lower (southwest) quadrant, indicating a pattern of none/weak opportunities and none/weak uptake by students. In the second through fourth quarters, classroom interaction formed a stable pattern, with both teacher offers and student uptake mostly rated "weak." In the fourth quarter, teacher offers varied from none to moderate, but student uptake remained mostly weak, as did the overall interaction pattern.

Strong teachers

In the first quarter, teacher-student interaction was somewhat unstable, ranging from "weak" to "strong" for teacher offers and from "none" to "strong" for student uptake, with weak being the most common student response. During four activity segments in quarter 1, both teachers and students were rated "strong" (3 different teachers). By the second semester, teacher-student interaction became more stable around the upper (northeast) quadrant, representing moderate to strong levels of opportunity and uptake. Examples of tasks and teacher-student dialogue will be presented to illustrate teacher offers and student uptake.

Theoretical and educational significance

This research demonstrates the social and dynamic nature of classroom interaction both within class periods and over time. In addition, it illustrates how patterns became stable over time. Teachers and students established interaction patterns, which tended to invite reciprocal behaviors from each other. Students tended to take up the kinds of opportunities offered; that is, weak opportunities were associated with weak uptake and strong opportunities often supported students in making content connections. Participation patterns varied the most at the beginning of the year when teachers and students were becoming acquainted.

Analyses point to the potential of understanding how classroom dynamics develop and how one might intervene to improve instruction. Teachers might study their patterns, relate them to specific instructional activities, and strive to change interaction patterns by redesigning tasks and ways of questioning and explaining ideas. Based on this study, students would be more likely to take up stronger opportunities if offered, thus supporting both engagement and learning

SYMPOSIUM

Cross-cultural aspects of learning technology acceptance

Chairperson: Armin Weinberger, Saarland University, Germany

Organiser: Nicolae Nistor, Ludwig-Maximilians-Universität München, Germany

Armin Weinberger, Saarland University, Germany

Discussant: Heinz Mandl, Ludwig-Maximilians-University Munich, Germany

Education in a global networked society implies the wide use of educational technology, which in turn requires learners' technology acceptance. The previous educational research has given little attention to the acceptance and use of learning technology in international or intercultural context. In this symposium, we present three empirical studies of technology acceptance by adult learners. All three are based on an acknowledged acceptance theory (i.e. the Unified Theory of Acceptance and Use of Technology, UTAUT, Venkatesh et al., 2003), and aim at applying it in contexts where different cultures are involved. The first deals with the introduction of a virtual learning environment at a Swedish, a Norwegian, and a Lithuanian university. The second examines the use of a learning management system at a Spanish university, distinguishing technological from non-technological culture as context of the technology use. The third is a large survey of general attitudes and use of computers for learning in Germany and Romania, considering both ethnical and professional culture. In each of them, the findings widely correspond with the previous acceptance theories, i.e. learners' expectations and the social influence determine their attitudes, which further determine the technology usage. Additionally, the cultural diversity highlights influences such as, e.g., individualism, uncertainty avoidance or computer anxiety, which can change both the values of the acceptance variables, and the relationships between them. Based on these evidences, the three studies provide a deeper insight into the interconnections between culture – in the national/ethnical, as well as in the professional sense – and learning technology acceptance.

A comparative case study of technology acceptance at three Northern European universities

Christina Keller, Jonkoping International Business School, Sweden

Virtual learning environments have in recent years become an important tool in higher education, in distance learning as well as on campus. This study analyzed factors influencing acceptance of virtual learning environments among academic staff and students in blended learning environments. The study was performed as a comparative, explanatory case study at three universities providing master education of public health in Sweden, Norway and Lithuania. The findings of the case study showed that national culture was powerful in influencing acceptance of virtual learning environments, positively as well as negatively. High degrees of performance expectancy and social influence affected acceptance of virtual learning environments positively. The high degree of social influence was hypothesized to be transferred by the values of the national culture. The high degree of acceptance of virtual learning environments in Lithuania was hypothesized to be due to high degrees of the cultural values of power distance and uncertainty-avoidance.

Aims

The aim of the study was to analyse factors influencing acceptance of virtual learning environments among students and staff in blended learning environments and different national settings.

Methodology

The research setting of the study was public health master education at three case universities: Nordic School of Public Health, Sweden, University of Tromsø, Norway, and Kaunas University of Medicine, Lithuania. The data collection was performed from 2004 until 2007, by interviews with key persons of the implementation process, for example, deans, project managers, and teachers. The interviews focused on the general level of acceptance of the virtual learning environment (VLE) at the university, as well as the core constructs of Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003); performance expectancy, effort expectancy, social influence and facilitating conditions.

105 students in the public health master programs of the three universities responded to a survey questionnaire, capturing the core constructs of UTAUT. Both the interview questions and questionnaire items were phrased by adapting the original items used in estimating UTAUT (Venkatesh et al., 2003) to a research setting of online learning. The statements were graded on a scale from 1 (I don't agree at all) to 5 (I agree completely). The students were also able to state their opinions about advantages and disadvantages in two open survey questions.

Findings

The general acceptance of the virtual learning environment was found to be low at the Swedish university, medium at the Norwegian university and high at the Lithuanian university. In table 1, the findings of the interviews and survey questionnaires on the core constructs of UTAUT are summarized.

The particularly negative perceptions from the Swedish university seemed to be due to a strong tradition of teaching on campus, which regarded the virtual learning environment as something negative. Lithuanian students regarded the web platform as a means of improved communication with teachers. Swedish students, on the other hand, associated the virtual learning environment with reduced communication with teachers: "Fronter [the virtual learning

environment] could never substitute the inspiration and response that you get from meeting teachers/tutors and other students face to face. Fronter is aimed at cognitive tasks, not for building relations.” (student, Swedish university, 2005). Norwegian teachers and students seemed to regard the web platform as an adequate tool for storage and retrieval of course material, and for postings of assignments, but nothing more: “It doesn’t make me a better teacher in any way, but the technology works...” (teacher, Norwegian university, 2005). On the other hand, students of the Lithuanian university were enthusiastic about the opportunity to interact with teachers by the e-mail feature in the virtual learning environment: “Now, at last we can speak to teachers one to one.” (student, Lithuanian university, 2004). The enthusiasm was shared by the university management: “This is the future of education, something new to offer our students” (dean, Lithuanian university, 2004).

Theoretical and educational significance

Technology acceptance research has shown that behavioural models, like TAM and UTAUT, do not universally hold across national cultures (Srite & Karahanna, 2006; Bandyopadhyay, & Fraccastoro, 2007). Hofstede (2001) defines national culture as “the collective programming of the mind that distinguishes the members of one group or category of people from another” (p. 9). In this study, national culture is defined as the shared norms, values and behaviours that distinguishes the members of one group or category of people from another. Applying Hofstede’s cultural values, Sweden and Norway are individualistic, feminine countries with a low degree of power distance. The degree of uncertainty-avoidance is somewhat higher in Norway (index value = 50), than in Sweden (index value = 29). Lithuania display another pattern of cultural values with high scores on uncertainty avoidance and masculinity, and medium scores on power distance and individualism (Sarvutyte & Streimikiene, 2010). Sweden and Norway are among the lowest rated nations in the world (index value = 31) on the cultural value of power distance. Lithuania has a higher degree of power distance (index value = 45), which i.e. means that decisions from university management are obeyed. In the two Scandinavian countries, staff and students generally take on a critical stance towards top-down decisions from university management. The high degree of uncertainty-avoidance in Lithuania (index value = 67) may also lead to obedience to university management, as this behavior reduces individual risk-taking. Moreover, a strong social norm, measured by the core construct of social influence was evident in explaining the positive perceptions of the virtual learning environment.

References

- Bandyopadhyay, K. & Fraccastoro, K. A. (2007). The effect of culture on user acceptance of information technology. *Communications of the Association for Information Systems*, 19, 522–543.
- Hofstede, G. (2001). *Culture’s Consequences. Comparing Values, Behaviors, Institutions, and Organizations Across Nations*. Thousand Oaks, CA: Sage Publications.
- Sarvutyte, M. & Streimikiene, D. (2010). New concepts and approaches of migration. *Economics and Management*, 15, 226-233.
- Srite, M. & Karahanna, E. (2006). The role of espoused national cultural values in technology acceptance. *MIS Quarterly*, 30 (3), 679-704.
- Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27 (3), 425–478.

An analysis of the influence of students’ technological culture on their technology acceptance

Santiago Iglesias-Pradas, Universidad Politecnica de Madrid, Spain; Angel Hernandez-Garcia, Universidad Politecnica de Madrid, Spain; Felix Pascual-Miguel, Universidad Politecnica de Madrid, Spain; Oscar Lorenzo Duenas-Rugnon, Universidad Politecnica de Madrid, Spain

The increasing implementation of learning management systems (LMS) in educational institutions during the last decade has raised the interest among the research community on the acceptance and use of these systems by both teachers and students. At first, the implementation of LMS was based on their technical design and the adaptation of the learning processes to the virtual environment, neglecting students’ characteristics when the systems were deployed, which led to expensive and failing implementations. The Unified Theory of Acceptance and Use of Technology (UTAUT) proposes a framework which allows the study of the acceptance and use of technology that takes into consideration the students’ characteristics and how they affect the acceptance and the degree of use of educational technology. This study questions the role of the user’s attitude towards use of LMS and uses the UTAUT to examine the moderating effect of technological culture in the adoption of LMS in Spain. The results from the comparison and analysis of three different models confirm the relevance of attitude towards use as an antecedent of intention to use the system, as well as the important moderating effect of gender and technological culture. The discussion of results suggests the need for a more in-depth analysis and interrelations of cultural dimensions in the adoption of educational technologies and learning management systems.

1 Introduction and research objectives

During the last twenty years a wide range of theoretical models for analysing technological acceptance have been used, mainly Davis's Technology Acceptance Model (TAM) [1], based on Fishbein and Ajzen's Theory of Reasoned Action (TRA) [2]. This study applies a TAM-followup, the Unified Theory of Acceptance and Use of Technology (UTAUT), an integrative model by Venkatesh et al. [3], as a ground for our research model. UTAUT consolidates features of eight different acceptance models and proposes a unified model with four core constructs that determine IT use behaviour, and which takes into account the moderating role of gender, age, experience and voluntariness of use. UTAUT is a relatively new theory, and the effect of cultural elements, a key factor in learning processes, is not yet taken into consideration in its original formulation [4].

This research then focuses on two aspects seldom covered by UTAUT studies: (1) the mediation role of attitude towards use as a predictor of behavioural intention to use and (2) the attitudinal differences between students with technological and non-technological background education and culture. The first one is a topic in which no consensus has been achieved yet [5]; the second examines a moderating variable on the adoption of e-learning technologies from a cultural perspective, an approach that has not been introduced in UTAUT studies until recently.

While the influence of experience in technology use and the role of computer literacy have been widely studied, the issue of technological education background as a cultural trait with shared beliefs and differential characteristics has been neglected in the technology acceptance literature for a long time. However, some recent studies have begun to take it into account, confirming the relationship between technological background and lower levels of anxiety, as well as more positive attitude towards use and intention to use the system [6].

2 Research Design and Methodology

Three different models have been analyzed in order to achieve the research goals: a basic TAM-based model, an extended UTAUT model – which also considers anxiety and self-efficacy – with attitude towards use as a predictor of behavioural intention to use and the extended UTAUT model without the attitude towards use construct. The second and third models included technical background education as a moderator variable.

In order to test the model, online surveys have been completed by 79 graduate, post-graduate and lifelong learning Spanish students – 62 of them belonging to the technologic culture – who already used a Learning Management System (Moodle). Results of these surveys have been analyzed with structural equation modelling with a partial least squares approach, for which PLS Graph 3.0.1130 and SPSS 18 software packages have been used.

3 Conclusions

After verifying the model and reformulating some constructs to assure the consistency and reliability of the measure instrument, the main results reveal the attitude towards use as a mediator between both performance expectancy and social influence, and behavioural intention. However, effort expectancy was not found to have a significant relevance for any of the models, contradicting thus prior literature.

While no moderation effect was found from experience – either Moodle-, LMS- or ICT-related –, age or voluntariness of use, the differences between technological and non-technological culture, together with gender differences, arised as strong moderators for the intention to use the LMS. This is an important finding which emphasizes the appropriateness of considering cultural factors to study the acceptance of technology in education – particularly, both moderating variables have been entwined in the Spanish educational system, where the majority of technological degree courses have traditionally comprised male students, in contrast to non-technological studies.

The study confirms that, for students belonging to a non-technological culture, higher levels of performance expectancy and social influence lead to a more positive attitude towards using a learning management system. Furthermore, facilitating conditions become, more than attitude, the determinant factor of the intention to use the LMS in the case of non-technological culture.

These results emphasize the importance of the existing support infrastructure – both technical and human – when delivering courses via LMS in order to reach a higher audience and expand to all educational disciplines. Also, the comparison between our research results and those found by Nistor et al. [7] with a larger sample of technical and non-technical participants suggests a balance between facilitating conditions and anxiety in the acceptance of ICT-based LMS, so that this reciprocal relation may not be explained only by psycho-social factors perceived by the individual, but also depend on the inherent socio-cultural dimensions.

4 References

1. Davis, F.D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology, *MIS Quarterly*, 13 (3), 319-339.
2. Fishbein, M., Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley.
3. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27 (3), 425-478.
4. Keller, C. (in this symposium). A comparative case study of acceptance of virtual learning environments at three Northern European universities.
5. Teo, T. (2009). Is there an attitude problem? Reconsidering the role of attitude in the TAM, *British Journal of Educational Technology*, 40 (6), 1139–1141.
6. Weinberger, A., Nistor, N. (2010). Culture, profession, and attitudes towards educational technology. A large-scale, German-Romanian study. Paper presented at the ICIC2010 Conference, August 19-20, 2010, Copenhagen, Denmark.
7. Nistor, N., Wagner, M., Istvanffy, E. & Dragota, M. (2010). The Unified Theory of Acceptance and Use of Technology: Verifying the model from a European perspective. *International Journal of Knowledge and Learning*, 6 (2-3), 185-199.

The influence of culture and infrastructure availability on learners' technology acceptance

Nicolae Nistor, Ludwig-Maximilians-Universitat Munchen, Germany; Thomas Lerche, Ludwig-Maximilians-Universitaet Munich, Germany; Ciprian Ceobanu, Universitatea Alexandru Ioan Cuza Iasi, Romania; Armin Weinberger, Saarland University, Germany

Technology-enhanced learning is increasingly used in international and multicultural contexts. However, little attention has been paid to learner characteristics and attitudes towards technology within different ethnical and professional cultures. This study attempts to integrate culture (in sensu Hofstede, 2001) and infrastructure availability into an established technology acceptance model (the Unified Theory of Acceptance and Use of Technology, UTAUT; Venkatesh, Morris, Davies & Davies, 2003). Relying on a relatively large sample (N = 2834) of technology users from Germany and Romania, we examine the differences in terms of culture, infrastructure availability and technology acceptance between sample subgroups. With respect to culture dimensions, we use an adapted test that estimates variances and the statistical significance of the differences in group values, which was not possible with previous methods. The collected data reveals significant cultural differences both between countries and regions, and between professions. Both culture and infrastructure availability significantly influence technology acceptance. Their influences can be discerned with respect to only one variable, i.e. individualism, which affects the perceived facilitating conditions, which further co-determines the technology use. The theoretical significance of our contribution lays in the first steps towards integrating Hofstede's culture model into the UTAUT. For the educational practice, it suggests a starting point of dealing with cultural discrepancies in the context of technology-enhanced learning.

Rationale

Technology-enhanced learning is increasingly used in international and multicultural contexts. However, little attention has been paid to learner characteristics and attitudes towards technology within different ethnical and professional cultures. A usual, implicit assumption seems to be that technology use implies the same acceptance mechanisms in every culture; there is however not yet sufficient empirical evidence to what extent this is true. Therefore, our study examines the influence of learners' culture on their learning technology acceptance (LTA), which may obviously interact with the availability of the technology infrastructure. More precisely, we attempt to integrate culture dimensions and infrastructure availability into an established acceptance model.

Theoretical background

Learning technology acceptance. The Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Moris, Davis, & Davis, 2003) is a powerful acceptance model describing technology use as a consequence of the use intention, further determined by performance expectancy, effort expectancy and social influence. Additionally, the facilitating conditions directly determine technology usage. In a larger, socio-political context, some of these predictors are likely to be influenced by culture.

Culture. Hofstede (2001) defines culture as patterns of thinking, feeling and potential acting, which may be determined by both nation and culture. Hofstede identifies five dimensions of culture: power distance, collectivism/individualism, femininity/masculinity, uncertainty avoidance, and long/short-term orientation. Recent research (e.g. Venkatesh & Zhang, 2010) attempts to identify connections between these dimensions and the LTA variables.

Infrastructure availability. Besides cultural differences, material conditions vary between Eastern and Western European countries and regions (Eurostat, 2009). Thus, there are major differences between Germany and Romania, and also within both countries, i.e. between Southern and Eastern Germany, and, within Romania, between Moldavia and the rest of the country. These discrepancies are connected with differences in infrastructure availability and technology diffusion, probably with different technology acceptance, as well.

Aims of the study

Against the background of a hypothesized research model that states the influence of culture and infrastructure availability on the UTAUT acceptance variables, we examine:

(RQ1) the difference between geographical regions and professions in terms of culture

(RQ2) the influence of culture on the acceptance variables

(RQ3) the influence of infrastructure availability on the acceptance variables.

Methods

Within this scope, we conducted a correlation study, recording longitudinal data in a one-shot survey, from undergraduate and graduate students and faculty/teachers, from universities, technical colleges, and adult education centres. We collected a sample ($N = 2834$) of Romanian ($n = 1016$) and German ($n = 1818$) students and professionals of technological ($n = 861$) and non-technological disciplines ($n = 1972$).

Since Hofstede's (1994) culture dimensions are defined only for sample sizes over 50, they may not be processed using statistical methods such as t-test or regression analysis. Therefore we developed a method (Lerche & Kiel, submitted) that allows estimating the variance of the cultural dimensions with the use of Carmer's theorem and a correction factor depending on the sample size. This method allows the application of Welch's test for the difference in culture dimensions (e.g. uncertainty avoidance) by two subsamples, drawn by use of a median split of the dependent variable (e.g. technology use). Instead of regression analysis or correlation, we split the sample according to the values of the dependent variable (e.g. technology use) and we test the difference in the independent variable (e.g. uncertainty avoidance) for the two subsamples. Against an appropriate theoretical background (e.g. a rationale proposing that uncertainty avoidance leads to less technology use), we assume that a significant difference will suggest a significant influence of the independent on the dependent variable.

Results

The collected data reveals cultural differences both between countries and regions, and between professions (RQ1). Culture dimensions appear to have diverse influence on the LTA variables. Individualism, masculinity and uncertainty avoidance display wide effects, influencing many of the LTA variables; power distance and long-term orientation restrict their effect to one LTA variable, i.e. social influence and respectively performance expectancy (RQ2). Insufficient infrastructure appears to significantly decrease expectancies and the technology usage, while increasing the use intention, which thus develops under social influence and is associated with anxiety. Since infrastructure availability has no significant effect on the perceived facilitating conditions, this important predictor of the technology use appears to be determined only by culture, i.e. by individualism (RQ3).

Discussion

The validity of these results is enhanced by the relatively large sample, and its appropriate variance of the independent variables geographical location, profession, culture dimensions, and infrastructure availability. The use of an adapted statistical test for Hofstede's variables (Lerche & Kiel, submitted) is new and confers special methodical significance to the study. However, we must keep in mind that this statistical approach has not yet the strength of a regression analysis. Also, the influences of culture and infrastructure availability may be confounded with respect to some of the UTAUT variables.

This study places main emphasis on theory, making the first steps towards integrating Hofstede's (2001) culture model into the UTAUT (Venkatesh et al., 2003). In this respect, our findings are in line with the previous research (e.g. Venkatesh & Zhang, 2010), while enlarging and deepening the view of the culture influence. With respect to the educational practice, the study suggests acceptance and culture dimensions as a starting point of dealing with cultural discrepancies in the context of technology-enhanced learning.

References

Eurostat (2009). Eurostat Jahrbuch der Regionen 2009 [Eurostat regional report 2009]. Luxemburg: Amt fuer Veroeffentlichungen der Europaeischen Union.

Hofstede, G. (1994). Value Survey Modules. Online available; download (October 26, 2010) from <http://www.geerthofstede.nl/research--vsm/vsm-94.aspx>

Hofstede, G. (2001). Culture's consequences: Comparing values, behaviors, institutions and organizations across nations. Thousand Oaks, CA: Sage.

Lerche, T. & Kiel, E. (submitted). Signifikanztestung der kulturellen Dimensionen von Geert Hofstede [Statistical significance tests of Geert Hofstede's cultural dimensions]. Diagnostica.

Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27, 425-478.

Venkatesh, V. & Zhang, X. (2010). The Unified Theory of Acceptance and Use of Technology: U.S. vs. China. Journal of Global Information Technology Management 13 (1), 5-27.

SYMPOSIUM

Assessment and Learning Implications of the Predictive Classification of Academic Performance

Chairperson: Eduardo C. Cascallar, Katholieke Universiteit Leuven, Belgium

Organiser: Eduardo C. Cascallar, Katholieke Universiteit Leuven, Belgium

Discussant: Mien Segers, Maastricht University, Netherlands

This symposium will summarize and integrate three highly successful and pioneering studies using a predictive systems approach in educational assessment. Given the complexity of the variables involved in the field of education and educational assessment in particular, it is possible to take full advantage of predictive systems in order to improve the quality of educational assessments. In particular, neural networks, with their superior potential for pattern recognition and classification are particularly well suited to use available data to give a much broader expectation of academic performance, based on a wider set of predictors which lead to increase validity, accuracy, and utility of the construct, while also increasing the accuracy of the resulting classifications. A predictive systems approach, and the resulting operational models can lead to better assessment programs and improved learning outcomes, improved diagnostic and placement evaluations, and an opportunity for "continuous assessment". Two studies involved the modelling of expected general academic performance and mathematics performance in higher education using basic cognitive, motivational, learning strategies, and background variables. The other study reports an applications of a predictive classification system of writing performance in secondary education. In all of these applications accuracy in classification was very high. In summary, these models are proposed as valuable alternatives to develop more comprehensive and accurate assessemnt systems which can increase the validity and the accuracy of assessment procedures, thus achieving higher levels of fairness and efficiency, while also increasing the understanding of the processes involved and those involved in reaching better learning outcomes.

Predicting and explaining writing outcomes: Neural network methodology at work

Monique Boekaerts, Leiden University, Belgium; Eduardo C. Cascallar, Katholieke Universiteit Leuven, Belgium

The study was set up with two objectives in mind, namely to understand the variables that influence writing performance and to be able to predict future high and low writing performance. Approximately 1500 vocational school students participated. Background variables provided information about students' home and personal environment, activities outside school, classroom environment, and daily (writing) practices. Questionnaires were used to collect this information. Writing process and writing outcome variables were measured on-line with specially designed software. Authentic writing tasks were selected to assess the quality of students' writing performance as well as the way they tried to steer and direct the writing process. Cues on the screen probed about their motivation to write, their emotions, meta-cognitive strategy use, self-efficacy, and use of external regulation. The traces that students left behind were also studied (e.g., time spent writing the letter, consulting the instruction). Teachers were involved in setting standards for assessing the students' writing performance. The data were analyzed with the neural network methodology, which allowed us to examine large amounts of data in an integrated fashion. It helped us to identify students who are and who are not at risk of becoming poor writers. Using cluster analyses, multi-dimensional scaling and other techniques we identify patterns of differences in core variables among different groups of writers. We will address the predictive and the exploratory aspects of the study.

In class, students find themselves in and create specific learning and working environments that are based on a multitude of factors that affect each other in multiple ways. We assumed that the writing environment that poor writers create is fundamentally different from the environment that good writers create for themselves. We argued that it is insufficient to single out a small set of variables that is assumed to affect writing outcome and study the extent to which higher scores on these variables affect students' writing performance. As Salomon (2006) correctly

pointed out, such an approach only allows us to look at patterns of differences between variables in good and poor writers but does not allow us to study how each of the core variables affects the nature of the writing environment. The research was aimed at predicting vocational students' level of writing performance on the basis of a large set of variables, including variables pertaining to the home context, students' beliefs about writing as a domain, and the quality of their actual writing process. Self-report questionnaires were used to assess aspects of the home context, the writing activities they engage in daily, the type of employment and the number of hours spent at work per week, reading habits, and being with friends. We used Boekaerts' six component self-regulation model to identify writing process variables. Authentic writing tasks were selected to assess the quality of students' writing performance as well as the way they tried to steer and direct the writing process. The interactive soft-ware program that was designed allowed us to measure writing performance on-line. Students engaged in two writing sessions, each lasting an hour, and completed several questionnaires in an additional one-hour session. They logged on to our Internet site and their responses were automatically submitted. Students were asked to write a letter to the editor and they also completed a sentence condensing task (Zimmerman & Kintsantas). They were asked to transform single sentences into the shortest possible Dutch sentence that conveyed the same meaning. On-line task probes appeared on screen to assess their cognitions, affects and strategy use, as well as their use of external regulation. The students' self-efficacy, learning intention, and affect prior to starting on each of the writing tasks were assessed. During each of the tasks their strategy use, the frequency of using the scaffolds and the writing tools provided (e.g., frequency of using the spellers, the model example, the instructions) were also assessed. After the tasks were completed, the traces left behind, such as the time taken to complete the letter and the sentence, the time taken to revise the letter and the sentence, and the number of revisions they had attempted, were noted and analyzed. In a separate session, students completed the questionnaires asking for their domain-specific beliefs about writing, their daily habits, and their meta-cognitive strategy use in relation to three writing genres (e-mail, term paper, and application letter). Students' access to meta-cognitive writing strategies was assessed in relation to the orientation, execution, and reflection stages of each of these writing genres. A neural network approach (NN) was used as a model building technique in order to maximize predictive accuracy. The NN was trained on a sub-sample and the weakest inputs were pruned back. The final solution was used to make a predictive classification into two main categories: students who were and those who were not at risk of having poor writing performance. This classification was then compared against observed writing outcomes in order to calculate accuracy of classification. The NN predicted with 96% total accuracy that students would be in the at-risk group and with 100% accuracy that they would not be. Looking at the classification of the students does not reveal the interactions between the variables that the NN discovered. Remarkably, none of the inputs showed considerable strength singly, but it was the aggregate of predictors in meaningful patterns that provided the NN the strength in prediction and classification. We conducted Ward's cluster analyses on the students in the at risk group to see whether it concerned a homogeneous group. This yielded three separate groups. Multi-dimensional scaling revealed that these groups differed mainly on the time spent writing the letter, tool use, access to meta-cognitive strategies, and affective variables. Using cluster analyses, multi-dimensional scaling and other techniques we identified patterns of differences in core variables among different groups of writers. We will address the predictive and the exploratory aspects of the study, highlighting the different insights that predictive methodology affords.

Cognitive processes, self-regulation and mathematical performance: Application of Neural Networks

Mariel Musso, Katholieke Universiteit Leuven, Argentina; Eva Kyndt, Katholieke Universiteit Leuven, Belgium; Eduardo C. Cascallar, Katholieke Universiteit Leuven, Belgium; Filip Dochy, K.U.Leuven, Belgium

There is substantial research which has investigated the influences of: working memory; attention, motivation, and learning strategies, on mathematical performance and self-regulation in general. However, these studies have looked at the separate effects of these components. We have little understanding about how they impact on the performance when taken together, understanding their interactions, and how much each can predict a mathematical performance. On the other hand, new methodologies and technologies, and the emergence of predictive systems, have focused on the possibility of assessments which use a wide range of data or student productions to evaluate their performance without the need of traditional testing (Boekaerts & Cascallar, 2006). This research addresses to understand different cognitive patterns and complex relations between cognitive variables, motivation and background variables, for different levels of mathematical performance, using Artificial Neural Networks (ANN). Sample: over 700 beginning university students, both genders, ages 18-25. Two neural networks were developed to identify the lowest 30% and highest 30% of estimated future performance in a mathematics test. Both models were able to reach 100% correct identification of all students, both in the target group for each network. They showed interesting differences in the pattern of relative normalized importance of those variables with the highest participation in the predictive model. For Low performers, basic cognitive variables were most important, while self-

regulation and background variables were good predictors for High performers. Their impact on educational quality and improvement, as well as accountability is highlighted.

Although there is substantial research which has investigated the influences of: (a) working memory (Adams & Hitch, 1997; Ashcraft, 1995; Geary, 1990; Geary & Widaman, 1992; Hitch, 1978; Lemaire, Abdi, & Fayol, 1996; Logie, Gilhooly, & Wynn, 1994; Passolunghi, Cornoldi, & Di Liberto, 1999; Passolunghi & Pazzaglia, 2004; Pickering, 2006; Widaman, Geary, Cormier, & Little, 1989); (b) attentional systems (Posner & Rothbart, 1998; Rueda, Posner, & Rothbart, 2004); and (c) motivation, on mathematical performance and self-regulation in general, these studies have looked at the separate effects of these components. Therefore, we have little understanding and data about how they impact performance when taken together, understanding their interactions, and how much each can predict the mathematical performance in an integrated model (Cascallar & Musso, 2008; Musso & Cascallar, 2009). On the other hand, new methodologies and technologies, and the emergence of predictive systems, have focused on the possibility of assessments which use a wide range of data or student productions to evaluate their performance without the need of traditional testing (Boekaerts & Cascallar, 2006). The purpose of this research was to develop predictive classification models that could identify with sufficient precision two groups of students corresponding to the highest 30% and lowest 30% of estimated future performance in a mathematics test, utilizing only cognitive, motivational and background variables, with no assessment of the mathematics content present in the test. It was expected that results would enable the development of an "early warning" system which would allow early and prompt intervention with those students most in need of support and remediation in mathematics (at the level of exit from secondary education, and beginning of university studies). Similarly, this approach could serve to identify top or advanced students and improve their placement and/or career choice. The sample included over 700 university students, of both genders, ages between 18 and 25, attending the first or second year in several different disciplines (Psychology, Engineering, Medicine, Law, Social Communication, Business and Marketing), academic year 2009-2010. After giving informed consent, all the participants completed the following cognitive tasks, during the first session (60 minutes): 1) Attention Network Test (ANT) (Fan, McCandliss, Sommer, Raz, & Posner, 2002), and 2) Automated Operation Span (Unsworth, Heitz, Schrock & Engle, 2005). In a second session (90 minutes) participants completed the Learning Strategies Questionnaire (LASSI, Weinstein, Schulte & Cascallar, 1982; Weinstein, Palmer, & Schulte, 1987), the Online Motivation Questionnaire (OMQ) (Boekaerts, 2002) before- after the math task and were given a mathematics test consisting of 65 items (50 items from a national mathematics test calibrated at exit from secondary education, and 15 items from the 12th grade TIMSS test administered worldwide). In addition, a questionnaire was applied in order to collect background variables, including individual and family characteristics.

Procedure: It had been used a back propagation network, that is, a multilayer network composed of nonlinear units, which computes its activation level by summing all the weighted activations it receives and which then transforms its activation into a response via a nonlinear transfer function. The results obtained were very successful in terms of the effectiveness of the two predictive classificatory models developed. Both models were able to reach 100% correct identification of all students, both in the target group for each network (Highest 30% of scores or Lowest 30% of scores, respectively) and those "not belonging" to the target group. Both networks showed interesting differences in the pattern of relative normalized importance of those variables with the highest participation in the predictive model. For the Low performers (those predicted to be in the lowest 30% of scores), several basic cognitive variables were most important, such as "reaction-time" and "working memory capacity". On the other hand, results from the predictive model for those expected to be in the Highest 30% of the scores, the top predictors with the most significant participation were self-regulation and background variables. Besides the evident predictive power of both neural networks to model the expected performance of the low and high performance groups, this methodology has also detected important differences in the factors that seem to underlie the students' performance. Among the lowest 30% of the student group, the main determinants of performance appear to be the basic cognitive processing variables, indicating the degree to which they represent the areas of relative weakness in the group, and more discriminating from the rest of the students. On the other hand, among the high 30% of the student group, the main determinants appear to be self-regulation and background variables (particularly how interested they were in the task, and social indicators such as parents' occupations), leaving the cognitive variables at much lower levels of importance, probably also due to the fact that they are more evenly represented in the group and are therefore less discriminating. The predictive systems approach allows for the understanding of the students' individual characteristics, in addition to the prediction of expected performance levels. This opens major possibilities for improvement of evaluation procedures and the planning of interventions. In addition it has implications for the application of these methods in educational research and in the implementation of diagnostic "early-warning" programs in educational settings, as well as informing cognitive theory and the development of automated tutoring and learning systems. The capacity to very accurately classify students, which is also what tests attempt to do (usually with much less success in terms of accurate classifications), without the performance sampling issues of traditional testing is a major step in using a much broader picture of a student's overall inputs into any attempted performance,

and therefore a much more valid approach to educational evaluation. In turn, this new approach allows for the conceptualization and development of new modes of assessment which could facilitate breaking away from traditional forms of testing while at the same time improving the quality of the assessment (Segers, Dochy & Cascallar, 2003).

Predicting academic performance in higher education: Role of cognitive, learning and motivation

Eva Kyndt, Katholieke Universiteit Leuven, Belgium; Mariel Musso, Katholieke Universiteit Leuven, Argentina;

Eduardo C. Cascallar, Katholieke Universiteit Leuven, Belgium; Filip Dochy, K.U.Leuven, Belgium

There is a substantial body of literature investigating academic performance. Former research has shown that a variety of student characteristics both states and traits effect academic performance. In this research study we will predict general academic performance in the first bachelor year educational sciences, based on students' motivation, approaches to learning, working memory capacity and attention, by means of a neural network analysis. Since the goal of a neural network analysis is classification it allows us to investigate the predictive value of the different variables for different categories of students. In this study three neural network analyses are performed for three categories of academic performers: the top 20%, the bottom 20%, and the 60% middle group of students. The relative importance of the variables will be examined in order to determine whether or not every variable is important for every category of students. Participants in this study were 128 university students. Results show that working memory capacity and attention are both good predictors of academic performance, especially for the best and weakest performers of the group. Students' motivation and approaches to learning were good predictors for the group of students whose performance was in the middle 60%.

A substantial body of literature has been dedicated to the educational achievement of students and what influences it (Lehto, 1995; Vansteenkiste, Simons, Lens, Sheldon & Deci, 2004). This study will investigate whether working memory capacity, attention, motivation and students' approaches to learning can provide enough information for a correct predictive classification of their academic performance. Research using traditional methods, has shown that all of these variables are related to students' academic achievement (Lehto, 1995; Trigwell & Prosser, 1991; Vansteenkiste et al., 2004). Neural network (NN) analysis has been utilized in business and social sciences as a statistical methodology for classification and recognition of patterns (Detienne, Detienne & Joshi, 2003; Neal & Wurst, 2001). However, when focusing on educational literature very few studies apply neural network analysis (Cascallar et al., 2006; Wilson & Hardgrave, 1995). Preliminary research applying NN-analysis suggests that NN-analysis may substantially improve the validity of the classifications and increase the accuracy and predictive validity of test (or other educational) information (Musso & Cascallar, 2009; Perkins, Gupta & Tammana, 1995). When applying NN-analysis, it is important to realise that although neural networks can address some of the same research issues as regression, it is inherently a different mathematical approach (Detienne et al., 2003). In this study, we will carry out predictive classifications of students that score high, low or around the mean. Moreover, for each of these categories we will look at the relative importance of the different predictors in this study. In total 236 university students, enrolled in the second bachelor year of educational sciences, participated in the study of whom the majority was female. For all independent variables validated measures were used. Approaches to learning were measured by means of the R-SPQ-2F (Biggs, Kember & Leung, 2001). Students were asked to answer the questions according to how they usually studied in the first bachelor year. For motivation, an adapted version of the Self-Regulation Questionnaire (Ryan & Connell, 1989) was administered. Working memory capacity was assessed by the 'Automated Operation Span Task' (Unsworth et al., 2005) and Attention was measured by the 'Attention Network Test' (Fan et al., 2002). Finally, the dependent variable academic performance equals the average percentage that students achieved in their first year in the bachelor program of educational sciences. In total three neural networks were carried out predicting the top 20%, bottom 20% and middle group of academic performers. The evaluation of the neural network is based on the precision, sensitivity, specificity, ROC curves and accuracy. The evaluation of the first network predicting the top 20% scores of academic performance can be considered very good. The precision of the network equals .86. The network's sensitivity equals 1 and can be described as perfect. The specificity of the network amounts .83. The area under the ROC curve equals .956. The accuracy of this first neural network amounts 82.6% in the training phase, in the testing phase the accuracy increased to 100%. The actual weight and normalized importance of the different predictors indicate that orienting attention, overall attention, and processing speed are the most important predictors. When adding the variables motivation and students approaches to learning to the network, the accuracy and overall evaluation of the model declined. The network including motivation and approaches to learning is evaluated as weak, especially in contrast with a network with only the cognitive capacities of the students as input. The second NN-analysis was designed to predict the bottom 20% of academic performance. The precision of this second neural network equals .77. The network's sensitivity equals 1. The specificity of the network amounts .70. The area under the curve equals .897. In the training phase accuracy reached 76.5%, while in the testing phase the

predictive accuracy achieved equaled 100%. Working memory capacity, processing speed and orienting attention are the most important predictors for students with scores in the bottom 20%. For this network, adding students' motivation and approaches to learning also declined the evaluation of the network. Indicating that these variables decrease the predictive accuracy of the network rather than adding valuable information. The third and final neural network focused on predicting the academic performance of the group of students with the middle 60% scores. The precision of this third neural network equals .56. The network's sensitivity equals .79. The specificity of the network amounts .27. The area under the curve for this network equals .681. This indicates that the prediction of this middle group could be more complex and requires additional variables. In the training phase accuracy was 74.5%, while in the testing phase the predictive accuracy reached 79.3%. In this final network processing speed, a surface approach to learning, working memory capacity and controlled motivation are the most important predictors. It is important to notice that in this network students' motivation and approaches to learning did add valuable information to the network. This study faces some limitations for generalisation. The first limitation is the sample composition and size. Due to practical constraints, more specifically the administration of the cognitive tests, our sample size was limited to 236 students. Moreover, the vast majority of the sample was female. Former research does not offer a clear indication of whether or not this disproportion affected our results (Cano, 2005; Castagnetti & Rosti, 2009; Lynn & Irwing, 2008; Mattick, Dennis & Bligh, 2004; Naglieri & Rohjahn, 2001). Another limitation of this study is the fact that we chose to investigate 'only' four independent variables while NN-analysis has the ability to handle a large amount of input variables. Future research could include more variables when predicting academic performance by means of NN-analysis. This study supports the idea that the use of predictive systems could contribute to the prediction of future academic performance, which in itself could be a useful construct in tasks like selection for academic admission, academic advising, and placement in general. At a theoretical level these results confirm the contribution of cognitive variables in the measurement of academic performance and refines the body of knowledge concerning approaches to learning and motivation.

SYMPOSIUM

Investigating domain-specific epistemological and learning beliefs

Chairperson: Bettina Roesken, Ruhr-Universität Bochum, Germany

Organiser: Bettina Roesken, Ruhr-Universität Bochum, Germany

Csaba Csikos, University of Szeged, Hungary

Discussant: Krista Muis, McGill University, Canada

Students' epistemological beliefs and beliefs about learning play an important role in their academic achievement. In Hofer's (2001) and Muis' (2007) models, students' epistemological beliefs have a fundamental, albeit often indirect effect on school-related academic factors. Previous research on student epistemological beliefs has primarily focused on general epistemic beliefs, i.e., what counts as knowledge, and how it is constructed in general (cf. Hofer and Pintrich, 2002; Swe Khine, 2008). Nevertheless, there are some domains where specific inventories have been developed, i.e., in mathematics (see De Corte, Op 't Eynde & Verschaffel, 2002; Schommer-Aikins, 2008), science (see Elder, 2002), reading (see Mokhtari and Reichard, 2002) and EFL/ESL learning (see Horwitz, 1985). Developing high reliability paper-pencil questionnaires on both levels of general and domain-specific epistemological beliefs requires considerations of validity issues like the question of congruity between Likert-scale propositional statements and real-world activities to which those statements pertain. The aim of this symposium is to demonstrate how domain-specific belief systems can be assessed, and what role they can play in academic achievement. In the first paper, by means of a questionnaire, comprehensive data was collected that gives an overview on Finnish students' beliefs related to their experiences as learners of mathematics. The second paper focuses on reading-related beliefs based on the MARS questionnaire (Mokhtari and Reichard, 2002). Self-referential statements about what one usually does were matched with general epistemic statements about what people usually should do in different reading-related situations. The third study focuses on how statements formulated in first person and third person differ not only in their means, but in the structure of the belief system that they manifest.

Structuring students' beliefs about learning mathematics

Bettina Roesken, Ruhr-Universität Bochum, Germany

For more than twenty years now, the influence and significance of beliefs have been in the focus of research in the field of mathematics education. Even nowadays, students' beliefs about mathematics and its teaching and learning are key since they are a decisive parameter for engagement and success in school. To approach the structure of students' mathematics-related beliefs we have used a questionnaire to collect and analyze data from a sample of secondary school students in Finland. We explored what dimensions describe their beliefs of learning mathematics, how they are related and what structure they generate. By means of factor analysis we obtained seven dimensions that are

described by reliable scales, which allow drawing an average image of Finnish students' beliefs about learning mathematics. We further analyzed relations between the dimensions and what structure they generate. Thereby a core of three high correlating dimensions could be identified. Participants in our study were 1436 randomized chosen students of secondary school, grade 11, from overall Finland.

Students' mathematics-related beliefs are a decisive parameter for engagement, motivation and success in school. The study of students' beliefs about mathematics and its teaching and learning has received much attention in recent years and many results have been presented. These studies are in most cases descriptive, for example reporting typical beliefs held by students (e.g. Ma & Kishor, 1997). Some of the studies compare student beliefs in different countries (e.g. Pehkonen, 1994) or according to background variables such as gender (e.g. Frost, Hyde and Fennema, 1994). Most of the studies of beliefs have been carried out with a separate focus on cognitive, motivational or affective aspects and only few contributions address explicitly belief systems. However, Op 't Eynde, De Corte and Verschaffel (2002), consider explicitly the structure of beliefs about mathematics. They provide a framework of students' mathematics-related beliefs that is based on the constitutive dimensions of object (mathematics education), self, and context (class), which further lead to several sub-categories. In our study, we focus explicitly on studying the structure of students' mathematical beliefs. To approach the subject, we have used a questionnaire to collect and analyze data from a sample of secondary school students. We explore what dimensions describe their beliefs of learning mathematics, how they are related and what structure they generate. The view of mathematics indicator has been developed in 2003 as part of the research project "Elementary teachers' mathematics" financed by the Academy of Finland (project #8201695). It has been applied to and tested on a sample of student teachers and was slightly modified for the present sample. The statements in the questionnaire are grouped around the following topics: · Experiences as mathematics learner · Image of oneself as a mathematics learner · View of mathematics and its teaching and learning The items also comprise a self-confidence scale containing ten items from the Fennema-Sherman mathematics attitude scales (Fennema & Sherman, 1976). The students were asked to respond on a Likert scale (5 point, agree to disagree) to statements such as the following: · I have worked hard to do mathematics · My family has encouraged me to study mathematics · I can get good grades in mathematics or · I would have needed a better teacher. The participants in our study came from fifty randomly chosen schools from overall Finland, including classes for both, advanced and general mathematics. The respondents were in their second year course for mathematics in grade eleven. Altogether 1436 students filled in the questionnaire and gave it back. Factor analysis led us to differentiating seven dimensions describing students' beliefs about learning mathematics. Those dimensions can be assigned to different topics around their experiences with mathematics. Three factors relate to personal beliefs since a clear self-relation aspect regarding ability (F1), effort (F2) and success (F7) can be found. Although the factors ability (F1) and success (F7) both deal with capacity to learn mathematics, they clearly broach different issues. F1 describes a more static view on ability while F2 stands for a more dynamic view mentioning student's expectations about future success. Two factors relate primarily to students' support by their teacher and family (F3: teacher quality, F4: family encouragement), one to emotions (F5: enjoyment of mathematics) and one to mathematics as a subject (F6: difficulty of mathematics). In terms of the framework suggested by Op't Eynde et al. (2002, 2004) the dimensions can be assigned to all main categories and, on a finer grain, to most of the subcategories. Nearly all dimensions correlate significantly with each other. Further, the correlation matrix indicates that three of the factors, that is ability (F1), difficulty of mathematics (F6) and success (F7), are closely related and form a core of students' beliefs about learning mathematics. When we studied the relations between the dimensions, we were able to identify a core of view of mathematics (Green, 1970) with a large value of covariance. This core consists of the dimensions ability, difficulty of mathematics and success. In addition, there is a moderate correlation of enjoyment of mathematics (F5) to this core. Hence, a student with a positive view believes him or herself to be talented in mathematics, to do well in the future, experiences mathematics as easy and also likes to do mathematics. These dimensions are crucial for view of mathematics and even form an obstacle for students when they do not feel able to do mathematics and simultaneously experience mathematics more and more difficult. Thus, the present study supports previous research on mathematics-related beliefs structure. In our analysis we found evidence for an extended conceptualization of beliefs as a system. By means of factor analysis we determined useful and statistically robust dimensions of students view of themselves as learners of mathematics.

References

- Fennema, E. & Sherman, J.A. (1976). 'Fennema-Sherman mathematics attitudes scales', *JSAS Catalog of Selected Documents in Psychology*, 6, 31 (Ms. No. 1225).
- Frost, L.A., Hyde, J.S. & Fennema, E. (1994). Gender, mathematics performance, and mathematics related attitudes and affect: a meta-analytic synthesis. *International Journal of Educational Research*, 21, 373–385.
- Green, T.F. (1971). *The activities of teaching*. New York: McGrawhill.
- Ma, X. & Kishor, N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics, a Meta-analysis. *Journal for Research in Mathematics Education*, 28 (1), 26-47.

Op 't Eynde, P., De Corte, E., & Verschaffel, L. (2002). Framing students' mathematics-related beliefs. A quest for conceptual clarity and a comprehensive categorization. In G.C. Leder, E. Pehkonen, & G. Tröner (Eds.), *Beliefs: A hidden variable in mathematics education?* (pp. 13-37). Netherlands: Kluwer Academic Publishers.

Pehkonen, E. (1994). On differences in pupils' conceptions about mathematics teaching. *The Mathematics Educator*, 5(1), 3-10.

Measuring beliefs on language learning

Csaba Csikos, University of Szeged, Hungary; Eva Bacsa, University of Szeged, Hungary

This study presents the process of developing a questionnaire on beliefs concerning language learning. The research aimed at developing a Hungarian questionnaire that (1) can be used as a means of formative evaluation in the classroom (2) utilizing items of English language instruments and (3) contains self-referential statements about ESL learning, and – being parallel in its content – contains statements about one should do when learning English. The primary objective of the present study is to focus the attention such a validity problem of questionnaire development that has not been emphasized in the literature – to the differences of self-referential statements and general epistemological statements which occurs at the wording of the questionnaire items. The findings of the two-round assessment process clearly indicates that the wording of the statements is a factor to be considered when developing a new instrument. Linguistic inconsistencies might deteriorate the validity of instruments intending to measure students' beliefs.

Introduction

Victori and Lockhart (1995, p. 224) define beliefs about language learning as "general assumptions that students hold about themselves as learners, about factors influencing learning and about the nature of language learning". Several research findings draw attention to the importance of beliefs in the process of mastering a foreign language (Horwitz, 1989; Cotteral, 1999; Diab, 2006; Rieger, 2009). However, the means and methods of exploring beliefs have been subject to serious debates from the beginning of research in this field (Cotteral, 1995; Kuntz, 1996; Sakui & Gaies, 1999; Nikitina & Furuoka, 2006). Different viewpoints have been articulated concerning the measurement of beliefs and about whether they could be treated as elements of metacognitive knowledge. The majority of research in the field uses the Beliefs About Language Learning (BALLI) (Horwitz, 1987) questionnaire, or its modified versions (Sakui and Gaies, 1999; Amuzie and Winke, 2009; Rieger, 2009), albeit both its reliability and its validity are questionable and the results are difficult to interpret. The major problem is the lack of statistical analysis of the domains defined by the author (Kuntz, 1996), hence the comparison of the scales are impossible, and the results might only be compared on the item level. Further problems with the instrument include overlap between the individual dimensions and the appearance of latent factors (Piniel, 2009). In addition, there is a need for formal and content analysis of the original instrument. Some of its items should be revised, since modern linguistic aids and authentic sources are getting more and more available to the students and it would be important to map students beliefs in these fields as well. Furthermore, the original instrument as well as the modified versions operate diverse linguistic formulae that lack consistency, hence causing validity concerns.

The research

The instrument presented here is the improved Hungarian version of Beliefs About Language Learning (BALLI) (Horwitz, 1987) questionnaire. The development was done in two steps. **Study 1** In the first step of developing the instrument, a 60 item questionnaire was constructed using two ways of wording for each item that are distributed among three questionnaires. The instrument adopted 25 items from BALLI (Horwitz, 1987), 7 items from Sakui and Gaies (1999) and contained another 28 newly developed items. Versions A, B, and C each included 40 items 20 of which were written in first person singular 20 written in third person singular. The instrument is sensitive to Hungarian specialities of language learning and to the beliefs about more modern technological and authentic possibilities of language learning. Our sample consisted of 210 students. The aim of the study was to compare the two kinds of wordings. It was hypothesized that the two versions measure the same beliefs. Significant differences were detected between the means of the two versions. More statements in third person got higher scores, however, while secondary students preferred this format, elementary students scored higher in the items where first person was used. The results suggest that the validity of an instrument is influenced by the wording of its items, hence research was continued. **Study 2** In the following step, the number of items was reduced, and a singular version of the instrument contained 16 pairs of items with the same content, but different wording (first vs. third person) along with another 18 single items with first person subject. The item pairs were the ones previously showing the largest differences, the single items were those with highest reliabilities. The second data-collection was conducted on a sample of 363 17-year-olds. Data were analysed using descriptive and comparative statistics, factor and cluster analyses. Data analysis was done on the set of all items and on the sub-questionnaires as well. (Third person item pairs and single

items together are referred to as sub-questionnaire A, while first person item pairs and single items together as sub-questionnaire B.) The hypotheses were as follows: 1. No significant difference can be detected between the item means of the sub-questionnaires. 2. Items of sub-questionnaire A and B can be expressed in a single scale. 3. Sub-questionnaires are statistically identical, i. e. they measure the same beliefs. Both the whole questionnaire (.88) and the sub-questionnaires (A: .81, B: .84) had acceptable reliabilities. Item pairs were compared with paired sample t-test to test the first hypothesis. It resulted in significant differences in item preference in 12 (75%) of the 16 cases, which differences are distributed equally among the first and third person versions. Thus, it can be stated that there are significant differences between the item means of the two versions. Factor analysis was conducted involving the sub-questionnaires to test the second hypothesis. The KMO indices (A: .82, B: .84) and the number of the factors (A: 10, B: 9) were high in both cases. The interpretation of the factors was not difficult in case of the B version, it covered mostly the pre-set categories. Version A, however, was problematic. Item distribution among the factors are mostly found random, difficult to interpret. The comparison of the two factors resulted in some form of correspondance, which means that the items of the two sub-questionnaires might not be expressed on the same scale. The third hypothesis is tested by the other two and some additional analyses (cluster analysis and analyses with merged variables). They show that the sub-questionnaires do not measure the same construct, which raises validity concerns. These results contribute to the verification of the existence of a validity concern that has not been stressed above, namely that there are differences between self-referential and general epistemological beliefs. This means that in the development of any further instruments, item wording has to be a central issue.

Investigating reading-related beliefs among vocational secondary school students

Csaba Csikos, University of Szeged, Hungary; Aniko Molitorisz, University of Szeged, Hungary

Analyzing epistemic beliefs is recently girdled with an increasing scientific interest (Hofer, 2001; Bromme, Kienhues & Stahl, 2008). Besides the measurement of general epistemic beliefs about knowledge and learning, questionnaires to assess students' domain specific beliefs has also been designed (mathematics: De Corte, Op't Eynde & Verschaffel, 2002; EFL/ESL: Horwitz, 1985). The questionnaire we applied in our present study contains 19 statements transformed from Mokhtari and Reichard's (2002) Metacognitive Awareness of Reading Strategies Inventory and three additional statements based on the study by O'Sullivan (1992). The aim of this investigation is to assess the reading-related beliefs of 10th grade vocational secondary school students by our questionnaire. Three hypotheses were tested: (1) The questionnaire is a reliable measure of reading-related epistemological beliefs. (2) Students believe that rereading and effort making are more useful than adaptive strategies like going back and forth in the text to find relationships in it or adjusting the reading speed. (3) Students' reading-related beliefs are connected with background variables such as the attitude of reading. Our sample consisted of 302 10th grade students from three vocational secondary schools in Budapest. The reliability of the instrument was acceptable. Results showed that students assign more importance to rereading and effort making while reading. Significant correlations were found with background variables like the attitude of reading and the use of the internet for finding the meaning of unknown words while reading. The educational implications and consequences are discussed.

Introduction

Theoretical background

There has been an increasing scientific interest on the analysis of students' epistemic beliefs in order to get a closer understanding about what students think about knowledge and learning (Hofer, 2001; Bromme, Kienhues & Stahl, 2008). According to Muis (2007) and Muis and Franco (2009), epistemic beliefs influence school achievement through achievement goals and learning strategies. Besides studying general epistemic beliefs, assessment tools for measuring domain specific epistemic beliefs have also been developed (mathematics: De Corte, Op't Eynde & Verschaffel, 2002; EFL/ESL: Horwitz, 1985). In reading, O'Sullivan (1992) studied the relationship between reading beliefs (including teachers' and parents' beliefs) and reading achievement. She found that students' beliefs about reading influenced significantly their achievement. Mokhtari and Reichard's (2002) Metacognitive Awareness of Reading Inventory (MARSI) was developed after a review of the literature concerning the preceding methods for assessing reading strategy use. Their questionnaire contained thirty self-referential statements about what one usually does while reading academic or school-related materials and its purpose was to examine the students' degree of awareness of their own processes involved in reading. While constructing our questionnaire about reading-related beliefs, 19 statements were based on the MARSI scale and three additional statements were formulated upon O'Sullivan's (1992) study. Items from MARSI were transformed from personal strategy use to general belief: e. g. 'I take notes while reading to help me understand what I read.' was transformed to 'Taking notes while reading helps better understanding.' or 'I underline or circle information in the text to help me remember it.' was transformed to 'Underlining or circling information in the text while reading helps the reader remember it.' Based on O'Sullivan's

study, we constructed a statement concerning the effort made while reading. We also applied two statements about parents' and teachers' beliefs concerning the student's reading ability (e.g. 'My parents believe I am a good reader.')

Aims and hypotheses

The aim of our research was to measure students' reading-related beliefs while reading academic or school-related materials. The following hypotheses were tested: (1) Our questionnaire is a reliable measure of reading-related epistemological beliefs. (2) Students believe that rereading and effort making are more useful than adaptive strategies like going back and forth in the text to find relationships in it or adjusting the reading speed. (3) Students' reading-related beliefs are connected with background variables such as the attitude of reading or the use of the internet in order to find the meaning of unknown words or expressions.

Methods

Participants 302 students of 10th grade filled in the inventory in three vocational secondary schools in Budapest in June 2010. Test and procedure Our questionnaire had two parts. The first part contained questions about socio-cultural and reading-related background variables including sex, number of siblings, number of books at home, attitude of reading, the use of the internet for searching the meaning of unknown words or expressions while reading etc. The second part contained the 22 epistemic statements about what people usually should do while reading academic or school-related materials for a better comprehension. Students had to answer on a five-point Likert-type scale by marking to what extent they agree with the statement. Results Our questionnaire about reading-related beliefs showed acceptable reliability (Cronbach-alpha: .78). Factor-analysis showed to be appropriate (Kaiser-Meyer-Olkin index = .75) and the statements were separated into seven different factors explaining 56 percent of the variance. The statement with which students agreed the most was 'If one puts more effort in reading, one can better understand what one is reading.' Students agreed the least with the following two statements: 'Trying to guess the meaning of unknown words or phrases while reading helps understanding.' and 'It is worth trying to guess what the material is about while reading.' (for the first and last three statements see table 1) As for the relation with background variables, the frequency of using internet to find the meaning of unknown words or expressions showed statistically significant relation with reading-related beliefs ($r = .23$). Significant correlation was also found between students' beliefs about reading academic materials and their attitude of reading ($r = .20$). Those students who talk about books with their family or friends, expressed significantly stronger agreement in the case of seven statements than those who don't talk about books.

Discussion – Theoretical and educational significance

The results confirmed our hypotheses. The reliability of the instrument was acceptable. The means of the items showed to which activities students assign more/less importance while reading academic materials. Significant correlations were found with background variables like the attitude of reading and the use of the internet for finding the meaning of unknown words while reading. In accordance with the literature, we suppose that the assessment of reading-related beliefs fosters more precise understanding of epistemic beliefs about learning and our results also can be used in designing more effective comprehension development programs.

SYMPOSIUM

Utilizing assessment information for (in)formative feedback

Chairperson: Dominique Sluijsmans, HAN University of Applied Sciences, Netherlands

Organiser: Anders Jonsson, Kristianstad University College, Sweden

Anton Havnes, Oslo University College, Norway

Discussant: Dai Hounsell, University of Edinburgh, United Kingdom

In order to support student learning, feedback is of crucial importance, since the students need to be informed about their current performance if they are to perform better in the future. The nature of feedback and its effects on student learning has been extensively investigated, as seen for instance by the large number of meta-studies and literature reviews on the subject. This research has, however, produced somewhat intriguing and sometimes even contradictory results, making it difficult to get a general view of this field of knowledge and even more so to create a simple set of guidelines for effectively supporting student learning. Clearly, more research is needed on this topic, investigating not only the effects of feedback, but also how students respond to feedback. The aim of this symposium is therefore to bring different contributions focusing on this topic together, providing: (1) a "state of the art" picture of the research, (2) a discussion about the conceptual underpinnings of the criteria for students' use of feedback, and (3)

examples of empirical research exploring students' use of feedback in a learning context. With these presentations, and by including perspectives from four different countries (Sweden, The Netherlands, Norway, and Scotland), we hope to create favourable conditions for a dialogue about a – until now – largely neglected area of research.

Students' use of feedback in higher education: a literature review

Anders Jonsson, Kristianstad University College, Sweden

This paper investigates what research evidence can be found on how students use information about their performance on assessment tasks, as provided by tutor feedback. A broad search was performed in several online databases, including recent empirical studies on feedback use in higher education, after which the reference lists in these studies were used to find further studies, going back to 1990. In total, less than 100 studies were found. The results from the review show that there are very few studies addressing students' use of feedback, and also that most of these rely on students' own statements in interviews. Only a hand full of studies have investigated what students actually do with their feedback. As indicated by these studies, some students do seem to have effective strategies for using feedback, but there are also a number of students who seem to have rather vague strategies, such as having to "work harder". Yet another group of students seem to have no strategies at all, or use the feedback in counterproductive ways, such as erasing or avoiding problematic areas. As compared to studies investigating how students use feedback, there is a much larger number of studies investigating factors that might promote or impede students' use of feedback. Examples of such factors are timing and relation to criteria. Most notable, however, is the fact that there are seldom any real possibilities for students to use the information they receive about their performance.

According to Sadler (1989), key premises for students to be able to "alter the gap" between current performance and the performance aimed for are that: (1) They must know what performance is aimed for; (2) They must be able to assess their performance in relation to some standard(s); and (3) They must possess some strategies to modify their performance in the light of the information provided by the comparison. While the second premise might well be fulfilled by the teacher assessing the student, thereby gathering the necessary information about current performance and passing it on to the student, the third premise inevitable involves the student. It must be the student that uses the information to adjust her performance, even if this process can also be aided by the teacher to some extent. Still, very little is known about how students use the feedback they receive and this paper therefore investigates what evidence can be found in the research literature on how students use information about their performance on assessment tasks, as provided by tutor feedback. The following questions have guided the review: (1) How do students use feedback? and (2) Which are the factors that promote or impede students' use of feedback?

Method

Research on students' use of feedback was searched by starting from a number (36) of recent publications on the topic, found by searching broadly online in a number of databases. The reference lists in these articles were then used to find new articles, continuing iteratively throughout the review process. Only studies explicitly reporting on empirical research on students' use of feedback in higher education were included and the search has been limited to include only printed and peer-reviewed material, such as articles in journals, edited books, research reports, and dissertations. Furthermore, a time limit was set to 1990, and studies published before that date has not been included.

Findings

In total, less than 100 studies were found. The majority of the studies included in this review were published as journal articles, followed by chapters in edited books, and research reports. The studies included vary across academic subject, but the feedback considered is almost exclusively written comments on students' written work. Research designs encompass mostly questionnaires and interviews, sometimes in combination. A number of studies have complemented students' perceptions with analyses of examination results or tutor feedback. The results from the review show that there are very few studies addressing students' use of feedback, and also that most of these rely on students' own statements in interviews. Only a hand full of studies have investigated what students actually do with their feedback. As indicated by these studies, some students do seem to have effective strategies for using feedback, but there are also a number of students who seem to have rather vague strategies, such as having to "work harder". Yet another group of students seem to have no strategies at all, or use the feedback in counterproductive ways, such as erasing or avoiding problematic areas. As compared to studies investigating how students use feedback, there is a much larger number of studies investigating factors that might promote or impede students' use of feedback. Examples of such factors are timing and relation to criteria. Most notable, however, is the fact that feedback is often used in accordance with a transmission model, rather than a feedback loop, and that there are seldom any real possibilities for students to use the information they receive about their performance. What becomes evident,

therefore, is that merely following a set of guidelines for producing high-quality feedback – even if it means providing the students with large amounts of personalized and detailed feedback – will probably still not do the job. This is because, although some students do possess strategies to modify their performance in the light of the information provided by feedback, many students seem to lack such strategies – and teaching strategies for using feedback does not generally seem to be a part of the curriculum. Instead, what seems to be needed is the active engagement of the students with feedback in relation to their own work, for instance through the use of model answers or exemplars, so that the students learn what high-quality work looks like, but also the active engagement with criteria and standards through peer- and self-assessment, so that they become able to assess their own work. Therefore, strategies for actively engaging in feedback have to become an integrated part of the curriculum, if most students (as opposed to only some of them) are to be able to "alter the gap".

References

Sadler, R. D. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119-144.

Following recommendations: differential use of feedback information

Harm Tillema, Universiteit Leiden, Netherlands

To date, many studies on feedback have looked into the conditions and methods of feedback provision; however, often without clear specification of its utilization criteria, i.e. the outcomes or effects of feedback on learning. This study provides a conceptual reinforcement of utilization criteria and looks into the variables that govern the process of use of feedback, viewed as: a) Acceptance of feedback, which is subsequently linked to b) Following recommendations. Furthermore this study explored utilization outcomes on student learning relative to the way assessment information was provided to these students by experimentally varying two formats of assessment provision of feedback, i.e. the portfolio method (instructor provided and individually targeted) and peer assessment (peer provided and generically targeted). A model is presented in which different influencing feedback provision variables in assessment are specified in relation to factors governing acceptance of feedback and the following of recommendations. Analysis of data in a field experimental pre test post test design, using one group of student teachers (subjects as their own control) (n=47) in learning to teach, showed that assessment format has a differential effect on acceptance of feedback (mainly on clearness and trust) which subsequently is related to following recommendations (mainly compliant and proficient use). Interaction effect revealed that the portfolio instrument addresses different acceptance criteria (trust) than peer assessment (feasibility) as well follow up criteria (adaptive use as compared to compliant use). This finding indicates that assessment tools can be utilized to provide a targeted impact from feedback.

"Feedback is only feed-back when it is processed", i.e., being used. To date, many studies on feedback have looked into the conditions and methods of feedback provision (Hattie & Timperley, 2007); however, often without clear specification of its utilization criteria, i.e., the outcomes or effects of feedback on (subsequent) learning. Student satisfaction with feedback would be an insufficient criterion to determine change in learning or achievement (Sadler, 2010). This study provides a conceptual reinforcement of utilization criteria and looks into the variables that govern the process of use of feedback, viewed as a) acceptance of feedback, which is subsequently linked to b) following recommendations. Furthermore, this study explored feedback utilization outcomes on student learning relative to the way assessment information was provided to these students by experimentally varying two formats of feedback provision by way of different assessment tools, i.e., the portfolio method and peer assessment (Tillema & Smith, 2009). A model is presented in which different influencing feedback provision variables in (formative) assessment tools are specified in relation to factors governing a) acceptance of feedback (London, 2003) by specifying different levels of user recognition, adoption, and approval of provided assessment information (Shute, 2008); and b) following recommendations, by specifying different levels of use as the recognized or evidenced implementation of advice and comments made by independent raters; using the Hall and Loucks' theory of Levels of Use (1977). As influencing factors to determine feedback effects different formats of assessment information delivery were used: By contrasting peer assessment as a format in which a) evaluative perceptions of b) fellow students on c) observable classroom behaviours with portfolio assessment as a format in which a) reflection of b) the student him/her self on c) self selected evidence collection

Method

A field experimental pre-test post-test design was deployed using one group of student teachers (subjects as their own control) (n=47) who participated in a training course on learning to teach/teacher preparation in practice schools. During their practice teaching semester students received as their treatment an account of assessment information (written report) on their individual lesson performance which consisted in case of peer assessment of an evaluative scoring by their fellow students of the student's teaching performance and in case of the portfolio assessment of a

written evaluation form with feedback comments from their mentors/supervisors. After receiving assessment information from their assessors on their initial teaching lesson the students filled out the Acceptance of Feedback questionnaire consisting of three scales (based on instrument developed by Tillema & Smith, 2009). After giving a subsequent lesson by the student-teacher assessors (peers or mentors/supervisors depending on the assessment tool used) filled in the Levels of Use questionnaire, specifying the adoption of comments from the initial lesson appraisal (rating scale based on Hall & Loucks' LoU instrument) and a rating scale on student teaching performance for the individual lesson. Pre measurement was conducted using the TPL instrument on student teachers' beliefs on self regulation in professional learning (Tillema, 2010). Analysis of data consisted of Log-linear regression analysis (influence of self-regulation beliefs on assessment condition/instrument) and both criterion variables; as well as Ancova analysis on differences between measurements. The intervention was conducted during one semester with subsequent administration of peer assessment (first) followed by portfolio assessment.

Findings

The results showed that assessment format has a differential effect on acceptance of feedback (mainly on clearness and trust) which subsequently is found to affect following recommendation (mainly on compliant and fidelity of use; but hardly on proficient or expert use). Regression analysis showed a moderate effect ($\beta=.34$). Interaction effect revealed that the portfolio instrument addresses different acceptance criteria (mainly trust) than peer assessment (feasibility); this is also the case for the follow up criteria (peer assessment being related to adaptive use as compared to portfolio assessment with compliant use). Additional regression analyses will be performed on the covariate relations, and change measures: i.e., assessor difference in performance rating between lessons and (improvement in) competence checklist teaching performance.

Conclusion

This finding indicates that assessment tools can be utilized to provide a targeted impact as a result of giving feedback. In essence this study lends support to the argument that assessment information is filtered through the tools by which it is provided which can have far reaching effects on the adoption and subsequent utilization of assessment information (Kluger & de Nisi, 1996). Bridging feedback with subsequent learning builds on the acceptance of feedback as a multi-facetted variable which can be "manipulated" through specific instruction and teaching approaches. Feedback therefore can be framed by the intention and purpose the provider has in mind, and by varying feedback provision tools differential effects can be obtained on subsequent learning.

References

- Hall, G. & Loucks, S. (1977). A developmental model for determining whether the treatment is actually implemented. *American Educational Research Journal*, 14, 263-276.
- Hattie, H. & Timperley, J. (2007). The power of feedback. *Review of Educational Research*, 77, 81-112
- Kluger, P & De Nisi A. 1996. The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, 119, 254-85.
- London, M. (2003). *Job feedback: giving, seeking, and using feedback for performance improvement*. Mahwah: Lawrence Erlbaum.
- Sadler, D.R. (2010). Beyond feedback, developing student capability in complex appraisal. *Assessment & Evaluation in higher education*, 35, 535-550.
- Shute, V.J. (2008). Focus on formative feedback. *Review of educational Research*, 78, 153-189.
- Tillema, H.H. & K. Smith (2009). Assessment orientation in formative assessment of learning to teach. *Teachers & Teaching: Theory and practice*, 15, 391-405.

Assessment and feedback: Making learning visible

Anton Havnes, Oslo University College, Norway; Kari Smith, University of Bergen, Norway; Olga Dysthe, University of Bergen, Norway; Kristine Ludvigsen, University of Bergen, Norway

The main focus of this study is to what extent and how assessment information is received and attended to in educational settings. By empirically investigating how students and teachers use assessment and feedback information, we are generating new knowledge that will bring the international discourse on assessment and feedback forward. The research is linked to a two year intervention project involving six Norwegian upper secondary schools, and with a particular focus on vocational training and the three core subjects English, Norwegian, Mathematics. Data have been collected from three schools, including both vocationally and academically oriented education. The data consists of teacher (N=192) and student (N=391) surveys in all schools, providing a baseline for teachers' structuring of students' use of assessment information and feedback. Other sources of data are focus-group interviews from three of the schools, involving school leaders and teachers (one group of each from each school) and two groups of students from each school (all attending their first year of upper-secondary school). The interviews explore teachers' and students' conceptions of assessment and feedback, as well as how assessment information and

feedback is used to support students' learning, in greater detail. Findings from the study show that there are significant differences in the way students and teachers perceive feedback and the practice of feedback. There are also significant differences between boys and girls, as well as within the various school subjects. Students experience feedback in a more positive manner in practical subjects than in the more traditional academic subjects.

By calling attention to the influence of assessment and feedback on students' learning activities, this project addresses the challenge of improving the quality of teaching and learning. While the focus of assessment research has primarily been on how teachers assess and provide feedback to student (Hattie, 2007; Hattie & Timperley, 2007; Shute, 2008), our focus is on what happens in the wake of assessment: To what extent and how do teachers and students use assessment information in further teaching and learning? The above referenced meta-studies have revealed that at this point there is a gap in existing research knowledge. Instead of taking assessment as an end-point of a teaching-learning process, the focus of the current project is to regard it as a starting point for further learning and development.

Research question

The research question is: How is information from assessment and feedback used by students and teachers in upper secondary school to support students' learning processes and to improve their learning outcomes? The main focus is on what happens in the wake of assessment – to what extent and how assessment information is received and attended to in educational settings. By empirically investigating how students and teachers use assessment and feedback information, we are generating new knowledge that will bring the international discourse on assessment and feedback forward

Context of the study

The paper reports on a two year research and development project in collaboration with the regional county. The project focuses on feedback practices in the three core academic subjects in Norwegian secondary schools: English, Norwegian, and Mathematics. In addition to differences across subjects, we also look at potential differences of feedback in academic programs and vocational education (e.g. cookery, carpentry, hairdressing, car mechanics, etc). Six upper secondary schools are involved. The schools are all situated in the Western part of Norway. To participate in the project all upper secondary schools in the county were invited to apply, and the six project schools were selected according to the following criteria:

Mixture of rural and city schools

Mixture of academic and vocational oriented schools

Mixture of small and larger schools willing to emphasize assessment for learning in the school's development plan

The research project runs parallel to the developmental project. Quantitative survey data have been collected from five of the schools, and qualitative data from three schools, including both vocational training and academic oriented schools.

Study design

The research part of the project consists of two stages. The current paper focuses on an early stage in the project, while the schools were planning interventions in their feedback system and practices. A post intervention study will be carried out in autumn 2011. The early stage interventions mapping consist of: A survey questionnaire to teachers in the five schools teaching Norwegian, English, Mathematics, and Vocational subjects in the first year of upper secondary school (N=192). A survey to all students in the first year of upper secondary schools in the five schools (N=391). Focus-group interviews with groups of teachers and school leaders (one group of each from each school), and two groups of students (separately) in the three research schools. The quantitative data provides a baseline for teachers' structuring of students' use of assessment information and feedback on projects, assignments, and tests. Interview data explore in more details teachers' and students' conceptions of assessment and feedback and how assessment information and feedback is used to support students' learning.

Data analysis

SPSS was used for analysing the quantitative data. Using factor analysis allowed us to condense a large set of variables to four categories; 1) Perceived quality of feedback, 2) Students' use of feedback, 3) Peer feedback, and 4) Student involvement in assessment practice. Correlation analysis was used to examine significant differences between teachers and students in each of the four categories in the various subjects.

Findings

While students express great interest in feedback from teachers and the majority find feedback they get useful, there is no systematic use of feedback. There are only some rare cases where students' use of feedback is structured. Students are not involved in discussing assessment criteria. Moreover, the findings show there are significant

differences between teachers and students in how feedback practice is perceived; what teachers say they do and what students experience. Additionally, it seems that assessment-related activities are to a large extent viewed as an individual activity, and the engagement with peers in relation to assessment is minimal. While there are no differences in feedback practice in the two language subjects (Norwegian and English), there seems to be significant differences between the language subjects and mathematics, and mathematics and vocational subjects. Feedback is more specific in the latter cases. The analysis of the interview data elaborates on leaders', teachers', and students' perception on feedback practices.

Implications

These results go beyond tests, assignments, and projects, and the study addresses feedback as an element in ongoing classroom practice and students' learning activities, in this way providing a broad perception of feedback. The study suggests that more research on how feedback is perceived and used by learners is needed internationally, as well as in the Norwegian context. We therefore see the current study as a starting point in engaging in international comparative research-based discussion as part of the process of developing a deep knowledge base on "what happens with feedback", which is currently missing.

References

Hattie, J. (2007). Developing potentials for learning. Keynote at the EARLI conference, Budapest, August, 2007. Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77, 81-112.
Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, 78, 153-188.

SYMPOSIUM

Neuroscience and education: Examples from the field of mathematics learning

Chairperson: Daniel Ansari, University of Western Ontario, Canada

Organiser: Bert De Smedt, University of Leuven, Belgium

Daniel Ansari, University of Western Ontario, Canada

Discussant: Andrew Tolmie, Institute of Education - London, United Kingdom

The potential contribution of cognitive neuroscience to research on learning and instruction remains a hot and debated issue. In this SIG-Invited Symposium, the field of mathematics learning is taken as a case study to illustrate how transdisciplinary research in the field of neuroscience and education is emerging. Three empirical studies that combine behavioral and neuroscientific methods to answer educational research questions in the field of school-taught mathematics learning are included. The symposium covers a variety of methods, comprising neuroscientific methods, such as functional magnetic resonance imaging and electroencephalography, as well as behavioral methods, such as large-scale longitudinal cohort-sequential designs. Two ways of connecting neuroscience and education are illustrated: (1) Neuroimaging data might provide a level of analysis and measurement that cannot be accessed by behavioral studies alone, adding new insights to theories of arithmetic fact development (2) Neuroimaging data are used as an input to design large-scale studies to examine the development of algebraic mathematical problem solving skills in relation to cognitive demands of existing pedagogical practices, and to investigate the origins of atypical mathematical development. Two contributions originate from Centres for Educational Neuroscience, partially located in Education departments, and will reflect on their general research policy in this new field. All empirical papers will address the theoretical and educational implications of their findings. The discussant will end with a critical discussion from an educational point of view on how the presented studies may or may not contribute to educational research and practice.

Brain activation during arithmetic in children with low and average levels of arithmetical fluency

Bert De Smedt, University of Leuven, Belgium; Ian Holloway, University of Western Ontario, Belgium; Daniel Ansari, University of Western Ontario, Canada

Most studies on mathematics learning in the field of neuroscience and education have investigated the neural correlates of very elementary numerical processing skills in children. Little is known about more complex mathematical skills that are formally taught in school, such as arithmetic. Using functional magnetic resonance imaging (fMRI), we investigated brain activity during arithmetic problem solving in children with different levels of arithmetical fluency. Participants were 28 children aged 10-12 years. During scanning they completed a single-digit arithmetic task, in which they had to select the correct answer to an arithmetic problem. These problems systematically differed in terms of problem size (small vs. large) and operation (addition vs. subtraction). Commensurate with adult data, large problems and subtractions activated a fronto-parietal network, including the intraparietal sulci, the latter of which indicates the influence of quantity-based processes during

procedural strategy execution. Different from adults, we observed that the left hippocampus was active during the solution of those problems that are expected to be solved by means of fact retrieval (i.e. small problems and addition). Children with low levels of arithmetical fluency showed higher activation in the right intraparietal sulcus during the solution of problems with a relatively small problem size, indicating that they continued to rely to a greater extent on quantity-based strategies on those problems that the children with relatively higher arithmetical fluency already retrieved from memory. This might represent a neural correlate of fact retrieval impairments in children with mathematical difficulties.

Background

The field of mathematics learning has been put forward as an ideal workspace for interdisciplinary research in the field of "Neuroscience and education" or "Mind, Brain, and Education" (De Smedt et al., 2010). The majority of studies in this field have focused on the neural correlates of very elementary numerical processing skills, such as the comparison of numerical magnitudes (see Houdé et al., 2010 for a meta-analysis). Less is known about the neural correlates of more complex mathematical skills that are formally taught in school, such as arithmetic, and particularly about how individual differences in arithmetical competence modulate the neural processes recruited by solving arithmetic problems. Against this background, the current study used functional magnetic resonance imaging (fMRI) to investigate how arithmetic problem solving affects brain activation in children who are in the process of becoming arithmetically fluent and how such neural processes differ between children with different levels of arithmetical fluency.

Methodology/Research design

Participants were 28 children aged 10-12 years, who all attended grades 5 to 7. All children completed standardized tests that assessed their mathematical ability (Woodcock-Johnson (WJ) III Math Fluency and Calculation), reading ability (WJ III Letter-word Identification and Reading Fluency), verbal IQ (WISC-IV Vocabulary), and nonverbal IQ (WISC-IV Block Design). Performance on the WJ Math Fluency test was used to define two competence groups. Children were included in the low arithmetical fluency (LAF) group if their standardized score on the WJ Math Fluency test was 1SD below the standardization sample mean. Children were included in the typical arithmetical fluency (TAF) group if their performance on the WJ Math Fluency was within the normal range, i.e. within 1SD of the standardization sample mean. The two competence groups did not differ in chronological age, months of education, reading ability and IQ.

During scanning, all children completed a single-digit arithmetic task, in which they had to select the correct answer to an arithmetic problem. The administered problems systematically differed in terms of problem size (small vs. large) and operation (addition vs. subtraction).

Functional imaging data were collected by means of an event-related fMRI design, which allowed us to examine brain activation during only those problems that were solved correctly. The imaging data were analyzed with Brain Voyager QX, version 2.1 (Brain Innovation, Maastricht, The Netherlands). We calculated a 2 (Problem Size: small vs. large) \times 2 (Operation: addition vs. subtraction) \times 2 (Group: typical vs. low arithmetical fluency) full factorial ANOVA with Problem Size and Operation as within-subject factors and Group as between-subjects factor to examine brain activity during the arithmetic task.

Findings

Analysis of the behavioral data revealed consistent effects of problem size and operation on arithmetic performance: small problems were solved significantly more accurately ($p < .001$).

Commensurate with adult data, large problems and subtractions activated a fronto-parietal network, including the intraparietal sulci, the latter of which indicates the influence of quantity-based processes during procedural strategy execution. Different from adults, the present findings revealed that particularly the left hippocampus was active during the solution of those problems that are expected to be solved by means of fact retrieval (i.e. small problems and addition), suggesting a specific role of the hippocampus in the early stages of learning arithmetic facts. Children with low levels of arithmetical fluency showed higher activation in the right intraparietal sulcus during the solution of problems with a relatively small problem size, indicating that they continued to rely to a greater extent on quantity-based strategies on those problems that the children with relatively higher arithmetical fluency already retrieved from memory.

Theoretical and educational significance

Being fluent and efficient in performing basic calculations is regarded as an important building block for one's mathematical development (Kilpatrick et al., 2001), yet children with mathematical difficulties are known to be delayed in mastering these basic number combinations (Geary, 2004). The current study provides evidence that such

slower development might also be found at the brain level, representing a neural correlate of the retrieval difficulties in children with mathematical difficulties. The present findings also highlight that predictions derived from adult neuroimaging studies may not always be adequate for characterizing functional brain organization in children, by clearly illustrating that the brain regions in children that subserve the computations of problems with a high probability of the use of retrieval strategies are not the same as those reported in previous studies with adults. In view of this, it can be speculated that retrieval is a graded phenomenon, with different levels in the automaticity of arithmetic fact retrieval being associated with different brain regions. Behavioral measures, such as verbal reports, might not always capture such different levels of arithmetic fact retrieval. Neuroimaging data might provide a level of analysis and measurement that cannot be accessed by behavioral studies alone, adding new insights to (educational) theories of arithmetic fact retrieval development in children.

Development of algebraic problem solving skills: math precursor skills and executive functions

Kerry Lee, National Institute of Education, Singapore; Ng Swee Fong, National Institute of Education, Singapore; Rebecca Bull, University of Aberdeen, United Kingdom

Although there are a large number of studies on the teaching and learning of algebra, few are devoted to the development of algebraic thinking with respect to children's cognitive proficiencies. We report findings from a 4-year longitudinal study that examined the relationships between algebraic problem solving, its precursor skills, and children's developing executive functioning capabilities. We also report findings from two neuroimaging studies that examined the cognitive demands of existing pedagogical practices. In the longitudinal study, we used a cohort-sequential design. 650 children (5, 7, 9, and 11 year olds) were administered annually tests of executive functioning (updating, inhibition, switching) and precursor skills believed to be important for algebra (e.g. computation, pattern recognition). Older children were also administered arithmetic and/or algebraic word problems. Preliminary findings showed that updating predicted performances on the mathematical measures for both the younger and the older children. For the 10 and 11-year-olds, the relationship between updating and algebraic proficiency was fully mediated by proficiencies on the computational and pattern tasks. The neuroimaging results showed that even for adults who are competent in algebra, differences between two methods commonly used for solving algebra word problems differ mostly in their demands on attentional or updating resources. These findings suggest that in addition to instructions on the specific content demands of algebra, a focus on the updating demands of algebra and its precursor tasks may be beneficial.

Developmental dyscalculia: Domain specific and domain general contributions

Denes Szucs, University of Cambridge, United Kingdom; Amy Devine, University of Cambridge, United Kingdom; Fruzsina Soltesz, University of Cambridge, United Kingdom; Alison Nobes, University of Cambridge, United Kingdom

Developmental dyscalculia (dyscalculia) is a badly defined concept. Here we define dyscalculia as a selective impairment of mathematics performance. Currently there are contrasting opinions about whether dyscalculia is related to the impairment of a domain-specific number representation in the intraparietal sulci of the brain or whether it may be related to other, more domain general processes, like working-memory, attention or inhibition skills. Here we report the initial stages of a large-scale investigation of dyscalculia. We have screened 926 children from 21 different schools in Cambridgeshire in the United Kingdom. After a thorough assessment of the properties of score distributions we classified about 6% of the sample as potentially having dyscalculia. These children and age, gender and school-class matched controls performing at an average level on mathematics were examined with an extensive battery of tests. Tests investigated variables related to the intraparietal magnitude representation of the brain as well as domain general skills. Systematic differences in performance patterns between children with dyscalculia and control children will be discussed.

Developmental dyscalculia (dyscalculia) is a badly defined concept. Currently there are contrasting opinions about whether dyscalculia is related to the impairment of a domain-specific number representation in the intraparietal sulci of the brain or whether it may be related to other, more domain general processes, like working-memory, attention or inhibition skills. Here we define dyscalculia in a theory-neutral way as a selective impairment of mathematics performance.

On the one hand, mathematics performance is thought to be related to the function of a basic representation of magnitude embodied in the intraparietal sulci. On the other hand, it is clear that success in mathematics requires the interplay of several skills beyond the understanding of magnitude. In previous studies we mapped the development of access to the magnitude representation and compared performance on magnitude tasks to mathematics performance. First, by using electro-encephalography (EEG) and event-related brain potentials (ERPs), in a series of studies [1,2], we found clear evidence that access to the magnitude representation is as effective in 6 to 9 year old children as in adults. In general, when using one digit number comparison, access to the magnitude code seems to

happen at around 200 ms after stimulus presentation in both young children and in adults. In one ERP study we compared access to the magnitude code in adolescents with dyscalculia and in controls in a one digit number comparison task. We found no difference in the ERP markers of access to the magnitude code at 200 ms after stimulus presentation. However, we found a difference at 400 ms after stimulus presentation. In addition, there were differences in group performance on tests of executive functions but there was no robust difference in the most frequent behavioural marker, the numerical distance effect. The data was interpreted to show that the early automatic stages of number comparison are similar in dyscalculics and controls and processing differences arise in later stages of magnitude analysis when executive functions are mobilized. This study gives some indication of more complex, domain general, rather than specific, magnitude representation-related impairments in dyscalculia. In another, behavioural study we mapped the co-development of behavioural markers of the intraparietal magnitude representation in kindergarten [3]. We found all typical magnitude representation markers reported in the literature. However, we found no relationship between magnitude representation effects and several measures of mathematical performance. A factor analysis also identified the magnitude representation measures in a standalone factor, unrelated to mathematical skills.

Overall, our previous studies indicate that the developmental landscape in mathematics is complex and most probably cannot be reduced to the development of a single representation. Hence, dyscalculia probably cannot be explained by the impairment of a single representation. In order to understand dyscalculia, large scale and complex studies are needed, taking into account several potential explanatory factors. This was the motivation for the current study. We report the initial stages of a large-scale investigation of dyscalculia. We have screened 926 children from 21 different schools in Cambridgeshire in the United Kingdom. After a thorough assessment of the properties of score distributions we classified about 6% of the sample as potentially having dyscalculia. These children and age, gender and school-class matched controls performing at an average level on mathematics were examined with an extensive battery of tests. Tests investigated mathematical and domain general skills. Systematic differences in performance patterns between children with dyscalculia and control children will be discussed.

[1] Szűcs D, Soltész F, Jármi É, Csépe V (2007), The speed of magnitude processing and executive functions in controlled and automatic number comparison in children: an electro-encephalography study. *Behavioural and Brain Functions*. 3:23

[2] Soltész F, White S, Szűcs D, (2010), Event-related brain potentials dissociate the developmental time-course of automatic numerical magnitude analysis and cognitive control functions during the first three years of primary school. *Developmental Neuropsychology*. In Press.

[3] Soltész F, Szűcs D, Szűcs L (2010), Relationships between magnitude representation, counting and memory in 4- to 7-year-old children: A developmental study. *Behavioural and Brain Functions*. 6:13.

SYMPOSIUM

Measuring Outcomes of Professional Education

Chairperson: LEIF CHRISTIAN LAHN, UNIVERSITY OF OSLO, Norway

Organiser: Susanne Weber, Ludwig-Maximilians-Universität-München, Germany

Discussant: Richard Shavelson, Stanford University, United States

Various socio-economic and technological changes have a decisive implication on job requirements, on the demand for skills and competencies as well as on the processes of skill acquisition in different institutions (schools, universities, vocational training, workplaces). With regard to changes within the service sector we can observe a shift towards the requirement of more flexible jobs as "creative knowledge workers", "entrepreneurs" with corresponding claims for more general, more analytical, managerial, entrepreneurial competencies and skills like teamwork, networking, autonomous acting, self-regulation, self-organized learning and business planning etc. To keep pace with these developments in the world of work it is necessary to investigate learners' characteristics (not only as traits but also as states), the specific learning and knowledge acquiring processes in different settings and phases as well as the output and outcome of workplace learning. In the first paper the different learning and knowledge construction outcomes of engineering students are investigated when confronted with the instructional measure of internships at the workplace. The second paper reports on investigating decisive personality traits and states relevant for launching a firm. In the third paper the focus is on teaching business planning as a decisive entrepreneurial skill by implementing new instructional designs of entrepreneurship education in higher education. Hereby different aspects of entrepreneurial competencies are measured as a result of the treatment.

Individual differences in learning during internship in engineering education

Vincent Donche, University of Antwerp, Belgium; David Gijbels, University of Antwerp, Belgium; Piet Van den Bossche, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium; Ingrid Ilsbroux, Internationale Hogeschool Leuven, Belgium

To increase our understanding of the quality of learning at the workplace, we investigated how future engineers differ in their engagement in cognitive and regulative activities during their internship in companies. Using the framework of dynamic sources of regulation of student learning during internship (Oosterheert & Vermunt, 2001) we aim to broaden current understandings about the quality of self-regulation and knowledge construction in workplace learning contexts. In an exploratory study we questioned how individual differences in learning are present among engineering students (N = 66) taking part at a long term internship during engineering education. The study indicated a considerable variety in how students regulate their learning and how they construct knowledge during internships. Five different dimensions of knowledge construction (KC) were distinguished: (1) KC through external regulation; (2) KC through self-regulation, (3) KC by actively relating theory to practice, (4) KC in close collaboration with co-workers, and (5) no knowledge construction or avoidance behaviour. The ways in which engineering students learn were also found to be associated with their motivational drive. This study underlines the importance of investigating the multi-dimensionality of regulation behaviour and knowledge construction during internships at the workplace. For practice, the results point at the importance of taking individual differences in learning into account when (re-)constructing effective workplaces for learning.

Extended summary Introduction and aims.

In today's rapidly evolving society, we are confronted with an exponential increase in information, a growing need for innovation, and the requirement to develop sufficient skills. In line with a rapid evolution towards a global knowledge society, our contemporary job market is making new demands on students and professionals at work. As Dall' Alba (2009, p. 4) describes very clearly: "Professionals in many countries around the globe are working in a context of continual change, including advances in biotechnology, computers and the internet, globalisation of the economy, expanding knowledge- and service-based industry, heightened threats to national and international security, and increased professionalization of the workforce. The ensuing context of flux and uncertainty presents new and pressing challenges for professionals, while reliance upon their skilful participation in society is heightened. Professionals are being required to take new issues into account before those issues can be fully grasped, while continuing to make judgements, acting on the basis of those judgements, and facing the consequences of their actions". Being successful in a job these days often implies being capable of operating in ill-defined and ever-changing environments, dealing with non-routine and abstract work processes, handling decisions and responsibilities and working in teams. Formal learning programmes alone aren't able to keep up with rapid changes (developments) in society to provide (future) workers with all necessary knowledge, skills and attitudes. Therefore, learning at the workplace, is increasing in importance for retaining a productive workforce and for the employees themselves in retaining their employability. Everyday work practice is full of potential learning processes. These learning activities during work can be very effective and necessary for the purposes of becoming more expert in a profession. Despite the theoretical reasoning, research on work-related learning and its antecedents has remained rather scarce. In many professional fields, internships are provided as an indispensable part of the education towards professional competence. It is suggested that the confrontation with the workplace triggers learning. To increase our understanding of the quality of learning at the workplace we investigated how future engineers differ in their engagement in cognitive and regulative activities during their internship in companies. Using the framework of dynamic sources of regulation of student learning during internship (Oosterheert & Vermunt, 2001) we aim to broaden current understandings about the quality of self-regulation and knowledge construction in workplace learning contexts. Two research questions are central: (1) Which dimensions of knowledge construction and regulation can be distinguished during internship?(2) Can distinct groups of learners be distinguished using dimensions of knowledge construction and regulation?

Methodology.

In an exploratory study we questioned how individual differences in learning are present among engineering students (N = 66) taking part at a long term internship during engineering education. Hereto, a selection of scales of the ILTP-questionnaire (Oosterheert, Vermunt, & Denessen, 2002) used to map differences in student teacher learning during internships was translated to the specific context of learning during engineering internships. In addition, the goal orientation questionnaire was administered. Exploratory factor analyses, correlation, and regression analyses were applied to investigate the interrelatedness and predictivity between the constructs under study. Hierarchical cluster analyses were carried out to explore learner group differences. Results. The study indicated a considerable variety in how students regulate their learning and how they construct knowledge during internships. Five different dimensions of knowledge construction (KC) were distinguished: (1) KC through external regulation; (2) KC through self-regulation, (3) KC by actively relating theory to practice, (4) KC in close collaboration with co-workers, and (5) no knowledge construction or avoidance behaviour. The ways in which engineering students learn were also found to be associated

with their motivational drive. Especially mastery oriented students undertake active and self-regulatory learning activities when learning at the workplace and they learn in close interaction with colleagues, which is in line with the research body on students' approaches to learning and achievement goal theory. Person oriented analyses techniques show the presence of different groups of engagers and avoiders regarding knowledge construction during internships. Theoretical and educational significance. This study underlines the importance of investigating the multi-dimensionality of regulation behaviour and knowledge construction during internships at the workplace. The practical relevance of this study can be situated on different levels. First of all, the study provides further evidence for a valid, reliable, and convenient questionnaire to map different cognitive and regulative activities among learners during internships at the workplace. Second, the results point at the importance of taking individual differences in learning into account when (re-)constructing decent workplaces for learning.

Keywords:

workplace learning, self-regulation, motivation, knowledge construction, internship

References

- Button, S. B., Mathieu, J. E., & Zajac, D. M. (1996). Goal orientation in organizational research: A conceptual and empirical foundation. *Organizational Behavior and Human Decision Processes*, 67(1), 26-48.
- Dall'Alba, G. (2009). *Learning to be Professionals. Innovation and Change in Professional Education*, 4. Dordrecht: Springer.
- Oosterheert, I.E., & Vermunt, J.D. (2001). Individual differences in learning to teach: relating cognition, regulation and affect. *Learning and Instruction*, 11, (2), 133-156.
- Oosterheert, I.E., Vermunt, J.D., & Denessen, E. (2002). Assessing orientations to learning to teach. *British Journal of Educational Psychology*, 72, 41-64.
- VandeWalle, D. (1997). Development and validation of a work domain goal orientation instrument. *Educational and Psychological Measurement*, 57(6), 995-1015.

On diagnosing the capacity to launch a firm: A test for entrepreneurial competences

Fritz Oser, Universität Freiburg, Switzerland; Heiko Bergmann, Universität St. Gallen, Switzerland; Thierry Volery, Universität St. Gallen, Switzerland; Nuria Del Rey, University of Fribourg, Switzerland.

The education of young entrepreneurs is often based on the results of diagnostic instruments. The main question is, to predict the founding volition of a person and her founding realization by means of personality traits. Such questioning bears the danger that educational policy makers believe that there is an inborn personality structure that "automatically" leads to set up a company. – We developed a new instrument, which is not only based on psychological traits like general achievement motivation or on specific personality sets like innovation affinity, but also on specific beliefs, competences, knowledge, opportunities to learn and launching intentionalities. This new instrument was tested in a pre-version and in a main investigation. The online questionnaire was linked to participants in "Venture Challenge" courses (A), "Venture Ideas" workshops (B) and to students of the universities Fribourg and St. Gallen (C), who were rather not interested in business foundations. A total of 21 scales were generated. In the first analysis we compared persons without intention for company creation with persons who are interested in company creation and finally with persons that already founded a company. The second comparison was taken from the three groups mentioned above. The results are convincing: In all scales persons having experience with launching an enterprise scored significantly higher than the other two groups. Subjects participating in the venture lab scored also significantly higher than "normal" students. The results will be used for the development of a valid and reliable instrument for distinguishing founders from non-founders.

Aim

Until today most of the diagnostic instruments for predicting entrepreneurial capacities deal with personality traits (Gartner, 1988; and meta-analysis' from Collins et al. 2004; Rauch & Frese, 2007; Zhao & Seibert, 2006). But from daily experience we know that the entrepreneur is the important motor for launching a firm, and that personality traits are certainly not enough for it. It is needed optimal contextual conditions, it needs staying power, and it needs financing, planning, marketing and legal knowledge (Fýglistaller et al. 2008; Carsrud & Brännbeck, 2009; Walter & Walter, 2009). Our question is whether it is possible to develop an instrument, which includes more than personality concepts and thus leads to higher predicting validity. Especially the launching success or at least beliefs about it should be taken into consideration with a new instrument. Whereas until now researchers measured especially psychological traits like self-efficacy beliefs, general achievement motivation, stress resistance etc. or specific personality sets like entrepreneurial achievement motivation and self efficacy beliefs, search for autonomy, risk attendance, innovation affinity etc., we now wanted to go beyond such restrictions. We wanted to integrate specific beliefs about success and overcoming problems, competences, that are needed for a start up, knowledge on economical and legal issues,

opportunities to learn in settings where someone had founded already a firm and launching intentionalities, that means internal planning of becoming independent.

Method I

A first step we developed a set of questionnaire items taken partly from an instrument we developed 2 years ago, taken from other personality questionnaires and developed by our own experience with founders having launching knowledge. Some few interviews helped us to validate some of our item propositions. Especially the dimensions beliefs, competences, knowledge, opportunities to learn and launching intentionalities were completely new. The thus developed new instrument was tested twice, in a pre-study and a main study. The questionnaire was developed in an on-line format. It was linked to participants in a "Venture Challenge" course A (n=76), to participants in a "Venture Ideas" workshop B (n=389) and to students of the universities Fribourg and St. Gallen C, who rather were not interested in business and business foundations. A total of 179 cases emerged, A=82, B=62 and C=35 (this total consisted of data from the pre- and main data collection, because of identical item numbers and item structure). The descriptive statistics reveals that the difficulties of the items range from 1 to 3. An item with the mean of 0.6 is of high difficulty because only few persons answered it in the sense of entrepreneurial shape. An item with the value 2.6 would be an item easy to solve because most of the respondent answered to it in the sense of entrepreneurial shape. The inter item correlation laid between 0.3 and 0.7; the Cronbach's alpha ranged from .62 to .92. In total we had 21 scales with item numbers ranging from 2-10. For the knowledge items no Cronbach's alpha is given, because of the scale format. From the 5 belief scales (desirability, realization possibility, optimal setting conditions, personal benefit and subjective norms) the optimal setting conditions had a too low Cronbach's alpha and had to be cut off.

Results

The interesting question was about differences between the reference groups. As said up off we compared on one hand real entrepreneurs with subjects who were interested in launching a firm and "normal" students trying to answer the questionnaire as a testing exercise. On the other hand we differentiated between participants of a venture challenge course with participants of a short venture ideas workshop and "normal" students. Let's take two examples of each group. With respect to the belief variable, "realization possibility", students elicit a value of .88, interested subjects 1.71, and entrepreneurs 2.39 (p in both comparisons). With respect to further research we would like to suggest first a scale reduction in the sense that this entrepreneur test lasts not more than 25 Minutes. In addition we would like to create a program that gives each individual feedback about his/her entrepreneurial competences. For that issue we must discuss further entrepreneurial benchmarks and optimal entrepreneurial competence clusters.

Assessing "Networking" and "Teamworking" within Entrepreneurship Education

Susanne Weber, Ludwig-Maximilians-Universität-München, Germany; Stephanie Starke, University of Munich, Germany; Sabine Funke, Human Resource Education & Management, Germany

Entrepreneurial activities are linked with economical growth (European Commission, 2004; KOM, 2006; Sheshinski, Strom & Baumol, 2007). Therefore, entrepreneurship education is set on the agenda of educational programs for all levels. This is especially the case for academic programs (Audretsch, 2007; KOM, 2006), because the impact of academic entrepreneurs is higher than those with lower grades: academics tend to employ more people, make higher investments, perform better and create important spill-over effects for the regional economy (Harhoff, 1999; von Gravenitz, Harhoff, & R. Weber, 2010). For coping with these different challenging entrepreneurial tasks a lot of skills and competencies are required. Studies show that central entrepreneurial tasks are better be solved if individuals possess and can refer to social capital (Walter & Walter, 2006; Volery & Shaper, 2007; De Carolis, Litzky, & Eddleston, 2009). This can be built and developed by activities of "networking" (Wolff & Moser, 2006) and "teamworking" (Stevens & Campion, 1994). Within our paper we operationalized these two concepts, try to foster them within an innovative real-life business planning course for business students on the tertiary level and assessed the output and structure of "networking" and "teamworking".

Aims

Business Planning as a complex task within entrepreneurship education can better be managed and solved by a team rather than alone (Aronson et al., 1998; Baron & Byrne, 1997; Figl, 2010, 12-13). The ability of "networking" (Wolff & Moser, 2006, 162) and "teamworking" (Stevens & Campion, 1994) gets indispensable. The corresponding literature is extensive and diverse, with multiple roots. Here we understand "networking" as a skill: It "circumscribes a syndrome of behaviours that are aimed at building, maintaining and using informal relationships that possess the (potential) benefit of facilitating work-related activities of individuals by voluntarily granting access to resources and maximizing common advantages" (Wolff & Moser, 2006, 162). Studies on entrepreneurship show that networking leads to bigger and more valuable networks with abundant, non-redundant resources which is a comparative advantage for

entrepreneurs. Granovetter (1973, 1361-1369) differentiates with regard to the quality of networks between so-called "strong-ties" and "weak-ties". "Strong ties" represent very narrow, time intensive and emotional connections where the persons involved have commonly shared knowledge at their disposal. "Weak ties" represent rather loose connections where persons involved have different knowledge and information. Social networks with "strong ties" are typical for entrepreneurs in start-up phases (Jack, 2005; Volkmann & Tokarski, 2006), but are also of disadvantage for innovative acting (Elfring & Hulsink, 2003). One decisive criterion for running different strategies of "networking" is the individual's perception of group potency (Guzzo et al., 1993; Stajkovic et al., 2009), whereby a high degree of group potency is a valid predictor of team success (Gibson, Randel & Early, 2000, 67-68). Successful entrepreneurs use networking for generating social context, tying entrepreneurial resources to bunches, building up organizational structures (Slotte-Kock & Coviello, 2009). We understand "teamworking" as two or more individuals' interacting within or between ("work" and "learning") teams (Johnson & Johnson, 2006, 18-21; Gladstein, 1984). They share common goals, are aware of their positive interdependence for striving achievement, and also aware of who is and is not member of a team, they have specific roles or functions to perform, and desire a productive outcome (Baker et al., 2005). Effective and high performance groups feel responsible for the common success, have a high degree of commitment and outperform their expectations. They also exhibit synergy and achieve "more than the sum of its parts" (Johnson & Johnson, 2006, 18-21). Such teams are built for start-ups as the tasks for business planning are complex and include lots of task types (e.g., additive, compensatory, disjunctive) which are better managed and solved by a team than alone (Steiner, 1972; Fischer & Wiswede, 2002; Aronson et al., 1998; Baron & Byrne, 1997; Figl, 2010, 12-13). Individual resources of "knowledge", "skills" and "abilities" are required beside personality traits, technical skills or resources on a collective team level (Tannenbaum Beard & Salas, 1992; Stevens & Campion, 1994, 503; Figl, 2010, 14-15). Reviews show that the process of "effective teamwork" is mainly represented by the two broad dimensions of "task management" (task reflexivity) on the one side with subdimensions of "goal setting", "planning" etc. and "interpersonal interaction" (social reflexivity) on the other side with subdimensions like "communication", "collaboration" and "conflict management" etc. (West, 1994; Stevens & Campion, 1994, 505; Kauffeld, 2001; Figl, 2010). Individuals holding such teamwork competencies are more successful (Rader, 1989; Stevens & Campion, 1994); they end up with high task effectiveness, good mental health and perform long-term viable solutions (West, 2004, p. 3). Furthermore, by more complex group tasks and more collaboration team members learn more about such attributes of teamwork (Kotey, 2007). As both "networking" and "teamworking" can be trained (Wolff & Moser, 2006) our research questions are: (1) Is it possible to increase these two competencies by a business planning course in a tertiary entrepreneurship program? (2) How do students engage in networking behaviour and which kind of relations are used when students are faced with a challenging task? (3) Is networking used as a compensatory approach when teams report low group potency? (4) Does the course result in positive effects concerning the entrepreneurial intention of students?

Methodology

Within our study we implemented a pre-post-experimental-control-group design in a German School of Management (N=429; average age 24,4 years (SD = 2,35); 210 females). In a first step we measured "networking"-behavior by a 12-items Likert scale by Wolff & Moser (2006) combined with the "willingness to communicate" scale of Mc Crosky (1992) (20 items), and "group potency" by an 8-items Likert scale (Guzzo et al., 1993). "Teamworking"-competence was measured in a second step by the cognitive achievement test of Stevens & Campion (1994) (35 items) as well as the team attitude scale (15 items) by Baker et al. (2005). The treatment was a one semester business planning course, where the students had to modify and advance the business plan of a real entrepreneur by working within small teams of 4-5 students.

Findings

By a confirmatory factor analysis we could confirm three dimensions of "networking" behaviour (building, maintaining, using) ($\chi^2/df=90$; SRMR.95; CFI>.97) (Schermelleh-Engel, 2008, 52). Significant progress of networking behaviour turned out for the experimental group ($\chi^2_1=4.19$; $\chi^2_2=4.39$; $p=.001$; $d=.28$) but not for the control group (which did not get an explicit treatment). Comparable advantages were given for "group potency", "willingness to communicate" and the "use of strong or weak ties". Furthermore, networking explains a significant part of the variance of the learning outcome (measured by achievement, grade, course satisfaction). For assessing teamworking competence IRT measurement was run by using Conquest (Wu et al., 2007). We could confirm our model by acceptable fit values (separation reliability = .983; $\chi^2/2 = 1814.16$; $df=34$, p Theoretical and educational significance of the research Describing and visualizing networking and teamworking competencies is an essential step for fostering these important 21st century skills in a sustainable way. The detailed analyses allow made to measure training methods. By IRT we can map out the item estimates separately from the individuals' ability estimates – and therefore, analysing individual competencies in relation to other variables of teamwork.

SYMPOSIUM

Methodological Perspectives on Researching Learning with ICT

Chairperson: Crina Damsa, University of Oslo, Norway

Organiser: Joerg Zumbach, University of Salzburg, Austria

Maria Beatrice Ligorio, University of Bari, Italy

Crina Damsa, University of Oslo, Norway

Discussant: Charles Crook, LSRI, United Kingdom

Learning with technological support had become a common site in contemporary educational practice. Consequently, research on ICT-supported learning emerged as a prominent field in teaching and learning research. With the width of these developments, research methodology employed for, e.g., investigating the functioning, applicability and efficiency of new approaches varies. Research studies range from strictly controlled experiments with single applications, to qualitative studies of complex electronic learning environments, or case studies of single learners using technology. In this symposium different theoretical and methodological perspectives on ICT research for learning will be presented. The aim is to create the settings for an open academic discussion on the assets of each of these perspectives. The speakers represent the fields of cognitive experimental methodology and of qualitative, ethnographic methodologies, and will present their stances and ideas on this topic. The discussion will focus on commonalities and diverging points between different approaches. As an outcome, we hope to facilitate a deeper understanding of how various research methodologies can serve the investigation of the educational technology in a meaningful manner.

Hybrid minds: researching learning and reasoning in the context of (digital) artefacts

Roger Saljo, Goteborg University, Sweden

Digital technologies produce important changes in the manners in which artefacts are intergrated into human activities. Storing, access and manipulation of information are examples of activities that currently undergo change. We now have the ability to externalize not just information but also to an increasing extent sophisticated cognitive processes. Thus, our future intellectual capacities are neither restricted by our innate abilities, nor bounded by the skin of our bodies; our minds and mindful practices rely on productive "mergers and coalitions" (Clark, 2003, p. 7, *italics in original*) with powerful and increasingly sophisticated external tools that the sociocultural evolution produces. For the study of learning and development this implies that digital technologies are not just resources for learning, they are also increasingly part of a cognitive infrastructure that we have at hand. We constantly oscillate between mind, body and external tools in the flow of our activities, and they give us new access points to knowing (Giddens, 2002). This evolution of technologies challenges the largely Platonic view of learning and development which dominates research. Alternative conceptions of learning and development have to rely on a different unit of analysis that incorporates tool-mediated action as object of research, and they have to accommodate to the fact learning itself is transformed in such circumstances from a reproductive to a more performative practice.

Everyone is willing to accept that physical – or primary (Wartofsky, 1979) – artefacts have changed the manner in which human beings lead their lives and perform many, if not most, activities. Hammers, tongs, saws, spirit levels and a range of increasingly sophisticated instruments have changed the manners in which we build houses, and spades, rakes, lawn movers and excavators have transformed how we lay out a garden. Such tools extend the strength, power and staying power of human performance in dramatic manners, and they transform the very activity they are part of. Lifting heavy objects does not rely on human strength if we have an excavator, and to drive a nail into a piece of wood are much simpler activities with designed artefacts. Our capacity for mastering nature has expanded in symbiosis with such external resources. It is much more difficult to gain widespread acceptance for the idea that there are tools and instruments of the mind that operate in analogous manners; they help us to operate in a world of ideas and discursive activities, and they provide resources for perspectivizing the world and conceptualizing it differently. Access to ideas and concepts such as those of measurement systems, grammar, legal systems and of various sciences help us organize our experiences and communicate with others in increasingly precise manners. We contextualize the world by framing it in discursive categories that suit a particular activity. We do mental digging and excavation by means of such intellectual or psychological tools (Vygotsky, 1978). In addition, most human practices imply combining materiality with intellectual tools; writing is a technology using symbols in combination with physical objects, and calculating is done by means of number systems implemented on artefacts (Cole, 1996). Such material-symbolic artefacts serve as our companions when we reason, remember and reflect. Through history, our practices – cognitive as well as physical – have become increasingly dependent on such material-symbolic artefacts that have emerged in society, and that we learn to use for specific purposes. Hybrid minds and research on learning.

The background of this presentation is an interest in the role of artefacts in human reasoning, learning and social action. The idea of the hybrid mind was introduced in the analysis of the evolution of human cognition presented by Donald (1991; 2001), but this line of thinking is present in the analytical frameworks of many cultural psychologists, anthropologists and other students of the evolution of human resources for thinking and reasoning (Cole & Derry, 2005; Kirlik, 2005; Nelson, 1996; Nickerson, 2005; Ong, 1982). The hybridity of human mindful activity is now so obvious that we tend to view professional competence as very much a manner of skilfully being able to handle instruments such as electronic scalpels (surgeons), advance book-keeping software (accountants) and gps-navigators (in a range of professions such as captains at sea, taxi drivers, emergency vehicle drivers etc.) Digital technologies imply important changes in the manners in which artefacts can be intergrated into human activities. Storing, access and manipulation of information are examples of activities that currently undergo change. We now have the ability to externalize not just information but also to an increasing extent sophisticated cognitive processes. Thus, our future intellectual capacities are neither restricted by our innate abilities, nor bounded by the skin of our bodies; our minds and mindful practices rely on productive "mergers and coalitions" (Clark, 2003, p. 7, italics in original) (Clark, 2003) with powerful and increasingly sophisticated external tools that the sociocultural evolution produces. For the study of learning and development this implies that digital technologies are not just resources for learning, they are also increasingly part of a cognitive infrastructure that we have at hand. We constantly oscillate between mind, body and external tools in the flow of our activities, and they give us new access points to knowing (Giddens, 2002). This evolution of technologies challenges the largely Platonic view of learning and development which dominates research. Alternative conceptions of learning and development have to rely on a different unit of analysis that incorporates tool-mediated action as object of research, and they have to accommodate to the fact learning itself is transformed in such circumstances from a reproductive to a more performative practice.

References

- Clark, A. (2003). *Natural-born cyborgs: Minds, technologies, and the future of human intelligence*. New York, NY: Oxford University Press.
- Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: The Belknap Press.
- Cole, M., & Derry, J. (2005). We have met technology and it is us. In R. J. Sternberg & D. D. Preiss (Eds.), *Intelligence and technology. The impact of tools on the nature and development of human abilities*. (pp. 209-227). Mahwah, NJ: Erlbaum.
- Donald, M. (1991). *Origins of the modern mind. Three stages in the evolution of culture and cognition*. Cambridge, MA: Harvard University Press.
- Donald, M. (2001). *A mind so rare. The evolution of human consciousness*. New York, NY: Norton.
- Giddens, A. (2002). *Runaway world: How globalisation is shaping our lives*. London: Profile Books.
- Kirlik, A. (2005). Work in progress: Reinventing intelligence for an invented world. In R. J. Sternberg & D. D. Preiss (Eds.), *Intelligence and technology. The impact of tools and the nature and development of human abilities*. (pp. 105-133). Mahwah, NJ: Erlbaum.
- Nelson, K. (1996). *Language in cognitive development. The emergence of the mediated mind*. Cambridge, England: Cambridge University Press.
- Nickerson, R. S. (2005). Technology and cognition amplification. In R. J. Sternberg & D. D. Preiss (Eds.), *Intelligence and technology. The impact of tools on the nature and development of human abilities*. (pp. 3-27). Mahwah, NJ: Erlbaum.
- Ong, W. J. (1982). *Orality and literacy. The technologizing of the word*. London: Methuen.
- Wartofsky, M. (1979). *Models. Representation and the scientific understanding*. Dordrecht, The Netherlands: Reidel.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Basic Experimental Research on Learning with ICT

Roland Bruenken, Saarland University, Germany

Common instructional design theories underlying the development of Information and Communication Technologies (ICT) are often based on assumptions derived from cognitive psychology. Prominent examples are Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2009) and Sweller's Cognitive Load Theory (Sweller, 2010). As technological theories, both aim at supporting instructional design decisions by evidence derived from different forms of empirical research like lab experiments or field experiments of evaluation studies. However, it often remains unclear, whether the underlying assumptions borrowed from basic psychological research are sufficient and used in an adequate way. Illustrated by two series of basic experimental lab studies on combining different cognitive load effects (series one) and on measuring cognitive load (series two) the options and limits of theory-testing psychological research to improve instructional design theories and practice are discussed.

Learning with ICT is one of the major topics of current educational psychology research. Two of the most prominent theoretical models in the field of learning with ICT are the Cognitive Theory of Multimedia Learning (CTML) proposed

by Rich Mayer (e.g. Mayer, 2009) and John Swellers Cognitive Load Theory (CLT) (e.g. Sweller, 2010). While both theories focus on different aspects of information processing, they are more or less compatible with each other. The CTML focuses on aspects of knowledge processing and representation in the human information processing system; CLT focuses on the consumption of (limited) cognitive resources and its relation to efficient learning with ICT. Both theories are characterized by borrowing diverse theoretical assumptions from cognitive psychology and combining them into integrated instructional design models (ID models), like Paivio's dual-coding theory (Paivio, 1986), Bartlett's schema theory (Bartlett, 1932), the three component model of memory from Atkinson and Shiffrin (1968), or Baddeley's working memory model (Baddeley, 1986). These integrated ID models are used to formulate "design principles" (Mayer, 2009) which are proposed to be suitable to guide design decisions of instructional designers as well as to explain differences in learning success while using different variants of ICT. However, when integrating theory pieces from diverse sources of basic psychological research into an integrated model of applied psychology, the question arises whether the whole is more than the sum of its parts. Can the effects found in basic research be replicated also in applied settings or has the increased complexity of the new setting an impact on the basic processes?

To answer this questions more research is asked for which links basic and applied research (e.g. Gerjets, 2010). However, ID models in general are hardly testable in total because of their complexity. Taking them seriously as psychological theories, they should be nevertheless testable at least in their core assumptions. In our view, this demand could be met by experimental research in at least two different ways: (1) by increasing the complexity of the experimental research from one-factorial to multi-factorial designs and (2) by applying research paradigms of basic psychological research in applied psychological research (Brýnken, Seufert & Paas, 2010). The first strategy should be suitable to prove theory based application assumptions like the consideration of multiple design principles in a controlled experimental setting and moreover test the underlying ID model. The second strategy should be suitable to test the basic assumptions of the ID model by testing the "borrowed" ideas in the new, applied field using established methods from basic research.

In the present talk we will show both research strategies by examples from our research group. With respect to (1) increasing the complexity of the experimental design, a series of three experiments will be presented on the simultaneous variation of different design principles and their impact on learning success and cognitive load; with respect to (2) applying research paradigms of basic research, the application of the dual-task paradigm to cognitive load measurement while learning with ICT is presented by three different experiments using different secondary tasks. Results revealed from various experiments of our research group lead to the conclusion that some of the basic assumptions of the ID models can be confirmed by basic experimental research, like the relation of learning efficiency and resources consumption, while other rather applied assumptions of the models like the beneficial effect of the simultaneous consideration of multiple design principles in form of a simple additivity hypothesis have to be thrown into question. With respect to an overall methodological point of view, it can be stated that basic experimental research on learning with ICT is suitable to test the assumptions of ID models on learning with ICT as well as to prove whether findings from basic psychology can be generalized to applied fields of psychological research.

References

- Clark, A. (2003). *Natural-born cyborgs: Minds, technologies, and the future of human intelligence*. New York, NY: Oxford University Press.
- Atkinson, R.C. & Shiffrin, R.M. (1968). Human memory. A proposed system its control processes. In K.W. Spence & J.T. Spence /Eds.). *The psychology of learning and motivation* (Vol.2, pp 89-195). New York: Academic press.
- Brýnken, R., Seufert, T. & Paas, F. (2010). Mesuring cognitive load. In: In. J. Plass, R. Moreno & R. Brýnken (Eds.). *Cognitive Load Theory* (pp 181-202). New York. Cambridge University Press.
- Baddeley, A. (1986). *Working memory*. New York: Oxford University Press. Bartlett, F. (1932). *Remembering: A study in experimental and social psychology*. New York: Cambridge University Press.
- Gerjets, P. (2010, August). *Bridge over troubled water: From Cognitive Science to designing digital instruction*. Meeting of EARLI SIG 6 Instructional Design & SIG 7 Learning and Instruction with Computers. Ulm.
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press.
- Paivio, A. (1986). *Mental representations: a dual coding approach*. New York: Oxford University Press.
- Sweller, J. (2010). *Cognitive Load Theory: Recent Theoretical Advances*. In. J. Plass, R. Moreno & R. Brýnken (Eds.). *Cognitive Load Theory* (pp 29-47.). New York. Cambridge University Press.

Combining different methodologies in computer supported collaborative learning

Sten Ludvigsen, University of Oslo, Norway

The empirical investigation in computer supported collaborative learning (CSCL) is mostly based on two different approaches, that is a) cognitive science and methodological individualism and b) a sociocultural approach based on methodological collectivism (Wertsch, 1991; Linell 2009). In controlled studies based on methodological individualism we optimize control of variables, and get insight into which specific cognitive processes and performance a CSCL environment will activate for the students. This means that we will be able to describe and explain the differences between the students. We can here specify how different tool features support cognitive performances. By means the socio-culturally oriented studies we can optimize ecological validity. These studies make it possible to explore and understand under which social conditions specific cognitive processes become activated and under which conditions students' collaboration is productive for their understanding of knowledge domain(s).

The cognitive science, with its close relationship with experimental psychology, provides a strong basis for the research within the CSCL field. In experimental psychology, a leading idea is to identify how different variables have an impact on cognitive functions and performance of individuals. In experiments, one tries, based on the idea of falsification, to understand which variables are the most important under the given condition (Popper, 1963). This means that the empirical evidence either supports or challenges models or theories that the research is based on. However given that the theories or models are built up on a high number of experiments, the issue at stake is more about refinement of models, or theories, rather than major changes. This means that the cumulative effects are based on two different aspects; the empirical analysis and the model/theory. This often idealised model or theory is referred to as "the information processing model".

In philosophy of science this model is based on ideas of methodological individualism, implying that the unit of analysis is the individual human mind. This idealised model of human cognition has been essential in projects the last 15 years. Another influential research approach represented in the CSCL is the socio-cultural approach. Since the 1990s what came to be termed as situated or socio-cultural approaches contributed to developing a research program build on different assumptions than the information-processing model. These assumptions are building on the idea that cognitive, social and cultural aspects of the human mind are interdependent and cannot be studied as independent variables. However the situated tradition have long historical roots back to sociocultural and pragmatic perspective developed in the 1920s both in Europe and USA by theorists such as Vygotsky, Mead, and Dewey. It is possible to argue these two research approaches are incommensurable, and that the many attempts to combine or synthesis the two of them have not been successful. Especially since the two approaches are based on different epistemological and ontological assumptions (see Greeno, (2006) for reasonable account for one type of synthesis. We could argue that a theoretical synthesis is not the best solution to this problem. CSCL studies based on the two approaches will make it possible to capture different aspects of students' learning activities, processes and outcomes. This way the two approaches can contribute to a more robust understanding of the phenomena under investigation. Furthermore, the two CSCL research approaches enable empirical studies that optimize two different methodological orientations; a) an orientation towards the individual as unit of analysis and b) an orientation towards the interactional processes as the unit of analysis.

A set of studies can be designed for understanding the context and activities in a broad sense, which means that we optimize the methodological principle of ecological validity. Such studies will cover the social organization, the institutional aspects, the social interaction and sense making around a selected number of tools, and a focus on students' individual and collective learning processes. The students' learning trajectories can be targeted by means of pre- and post-tests, studies of the students' production of objects, and analyses of students' tool use and interaction during their working processes. Such analytic focus can give a robust account of what it's possible to learn in an environment a CSCL, and also seen in relation to the institutional context in which the CSCL environment is used. The most central question in scientific activities is on what grounds we can generalize our findings. It's a long and heated debate about differences in education research about generalizations. In a recent contribution by Ercikan and Roth (2009) a more constructive route is taken. Along these lines, we argue that high-level generalization must of course be based on statistical means. By high level we here talk about claims that involves findings such as "80% of Norwegian students in the Pisa studies have high score on problem solving skills". In most CSCL projects we do not aim for this type of generalization. We aim for what we can call analytic and theoretical generalizations, or what we here label mid-level generalizations. The socio-culturally oriented studies aim to optimize ecological validity. These studies make it possible to explore and understand under which social conditions specific cognitive processes become activated, and under which conditions that students' collaboration is productive for their understanding of the knowledge domain(s). In the controlled studies, where one optimizes control of variables, we can gain insight into which specific cognitive processes and performance will activate for the students. This means that we will be able to describe and explain the differences between the students. We can then further specify how different tool features support cognitive performances. These two approaches imply that the types of generalization we can do are both analytic generalizations and theoretical generalizations, building on the two different methodologies. The analytical

generalizations will be the summary of empirical findings within a set of conducted studies based on both types of approaches. Theoretical generalizations would be the kind of generalizations that can be made within each of the two methodological orientations, and not across, since the generalization here involves the theoretical assumptions in which the studies build on. Both types of generalization are what we can call mid-level generalizations, which means that we aim for generalization based on the following logic; what kind of cognitive processes and activities can occur in relation to which types of tools, and under which types of social conditions.

References:

- Ercikan, K. & Roth, W.M. (2009). *Generalizing from Educational Research: Beyond Qualitative and Quantitative Polarization*. London, Routledge, 2009.
- Greeno, J.G. (2006), "Learning in Activity", in R.K. Sawyer (ed.), *Cambridge Handbook of the Learning Sciences*, Cambridge University Press, New York, pp. 79-96.
- Linell, P. (2009). *Rethinking Language, Mind, And World Dialogically: Interactional And Contextual Theories Of Human Sense-Making*. Charlotte, NC: Information Age Publishing, 2009. 482pp. ISBN 978-1593119966 (hbk).
- Popper, K. (1963). *Conjectures and Refutations*, London: Routledge and Keagan Paul.
- Wertsch, J. V. (1991). *Voices of the mind: a sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.

SYMPOSIUM

Conceptualizing and Measuring Teacher Learning

Chairperson: Maaïke Endedijk, University of Twente, Netherlands

Organiser: Fritz C. Staub, University of Fribourg, Switzerland

Discussant: Frances Rust, University of Pennsylvania, United States

To advance our understanding of the causal chain from teacher preparation or teacher development programs to the achievement of pupils in classrooms we need reliable and valid outcome measures for teacher learning and well grounded conceptualizations for the processes that lead to the development of professional competencies. The aim of this symposium is to bring together research that provides different perspectives and methodological approaches of conceptualizing and measuring teacher learning. In his position paper Vermunt discusses alternatives for conceptualizing and measuring elements of a model of teacher learning (e.g., learning activities, motivation to learn, learning outcomes, and personal and contextual factors) that takes student learning as a point of departure. Based on a model of professional competence and corresponding standardized tests and questionnaires for large-scale research Kunter, Baumert, Kleickmann and Richter investigate the change and stability of knowledge, beliefs and motivational-affective variables during the induction phase of teacher education and search for institutional and individual factors that moderate change trajectories. Kreis and Staub study student teachers' talk with mentor teachers about specific lessons in practica. Based on detailed analyses of such discourse in pre- and post-lesson conferences the goal of this research is to identify discourse moves and characteristics of lesson conferences that foster the learning of student teachers. Rust will address the underlying theoretical and methodological conceptualizations of the presented research and discuss its contribution for the advancement of teacher and pupil learning.

Teacher Learning from the Perspective of Student Learning

Jan Vermunt, Utrecht University, Netherlands

The aim of this paper is to contribute to the development of a model of teacher learning that takes student learning as a point of departure. A firm link between models of teacher and student learning is considered important, because this link can improve our understanding of the "chain of causation" from teacher professional development initiatives to student learning outcomes. The model comprises the following elements: learning activities, regulation of learning, beliefs on learning, motivation to learn, learning outcomes, and personal and contextual factors. I will propose suitable conceptualisations for the domain of teacher learning for all elements of the model. To that end, relevant research literature from a variety of research fields was explored, among which: student learning, teacher learning and professional development, teacher education, and professional and workplace learning. Research on top-down, prescriptive models as well as bottom-up, descriptive models were included. The literature was also explored for measurement instruments that are in line with the conceptualisations considered suitable. For every element of the model, the literature search revealed several possible conceptualisations. I will use recent empirical studies from our research program on 'teacher learning and expertise throughout the professional career' to illustrate and underpin the choices we made for concepts and measurements. The discussion will focus on the current state of the art of the scientific knowledge base of teacher learning from the perspective of student learning.

Aims

The study of teacher learning is a relatively young field. Programs for teacher professional development all claim to foster teacher learning, yet vary widely in their characteristics and theoretical underpinnings, if these underpinnings exist at all. Most models of teacher learning are prescriptive, in the sense that they describe how teachers should learn best. In my view, any attempt to foster teacher learning should be based on solid scientific knowledge about how teachers learn in natural contexts. The aim of this paper is to contribute to the development of a model of teacher learning that incorporates the state-of-the-art scientific knowledge about teacher learning and that takes student learning as a point of departure. A firm link between models of teacher and student learning is considered important, because this link can improve our understanding of the “chain of causation” from teacher professional development initiatives to student learning outcomes.

Methodology

The model is derived from research on student learning. It comprises the following elements: learning activities, regulation of learning, beliefs on learning, motivation to learn, learning outcomes, and personal and contextual factors.

A model of teacher learning

The elements of the model are identical to the elements of models of student learning, but the way these elements are conceptualised is quite different. For example, in the field of student learning ‘learning outcomes’ are often conceptualised as scores on a knowledge test. In the field of teacher learning, knowledge tests are not felt to be a sensible measure of learning outcomes. There is a need for different conceptualisations. The same holds for the other elements of the model.

In this paper, I will propose suitable conceptualisations for all elements of the model. To that end, relevant research literature from a variety of domains was explored: student learning (e.g. Entwistle, 2009), teacher learning and professional development (e.g. Borko, 2004; Feiman-Nemser, 2008; Vermunt, 2011), teacher education (e.g. Grossman, 2005; Korthagen, 2010), and professional and workplace learning (e.g. Eraut, 2004; Tynjälä, 2008). Research on top-down, prescriptive models (e.g. Clarke & Hollingsworth, 2002) as well as bottom-up, descriptive models (e.g. Bakkenes et al, 2010) was included.

The measurement of the components of teacher learning depends, of course, of their conceptualisation. When valuable learning outcomes are not viewed as factual knowledge but as, for example, new teaching practices, instruments have to be used that can measure these practices. Therefore, the literature was also explored for measurement instruments that are in line with the conceptualisations that are considered suitable. Advantages and disadvantages of those instruments will be discussed.

Findings

For every element of the model, the literature search revealed several possible conceptualisations. I will use recent empirical studies from our research program on ‘teacher learning and expertise throughout the professional career’ to illustrate and underpin the choices we made for concepts and measurements. For example, several empirical studies on student teachers’ ‘regulation of learning’ revealed two important dimensions here: active versus passive regulation and prospective versus retrospective regulation of learning. In the domain of learning outcomes, another line of empirical research on experienced teachers’ learning in the context of educational innovation yielded main categories such as: changes in knowledge and beliefs; intentions for new classroom practice; actual changes in teaching practices; and emotional outcomes. Measurement instruments used to tap these components of teacher learning included digital logs, belief questionnaires, standardized teacher learning inventories, learning reports, student perceptions and video recordings of teacher classroom behaviour, and classroom video cases to elicit immediate teacher reactions.

Evidence of relations between components of the model were gathered from these studies as well. Theoretical and educational significance The discussion will focus in the current state of the art of the scientific knowledge base of teacher learning from the perspective of student learning. One advantage of this conceptualisation refers to the “chain of evidence”: student learning leads to learning outcomes, teaching leads to student learning, teacher education leads to student teacher learning, etc. Only one particular kind of learning outcomes that teachers achieve in their learning, namely actual changes in teaching practices, can influence student learning, because only these are part of the context (learning environment) for students’ learning.

The model organizes the scientific knowledge available at this moment. Moreover, it makes it possible to identify directions for further research, especially in the direction of: further study of components of the model and their

interrelations with different populations; the development of well-researched diagnostic measurement instruments for the various elements of teacher learning discussed here; and intervention studies on pedagogical approaches to foster teacher learning.

References

- Bakkenes, I., Vermunt, J. D., & Wubbels, T. (2010). Teacher learning in the context of educational innovation: Learning activities and learning outcomes of experienced teachers. *Learning and Instruction*, 20, 533-548.
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33, 3-15.
- Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education*, 18, 947-967.
- Entwistle, N.J. (2009). *Teaching for understanding at university*. Basingstoke: Palgrave Macmillan.
- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26, 247-273.
- Feiman-Nemser, S. (2008). Teacher learning: How do teachers learn to teach? In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of research on teacher education – Enduring questions in changing contexts* (pp. 697-705). New York: Routledge.
- Grossman, P. (2005). Research on pedagogical approaches in teacher education. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education – The report of the AERA panel on research and teacher education* (pp. 425-476). Mahwah, NJ: Erlbaum.
- Korthagen, F.A.J. (2010). Situated learning theory and the pedagogy of teacher education: Towards an integrated view of teacher behaviour and teacher learning. *Teaching and Teacher Education*, 26, 98-106.
- Tynjala, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, 3, 130-154.
- Vermunt, J. D. (2011). Patterns in student learning and teacher learning: Similarities and differences. In S. Rayner, & E. Cools (Eds.), *Style differences in cognition, learning and management: Theory, research and practice* (pp. 173-187). New York: Routledge.

SYMPOSIUM

Changes in Teachers' Professional Competence during a Practical Induction Phase

Mareike Kunter, Goethe-University, Institute of Psychology, Germany; Jurgen Baumert, Max Planck Institute for Human Development, Germany; Thilo Kleickmann, University of Kiel IPN, Germany; Dirk Richter, Humboldt University Berlin IQB, Germany

In this paper, we introduce a model of the determinants and effects of teachers' professional competence and present the results of a study investigating the development of professional competence during teacher education. Our model assumes that professional competence – i.e., the knowledge, beliefs, motivational and affective variables that teachers need to master the demands of their profession – develops in the interplay between formal and informal learning situations and personal prerequisites that shape the uptake of learning opportunities. In our two-cohort study 556 German teacher candidates enrolled in a teacher induction programme were assessed twice over the course of one year, using standardized tests and questionnaires. As a general trend, small linear gains in knowledge, stability in beliefs, and a curvilinear trend in motivational-affective variables was observed. However, institutional and individual factors such as type of academic programme or prior stress levels moderated the change trajectory, supporting the assumption of differential competence development.

Aims/Theoretical Background

Identifying the personal characteristics of good teachers is considered crucial for improving the quality of educational processes. Some researchers argue that extensive professional knowledge and functional professional beliefs are the result of learning processes within teacher education, and that teacher quality can be best assured by providing high quality learning situations for all candidates (e.g., Darling-Hammond, 2006). Others assume that stable personal characteristics such as general abilities or personality traits play a key role, and that teacher quality can best be assured by selecting persons with the "right" prerequisites (e.g., Yeh, 2009).

"Professional competence" describes knowledge, skills, but also attitudes and motivation that are needed for mastering complex situations (Kane, 1992). Applied to teachers, this includes professional knowledge, professional beliefs, motivation, and self-regulatory skills (Kunter et al., 2007). Empirical studies show that teachers differ substantially in these competence aspects, and that differences in these aspects are reflected in their teaching quality, their students' learning rates, and their professional well-being (e.g., Baumert et al., 2010; Kunter et al., 2008). In this paper, we present a theoretical model that assumes that teachers' professional competence is developed in formal as well as informal learning situations (e.g., in teacher education, but also in the school context). Meanwhile we assume that the existence of learning opportunities alone is not the decisive factor for competence development, but that the uptake of learning opportunities depends also on characteristics of the teachers themselves.

We test this assumption by means of a longitudinal study of German teacher candidates that were investigated during a 2-year induction phase. During this time, candidates are gradually introduced to teaching and are supported by mentor teachers and theoretical seminars. With its gradual transition from theory into practice, the induction phase is assumed to be crucial for developing professional competence. While one may assume that teachers' competence increases substantially during this phase, the first encounter with teaching practice has also been described as a particularly stressful time where professional beliefs and motivation may regress, and is sometimes referred to as practice shock (Veenman, 1984). Following the model of differential uptake of learning opportunities, we were interested in the inter-individual differences in how teacher candidates develop during this intense learning phase.

Methods

Sample and Procedure

The COACTIV-R study is a two-cohort longitudinal study that examines teacher candidates during the induction phase in Germany. The sample for the present analysis included 556 mathematics teacher candidates (65 % women, mean age = 28 years). 430 candidates were in their first year of the programme and 135 in their second year. Corresponding to academic tracking, which is a characteristic of the German schooling system, 43 % were training to be teachers on the academic track, the rest being trained for other tracks.

Candidates worked on tests and questionnaires at the beginning of the school year, and again at the end of the school year. By combining the two-cohort comparison with the repeated measurement, it was possible to draw conclusions relevant to the whole course of the induction phase (see figure 1).

Instruments

Teachers' knowledge was assessed via tests constructed within the project, testing mathematical content knowledge (?time1=.83/?time2=.81) and mathematical pedagogical knowledge (?time1=.76/?time2=.75). Two questionnaire scales measured teachers' beliefs about learning processes, reflecting a constructivist (?time1=.79/?time2=.82) and a transmission orientation (?time1=.78/?time2=.83). As motivational-affective variables, questionnaire scales tapped teachers' enthusiasm for teaching (?time1=.85/?time2=.84), their job satisfaction (?time1=.89/?time2=.91), and their emotional exhaustion (?time1=.77/?time2=.82).

Results

Overall, regarding knowledge, very small linear gains emerged over the course of the two years ($d's < .10$). Regarding beliefs, no significant changes occurred. Regarding motivational-affective variables, we found non-linear trends showing that enthusiasm and job satisfaction decreased towards the end of the first year, and increased again towards the end of the second year, with a reverse trend for emotional exhaustion.

However, investigating possible institutional or individual moderators for change, we found that candidates who trained for the academic track showed significant changes in their knowledge ($d's$ between .20 and .30), while other candidates showed no such gain, indicating that the learning settings in which candidates are trained differ in their potential to foster professional learning. Investigating the role of possible individual moderators, we found that changes in teachers' beliefs occurred in one particular subgroup, namely in teachers who started with high emotional exhaustion. Their transmission orientations increased and constructivist orientations decreased, while teachers with lower exhaustion remained stable. Further individual moderators will be investigated.

Discussion

There is currently a lack of empirical research that examines teachers' learning processes in large scale settings that allow for investigating moderators for change. Our study investigated changes in professional knowledge, beliefs, and motivational-affective competence aspects of young teachers during their induction phase. We found that – differentiating the overall change trends – institutional factors such as the academic programme the teachers were involved in or individual factors such as their stress levels influenced the trajectories of change. Future research on teacher learning should thus take the interaction of different learning settings and personal prerequisites into account.

Literature

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., et al. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal*, 47(1), 133–180.

Darling-Hammond, L. (2006). *Powerful teacher education*. San Francisco, CA: Jossey-Bass.

Kane, M. T. (1992). The assessment of professional competence Evaluation & the Health Professions, 15(2), 163–182.

Kunter, M., Klusmann, U., Dubberke, T., Baumert, J., Blum, W., Brunner, M., et al. (2007). Linking aspects of teacher competence to their instruction: Results from the COACTIV project. In M. Prenzel (Ed.), *Studies on the educational quality of schools. The final report on the DFG Priority Programme* (pp. 39–59). Munster: Waxmann.

Kunter, M., Tsai, Y.-M., Klusmann, U., Brunner, M., Krauss, S., & Baumert, J. (2008). Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction. *Learning and Instruction*, 18(5), 468–482.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research*, 54(2), 143–178.

Yeh, S. S. (2009). The cost-effectiveness of raising teacher quality. *Educational Research Review*, 4(3), 220–232.

SYMPOSIUM

Characteristics of Lesson Conferences that Foster Student Teacher Learning

Annelies Kreis, University of Teacher Education Thurgau, Switzerland; Fritz C. Staub, University of Fribourg, Switzerland

School-based practica provide pivotal learning opportunities for student teachers, but empirical studies show that practice often does not correspond to normative models (Hennissen et al., 2008). Content-Focused Coaching (West & Staub, 2003) is an approach that can be used to foster pre-service teacher learning during practica. Based on this model we examined how discourse analytical characteristics of lesson conferences relate to student teacher learning. This study is part of a quasi-experimental intervention study. Empirical data include video recorded pre- and post-lesson conferences of 31 dyads of student teachers and mentors. Lesson conferences were subjected to discourse analyses applying a previously developed coding system (Kreis, in prep.). Codes cover the interactional characteristics as well as discourse activities that are specific for lesson conferences (e.g. invitation to elaborate a lesson plan). In addition, we conducted interviews with student teachers about learning incidences during the recorded lesson conferences. The frequency of reported learning incidences was then related to the aggregated duration of specific discourse activities. Findings indicate the important role of co-constructive and project specific discourse activities for student teacher learning in the context of lesson conferences that are recommended by Content-Focused Coaching.

Aims

School-based practica provide pivotal learning opportunities for student teachers (e.g. Hascher et al., 2004). Normative models calling for reflective practice are prevalent. Empirical studies, however, show that mentors often dominate the interaction and dialogic reflection is found only rarely (e.g., Crasborn & Hennissen, 2010). According to the new approach of Content-Focused Coaching (West & Staub, 2003) student teacher learning is assisted through dialogical post-lesson conferences as well as collaborative pre-lesson planning. In a quasi-experimental intervention study this approach has been shown to lead to significantly more self-reported student teacher learning than the traditional way of assisting student teachers in practica (Kreis & Staub, submitted). The intervention consisted in a substantial professional development for the school-based mentor teachers (120 hours over a period of 15 months) in the experimental group. In this study we analyze lesson conferences regarding relationships between (a) discourse analytical characteristics of lesson conferences and (b) learning gains of student teachers attributed to the respective conferences. Based on research on learning in tutoring (Chi et al., 2001) we expected co-constructive interactions leading to higher learning gains than micro-monological discourse activities. In particular, we expected the occurrence of discourse moves that contribute to a dialogue on lesson plans and to collaborative transformations to be associated with learning gains of student teachers.

Methodology

Data from the quasi-experimental intervention study includes (a) video recorded lesson conferences from 31 dyads of student teachers and their mentors and (b) interviews with 31 student teachers. The mentors of the experimental group (NEG=15) participated in specific professional development, the mentors of the control group (NCG= 16) did not. Both groups consisted of volunteers and did not differ on variables such as teaching experience. The mathematics lessons and the associated lesson conferences were randomly chosen from lessons taught during the last two weeks of a school-based practicum of seven weeks (primary school, grades 1-6). In semi-structured interviews student teachers reported in detail what they had learned from the recorded lesson conference(s). The interviews were transcribed and subject to qualitative content analysis (Kreis, in prep.). The number of reported learning incidences in these interviews is used as an indicator for student teacher learning. Lesson conferences were also transcribed and subjected to a detailed video based and computer-supported discourse analysis applying a coding system developed on the data of a sub-sample of 16 dyads in a previous study (Kreis, in prep.). Units of analysis are sequences of dialogues, which cover one project (e.g. how to give students an assignment). Boundaries between units of analysis are identifiable on the basis of discourse markers and code definitions. 17 Codes capture the function of utterances with respect to the dialogue (e.g. checking understanding, invitation to elaborate the lesson plan, elaborating the lesson plan, reflecting on a past lesson). Codes for sequences are furthermore specified with respect to the initiator of the sequence (mentor or student teacher) and their interactional character (micro-monological in which a project is described by one person alone versus co-constructive in the sense of Chi et al. (2001), if interacting persons mutually discuss and contribute ideas to a project). Interrater reliability on the basis of given units is .8 (Cohen's Kappa). The

duration of the specific discourse activities identified is aggregated per dyad and correlated with the indicator for student teacher learning (Spearman's ρ).

Findings

Significant correlations were found between the number of reported learning incidents (Mode=3, Range=0-8,) and the mean duration of pre-lesson conferences (N=20, M=42', s=25', $r_s=.46$, $p=.020$) and of post-lesson conferences (N=31, M=19', s=11', $r_s=.36$, $p=.024$). There is a significant correlation between reported learning and the overall time of co-constructive interaction for pre-lesson conferences (M=25', s=16', $r_s=.68$, $p=.001$), but not for post-lesson conferences. There are no significant correlations between reported learning and the overall time of micro-monological sequences, neither by student teachers nor by mentor teachers in pre- or post-lesson conferences. At a differentiated level there are significant correlations between teacher learning and eleven specific discourse activities such as e.g. "Invitation by cooperating teachers to elaborate their lesson plan followed by a dialogue" (pre-lesson: $r_s = .64$, $p=.000$), "micro-monological problematization" by cooperating teachers (pre-lesson: $r_s = .52$, $p=.009$) or by student teachers (pre-lesson: $r_s=.56$, $p=.005$), or "co-constructive problematization" initiated by student teachers (pre-lesson: $r_s=.42$, $p=.033$, post-lesson: $r_s=.39$, $p=.015$). There are no significant correlations for the other sub-codes (e.g. „hypothetical optimization of lesson plan“ during post-lesson conferences).

Theoretical and educational significance

Results from our quasi-experimental intervention study have previously shown that mentor teachers who had learned to assist student teachers on the basis of Content-Focused Coaching were more successful in fostering student teacher learning in terms of their reported learning (Kreis & Staub, submitted). A main goal for the mentor teachers in the experimental group (beyond reflecting and elaborating their pedagogical content knowledge) was learning how to foster co-constructive lesson conferences. The analyses presented in this study look in detail at the lesson conferences and search for relationships between co-constructive and project specific discourse activities in lesson conferences and student teacher learning. The research presented draws on conceptualizations and results from previous research in tutoring (e.g., Chi et al., 2001) and extends this work to the domain of mentoring in pre-service teacher education. Such research can help us to better understand the nature of lesson conferences that have the potential to advance teacher learning.

References

- Chi, M. T. H., Siler, S. A., Jeong, H., Yamauchi, T. & Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive Science*, 25 (4), 471-533.
- Crasborn, F. & Hennissen, P. (2010). The skilled mentor. Mentor teachers' use and acquisition of supervisory skills. Published dissertation. The Netherlands.
- Hascher, T., Cocard, Y. & Moser, P. (2004). Forget about theory – practice is all? Student teachers' learning in practicum. *Teachers and Teaching: Theory and Practice*, 10(6), 623-637.
- Kreis, A. (in prep.). Produktive Unterrichtsbesprechungen. Lernen im Dialog zwischen Praxislehrperson und angehender Lehrperson. Bern: Haupt.
- Kreis, A. & Staub, F. C. (submitted). Forderung des Lehrenlernens im Unterrichtspraktikum durch fachspezifisches Unterrichtscoaching: eine Interventionsstudie. *Zeitschrift für Erziehungswissenschaft*, 14 (1).
- West, L. & Staub, F. C. (2003). Content-Focused CoachingSM: Transforming mathematics lessons.

SYMPOSIUM

Understanding and solving word problems: The role of representational models

Chairperson: Erik De Corte, University of Leuven, Belgium

Organiser: Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Discussant: Kurt Reusser, University of Zurich, Switzerland

Over the past decades, word problems have elicited a lot of research. During the 1980s and 1990s, many studies were set up aimed at constructing and testing theoretical models about the cognitive processes taking place when learners try to understand, represent, and solve word problems as well as about the components that are involved in those processes. Nevertheless, several important questions and challenges for research remain, especially relating to the initial phases of the problem-solving process wherein the solver tries to build an appropriate and functional representation of the problem. The three papers in this symposium represent theoretical and methodological attempts to deepen our insight into these initial representational phases, and their impact on the subsequent phases in the word-problem solving process. They all yield strong support for the complexity of these representational processes, and their crucial role in the whole solution process. The first paper analyses whether the generation of

inferences about the situation, which is typical for (text) comprehension processes, also occurs when the children solve word problems. The second study compares children's understanding and solution of a quantitative problem about fair sharing in a mathematics and a religion class. The third paper describes the conditions under which solvers (can) construct a computationally more efficient alternative mental representation to the initial one. The three papers are discussed by a scholar who developed one of the most influential models about understanding and solving word problems.

Processing of situational information in story problem texts. An analysis from on-line measures

Jose Orrantia, University of Salamanca, Spain; Julio Tarin, University of Valencia, Spain; David Munez, University of Salamanca, Spain; Santiago Vicente, University of Salamanca, Spain

In three experiments, we investigated the extent to which readers process information related to the construction of a situation model when they are confronted with solving word problems. Considering that generation of inferences to match actions with particular goals is part of constructing of the situation model, we constructed "rich story problems", that is, word problems included in the context of a story, in which the characters set goals that are followed by actions to achieve these goals. In Experiments 1 and 2 the story problems were designed so that the character's goal was explicitly (Experiment 1) or implicitly (Experiment 2) related to the activation of a problem schema. In Experiment 3 the problem schema activation was clearly separated from the goal information. In all three experiments, goal information availability was assessed by on-line measures. The results showed that participants processed situational information by keeping track of characters' goals. These results fit nicely with those studies that emphasize the role of situation model construction in word problem solving.

Arithmetic word problem solving can be considered as a complex activity in which solvers create different levels of representation, both mathematical and nonmathematical. The aim of this paper is to analyse the role that nonmathematical representation plays in problem comprehension, representation related to informal comprehension of the situation described in the problem, the so-called situation model, which corresponds to a more qualitative level of representation that specifies the agents, the actions, and the relationship between the events of the problem in everyday contexts.

Although the evolution of the different models of understanding and solving arithmetic word problems can be described as a growing recognition of the importance of the comprehension of the situation described in the problem, the role that this initial nonmathematical representation plays in understanding and solving arithmetic word problems is still put to test nowadays. A specific question that needs to be answered is whether inferences related to the construction of a situation model are generated on line when the word problems are presented in the context of a story, that is, when they are presented in a more enriched and elaborated way by highlighting the situation described by the problem.

The purpose of our research was to demonstrate that readers are, in effect, sensitive to situational information (e.g., causal inferences guided by the goals of a story character, a kind of inferences related to the construction of the situation model). To demonstrate such sensitivity, we designed three experiments in which the situational information was more or less related to the activation of the problem schema. In Experiment 1, the story problems were designed so that the character's explicitly stated goal was closely related to the activation of a problem schema, e.g., the character wants to increase or to decrease a flock of sheep. Experiment 2 was similar to Experiment 1 except that the goal of the character was not explicitly stated; to activate the schema readers would need to infer the character's goal. In these first two experiments, measuring participants' reading times for action statements that were either consistent or inconsistent with the characters' goals assessed goal information availability in participants' working memory. In Experiment 3 the goal information was not linked to any problem schema. In this experiment, the availability of the goal was tested by measuring participants' response times to target words selected from goals that were either completed or failed by the character.

Experiments 1 and 2

Method

Participants

Sixty Spanish psychology undergraduates participated in Experiment 1, and 40 in Experiment 2.

Materials

We created 12 experimental story problems. All problems were constructed on the same model, referring to a single character who performed an action that was either consistent or inconsistent with his or her goal. Whereas in Experiment 1 the character's goal was explicitly stated, in Experiment 2 it was not.

Procedure

Problems were presented on a computer screen one line at a time. Participants controlled the presentation of the problem with a line advance key.

Results

Both in Experiment 1 and in Experiment 2, readers spent more time on the inconsistent target lines than on the consistent target lines, $F(1, 57) = 65.44$, $MSE = 64,117$; $F(1, 22) = 26.46$, $MSE = 45,204$, for Experiment 1, and $F(1, 38) = 23.39$, $MSE = 48,175$; $F(1, 22) = 6.72$, $MSE = 71,358$, for Experiment 2, which indicates that information related to the characters' goals remained available in participants' working memory during the processing of the problem.

Experiment 3

Method

Participants

Fifty-four psychology undergraduates participated in Experiment 3.

Materials

There were 16 experimental story problems. Each problem had two versions: failed goal and completed goal. To determine whether participants maintained the availability of the failed goal information, we recorded, in the context of a lexical decision task, responses to target words that were selected from the goal statement in the story problem.

Procedure

The procedure was the same as for Experiment 1 and 2. The lexical decision task proceeded as follows. After reading a line, a row of asterisks was presented for 500 ms at the center of the screen and was then replaced by the target letter string. Participants had to decide whether the letter string was a word or a non-word by pressing one of two keys ("yes" and "no").

Results

The results showed that failed goal information is more available to readers than completed goal information. This effect was significant by subjects, $F(1, 52) = 12.52$, $MSE = 3,209$; and approached significance by items, $F(1, 30) = 3.4$, $MSE = 6,226$, $p = .07$.

General discussion

Generally, the results showed that participants processed situational information by keeping track of the characters' goals. These results suggest that the generation of goal inferences occurs even when explicit instructions indicate it is not necessary, that is when participants had to solve the story problems. The results of our experiments fit nicely with those studies that emphasize the role of situation model construction in word problem solving. According to these studies, to understand a problem it is important to pay attention not only to specific mathematical information (i.e., the problem schema) but also to the situation and the events described in the text. Although participants were instructed to adopt a problem-solving strategy that, according to some older word problem solving models, does not require the development of a situation model, we emphasize that situational information, particularly information related to goals of characters, remained available in participants' working memory during the processing of the problems. In this way, the construction of the problem model could be facilitated by the provision of situational information, since readers need to engage in some sort of inferential process to attempt to reestablish coherence when they detect an inconsistency (Experiments 1 and 2), and need to hold a goal active when it has not been completed (Experiment 3). One educational implication is that the introduction in the problem texts of relevant goals (which allow the problem solvers to infer the mathematical structure of the problem) may improve their performance.

SYMPOSIUM

Children's understanding and solution of a word problem inside and outside the mathematics class

Tinne Dewolf, KULeuven, Belgium; Wim Van Dooren, K.U. Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Research shows that primary school pupils tend to exclude realistic considerations when solving mathematical word problems (Verschaffel et al., 2009). Several authors have suggested that this tendency is due to the practice and culture of the mathematics class, but systematic empirical evidence in favour of this claim is scarce (for an exception, see Säljö, 1991). To further examine the influence of the context on pupils' realistic considerations when solving word problems, we confronted 151 pupils (5th and 6th grade) with a quantitative problem in the context of a mathematics

or religion class. Pupils were first asked to solve an assignment during regular teaching hours (mathematics or religion). The quantitative problem, which was about dividing an amount of money fairly, was the same in both groups. Afterwards, pupils had to evaluate several (fictional) answers for this problem. We compared the responses from both groups and found that a) in the mathematics class pupils mainly used precise numerical answers, while in the religion class half of the pupils gave a verbal description of the solution as their answer b) the answers of the pupils in the mathematics class were mostly motivated by calculations, while in the religion class, pupils mostly used non-numerical arguments c) the concept "fairness" was interpreted differently in both conditions d) especially in the mathematics class, pupils expected that there was (only) one correct solution for the problem. These findings provide evidence that the context influences primary school children's solutions of mathematical word problems and their accompanying argumentations.

Introduction

Historically, the inclusion of word problems was mainly intended to develop in students the skills of knowing when and how to apply their mathematics effectively in various kinds of problem situations encountered in everyday life. For a very long time, word problems have played this application function without much reflection and critical concern. But during the last 10-15 years, it has been argued by many scholars from different disciplines that the current practice of word problems in school mathematics does not at all foster in students a genuine disposition towards mathematical modeling. These scholars refer, among others, to research that shows that primary school pupils tend to exclude realistic considerations when representing and solving mathematical word problems (Verschaffel et al., 2009). Several authors have suggested that this tendency is due to the practice and culture of the mathematics class, but empirical evidence in favour of this claim is scarce (for an exception, see Säljö, 1991). In this study we therefore examined the influence of the context on realistic considerations when solving quantitative problems. Our main hypothesis was that pupils would approach a quantitative problem differently when it is presented in a mathematics class as compared to a religion class. Because the problem we used was about dividing an amount of money fairly between two boys, we expected that pupils also would interpret and handle the word "fair" differently in these two contexts.

Method

151 primary school pupils from the 5th and 6th grade, coming from two different schools, received a paper-and-pencil test with the following word problem from Säljö, Riesbeck, and Wyndhamn (2009):

Two boys, Charles and Martin, are going to help Nicholas rake leaves on his plot of land. The plot is 1200 square metres. Charles rakes 700 square metres during four hours and Martin does 500 square metres during two hours. They get 180 crowns/kronor (SEK) for their work. How are the boys going to divide the money so that it is fair? (p. 180) This problem was presented in the context of a religion or mathematics assignment. Seventy-nine pupils completed the assignment in the mathematics class and seventy-two pupils in the religion class. The assignment was offered by the teacher and consisted of two parts. In the first part, the problem from Säljö et al. (2009) was presented together with two other problems. In the religion class these two accompanying problems were typical ethical dilemmas, whereas in the mathematics class they were classical word problems. In the second part of the assignment, pupils were asked to evaluate five fictional answers on the above problem about "fair sharing". Each fictional answer represented a different way of responding to the problem: "dividing the amount of money in half", "a bigger amount for the boy who worked longer", "a bigger amount for the boy who did more square metres", "considering the time and amount of work", and "there is no (single) right solution for the problem". This second part was the same for both groups.

For the first part, pupils' answers on the problem were coded on three characteristics; solution (numerical or non-numerical), response style (calculation or argument), and criteria being implicitly or explicitly used to solve the problem (equality, time used for work, amount of work, efficiency, and other, vague, or no (visible) criterion). In the second part of the assignment, pupils had to grade five fictional answers. We compared the responses of both groups for both parts of the assignment.

Findings

Table 1 presents the results for the first part of the study. First, the answers of the pupils who received the assignment in the mathematics class were more often expressed in a precise numerical form (e.g., Charles gets 120 and Martin gets 60) (86.1%) than those who received it in the religion class (52.8%). In the latter group almost half of the pupils gave another kind of description of their answer: 25% were precise but not calculated numerical (e.g., Charles deserves twice as much as Martin) and 20.8% were non-precise numerical (e.g., Charles deserves a bit more). Second, the answers of the pupils in the mathematics class were mostly motivated by calculations (74.7%), whereas in the religion class giving a non-numerical argument was the most frequent response style (38.9%). Another substantial

number of children (29.2%) of the religion class didn't use any argument or calculation at all, and only wrote down a certain amount of money. Third, in the mathematics class 73.4% of the pupils based their answer on only one criterion, while in the religion class the number of criteria used was more diverse: 38.9% of the pupils didn't use a criterion, 41.7% used one criterion, and 19.5% used more than one criterion. Finally, with respect to the kind of criterion being mostly used, the most striking finding was that only 2.5% of the pupils in the mathematics class found it fair to divide the money equally, whereas in the religion class 18.1% of the pupils applied this criterion in their response.

The analysis of the second part showed that in both groups the fictional answer "there is no (single) right solution for the problem" received the least points. However, in the mathematics class this answer was scored significantly lower (5.2/10) than in the religion class (6.8/10). This suggests that pupils in the religion class more easily accepted that there is no (single) right solution for the problem.

Conclusion and discussion

Our findings show that upper primary school pupils approach and solve quantitative problems differently when the problem is presented in a mathematics class as compared to a religion class. So they yield further evidence to the claim that the context influences pupils' solutions of mathematical word problems and their accompanying argumentations. More specifically, it documents pupils' tendency to reduce the modelling cycle to "doing something with the numbers in the problem" relying on a narrow mathematical interpretation of the problem situation and of the concepts involved in it (Säljö & Wyndham, 1993; Verschaffel et al., 1994, 2000).

SYMPOSIUM

The construction of an alternative mental representation for arithmetic word problems

Catherine Thevenot, University of Geneva, Switzerland

Multiple-step arithmetic problems can be solved by diverse strategies depending on the mental representation constructed by individuals from the situation described in the text of the problem. The initial representation constructed by individuals is based on the sub-goals that are explicitly described in the text of the problem. However, this initial representation is not always the more economic one in terms of cognitive demand during the solving process. In this presentation, we will describe the conditions under which an alternative mental representation to the initial one can be constructed. We will show that the probability of the implementation of an alternative representation depends on its similarity with the representation induced by the text. This result comforts Knoblich's representational change theory initially developed in the domain of insight problems.

Theoretical and empirical background

In verbal arithmetic, multiple-step problems can be solved by different strategies; all of which may lead to the solution, but not all in an optimum way. Let us consider the problem 'How many marbles does Tom have less than John and Paul together? John has 41 marbles, Tom has 31 marbles and Paul has 43 marbles'. The strategy that is most likely to be used by individuals is the one based on the sub-goal explicitly described in the text of the problem. Most adults and children will reach the sub-goal 'John + Paul' and then subtract the quantity of Tom's marbles from the result obtained: $41 + 43 = 84 - 31 = 53$. However, another strategy would be to subtract the quantity of Tom's marbles from the quantity of John's marbles and then, to add the quantity of Paul's marbles to the result obtained: $41 - 31 = 10 + 43 = 53$. In order to solve the problem mentally, this second strategy is obviously more economical than the first one. However, it is not implemented spontaneously by individuals who base their strategy on their initial mental representation of the problem. Such individuals would not engage in the construction of an alternative representation because it is an additional and rather demanding activity.

Nevertheless, we showed that when the solution is extremely difficult to reach from the initial representation (for example when three-digit instead of two-digit numbers are used in the text), an alternative one that leads to the optimum strategy can be constructed by the solvers (Thevenot & Oakhill, 2005).

Aim

In order to precisely account for the conditions under which such alternative representations are constructed by individuals, we have recently adapted the representational change theory proposed by Knoblich and colleagues (1999; 2001) in the domain of insight problem to the domain of arithmetic word problem (Thevenot & Oakhill, 2008). In Knoblich's theory, insight problem solving often lead to impasses because the solver constructs an initial representation of the problem that has a low probability of success. It is only by revising this representation that the solver will overcome the impasse. The probability of such a successful revision depends on two processes, namely constraint relaxation and chunk decomposition. Within the initial representation, some constraints (i.e., what does

and does not count as a solution) are inappropriate and need to be relaxed. It turns out that certain constraints are more likely to be relaxed than others. Indeed, according to the authors, the probability of relaxation of a constraint is inversely proportional to its scope. In other words, it depends on how much a problem representation is affected if the constraint is relaxed: Constraints of narrow scope have a higher probability of being relaxed than constraints of wide scope because the resulting revisions in the problem representation are more circumscribed.

Method and results

Similarly, in a series of two experiments, we studied different types of arithmetic word problems that differ on the scope of the constraint to be relaxed in order to set up a more economic strategy than the one induced by their explicit wording. In our experiments, the number of steps needed to reach the alternative representation was the main variable and was systematically manipulated. In the example taken above, later referred to as P3 problems (i.e., 'How many marbles does Tom have less than John and Paul together? John has 41 marbles, Tom has 31 marbles and Paul has 43 marbles'), the initial representation would take the form "(John + Paul) – Tom". In order to change this representation into the alternative one "(John – Tom) + Paul", the chunk "John + Tom" would have to be broken down. Then, a reorganization into John – Tom + Paul would be necessary and finally, a new chunk ("John – Tom") would have to be created. Therefore, for this specific problem, three steps separate the new and the initial representation. However, it takes only two steps in order to shift from the initial representation of the problem "How many marbles does John have more than Tom and Paul together?" (later referred to as P2 problems) to an alternative one specifying a sub-goal involving the quantities of John and Tom marbles. Indeed, the initial representation "John – (Tom + Paul)" has to be decomposed, which leads to represent the problem as follow: John - Tom - Paul. No reorganization is needed but the new chunk (John – Tom) has to be created.

In the first experiment, we explicitly asked 29 participants to find an alternative strategy in order to solve P2 and P3 problems. More precisely, for both problems, individuals were asked to write down how they would solve them if they were to first find a sub-result that did not involve the number of marbles that Paul has. We showed that it took longer for participants to find this alternative strategy for P3 (134 seconds) than for P2 problems (83 seconds). This result is in accordance with Knoblich's theory because, as already explained above, 3 steps are necessary in order to find the alternative strategy for P2 problems. In the second experiment, we taught 29 adults how to relax the constraint of P2 and P3 problems and asked them to base their subsequent solution strategy on their new representation. We showed that, despite an explicit teaching, it was still demanding for participants to implement systematically the new strategy, especially for P3 problems. Such demand was operationalized by the time that participants took to read the question, only information in the text conveying the relational structure of the problem.

Educational implications

These results indicate that shifting from an initial mental representation to an alternative one that could release memory resources is a difficult cognitive activity. This suggests that individuals have rigid mental representations of situation problems and that children should be taught more systematically that, most of the time, different solution processes can lead to the right answer. This could help people to think more flexibly.

SYMPOSIUM

Factors influencing student achievement in Problem-Based Learning

Chairperson: Sofie Loyens, Erasmus University Rotterdam, Netherlands

Organiser: Sofie Loyens, Erasmus University Rotterdam, Netherlands

Discussant: David Gijbels, University of Antwerp, Belgium

Problem-based learning (PBL) has been successfully implemented in many medical schools all over the world. Many studies have been conducted in which PBL curricula were compared with conventional curricula. These studies demonstrated that students knowledge levels are comparable (Colliver, 2000; Newman, 2003; Dochy, Segers, van den Bossche & Gijbels, 2003; Schmidt, Van der Molen, te Winkel & Wijnen, 2009), but that PBL graduates demonstrated better communication skills, were better at coping with uncertainties and had better collaboration skills (Jones et al., 2002; Schmidt et al., 2006; Hoffman et al., 2006; Cohen-Schotanus et al., 2008; Schlett et al., 2010). However, so far not much is known about why and how distinctive aspects of group learning in PBL positively influence student learning, student motivation and student achievement (Dolmans & Schmidt, 2006). The proposed symposium is aimed at presenting three studies in which factors influencing student achievement in PBL are investigated. In a first study it is investigated how students' situational interest develops during the tutorial group session and how distinctive tutor behaviors influence students' situational interest and achievement. In a second study it is investigated whether tutors

can predict student performance. In a final study it is investigated how constructive, motivational and collaborative activities in the group influence student achievement.

SYMPOSIUM

Problem-based learning and student motivation: The role of interest in learning and achievement

Jerome Rotgans , National Institute of Education, Singapore; Henk Schmidt, Erasmus University Rotterdam, Netherlands

The findings of two studies are reported that shed some light on conditions that influence student motivation in problem-based learning (PBL). Both studies operationalized student motivation by means of situational interest, which is defined as an immediate affective response to a stimulus. The objective of the first study was to investigate how situational interest develops during a one-day PBL event. To that end, five measures of situational interest were administered at critical points in time during the learning event to 69 polytechnic students. Results demonstrate that situational interest significantly increased after the problem stimulus was presented. Subsequently, situational interest gradually and significantly decreased over the day. Testing a path model relating the situational interest measures revealed strong interrelations. Moreover, situational interest was highly predictive of academic achievement. The second study sought to explore whether the tutor characteristics increase students' situational interest in PBL. An analysis of variance (ANOVA) and path analysis were conducted ($N = 498$) to assess potential differences in situational interest based on three tutor characteristics and how well these characteristics predict situational interest. Results revealed that students supported by tutors who scored high on these characteristics reported significantly higher levels of situational interest. The findings suggest that tutors play an influential role in increasing students' situational interest in the PBL classroom. Implications of these findings are discussed.

Aim

Many advocates of problem-based learning (PBL) implicitly assume that this instructional method is highly motivating for students to study. It is expected that specific features of the PBL pedagogy, such as working on meaningful, real-life problems independently in small groups under minimal intervention of a tutor, would promote student motivation and learning. Whether this is the case, however, has not been studied extensively. The objective of this paper is to report two studies that examined whether a PBL environment has a motivating effect on student learning. In both studies, motivation was operationalized by means of students' situational interest, which has been defined as an immediate affective response to certain conditions and/or stimuli in the learning environment that focuses one's attention on the task (Hidi, 1990; Hidi & Renninger, 2006). In study 1 it was investigated how students' situational interest developed over the course of a one-day PBL event. In study 2 it was investigated in how far three distinct tutor characteristics, viz. social congruence, subject-matter expertise, and cognitive congruence (Schmidt & Moust, 1995), influence situational interest in the PBL classroom.

Methodology

Study 1

The sample for Study 1 consisted of 69 participants (61% female) with an average age of 20 years ($SD = 1.18$). All participants were enrolled in a second year PBL economics module at a Polytechnic in Singapore. Unique to this PBL approach is that students work on one problem during the course of one day (Alwis & O'Grady, 2002). A measure of situational interest was devised and validated. In order to determine students' prior knowledge and their academic achievement, a knowledge test was administered twice a day, once in the morning as a pre-test to measure students' prior knowledge and a second time at the end of the day as a post-test to determine what students have learned over the day.

The situational interest measure used in this study was administered for five critical occasions during the day. Potential mean level differences between the situational interest measures were determined by means of a repeated measures ANOVA. Subsequently, the relationships between the five situational interest measures as well as the pre- and post-test were analyzed using path analysis.

Study 2

The sample for Study 2 consisted of 498 participants (52% female) with an average age of 19 years ($SD = 1.62$). The participants were enrolled in various diploma programs at the same polytechnic as in Study 1. To measure the tutor characteristics a rating scale was adapted from Schmidt and Moust (1995), which is used on a regular basis as a program evaluation questionnaire at the polytechnic. Three subscales were administered: (1) social congruence, (2) subject-matter expertise, and (3) cognitive congruence. As a measure for students' situational interest, the same measure was used as in Study 1. Data concerning the three tutor characteristics were extracted from the routine program evaluation. About a month later, the situational interest measure was administered in these classes at five critical occasions during a PBL day (see Study 1). For further analysis, the average value of the five situational interest

measurements was used. In order to determine which of the three tutor characteristics predicted situational interest best, path analysis was carried out.

Findings

The results of Study 1 revealed that situational interest increased significantly after the problem trigger was presented. However, over the course of the day, students' situational interest gradually decreased. In the path analysis, the simplest fitting model was the one in which each measure of situational interest uniquely influenced each subsequent situational interest measure. Moreover, situational interest was a strong predictor of students' academic achievement. In our sample, prior knowledge was not related to situational interest, but it was a significant factor in predicting student achievement at the end of the day.

The results of Study 2 revealed that social congruence and subject-matter expertise were not directly related to situational interest, but were antecedent variables of a tutor's cognitive congruence. Our findings imply that being friendly, socially and emotionally connected with the students as well as having a large body of knowledge about a topic are highly predictive of how cognitively congruent a tutor is. Being cognitively congruent, that is helping students to understand the topic by providing scaffolds and structure to the topic, was a significant factor in predicting students' level of situational interest in the PBL.

Implications

The overall findings of the studies demonstrate the significant influence problems and tutors have on triggering and maintaining students' situational interest in PBL. Study 1 revealed a strong relationship between situational interest and academic achievement. The findings of Study 2 have direct implications for tutor training. If one attempts to increase situational interest by means of controlling for tutor characteristics it is recommended to: (1) increase a tutor's social congruence and (2) a tutor's subject-matter expertise – both resulting in an increased level of cognitive congruence, which eventually has a positive effect on students' situational interest.

References

- Alwis, W. A. M., & O'Grady, G. (2002). One day-one problem at Republic Polytechnic. Paper presented at the 4th Asia-Pacific Conference on PBL.
- Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Research*, 60(4), 549-571.
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111-127.
- Schmidt, H. G., & Moust, J. H. C. (1995). What makes a tutor effective? A structural equations modelling approach to learning in problem-based curricula. *Academic Medicine*, 70(1), 708-714.

SYMPOSIUM

Tutor predictions of students' study success

Lisette Wijnia, Erasmus University Rotterdam, Netherlands; Sofie Loyens, Erasmus University Rotterdam, Netherlands; Nitaasha Koendjie, Erasmus University Rotterdam, Netherlands; Henk Schmidt, Erasmus University Rotterdam, Netherlands

This study examines whether tutors (N =15) from a problem-based learning (PBL) environment were able to predict students' (N = 211) study success in the first year and their entire bachelor program. Tutors were asked to rate each student in his or her tutorial group on the chance that this student would successfully finish the first study year and the entire program. Logistic regression analysis indicated that tutors could successfully predict study success in the first year and completion of the bachelor program. In contrast to earlier studies in PBL, this study indicated that tutors can accurately predict students' study success. The results of this study suggest that tutors' can accurately identify students' at risk of failing or drop out in an early stage of the program. Therefore, tutor judgments of students' performance can be an additional useful source of information to identify students at risk of failing or drop out.

Aim

Drop-out in higher education is a major concern (Georg, 2009). Often successfulness of programs is evaluated based on rates of student success and drop-out. Loyens, Rikers, and Schmidt (2007) demonstrated that students who obtained higher achievement grades and positive tutor ratings of their learning activities were less likely to drop-out. These results demonstrate that teacher ratings of student behavior are negatively correlated with student drop-out, but can teachers also predict study success?

The aim of this study is to investigate the accuracy of tutor predictions in problem-based learning (PBL). Earlier research that examined teacher judgments in PBL was inconclusive. Although Loyens et al. (2007) indicated that students' with positive tutor ratings were less prone to drop-out, two previous studies indicated that tutors cannot

accurately judge students' performance. Kaufman and Hansell (1997) found a significant positive correlation between tutor ratings of students' performance in tutorial meetings and actual performance, explaining 4% of the variance. However, closer examination revealed that only 3 of the 31 tutors in the study could accurately predict student performance. Similar results were found by Whitfield and Xie (2002). Although positive correlations were found between tutor ratings and actual student performance, only a small proportion of the variance in student achievement could be explained.

Methodology

The participants were all first-year tutors (N = 15; 4 male, 11 female) and 211 first-year psychology (57 male, 154 female) students of the 2002-2003 academic year. Students had a mean age of 20.01 (SD = 3.11).

In the first course (i.e., first five weeks) of the academic year tutors were asked to write down the chance that each student of their tutorial group would successfully finish the first study year and the chance each student would successfully complete the entire program. Tutors had no prior knowledge about students' achievement in secondary education. Chance percentages were coded into four categories, ranging from 0-25 to 76-100 percent.

First year study success was coded in two categories: (1) pass (i.e., earned at least 42 study credits) and (0) failed (i.e., less than 42 credits). Study success in the bachelor program was coded into three categories: (0) drop out during bachelor program, (1) not finished the program in three years, and (2) finished.

Findings

Because of the categorical outcome variable, logistic regression analyses were performed. The model with tutor ratings as the predictor variable was significant, $\chi^2(3, N = 211) = 39.57, p(N = 211) = 29.12, p$

Table 1- Logistic regression first year study success

Implications

This study aimed to investigate whether tutors are able to predict students' study success. In contrast to the earlier studies conducted in PBL (Kaufman & Hansell, 1997; Whitfield & Xie, 2002), this study shows tutors can predict first year success and success in the bachelor program. This finding is important because it enables educators to identify and help students who are at risk of failing or drop-out in an earlier stage of their program.

In this study we did not examine on what information tutors based their expectations. Knowing on which information tutors based their decisions, could give more insight in how tutors make judgments about future study success. As mentioned, the tutors did not have access to relevant prior information about students' performance in secondary education. They did observe students participating in group discussions and students' roles as chair or scribe of a tutorial meeting. It is likely that tutors mostly based their expectations on observed learning activities in group meetings, since they had no further information about the students' learning activities and history.

In conclusion, the results of this study show tutors can accurately predict students' short and long term study success. Therefore, tutor judgments can act as an additional useful source of information to identify students at risk of failing. By doing so student drop-out can be diminished.

References

- Georg, W. (2009). Individual and institutional factors in the tendency to drop out of higher education: A multilevel analysis using data from the Konstanz Student Survey. *Studies in Higher Education*, 34, 647-661.
- Kaufman, D. M., & Hansell, M. M. (1997). Can non-expert PBL tutors predict their students' achievement? An exploratory study. *Academic Medicine*, 72(Suppl. 1), S16-S18.
- Loyens, S. M. M., Rikers, R. M. J. P., & Schmidt, H. G. (2007). The impact of students' conceptions of constructivist assumptions on academic achievement and drop-out. *Studies in Higher Education*, 32, 581-602.
- Whitfield, C. F., & Xie, S. X. (2002). Correlation of problem-based learning facilitators' scores with student performance on written exams. *Advances in Health Sciences Education*, 7, 41-51.

SYMPOSIUM

The relationship between students' small group activities, time spent on self-study and achievement

Rachelle Kamp, Maastricht University, Netherlands; Diana Dolmans, Maastricht University, Netherlands;

Henk van Berkel, Maastricht University, Netherlands; Henk Schmidt, Erasmus University Rotterdam, Netherlands

Within Problem-based learning it remains unclear which specific student activities are crucial for good learning achievements. Therefore, this study investigated the relationship between the contributions students make to the problem-based tutorial group processes as observed by their peers, self-study time and achievement. To that end, the Maastricht-Peer Activity Rating Scale (M-PARS) was administered to students participating in PBL tutorial groups. With this rating scale students had to rate the constructive, collaborative and motivational activities of their peers within

the tutorial group. In addition, time spent on self-study was measured with a self-estimation method and achievement was measured with a unit test and a group assignment. A causal model of these variables was developed, in which the three types of activities were assumed to affect self-study time, which would subsequently affect test and group assignment scores. A Structural Equation Modeling analysis indicated acceptable model fit. Especially apparent were the causal relations between a student's constructive activities and his/her unit test score and between a student's collaborative activities and the group assignment score. Surprisingly, time spent on self-study was not affected by the students' contributions, nor did it have an effect on the unit test score. The results suggest that there are indeed causal relations between a student's contributions to the tutorial group process, as perceived by their peers, and achievement. These findings suggest that it is important to monitor and evaluate the contributions of students in tutorial groups.

Aim

The quality of the discussion within a problem-based learning (PBL) tutorial group seems to play a crucial role in the success of PBL (Savery & Duffy). Gijssels and Schmidt (1989) found that tutorial groups that are perceived as well functioning by the students within the group, spent more time on self-study and subsequently achieved better. A shortcoming of this model is that it treats group functioning as a single variable and therefore does not differentiate between types of students' contributions. Other research has studied the different processes that take place within tutorial groups, but the relationship between these different processes, self-study time and achievement has not been investigated. It remains unclear which specific student activities are crucial for good learning achievements (Hak & Maguire, 2000). Another shortcoming is that measurements of PBL group functioning are often based on students' self-evaluations, while the validity and reliability of self-evaluation are not optimal (e.g. Eva, 2001). Therefore, this study investigated the relationship between the contributions students make to the tutorial group process as observed by their peers, self-study time and achievement. Three different types of student contributions were evaluated by peer group members, viz. constructive, collaborative and motivational contributions, which are thought to be conducive to effective learning in small groups (Slavin, Hurley & Chamberlain, 2003). The central research question is: 'Do students who perform better in tutorial groups (i.e. display more constructive, collaborative and motivational activities according to their peers) also spend more time on self-study and subsequently achieve better' (see Figure 1).

Methodology

Participants were 650, divided into 65 tutorial groups, first- and second-year students attending the medical curriculum (PBL) at Maastricht University during the academic year 2009-2010. Students met each other twice a week for a two-hour session over a period of six (first year students) to 10 (second year students) weeks.

Students' activities were measured with the earlier validated 14-item Maastricht-Peer Activity Rating Scale (M-PARS) (Kamp, Dolmans, Van Berkel & Schmidt, 2010), consisting of three subscales: constructive (i.e. This student asked critical questions), collaborative (i.e. This student felt responsible for the group) and, motivational activities (i.e. This student participated well). With this scale students evaluated the performance of their peers in the tutorial group by responding on a 5-point Likert-scale (1 = strongly disagree – 5 = strongly agree).

Student achievement was measured with a group assignment and a test at the end of the unit.

Self-study time was measured at the end of the course, before the unit test, with a self-estimation method.

The causal relations between student activities, self-study time and achievement, were investigated with a structural equation modeling analysis on the model in Figure 1 (AMOS Version 17.0). Good model fit was assessed by the following criteria: CMIN/DFp-value, RMSEA \leq .05, and NFI $>$.95 (Garson, 2009).

Findings

The initial model (Figure 1) generated a poor fit. Based on the modification indices and theoretical insights the causal model in Figure 2 was developed, which demonstrated good model fit: chi-square [5df] = 5.167, $p = 0.396$, RMSEA = 0.008 and NFI = 0.997. Figure 2 illustrates a significant causal relation between a student's constructive activities and his/her unit test score, between a student's collaborative activities and his/her group assignment score and between a student's group assignment score and his/her unit test score. Unexpectedly, the effect of the tutorial group activities on achievement was not mediated by self-study time.

Insert Figure 2 here

Significance

The significance of this study is that it further specifies the relationship between group functioning in PBL and achievement. The findings indicate that students who, according to their peers, display more constructive activities achieve better on the unit test than their peers who make less constructive contributions. In addition, the results indicate that students who are perceived as more committed to the group and promote collaboration within the

group, achieve better on the group assignment than students who are perceived as less committed. The absence of the mediating effect of self-study time could be explained by the argument of Plant, Ericsson, Hill, and Asberg (2005), that learning achievements are not so much influenced by the amount of time students spend on self-study, but by the manner in which they spend it.

The findings also suggest that in order to improve achievement in PBL curricula, students' tutorial contributions should be evaluated and monitored. For this purpose the M-PARS could be used as a feedback instrument. Based on their scores, students receive feedback on the quality of their behavior within the tutorial group, which might lead to improved behavior and subsequently, better achievement. Further research is needed to investigate this hypothesis.

References

- Eva, K.W. (2001) Assessing tutorial-based assessment. *Advances in Health Sciences Education*, 6, 243-257.
- Garson, G.D. (2009). *Structural Equation Modeling, from Statnotes: Topics in Multivariate Analysis*. Retrieved 18/08/2010 from <http://faculty.chass.ncsu.edu/garson/pa765/statnote.htm>.
- Gijselaers, W.H., & Schmidt, H.G. (1989). Towards a causal model of student learning within the context of a problem-based curriculum. In Z. Nooman, H.G. Schmidt & E. Ezzat (Eds.), *Innovation in medical education: an evaluation of its present status* (pp. 95-113). New York: Springer Publishing.
- Hak, T., & Maguire, P. (2000). Group process: The black box of studies on problem-based learning. *Academic medicine*, 75(7), 769-772.
- Kamp, R.J.A., Dolmans, D.H.J.M., Van Berkel, H.J.M., & Schmidt, H.G. (2010). Can students adequately evaluate the activities of their peers in PBL? Paper presented at the Annual Meeting of the American Educational Research Association, 2010 April 30–May 4, Denver, CO.
- Plant, E.A., Ericsson, K.A., Hill, L., & Asberg, K. (2005). Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance. *Contemporary Educational Psychology*, 30, 96–116.
- Savery, J.R. & Duffy, T.M. (1996). Problem Based Learning: An instructional model and its constructivist framework. In B.G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 135-148). Englewood Cliffs, NJ: Educational Technology Publications.
- Slavin, R.E., Hurley, E.A., & Chamberlain, A.M. (2003). Cooperative learning and achievement: Theory and research. In W.M. Reynolds & G.E. Miller (Eds.), *Handbook of Psychology*, Volume 7 (pp. 177-198). Hoboken, NJ: Wiley.

SYMPOSIUM

Motivational perspectives on study behaviors and learning outcomes in Higher Education.

Chairperson: Richard Walker, University of Sydney, Australia

Organiser: Luke K. Fryer, Kyushu Sangyo University, Japan

Discussant: Kirsti Lonka, University of Helsinki, Finland

Student Learning Theory (SLT) research has often failed to include current motivational theorizing within model development. Contemporary motivational theories may provide opportunities for further conceptual and practical development. This symposium addresses the role of current motivational theories within Higher Education learning research. The symposium consists of three quantitative, empirical papers centered upon two current, broad motivational fields—Achievement Goals and Self Determination Theory (SDT)—and their relationship with student's study behaviors and learning outcomes. Paper-1 tests the suitability of the Achievement Goal Questionnaire (AGQ) (Elliot & McGregor, 2001) framework for adult learners. Following validation of the AGQ, relationships between goal adoption and learning-related outcomes are assessed. Paper-2 takes a primarily participant-orientated analytical approach to the question of study behaviours' relationship with motivation; results logically follow from prior theory but also raise new questions. Paper-3 tests the effect of student' reasons "to study" and "not study" on their approaches and achievement outcomes by employing SEM panel analysis. Results suggest both "reasons" have an effect on approaches but only high-quality goals affect achievement outcomes.

Motivations have a clear relationship with both study behaviours and outcomes such as achievement and course dropout. Amotivations had a direct effect on students' adoption of maladaptive study behaviours, raising questions about this hitherto under-researched aspect of SDT and its implications for learning in tertiary education. These papers suggest that a range of motivations play important roles in Higher Education. Further research, employing current motivational theories and modern analytic methods may lead to stronger models of tertiary learning.

SYMPOSIUM

Achievement goals in adult learners: Evidence from distance education.

John Richardson, The Open University, United Kingdom; Richard Remedios, University of Durham, United Kingdom

There is evidence that learners may adopt different kinds of achievement goal: mastery-approach, mastery-avoidance, performance-approach and performance-avoidance. In higher education, this evidence has mainly come from young people who have recently gone straight from high school to college. In this study, the Achievement Goal Questionnaire was administered to adult learners taking courses by distance education. Usable data were obtained from 195 men and 586 women between the ages of 19 and 87. The results confirmed the reliability and construct validity of the Questionnaire in this distinctive population. As in previous studies of younger students, mastery-approach goals were unrelated to attainment, performance-approach goals facilitated attainment, and performance-avoidance goals tended to impair attainment. In addition, mastery-avoidance goals impaired students' attainment and also increased the likelihood that they would drop out of their course altogether. The achievement-goal framework is as appropriate for understanding the influences on attainment on adult learners as it is in younger students. There is also evidence that students who adopt mastery goals are more likely to hold reconstructive conceptions of learning and are more likely to adopt a deep approach to their studies. Future research needs to explore these links between students' achievement goals and their approaches to learning.

Aims. Dweck and Elliott (1983) suggested that achievement motivation involved two broad kinds of goal: learning goals (seeking to increase one's competence, understanding, or mastery) and performance goals (seeking favourable judgments or avoiding negative judgments of one's competence from others). Both kinds of goal could promote mastery-oriented behaviour. However, if confidence in one's ability was low, performance goals increased helpless behaviour and lowered motivation. Ames and Archer (1988) offered a similar account but referred to learning goals as "mastery goals". Students who adopt mastery goals are more likely to hold reconstructive conceptions of learning (Sachs, 2001) and are more likely to adopt a deep approach to studying (Grant & Dweck, 2003). Elliot and Harackiewicz (1996) divided performance goals according to whether they were oriented towards the attainment of success or the avoidance of failure. Elliot and McGregor (2001) noted that this distinction could be applied to mastery goals, too. They developed an Achievement Goal Questionnaire (AGQ) measuring mastery-approach goals ("I want to learn as much as possible from this class"), mastery-avoidance goals ("I worry that I may not learn all that I possibly could in this class"), performance-approach goals ("It is important for me to do better than other students"), and performance-avoidance goals ("I just want to avoid doing poorly in this class"). They found that students who adopted mastery-approach goals were more likely to adopt deep processing in their learning, whereas students who adopted performance-avoidance goals were more likely to adopt surface processing. Performance-approach goals appeared to facilitate academic attainment, performance-avoidance goals appeared to impair attainment, but neither mastery-approach nor mastery-avoidance goals were significantly related to attainment. Subsequent research has provided extensive confirmation of this framework. However, a major limitation of the research is that it was carried out with samples consisting predominantly of young people who had recently gone straight from secondary school to college. The present study was carried out to evaluate Elliot and McGregor's (2001) framework in adult learners using a large sample of students who were taking courses by distance learning. Our interest was in the component structure of the AGQ in this population and in whether their scores predicted their subsequent attainment in a similar manner to previous studies.

Methodology

A sample of 1,140 students was drawn from students about to embark on three courses with the Open University in 2005. They were supplemented by three additional items. Two were "On the whole, I expect this course to be very interesting" and "On the whole, I expect this course to be very enjoyable", and the participants responded on the same response scale. The final item asked participants to say whether they were studying to understand the material or to obtain a good grade by checking one of seven boxes, where the extreme categories were labelled "primarily understanding" (coded 1) and "primarily grades" (coded 7). The questionnaire was distributed in a postal survey that was mailed at the beginning of September 2005, and a reminder was mailed 2 weeks later. The survey was closed 6 weeks after the original mailing when the courses had just started so that the students' responses would not be influenced by their experience of their courses.

Findings.

Completed questionnaires were returned by 781 (or 68.5%) of the participants, consisting of 195 men and 586 women varying in age from 19 to 87 years. A principal components analysis of their AGQ responses yielded four components that corresponded to the Mastery Approach, Mastery Avoidance, Performance Approach and Performance Avoidance scales. For each of the four scale scores Cronbach's (1951) coefficient alpha was 0.69 or higher. The correlation coefficients among the four scale scores were all positive and statistically significant, which is consistent with the idea that students can pursue different kinds of achievement goal at the same time. The students obtained very high

scores on Mastery Approach, high scores on Mastery Avoidance and Performance Avoidance, but low scores on Performance Approach. The majority of students expected their course to be both interesting and enjoyable, but they were evenly divided between intrinsic and extrinsic motives for studying. The students' scale scores were compared with (a) whether they completed their course, (b) whether those who completed their course passed, and (c) the marks (on a percentage scale) awarded for assignments and an examination to the students who passed their course. Scores on Mastery Avoidance were negatively related to course completion, but none of the scale scores significantly predicted passing versus failing in students who had completed the relevant course. There was no relationship between scores on Mastery Approach and marks. Students who obtained higher scores on Mastery Avoidance achieved significantly lower marks; students who obtained higher scores on Performance Approach obtained significantly higher marks; and students who obtained higher scores on Performance Avoidance obtained significantly lower marks.

Theoretical and educational significance.

Our results are entirely consistent with those of previous research in showing that the different kinds of achievement goal are related to students' academic attainment in different ways: mastery-approach goals are unrelated to attainment; performance-approach goals tend to facilitate attainment; and performance-avoidance goals tend to impair attainment. The findings are further evidence of the robustness of the goal-outcome relationships, at least for mastery-approach, performance-approach and performance-avoidance goal constructs. In addition, the adoption of mastery-avoidance goals not only tends to impair attainment but also makes it more likely that students will drop out of their course. From a theoretical point of view, this provides additional evidence for Elliot and McGregor's (2001) position that mastery-avoidance goals operate in many achievement settings and have consequences for subsequent attainment. From a practical point of view, these results suggest that the AGQ could provide a simple but useful diagnostic tool to identify students at risk of dropping out of their studies. More generally, the present study demonstrates that the achievement-goal framework is as appropriate for understanding influences on attainment in adult learners as it is in younger students. Future research needs to explore the relationship between students' achievement goals, their conceptions of learning and their approaches to studying.

SYMPOSIUM

Relating academic motivation and processing strategies with students in higher education.

Gert Vanthournout, University of Antwerp, Belgium; Sven De Maeyer, Antwerp University, Belgium; David Gijbels, University of Antwerp, Belgium; Vincent Donche, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium

The present study aims at exploring the theoretically proposed relation between motivation and learning strategies, using contemporary and complex models of learning and motivation, namely the learning pattern-model and self-determination theory. To gain a nuanced and in-depth understanding of this relation the combination of a variable-oriented and a person-oriented perspective in data-analysis was used. Three research questions were addressed: (RQ1) What profiles can be identified, based on students' processing strategies? (RQ2) Do motivational dimensions predict the use of processing strategies? (RQ3) Do motivational dimensions predict profile membership? 408 students in the first year of a professional bachelor programme participated in the study. Students' motivation and learning strategies were assessed using the Learning and Motivation-questionnaire. To identify profiles, a hierarchical cluster analysis, using Ward's method, was used. A multivariate regression analysis was carried out to answer the second research question. To answer the third research question, a multinomial regression analysis was conducted. Results of these analyses on the one hand confirm the relationship between motivation and processing strategies, but on the other hand caution that this relation is not as straightforward as the theoretical models propose. No evidence for one-on-one relations between motivational dimensions and specific strategies were found. A clear relation between high quality motivational regulation and deep processing strategies or profiles could be established. However, the picture becomes less clear-cut at the other end of the continuum. High scores on surface strategies or membership of weaker profiles were not predicted by low quality or quantity of motivation.

Aims

Previous research-models in the approaches to learning tradition hypothesize a direct link between motivational aspects and students' learning strategy use (e.g. Entwistle, 1988). However, most models incorporate traditional and general motivational dimensions. Moreover some models theoretically assume an almost irrevocable relation between certain specific types of motivation and the use of specific strategies (e.g Biggs, 2003). Advances in research and theorizing on learning and motivation, however, suggest that reality is more complex (Baeten et al., 2009; Cano & Berben, 2007). The present study aims at exploring the relationship between motivation and processing strategies, using contemporary and complex models in learning and motivation. To investigate students' motivation, self-determination theory (Deci & Ryan, 2002) was used. This model distinguishes between five types of motivational

regulation: lack of motivation, external regulation, introjected regulation, identified regulation and intrinsic regulation. To map students' processing strategies, Vermunt's learning pattern model (Vermunt & Vermetten, 2004) was used, encompassing five processing strategies: relating and structuring, critical processing, analysing, memorising and concrete processing.

The following research questions were addressed: .

- (RQ1) What profiles/clusters can be identified, based on students' processing strategies? (person-oriented approach) .
- (RQ2) Do motivational dimensions predict the use of processing strategies? (variable-oriented approach) .
- (RQ3) Do motivational dimensions predict profile membership? (combined approach)

Based on previous research and theoretical models we expect high quality motivation (intrinsic or identified regulation) to predict the use of deep strategies (relating and structuring, critical processing, concrete processing) and membership of strong learning profiles. Similarly we hypothesize low quality (introjected or external regulation) or quantity of motivation (lack of motivation) to be related to the use of surface strategies (memorising, analysing) or weaker profiles.

Methodology

Participants were 408 first year students enrolled in a professional bachelor programme. Students were questioned on their motivation and processing strategies using the Learning and Motivation questionnaire (Donche & Van Petegem, 2008). This instrument combines adapted scales from Vermunt's Inventory of Learning Styles (Vermunt, 1998) with adapted and selected items and scales from the Academic Self-Regulation Scale (Ryan & Conell, 1989) and the Academic Motivation Scale (Vallerand et al., 1997). A combination of a variable-oriented and a person-oriented perspective in data-analysis was carried out because both perspectives provide complementary information (Goldblatt & Fortunato, 1996). To identify profiles, a hierarchical cluster-analysis was carried out on the processing strategies, using Ward's method. Statistical and theoretical criteria were taken into account to determine the most suitable number of clusters. To explore the relationship between motivational dimensions and processing strategies a multivariate regression analysis was used, with the regulations as predictors and the processing strategies as dependents. To investigate the relationship between these profiles and motivational dimensions, a multinomial regression analysis was conducted with the motivational dimensions as predictors and the profiles as dependents.

Findings

Results In the cluster analyses, a six cluster solution was deemed most appropriate. The resulting clusters were labeled as follows: 1. Deep-flexible learners (n=92; 23%): Students in this cluster combine high scores on relating, concrete and critical processing with average scores on analysing and below average scores on memorising. 2. Moderate deep learners (n=72; 18%): Students with this profile have moderate scores on relating, concrete and critical processing as well as below average scores on both analysing and memorising. 3. Stepwise learners (n=63; 15%): Students in this cluster have a combination of high scores on analysing and memorising and moderate scores on relating, concrete processing and critical thinking. 4. Memorizers (n=140; 34%): Students with this profile score below average on most processing strategies except for memorising. 5. Passive learners (n=41; 10%): Students in this cluster have low scores on all processing strategies. Results of the multivariate regression analysis indicate that all predictors except external regulation and lack of motivation are significant predictors of the full model, explaining about 20% of the variance. Introjected regulation predicts the use of analysing and memorising strategies, while identified regulation is linked to the use of all processing strategies. Finally, Intrinsic regulation significantly predicts the use of critical processing and relating as processing strategies. The multinomial regression analysis was conducted with the deep-flexible learners as reference group. The model is significant at the .001 level. All motivational dimensions except external regulation and lack of motivation prove to be significant predictors of cluster membership. Scores on introjected, identified and intrinsic regulation differentiate between the deep flexible learners and the passive learners. Students with lower scores on these regulations have a higher chance of being members of the passive learners profile. Identified and intrinsic regulation also distinguish between the deep-flexible learners and the memorizers. Students who perceive courses as being relevant or are personally interested, have a higher chance of belonging to the deep-flexible profile. Intrinsic motivation is the sole significant predictor for distinguishing between the deep-flexible learners and the stepwise learners. Deep-flexible learners are more interested in the courses. Finally, none of the motivational dimensions significantly predicts cluster membership when comparing the deep-flexible with the moderate deep profile.

Theoretical and educational significance

Results from our analyses on the one hand confirm the link between motivation and the use of processing strategies as proposed by theoretical models in the SAL-tradition. On the other hand, they also caution that this relation might not be as straightforward as these models envisage. For instance, there doesn't seem to be an unequivocal relationship between specific motivational drives and accompanying processing strategies. Moreover, although there seem to be a clear link between high quality of motivation and deep learning strategies or strong learning profiles, the relation becomes less clear-cut at the other end of the continuum. For instance, students in the memorizers or passive learners profile have a lower score on high quality motivational dimensions, compared to the deep-flexible learners, but this is not accompanied by higher scores on low quality or quantity motivational regulations. For research and theory, these results contribute to a more in-depth and nuanced understanding of what appears to be a complex relationship between learning and motivation. They also warn practitioners not to draw conclusions on students' strategy use based solely on motivational indicators.

SYMPOSIUM

The longitudinal effect of reasons to study and not study on approaches to learning and achievement.

Luke K. Fryer, Kyushu Sangyo University, Japan; Richard Walker, University of Sydney, Australia; Paul Ginns, University of Sydney, Australia; Raymond Debus, University of Sydney, Australia

This research tested a longitudinal structural model assessing the effect of students' reasons "to study" and "not to study" on their approaches to learning and achievement. Students' Instrumental goals and Amotivation for learning were hypothesized to have a direct effect on students' self-reports of study behavior. Effort-belief amotivations were found to have a direct medium effect on Surface Approaches and Distal-internal goals had a direct medium effect on Deep Approaches and achievement. Effort-beliefs are important sources of maladaptive study behaviours and therefore a practical topic for instructors concerned with helping students pursue adaptive study strategies. Conversely, the adoption of internal goals by students was positively associated with both adaptive study strategies and achievement. This would suggest that aiding students in developing instrumental goals, beyond external sources of instrumentality such as graduation and future employment, might be beneficial for student learning in university.

The importance of a student's approaches to learning, including Deep (DA) and Surface (SA) approaches, has been widely recognized within the higher education literature. Reflecting the original Student Learning Theory (SLT) research (Marton & Säljö, 1976), questions regarding the inducement of DA and prevention of SA have generally focused on correlational research examining the relationship between the learning environment and students' approaches (e.g. Ramsden & Entwistle, 1981). Relatively fewer studies have explored other intra-individual factors related to students' approaches, although some researchers have begun to explore individual and motivational correlates (e.g. Chamorro-Premuzic & Furnham, 2009; Prat-Sala & Redford, 2010). The present study tests a structural model including both perceptions of the learning environment, and emerging motivational constructs, as they relate to approaches to learning and academic achievement.

Aims

To date, relatively little SLT research has employed a Structural Equation Modeling (SEM) approach. SEM with longitudinal rather than cross-sectional data enables causal models to be tested, and is therefore an essential step toward developing a SLT model with practical implications for higher education stakeholders concerned with quality assurance.

Student perceptions of Good Teaching tend to be moderately correlated with DA (positively) and SA (negatively) to learning (Wilson, Lizzio, & Ramsden, 1997). This core SLT construct thus provides a "benchmark" to judge the relative importance of novel constructs.

Two areas of motivational research that may be of practical importance in higher education are Instrumental motivation and Amotivation. Both types of motivation are relatively new components of Self Determination Theory (SDT). Amotivation refers to a lack of motivation. Considerable research during the past two decades has led to the development of the Academic Amotivation Inventory (AAI) (Legault, Green-Demers, & Pelletier, 2006). The AAI measures amotivation within four motivational frameworks: Task-Value, Effort Beliefs, Ability Beliefs and Task Characteristics.

Instrumental motivation is a mixture of task-value, extrinsic motivation and future-time perspective. Higher education, with its strong connection and close proximity to work-life, is a context within which instrumental motivation is both ubiquitous and varied. Depending on the students, their development, and their study context, they may be motivated by different instrumental motivations. Research has shown that it is not the quantity of motivation but the quality that is important for learning outcomes (Vansteenkiste, Lens, & Deci, 2006). Therefore, to assess a range of

instrumental reasons for studying in Higher Education, Simons, Dewitte, & Lens' (2004) 2 (Proximal/Distal) x 2 (Internal/External) goal framework was employed for scale development during prior piloting. To test the relative causal efficacy of Instrumental goals and Amotivation on student approaches, Trigwell & Ashwin's (2006) version of the Approaches to Study Inventory, measuring DA and SA constructs, was employed.

Methodology

At Time 1, perceptions of Good Teaching, Instrumental motivations for studying and Amotivations for not studying were measured. At Time 2 (seven months later), students' approaches were measured, and student achievement data for the entire year, in the form of annualized GPA, were obtained from the university with students' written consent. All surveys were piloted the year prior to research and found to be valid measures of their respective constructs. The sample was 70% male, proportional to enrolment. The final matched sample was $n = 1173$. An example item and the scale reliability for the finalized scales are listed in Table 1.

Table 1. Scale items, reliability and example item.

The hypothesized model tested both direct and indirect relations between constructs measured at Time 1 and Time 2.

Findings

Figure 1 presents the final longitudinal model: beginning of semester one, to the end of semester two. The presented model fits the data acceptably: CFI = .93, TLI = .92, RMSEA = .05. Only nine of the tested paths were significant ($p > .05$)—represented by solid lines in Figure 1.

Figure 1. Longitudinal SEM at three time points: Motivation, Approaches, and Achievement.

Theoretical and educational significance

The longitudinal effect of students' Effort-beliefs and Distal-internal goals are of particular significance for practice. Despite the temporal distance (seven months), Effort-beliefs have a consistent medium effect on students' less adaptive approaches. Instructors seeking to improve their students' study behaviours would be well advised to discuss time management and explicitly portray the time demands of the course in a comprehensible and achievable manner. As hypothesized, high quality internal goals had the strongest impact on adaptive study behaviours. This suggests that helping students develop clear internal goals, beyond grade and career would benefit not only their approaches but also directly improve their learning outcomes.

Several unexpected results emerged in the present study. Firstly, perceptions of Good Teaching were positively correlated with both approaches. In addition, SA and DA were positively correlated ($r = .38$). Both of these results suggest that the learning environment in Japanese universities may be inconsistent with what is generally found in many western Universities, indicating a need for further examination of this under-researched higher education setting.

SYMPOSIUM

Strategy flexibility: Analyzing its related structures and processes

Chairperson: Joke Torbeyns, K.U.Leuven & GROUP T - Leuven University College, Belgium

Organiser: Joke Torbeyns, K.U.Leuven & GROUP T - Leuven University College, Belgium

Discussant: Ineke Imbo, Department Experimental Psychology, Belgium

During the last decades, the efficient and flexible or adaptive use of various strategies on mathematical tasks has become an important topic for researchers in the domain of cognitive and educational psychology (e.g., Baroody & Dowker, 2003; Kilpatrick et al., 2001; Shrager & Siegler, 1998; Verschaffel et al., 2007). This symposium brings together three empirical contributions focusing on children's and adults' strategy flexibility on mathematical tasks and its related structures and processes. The three studies start from a common definition of what it means to select strategies flexibly/adaptively, but use an interesting variation in methodologies to study this topic. In the first contribution, meta-analytic techniques are used to analyze the relations between people's conceptual and procedural mathematical knowledge. In the second contribution, a micro-genetic study is presented in which the role of feedback on children's adaptive strategy use is tested. In the third and final study, the authors show the impact of previous strategy selection on the choice process. Taken together, the different contributions do not only increase our understanding of the structures and processes that are related to the flexible use of different strategies on mathematical tasks, but also provide building blocks for cultivating the acquisition of adaptive expertise in mathematics classrooms.

SYMPOSIUM

Strategy flexibility matters for student achievement: How flexibility relates to other outcomes

Kelley Durkin, Vanderbilt University, United States; Bethany Rittle-Johnson, Vanderbilt University, United States; Jon Star, Harvard University, United States

Strategy flexibility is an important component of student learning in mathematics but has only recently been rigorously examined by researchers. Consequently, the relationships between strategy flexibility and other constructs, such as conceptual and procedural knowledge or general mathematics achievement, remain poorly understood. The current paper used meta-analytic techniques to find mean effect sizes for the relationships between strategy flexibility and these other constructs. Using data from eight studies that measured strategy flexibility, conceptual knowledge, procedural knowledge and general mathematics achievement, we found moderate to strong relationships between flexibility and each of the other constructs. These results provide empirical support for the idea that strategy flexibility is an important construct that is related to, but distinct from, other constructs. Also, based on these results, test makers may want to consider adding measures of students' strategy flexibility to standardized measures of mathematics achievement to give teachers and parents a more complete understanding of students' mathematics abilities.

While conceptual and procedural knowledge have been the focus of much discussion for years in mathematics education, flexibility in problem solving has only recently been examined and measured more rigorously (Star, 2005). This increased attention on strategy flexibility suggests the need to investigate how flexibility may relate to other constructs, including conceptual and procedural knowledge and general measures of mathematics achievement. The current paper provides empirical support for the idea that strategy flexibility is important and is related to, but distinct from, other constructs related to students' mathematical abilities. Flexibility is acknowledged as an important component of student learning in mathematics, and people who develop strategy flexibility are more likely to use or adapt existing procedures when facing unfamiliar problems and to have a greater understanding of domain concepts (e.g., Blöte, Van der Burg, & Klein, 2001).

While the importance of flexibility is increasingly acknowledged by researchers, flexibility is not frequently assessed as an instructional outcome in schools (Star, 2005). More specifically, standardized tests in the United States often include sections on concepts, procedures, and problem solving, but they do not include measures of flexibility. However, in recent years, researchers have begun to develop assessments of strategy flexibility and to consider how this outcome is or is not related to conceptual and procedural knowledge (Star, 2005; Verschaffel, Luwel, Torbeyns, & Van Dooren, 2007). There are some differences in how researchers define flexibility (e.g., Verschaffel et al., 2007). We use a common definition, which is that flexibility involves knowing multiple strategies and their relative efficiencies and adapting strategy choice to specific problem features (e.g., Blöte et al., 2001; Rittle-Johnson & Star, 2007). We separated the construct of strategy flexibility into flexibility knowledge and flexible use of procedures (e.g., Rittle-Johnson & Star, 2007). Flexibility knowledge is defined as knowing multiple strategies and the relative efficiency of the procedures. Flexible use of strategies is defined as students picking the most efficient procedure depending on problem features. It is important to examine both flexibility knowledge and flexible use because students can sometimes identify a more appropriate strategy for solving a problem before they actually choose to use it (e.g., Blöte et al., 2001).

To examine the relationship between flexibility and other measures, we searched for studies that measured strategy flexibility, conceptual knowledge, and procedural knowledge, and included standardized test data. This resulted in the inclusion of eight studies that focused on flexibility in the domains of equation solving and computational estimation with students in Grades 5 – 8 in the United States (e.g., Rittle-Johnson & Star, 2007; Star & Rittle-Johnson, 2009). Each study used a pretest-intervention-posttest design, and all of the interventions involved learning conditions meant to promote flexibility, such as having students compare multiple solution methods. In the included studies, the conceptual knowledge measures assessed the ability to recognize and explain key domain concepts (Hiebert & Wearne, 1996).

Procedural knowledge was defined as the ability to execute action sequences to solve problems on both familiar and novel problem types (Hiebert & Wearne, 1996). Different mathematics standardized tests were used in different studies depending on what was used at the participating schools. We examined correlations between measures at posttest. Because these were correlations between continuous variables, we used Fischer's Z to transform correlations to effect sizes (Lipsey & Wilson, 2001). The mean effect size for each type of correlation (e.g., the correlation between flexibility knowledge and flexible use) was calculated using meta-analytic techniques and then transformed using the inverse Fischer's Z transform.

The mean effect sizes for each correlation are shown in Table 1. Our analysis yielded three main results. First, as expected, flexibility knowledge and flexible use measures were strongly related to each other, although they were not perfectly correlated with one another ($r = .635$). We interpret this finding to indicate that it is important to measure flexible use and flexibility knowledge separately; measures of knowledge and measures of use appear to be tapping somewhat different aspects of flexibility. Second, we found that conceptual and procedural knowledge had moderately strong relationships to both flexibility measures (r 's from .541 to .627), indicating that conceptual and procedural knowledge are related to, but distinct from, flexibility. Finally, the standardized test measures were significantly correlated with other outcome measures, especially flexibility knowledge ($r = .535$).

Overall, these results suggest that it is important to measure students' flexibility, both in terms of knowledge of multiple strategies and ability to flexibly choose efficient strategies. In addition, test makers may want to consider adding measures of students' strategy flexibility to standardized measures of mathematics achievement to give teachers and parents a more complete understanding of students' mathematics abilities.

SYMPOSIUM

Practice without feedback can increase the adaptivity of strategy choices: A microgenetic study

Michael Schneider, ETH Zurich, Switzerland; Daniela Nussbaumer, Verhaltenswissenschaften, Switzerland

The ability to choose problem solving strategies flexibly and adaptively is an important part of mathematical competence. However, it is unclear how simple forms of problem solving practice affect this ability. On the one hand, as demonstrated by the Einstellung effect and the Stroop effect, practice leads to automatized routines which can decrease the adaptivity of strategy choices. On the other hand, practice helps problem solvers to associate problem types with effective solution strategies what can increase the adaptivity of strategy choices. It is unknown which of those two mechanisms has a stronger effect on adaptivity. In a microgenetic design with 48 trials of a mathematical problem solving task, we found that the adaptivity of strategy choices increased linearly during practice without feedback in a group of ninth-graders. Instructional support to stimulate insight sped up this process in a second experimental group. Adapting strategy choices to problem types led to shorter solution paths, higher solution rates, and higher speed. The results are interpreted in terms of cognitive models of strategy choices and their educational implications. They demonstrate how procedural practice and feedback to foster learning with understanding together shape the development of adaptive strategy choices.

Theoretical background Strategies are step-by-step procedures for solving a problem. From among available strategies adaptive problem solvers choose the strategy which allows them to solve the problem most efficiently, particularly in terms of high accuracy and high speed. The adaptivity of strategy choices has been recognized as an important outcome of competence development, as a central component of expertise, and as a favorable educational outcome (Star & Rittle-Johnson, 2008). In the current study we investigated the effect of simple problem solving practice without feedback on adaptivity. Two opposing influences of practice on adaptivity have been proposed in the literature. On the one hand, practice leads to automatized problem solving routines that can decrease the adaptivity of a problem solvers behavior. These phenomena are discussed, for example, in the literatures on the costs of expertise, on the Einstellung effect, and on the Stroop effect (Bilalic, McLeod, & Gobet, 2008). On the other hand, over the course of practice a problem solver can gather information about which strategy is most efficient for solving which problem type. This mechanism can increase the adaptivity of strategy choices. It has been described most comprehensively in Robert S. Siegler's models of strategy choices and development (e.g., Shrager & Siegler, 1998).

According to the models, during practice individuals acquire information about each strategy's effectiveness, in terms of accuracy and speed, for solving the encountered problem types. This information subsequently helps learners to choose the strategies that maximize the efficiency of the problem solution. These two opposing mechanisms might co-exist but it is currently unknown which of them is stronger. Therefore, it is also not known whether practice without feedback ultimately increases the flexibility of strategy choices, decreases it or leaves it unchanged. The aim of our study is to investigate this question.

Method

The sample consisted of 77 ninth-graders. Each student solved 48 trials of a mathematical problem solving task, i.e., solving two equations with two unknowns. This task can be solved by three alternative strategies: the equating strategy, the substitution strategy, and the addition strategy. Depending on the structure of the presented equations, one of the three strategies is most efficient because it requires the smallest number of mathematical operations to derive the solution. We constructed three types of problems. For equating problems the equating strategy is more efficient than the other two strategies. For addition problems the addition strategy is most efficient; and on substitution problems the substitution strategy is most efficient. In the following, we label strategy choices following

this pattern as adaptive. The problems were presented one by one in 16 blocks of three trials. Each block comprised, in a random order, one addition problem, one substitution problem, and one equating problem. The problems were presented on a computer screen, had to be copied to a booklet, and solved in written form. The solutions had to be entered into the computer which recorded accuracy and speed. Two raters (agreement: 99% of trials) categorized each written solution path as (a) addition strategy, (b) equating strategy, (c) substitution strategy, or (d) other. We made sure that all students knew the three solution strategies. They did not receive any instruction with respect to making adaptive strategy choices. Each student was randomly assigned to one of two treatment groups. The no-feedback group ($n = 39$) practiced problem solving without any instructional support. The feedback group ($n = 38$) solved the same problems and indicated after each trial by clicking one of three buttons which of the alternative strategies they had used. The computer told them if they had chosen the most efficient strategy, which saved them unnecessary work, or if they had chosen a less efficient strategy, which created unnecessary work.

Results

Compared to all the other trials, trials with adaptive strategy choices had higher mean solution rates (68 vs. 53 %, $p = .000$), lower mean solution times (126 vs. 171 sec, $p = .000$), and a smaller number of lines in the written solution paths (4.4 vs. 6.0 lines, $p = .000$). So matching strategies to problem types is adaptive behavior. Adaptivity increased in both treatment groups, as we confirmed by regression analyses ($p = .000$ for both groups) and as is displayed in Figure 1.

Discussion

Our results provide strong evidence for the hypothesis that practice has a positive net effect on the adaptivity of strategy choices. Adaptivity increased in both treatment groups but the increases were stronger and quicker in the feedback group. The strong positive net effect of practice without feedback on the adaptivity of strategy choices is remarkable because the students were in a complex situation and received minimal information. The students solved equation problems while simultaneously learning how to increase adaptivity. They were not instructed to focus on strategy use, efficiency or strategy choices. They also did not know ahead of time that there would be three different problem types, each corresponding to one strategy. Still the students increased their adaptivity, what provides evidence for the associative learning mechanisms outlined in Siegler's model of strategy choices. The students learned to associate problem types with those strategies that led to the lowest solution times, shortest solution paths, and highest solution rates. From an educational perspective, the results emphasize the importance of feedback in problem solving practice. The feedback group learned more quickly than the no-feedback group. However, the results also show clearly that problem solving without immediate feedback, as it is common in homework assignments, does not hurt students' flexibility but further increases it. Future studies need to test the generalizability of our results to students in different age groups and on different achievement levels.

SYMPOSIUM

The perseveration effect: Individuals' tendency to reuse the preceding strategy

Viki Schillemans, Katholieke Universiteit Leuven, Belgium; Koen Luwel, Katholieke Universiteit Leuven, Belgium; Patrick Onghena, K.U.Leuven, Belgium; Lieven Verschaffel, K.U.Leuven, Belgium

Adaptivity is an important feature of strategy use. Among other things, this implies that one can switch smoothly between strategies when appropriate. However, using a numerosity judgement task, Schillemans, Luwel, Bult  , Onghena, and Verschaffel (2009) recently demonstrated that participants are not always adaptive; they often persevere on the last applied strategy. In this study, we replicated this result with the same task but with a different paradigm. Adult participants had to determine the number of coloured blocks presented in 5x10 grids using one of two strategies: an addition strategy (whereby participants add the coloured blocks) or a subtraction strategy (whereby they subtract the number of empty cells from the total grid size). The different numerosities were presented in three different presentation orders: ascending, random, and descending. In the ascending order, participants started with solving low-numerosity items (which are known to be solved with the addition strategy) that gradually increased to high-numerosity items (which are known to be solved with the subtraction strategy). In the descending order, participants started with solving high-numerosity items that gradually decreased to low-numerosity items. We hypothesized that participants' change point (i.e., the numerosity on which they switch from one strategy to the other) would differ for the three presentation orders, and, more specifically, that it would be largest in the ascending order and smallest in the descending order. The results confirmed this hypothesis. As such, this study provides further evidence for the previously observed perseveration effect. The educational implications of this result will be discussed.

In the last 25 years, numerous studies have shown that individuals exhibit a remarkable variability in their strategies for accomplishing cognitive tasks. Strategy diversity is advantageous since it offers the potential to adapt to problem

characteristics, but also to changing situational demands, and to subject features (e.g., Verschaffel, Luwel, Torbeyns, & Van Dooren, 2009). This strategic variability implies that one always has to choose a strategy from his/her strategic repertoire for each problem at hand. It can be assumed that the better one can adapt one's strategy to the demands of the task and situation and to one's own abilities, the better the resulting performance in a specific task will be. Being adaptive, however, requires that one can switch smoothly between strategies when appropriate. This involves, among other things, that one is able to disengage from the last activated strategy and select and execute another strategy that is more adaptive. However, it has recently been shown that participants persevere on the last applied strategy. Schillemans, Bulté, Luwel, Onghena, and Verschaffel (2009) used a numerosity judgement task to demonstrate that participants are more inclined to use the strategy that they had been using on the preceding trials, at least for certain numerosities.

The goal of the task was to determine the number of coloured blocks in 5x10 grids. To do so, participants can use two strategies, namely the addition strategy (whereby they add the coloured blocks) and the subtraction strategy (whereby they subtract the number of empty cells from the total grid size) (e.g., Verschaffel, De Corte, Lamote, D'Herdt, 1998). Schillemans et al. demonstrated that participants choose more often for the addition strategy after a series of addition items (i.e., items with small numerosities that strongly elicit the addition strategy) and more often for the subtraction strategy after a series of subtraction items (i.e., items with large numerosities that strongly elicit the subtraction strategy), but only on midrange numerosities that are not strongly associated with either strategy. Likewise, using a two-digit mental addition task that can be solved with two strategies (i.e., partial-decomposition and full-decompositions), Lemaire and Lecacheur (2010) also demonstrated that participants were more inclined to repeat the previous strategy than to switch to the other strategy.

The purpose of this study was to replicate these findings with the same numerosity judgment task as Schillemans et al. (2009) but with a different paradigm. We looked for the perseveration effect in terms of participants' change point, that is, the numerosity on which they switch from one strategy to the other. It has previously been demonstrated (e.g., Luwel, Lemaire, & Verschaffel, 2005) that when the numerosities are presented randomly, participants use the addition strategy for numerosities below that change point and the subtraction strategy for numerosities above it. However, some unexpected strategy choices were observed around the change point (i.e., the subtraction strategy being used in the numerosity range below the change point and the addition strategy above it). A closer inspection revealed that these were almost always replications of the previous strategy.

For the present study, wherein we manipulated the presentation order, we hypothesized that this change point would depend on the order in which the numerosities are presented to the participants: in an ascending, a random, or descending order. In the ascending order, participants started with solving low-numerosity items (e.g., 16, 18), which are known to be solved with the addition strategy and we gradually increased the items to high-numerosity items (e.g., 36, 38), which are known to be solved with the subtraction strategy. In the descending order, the items were presented in the opposite presentation order compared to the ascending order: Participants started with solving high-numerosity items and we gradually decreased the items to low-numerosity items. In the random order, the different numerosities were presented randomly. We hypothesized that participants' change point would differ for the three presentation orders, and, more specifically, that it would be largest in the ascending order and smallest in the descending order.

Method

Fifty-seven university students (mean age = 18.72 years) were individually tested with the above-mentioned numerosity judgement task. They were instructed to judge coloured blocks in 5x10 grids in three presentation orders, namely an ascending, a random and a descending order. The numerosities 16-38 were used as the test items. So, an example of an ascending order was 16-18-19-22-24-26-27-28-29-31-34-35-37. An example of a descending order was 38-36-33-32-30-28-27-26-25-23-21-20-17. The three orders were presented twice (in a counterbalanced order) and were separated from each other by a lexical decision task to prevent for influences from one sequence to the next one.

Results

The main result of this study was a significant difference in participants' individual change points. In line with our hypothesis, the average change points for the ascending, random and descending orders were, respectively Ms: 27.88, 26.67, and 25.90, $F(2, 100) = 4.71$, $p = .01$

Discussion

The results of this study provided additional evidence for the existence of a perseveration effect in strategy selection; that is, participants are more inclined to repeat the previously used strategy, at least for items that are not too

strongly associated with a particular strategy. The question remains whether this behaviour can be called adaptive or not. At first sight, just repeating the previous strategy does not seem to be adaptive but rather an expression of stereotyped behaviour. But, if the items on which the perseveration effect occurs are indeed strategy-neutral, it can be cognitively advantageous to repeat the previously used strategy because this reduces cognitive load without leading to decline in performance. Therefore, now that the existence of the perseveration effect has been shown for different tasks and with different paradigms, an important issue for further research is testing whether the perseveration effect only occurs on items for which both strategies are equally applicable or also for items for which one of the strategies is clearly more suitable. From a (mathematics) educational perspective, a better understanding of the perseveration effect may lead, for instance, to adaptations in the sequencing of exercises in textbooks and test.

SYMPOSIUM

Gender differences in interest and achievement in science classrooms

Chairperson: Manuela Paechter, Karl-Franzens-University Graz, Austria

Organiser: Bernhard Ertl, Universität der Bundeswehr München, Germany

Manuela Paechter, Karl-Franzens-University Graz, Austria

Discussant: Jim Ridgway, University of Durham, United Kingdom

Across the domains of mathematics and science, there are significant gender differences in achievement, interest, and motivation for male and female students. For example, in most of the countries which took part in the PISA studies, girls were less likely than males to choose science courses, showed less interest and motivation, and put less priority on doing well in science. In some countries, girls also achieved less, especially in physics. The contributions of this symposium aim to explain reasons for such gender differences and to give didactic solutions or good-practice examples.

According to the study of Ding, differences between girls' and boys' achievements may be explained by differences in processing information, e.g. graphical representations in physics. Girls processed representations with a focus on explaining a problem while boys focused on finding a solution. Ding also shows that female students achieved less in gender-mixed groups.

These results can be explained by the study of Ertl: In his survey, girls expressed less interest and self-confidence in science and mathematics classrooms than boys. The results of the study can also be seen as recommendations of how to design instruction from students' point of view.

The study of Paechter and Jones takes up these recommendations. They investigate an instructional design which supports female and male middle and high school students' interest by introducing hands-on experiences in science education. Results show that female students' interest was related to the linking of science content to opportunities for hands-on and social interaction.

SYMPOSIUM

Equal-status interaction and gender experiences in computer supported STEM classrooms

Bernhard Ertl, Universität der Bundeswehr München, Germany

Researchers and practitioners aim at providing equal-status interactions in the classroom to allow all students to make beneficial learning experiences. Yet, in STEM (sciences, technology, engineering, and mathematics) classes there are often status inequalities with respect to gender, which is associated with the phenomenon that girls show less self-confidence and interest.

This paper investigates prerequisites for equal status interaction in computer supported STEM classrooms in the context of gender. It provides results from a quantitative study and a qualitative study. The quantitative study investigates females' and males' structure and self-confidence (according to Rheinberg, Vollmeyer, & Burns, 2001) with respect to STEM and the qualitative part analyses how students perceive gender and status inequalities.

Results of the quantitative study show no differences between boys and girls for the dimensions of fear of failure, chance for success, and challenge but that boys score significantly higher for the dimension of interest and self-confidence. The qualitative part presents deeper insights how gender and status inequalities are perceived by girls and boys.

Providing equal-status interaction in computer supported STEM classrooms

Heterogeneity in classrooms can be seen as a chance and as an obstacle for learning. As chance, it provides motivation for knowledge sharing and mutual learning; as obstacle heterogeneity often enables more knowledgeable pupils to benefit more in such scenarios. One reason for this are status inequalities that allow higher status pupils a more active part in learning while pupils with a lower status have a more passive spectator role. To avoid this, teachers should aim at providing equal-status interaction in the classroom (see Cohen & Lotan, 1995).

Status inequalities may result from different sources, e.g. ethnicity, socio-economic-status, or gender. For computer supported STEM classrooms, perceived status inequalities coming from gender stereotypes can be an important issue. They can result in differences in self-confidence, interest and motivation and thereby support the development of self-fulfilling prophecies that have a negative effect on girls' achievements (see Cohen & Lotan, 1995).

Research Questions

The aim of this study is to investigate gender related for status inequalities in STEM:

Research question 1: What are the differences of girls and boys regarding their motivational structure and self-confidence in STEM?

Research question 2: How are gender inequalities perceived in computer supported STEM classrooms?

Method

For answering these research questions, the paper will present the results of two empirical studies. Study 1 was a questionnaire survey of 91 upper secondary students, 49 females and 42 males, enrolled in a computer science course; study 2 comprised of 14 qualitative interviews with 8 girls and 6 boys of this course. Both studies were part of a bigger study project and therefore only the parts relevant for this paper were reported.

Quantitative study

The quantitative study was done by a questionnaire which comprised of scales for self-confidence and actual motivations (adapted from Rheinberg et al., 2001).

The self-confidence scale comprised of 7 items surveying a student's self-confidence in performing computer science tasks. The internal consistence of the scale was good (Cronbach's $\alpha > .75$).

The questionnaire for actual motivations comprised of four sub-scales: challenge (4 items, Cronbach's $\alpha > .56$), interest (5 items, Cronbach's $\alpha > .72$), chance for success (4 items, Cronbach's $\alpha > .95$), and fear of failure (5 items, Cronbach's $\alpha > .76$).

Qualitative study

The qualitative study aimed at looking beyond the gender differences to get insights about how pupils perceive gender interaction in the computer supported STEM classroom. The study was carried out by 7 small focus groups, each with two participants. Students in the focus groups followed a semi-structured interview protocol concerning topics e.g. how pupils estimated the class climate and if they perceive differences between females and males in class. The interviews were recorded, transcribed and analyzed according to grounded theory.

Results

Research question 1

Results of the questionnaires show that there are some sub-scales without differences and some with significant differences between males and females (see values in table 1). There was no significant difference for the dimensions of chance for success ($F(89,1) = 0$; n.s.), fear of failure ($F(89,1) = 0$; n.s.), and challenge ($F(89,1) = 1.41$; n.s.) even if females felt slightly more challenge than boys. Yet, females and males differ significantly with respect to interest ($F(89,1) = 7.04$; $p = .07$) and self-confidence ($F(89,1) = 4.08$; $p = .04$). Table 1: Results of the quantitative study (Min = 1; Max = 10).

Research Question 2

Results of the qualitative study support the quantitative results. In particular, boys attribute girls as less capable compared to themselves. Girls are often attributing boys more knowledge or giftedness, however they sometimes realize that boys are often acting "the big shot" which means that they just pretend to have experience. Yet, in several cases females stated that they avoid to make contributions during lessons because they are afraid of receiving negative comments from males.

Discussion

Results of the qualitative and quantitative study show an ambiguous image on gender in the computer supported STEM classroom: On the one hand regarding outcome expectancies females estimate themselves the same level of chance for success and fear of failure like boys. This is an important prerequisite for equal-status interaction. Besides, females estimate the tasks a little bit more challenging than boys (not significant). On the other hand, girls show

significantly less interest and less self-confidence. Particularly the latter is an important finding because this can inhibit equal status interaction. A reason for this may be found in the qualitative study: During lessons, girls perceive boys to be more capable in the subject. This may lead to the lower self-confidence of girls in this subject. In contrast, fear of failure and chance for success are more outcome-oriented than subject oriented. As the test outcomes are comparable between boys and girls, it seems reasonable that the estimations of outcomes are also comparable. This leads us to the hypothesis, that gender differences in computer supported STEM classrooms belong more to attributions than that they are grounded by outcomes. However, as these estimated differences are an obstacle for equal-status interaction, there is the educational goal to find appropriate support methods.

Consequences

Based on these findings, one should focus support on interests and self-confidence, e.g. by task selection or by facilitating appropriate attributions. This could be accompanied by designing a beneficial classroom collaboration, e.g. by scripting gender interaction in computer supported STEM classrooms.

References

Cohen, E. G., & Lotan, R. A. (1995). Producing equal-status interaction in the heterogeneous classroom. *American Educational Research Journal*, 32(1), 99-120.

Rheinberg, F., Vollmeyer, R., & Burns, B. D. (Langversion, 2001). FAM: Ein Fragebogen zur Erfassung aktueller Motivation in Lern- und Leistungssituationen/ QCM: A questionnaire to assess current motivation in learning situations. Retrieved 12.01.09, from <http://www.psych.unipotsdam.de/people/rheinberg/messverfahren/FAMLangfassung.pdf>

SYMPOSIUM

Promoting female and male students' interest in science by hands-on experiences

Manuela Paechter, Karl-Franzens-University Graz, Austria; Gail Jones, North Carolina State University, United States

An instructional program on the study of viruses, related mathematical and science concepts, and the use of nanotechnology tools was designed. To widen appeal to female and to male students science content was connected to applications, opportunities for hands-on experiences and social interactions with researchers were provided.

The instructional program was evaluated by the following research questions: Do female and male students differ in their interest toward the instructional program prior to the instruction? Does the instructional program lead to a change in interest and are any such changes different between the genders?

Four middle school and four high school classes took part in the empirical testing and completed the instructional program. The results show no differences in initial interest for middle school students but a lower level of interest for female high school students in comparison to male students. Both, in middle and in high school, female and male students showed a positive shift in interest towards the learning contents. Female high school students showed an even higher shift in their interest than male students.

The results suggest various measures to widen appeal of science education for female students. Linking science content to application, providing opportunities for social interactions, and hands-on experiences proved to be interesting for both, male and female students in this investigation.

Introduction and aims of the research

Across the domains of mathematics and science there are significant gender differences in course grades, interests, and career selection for males and females. For example, in most of the countries which took part in the TIMS or the PISA studies girls are less likely to choose science in their courses or for a career and they show less interest in science (e.g., Mullis, Martin, Fierros, Goldberg, & Stemler, 2002). One reason for such gender differences lies in the lower interest of girls in sciences and mathematics (e.g., Hoffmann, Häussler, & Lehrke, 1998; Tracey, Robbins, & Hofsess, 2005).

A possibility to design instruction in such a fashion that it appeals to girls and boys is to offer different learning opportunities. In the reported study an instructional program for middle and high school focusing on viruses and scaling concepts was designed. The instructional program incorporated sophisticated nanotechnology tools to conduct the investigations of viruses. It attempted to stimulate students' interest and curiosity by providing hands-on experiences with the nanotechnology tools, by connecting the science content to applications, and by providing interactions with numerous scientists. The instruction about viruses and scaling effects intentionally made connections to a variety of applications and everyday situations.

It was investigated how the instructional program is able to arouse students' interest in its most central learning content, the use of the technology and the technological aspects of the program. Three research questions were investigated:

1. Prior to the instruction, do female and male students differ in their interest toward the technology?
2. Does the instructional program lead to a change in interest and are any such changes different between the genders?
3. Are certain elements of the instructional program more interesting for female or for male students?

Methodology

Four high school biology classes (38 female, 40 male) and four middle-school science classes (38 female, 28 male), all in North Carolina (USA), completed the instructional program.

Prior to the instruction (pre-test) and one week after the instruction (post-test), students completed an attitudes questionnaire that assessed their interests related to the technology introduced in the instructional program. Immediately after the students completed the instructional program, they wrote an article about their experiences. The stories were analyzed for the length of stories and the number of words written about the different elements of the instructional program

Findings

Results of the middle school sample:

Differences on the pre-test between female and male students on attitudes related to the technology of the instructional program were investigated using a Mann-Whitney non-parametric test. The analysis yielded no significant differences between female and male students' attitudes. To investigate whether the instructional program had led to a change in the students' attitudes, Wilcoxon rank test were carried out separately for female and male students. Results showed a more positive attitude towards the technology of the instructional program for both, female and male students (where necessary alpha-adjustments were carried out). Responses to the attitudes questionnaire were also analyzed to determine if females and males expressed differing levels of change in their attitudes towards the instructional program. A difference score was computed (value on the post-test minus value on the pre-test). Only a statistical tendency was found (p

Data on students' impressions of the various elements of the instruction were taken from the stories they wrote at the conclusion of the instruction. Mann-Whitney comparison showed that females wrote longer stories about their experiences than did males. However, they did not write longer or shorter parts about the different elements of the instruction.

Results of the high school sample:

Differences on the pre-test for interest were investigated using a Mann-Whitney test. Results showed a lower level of interest for females. Wilcoxon rank tests showed significant positive changes in interest after instruction for both, females and male students. Again, responses to the attitude questionnaire were analyzed to determine if females and males expressed differing levels of change in their attitudes (Mann-Whitney test). Females improved significantly more than males, indicating a more positive shift in the level of interest than males. High school females showed a statistical tendency to write longer stories about their week-long experience (Mann-Whitney test). Female students showed a statistical tendency to write more about the interviews with scientists than did male students.

Theoretical and educational significance

The results parallel findings of studies on gender differences in science subjects (Häussler & Hoffmann, 2002): Younger students (middle school) had similar attitudes whereas in the high school sample a shift in the attitudes could be observed. Here, female students expressed less interest than males. It also seems that gender differences are not restricted only to specific subjects but include the use of specific technologies. Two aspects ascertain the success of the instructional program: Firstly, the program led to a higher interest in using the technology, and secondly, the program was appealing to female students. Indeed, students in middle and in high school showed more positive attitudes after their instructional experience. Female high school students showed a higher shift in their interest than male students. The results suggest various measures to widen appeal of science education for female students. Linking science content to application, providing opportunities for social interactions, and hands-on experiences proved to be interesting for the female high school students in this investigation. It seems, however, that not only one specific measure but rather a diversity of instructional experiences was important to raise girls' interest in science instruction.

References

Häussler, P., & Hoffmann, L. (2002). An intervention study to enhance girls' interest, self-concept, and achievement in physics classes. *Journal of Research in Science Teaching*, 39, 870-888.

Mullis, I.V.S., Martin, M.O., Fierros, E.G., Goldberg, A.L., & Stemler, S.E. (2000). *Gender Differences in Achievement*. IEA's Third International Mathematics and Science Study (TIMSS). Boston: 2000. Retrieved 19.02.10.

Tracey, T. J. G., Robbins, S. B., & Hofsess, C. D. (2005). Stability and change in interests: a longitudinal study of adolescents from grades 8 through 12. *Journal of Vocational Behavior*, 66, 1-25.

SYMPOSIUM

Gender Difference in Graphical Representations during Collaborative Problem-Solving in Physics

Ning Ding, Hanze University of Applied Science, Netherlands; Egbert Harskamp, GION, University of Groningen, Netherlands; Bernhard Ertl, Universität der Bundeswehr München, Germany

The aim of this study was to explore the gender difference in terms of the way that students represent their knowledge when solving a physics problem collaboratively. This empirical study was based on a pre- and posttest design. Twenty-five dyads of Chinese tenth graders participated. The analyses included students' pre- and posttest scores, and their graphical representations on the communication log-sheets. A gender difference in graphic representations in problem-solving was found.

In high school physics education, students are expected to represent their understanding in a scientific pictorial manner. Problem information needs to be accurately and pictorially reflected, while problem components need to be interrelated and categorized into an abstract representation (Kellogg, 1995, pp.167). But in practice, it is frequently found that students tend to miss the important features of the problem or stick to a superficial interpretation of problem information.

The current study focuses on high school students' graphical representations in collaborative physics problem solving, examining whether there is a gender difference and whether it is related to students' learning achievement.

The research question is: Is there a gender difference in graphical representations in collaborative physics problem-solving?

We distinguished three levels of graphical representation: Interpretation, Qualitative Reasoning, and Developing the Solution Strategy (Table I).

Methods:

The study was conducted in a high school in Shanghai, China. Fifty tenth-graders (26 females and 24 males), aged 16, participated in the study. Students were randomly paired: 12 mixed-gender dyads, 7 female-female dyads, and 7 male-male dyads.

We used a randomized group design with a pre- and a posttest. Each test was 50-minute long and consisted of five problems about Newtonian mechanics (see Figure 1). Every graphical representation shown students' communication on the log-sheets was the basic unit of analysis on the aforementioned three levels. Figure 2 is one of the students' communication log sheets based on the pulley problem.

Results:

The ANOVA test with "gender" as the independent factor and "pretest" as the dependent variable showed that there was no significant gender difference, ($F(1, 48) = .00, p = .95$). The ANCOVA test with the pretest as covariate showed students' learning achievement in the pre- and posttest (Table II). A pair-wise comparison with Bonferroni adjustment indicated that females in the single-gender dyads did significantly better than females in mixed-gender dyads ($F(1,23) = 9.63, p = .02$). Besides, within the mixed-gender dyads, male students scored significantly higher than their female partners ($F(1,21) = 12.08, p = .02$).

We classified students' graphical messages into three modes: interpretation, qualitative reasoning and developing the solution strategy. Table III summarizes the sums of students' graphical representations from eight Newtonian problems.

Overall, male students generated significantly more graphical representations than female students ($F(1,48) = 12.01, p = .00$). Females' graphical representations were much more at the interpretations level than males' ($F(1,48) = 5.21, p = .03$), while males' had more representations concerning developing the solution strategy than females ($F(1,48) = 23.47, p = .00$). Figure 3 shows the sum of three levels graphical representations for both female and male students throughout eight physics problems.

Table IV shows the correlations controlling for students' pretest scores. A positive correlation between the sum of students' graphical representations and their learning achievement was found, $r = .49$, p (one-tailed) $= .00$. Among the three levels of graphical representations, only the third level, developing a solution strategy, was found to be significantly correlated with students' learning achievement, $r = .52$, p (one-tailed) $= .00$.

Figure 4 illustrates the relationship between the amount of three levels graphical representations and students' learning achievement. It is evident that male students produced significantly more representations as developing a solution strategy (level 3) than female students did, and the amount of level 3 representations was positively correlated with their learning achievement.

Conclusion and Discussion

Our study suggested that female and male students did have differences in representing knowledge graphically. Female students generated much more graphical representations to interpret the problem information while males used the graphical representations to map the relationship of problem components and develop their solution strategy. Females' tendency in this regard shouldn't be downplayed in instructions. This finding sheds light on the future research focus such as computer-supported collaborative learning, structured collaborative learning with clear-cut labor division, etc.

Reference

Kellogg, R.T. (1995). *Cognitive Psychology*, APT, Sage Publications.

SYMPOSIUM

Teacher goals: theory development and future research

Chairperson: Marold Wosnitza, RWTHUniversity Aachen, Germany

Organiser: Marold Wosnitza, RWTHUniversity Aachen, Germany

Caroline Mansfield, Murdoch Universityity, Australia

Discussant: Helen Watt, Monash University, Australia

Teacher motivation has become an increasingly important field of research (Richardson & Watt, 2010) and researchers have utilized theories regarding student motivation to inform research about how and why teachers are motivated to teach. Consequently a range of theoretical approaches have been used to investigate teacher motivation, one of which is goal theory. Research on teacher goals, however, is in its infancy and is currently very narrow despite the fact that research in other fields has shown individuals' goals as significant for learning and working. The aim of this symposium is to contribute to the under researched field of teacher goals by presenting studies grounded in different theoretical perspectives that used different methodologies and focused on different career stages of teachers. Hagger & Malmberg focus on the ideographic goals and concerns, future time extension, and wellbeing of pre-service teachers. Mansfield, et al. present a conceptual framework for understanding goals for teaching. The framework is grounded in a goal content approach and is informed by data collected from graduating teachers, early career teachers, and experienced teachers. Butler focuses on a further development of her achievement goal approach, which she extends to incorporate relational goals; she will present data from three different studies with student teachers, practicing teachers, and teacher-class pairs. This symposium will provide evidence for the significance of using goals to inform teacher motivation research and will shed light on the contribution of conceptualizations of teachers' goal structures to better understanding teacher motivation before and during the profession.

SYMPOSIUM

Pre-service teachers' ideographic goals and concerns, future time extension, and well-being.

Hazel Hager, University of Oxford, United Kingdom; Lars-Erik Malmberg, University of Oxford, United Kingdom

Human goal processes are conceptualised in an action-theoretic model of motivation. In line with discourse on self-directed teachers we, within this model posited teachers' teaching related goals, future time extension, concerns, and well-being. Doing so, we expand previous studies focusing only on teachers concerns, or on their goals and concerns. Eighty-eight pre-service teachers reported ideographic professionally-related goals and concerns, future time extension of the goals, and well-being (self-esteem and depression). Thirteen goal and fifteen concern categories were identified, broadly reflecting the literature on teachers' transition into the profession. When the goals were ordered in a perceived future time-sequence these did not reflect discrete developmental stages of teachers. Goals were related to concerns in six content domains demonstrating the utility of investigating both. Analyses of relationships between goals and concerns, and well-being revealed interesting patterns, suggesting one the one hand that goals and

concerns, at a general level reflect objects in mind that teachers both hope to realize and, simultaneously are worried not to realize. On the other hand, not all goals were deemed "good" and all concerns "bad".

In the 21st Century teachers face several challenges, which demand flexibility, adaptability, self-regulatory skills, problem solving, and interpersonal skills, within a changing context. In order to understand pre-service teachers' thoughts in relation to such a challenging context, their goal-processes are important to unveil.

Earlier models of teacher development focussed on how teachers expressed different concerns at different stages of their professional career, while recent models have focussed on both goals and concerns. In order to broaden our understanding of pre-service teachers' thoughts about their development, we propose a heuristic action-theoretical model (Brandtstädter, 1998) of motivation (Kuhl & Goeshke, 1994). Human actions are regarded goal-orientated. A history of successful goal pursuits promotes motivation for further goal-setting and a sense of well-being, while a history of failures undermines further goal setting and thwarts well-being.

The first major attempt to conceptualise teacher concerns was carried out by Fuller and Bown (1975), who proposed that teachers first focus on the self, then on teaching tasks and situations, then on students and finally on the impact they have on learners. Although the stage model has intuitive appeal, the number and order of stages, and their contents have been called into question (Watzke, 2007). Moreover, the "concern-only" model has been described as being a one-sided (Conway & Clark, 2003), suggesting that aspirations and goals should be incorporated. We expanded previous studies of teachers' goals and concerns, by including a measure of their future-orientated thinking, and measures of well-being.

Research questions and aims

- (1) What are the contents of pre-service teachers' professional goals and concerns?
- (2) Within which future time perspective do pre-service teachers expect to realize their goals?
- (3) How are goals, future time extension and concerns associated with well-being?

Methodology

As part of a larger study (see Malmberg & Hagger, 2009) 88 pre-service teachers (69.4% females, Mage = 25.9 years), within one Post Graduate Certificate of Education (PGCE) course, filled in an adapted version of the "hopes and fears" questionnaire (e.g., Salmela-Aro et al., 2007). Respondents were asked to report up to five professionally related goals and five concerns. For each goal they were asked to indicate the time point at which they thought they could realize it. Participants also filled in two measures of well-being, the Rosenberg (1965) self-esteem and the General Health Questionnaire for measuring depression (Goldberg, 1982).

In total 266 goals, 242 future extensions and 174 concerns were categorized separately into 13 categories which were common for both hopes and concerns (presented in order of expected realization: relations with pupils, teaching strategies, PGCE-course, self, planning and organisation, differentiation, behaviour management, subject/curriculum knowledge, teacher engagement, teacher impact, student engagement, relations with colleagues and community, career), and two additional categories for concerns only (health and external restrictions), giving 15 concern categories in total. Future time extension was coded into the number of months from the present they thought they would be able to realise the goal. Co-judge agreement was 87% for goals, 87% for concerns, and 93.8% for future time extension.

Findings

The most frequent goal categories, expressed as proportion of the pre-service teacher groups reporting one or more of each content category: teaching strategies (22.7%), self (30.7%), planning and organisation (29.5%), behaviour management (27.3%), teacher impact (29.5%), student engagement (28.4%), and career (25.0%). The most frequent concerns were about behaviour management (31.8%) and career (21.6%).

Next we inspected within which timeframe future goals were expected to be realized. The first five goals (see above) were located approximately within the next term (within the next four months ahead in time). The next batch of goals was located in the third and final term (between five and eight months ahead). The following three goals were roughly located within the first year of teaching. Career related goals were located in the second year of teaching. Overall, it was noticeable that the variability of the future time extension of the goals (i.e., the SD), was larger the further into the future the goal was projected.

The number of concerns was associated with an elevated level of depression ($r = .20$). Goals and concerns within the same content category were associated in the categories of relations with students, self, behaviour management, teacher impact, student engagement and career, indicating that teacher can strive toward realizing a certain goal, and at the same time being worried they might not be successful.

A higher self-esteem was associated with fewer goals about behaviour management ($r = -.18$) and with more career goals ($r = .20$). A higher level of depression was related to more goals about relations with students ($r = .19$) and planning and organisation ($r = .21$). A higher self-esteem was associated with fewer concerns about teaching strategies ($r = -.23$) and differentiation ($r = -.22$). A higher level of depression was related to more concerns about the self ($r = .31$), and student engagement ($r = .19$), but fewer concerns about planning and organisation ($r = -.23$). Theoretical and educational significance of the research

When asking pre-service teachers about their professionally related goals and concerns, the contents reflect both the self (themselves, their health and their career progression), teaching tasks (skills and techniques), students (relationships with students, colleagues and community) and impact. When asked about the anticipated timing (future time extension) of the goals pre-service teachers are definitely on a steep, and in the beginning quite well-defined (i.e., narrow variation in timing between pre-service teachers) learning trajectory as two thirds of the goals are located within the second and third terms within the one year teacher education program, with the remaining goals situated up to the middle of the second year of teaching. The order and the timing of the goals reflected cultural prototypes and grand narratives of teacher development. Goals were related to concerns in six content domains reflecting underlying human promoting and undermining processes (anticipating goal realization but at the same time being concerned that it might not be realized), but also in the relationships between well-being and goals and depression and concerns. Overall, the inclusion of goals and future time extension as conceptual entities alongside concerns provides a theoretically broader basis for future research on teacher development than using a model restricted to teachers' concerns only.

SYMPOSIUM

Goals for teaching: A goal content approach to understanding teacher motivation.

Caroline Mansfield, Murdoch University, Australia; Marold Wosnitza, RWTH University Aachen, Germany;
Susan Beltman, Curtin University, Australia

Teacher motivation is an important field of research, especially in countries where issues such as teacher retention and quality have become prominent concerns. This paper presents a conceptual framework for understanding the stage appropriate goals for teaching of graduating teacher education students. Participants were 218 graduating teacher education students who nominated their goals for their future teaching careers. Goals were analysed through a collaborative, iterative, inductive-deductive process, generated from both empirical data and grounded in established literature (Ford & Nichols, 1987). Through this process the framework for understanding goals for teaching was developed. Results show that both within-person and person-environment consequences inform goals for teaching and that graduating teachers pursue multiple goals. The goals for teaching framework is proposed as a useful tool which can be further developed to reflect the content of teachers' goals at particular career stages and thus provide further insights into teacher motivation.

Many factors motivate individuals to pursue a teaching career and teacher motivation has been investigated from a variety of perspectives. Achievement goals have been used to explain teacher and student goals and have yielded important findings about teacher motivation and its association with instructional practices, interest in teaching and burnout. Even so, the focus on specific pre-determined goals can be limiting and may reduce opportunities to understand teacher motivation more broadly, in the context not only of the work of the classroom, but of broader life goals. The field of teacher motivation is yet to benefit from understanding the content of teachers' multiple goals and how these may influence motivation, well-being and career decisions.

Aims

The aim of this paper is to extend the current teacher motivation literature in two unique ways. First, it presents a study examining the content of goals for teaching reported by graduating teachers, thus offering some insight into both reasons for choosing teaching as a career and the motivating factors for future professional work. Second, as there is no current consensus in the literature as to how to conceptualize teacher goals from a content perspective, a conceptual framework for understanding goal content is presented. The framework is generated from empirical data and grounded in a goal content approach (Ford & Nichols, 1987).

Methodology

The participants were 218 graduating student teachers from two universities in Australia, qualified to teach in primary ($n=128$), secondary ($n=66$) or early childhood ($n=24$) settings. Participants completed a survey at the end of their teacher education program which included the open ended questions "Considering your future career as a teacher what are your three major goals? Please list these in order of importance. Why are these goals important to you?" A total of 598 responses were obtained.

Data analysis

To analyse the responses, a coding system that reflected the broad goals articulated by graduating teachers was developed. Using a combination of inductive and deductive processes to examine the data, the comprehensive Ford and Nichols' (1987) Taxonomy of Human Goals provided the most appropriate system for identifying and categorising goals emerging from the data. This Taxonomy was contextualised to reflect 'stage appropriate' goals for graduating teachers. All responses were analysed iteratively using a collaborative process involving three researchers. Inter-judge agreement was 86%. Where disagreements occurred, responses were re-examined and coded by agreement.

Findings

Graduating teachers have multiple content goals that inform their future teaching. These goals include self-focused goals (affective goals: wellbeing, happiness; cognitive goals: understanding, positive self-evaluations, intellectual creativity) and socially focused goals (social relationship goals: resource acquisition, superiority, belongingness, resource provision, equity, altruism; and task goals: instrumental goals, career aspirations, mastery). Consistent with their stage of professional development, graduating teachers are focused on obtaining employment, continuing to develop and learn, and be the best teacher they can be.

Overall, the sub-category mentioned most was instrumental goals such as gaining employment ($n=83$; 13.9% of responses), followed by cognitive understanding goals ($n=73$; 12.2% of responses), resource provision ($n=66$; 11% of responses) and positive self-evaluation ($n=65$; 10.9% of responses). With 33 nominations (5.5% of responses) altruism, which is newly included in this taxonomy, is only in the mid-range of nominations. The least nominated sub-category was superiority ($n=8$; 1.3% of responses). It would appear that in this sample, participants were aiming to attain employment where they would continue to gain knowledge as learners and professionals, and provide effective learning experiences for their students.

The broader dimensions and categories were compared for significant differences in frequency of nominations. Consistent with their aim of being effective teachers for their students, the distribution of nominations of goals showed that the graduating teachers nominated significantly more person-environment consequences than within person consequences ($\chi^2=4.876$, $df=1$, $p=.027$). With regard to the dimension of within person consequences, cognitive goals like understanding, positive self-evaluations and intellectual creativity were significantly more nominated than affective goals that focus on well-being and happiness ($\chi^2=19.059$, $df=1$, $p=.000$). With regard to the dimension of person-environment consequences, there was no significant difference between nominations of social relationship goals and task goals ($\chi^2=.442$, $df=1$, $p=.506$), although the category of task goals did have the most nominations.

Theoretical and educational significance of the research

The Goals for Teaching Framework was developed through collaborative, iterative, inductive-deductive processes generated both from the empirical data and from established literature. Use of an open-ended question (rather than a pre-determined set of goals) to elicit responses means the data represent graduating teachers' spontaneously articulated goals for teaching. As such, the framework has the advantage of accurately reflecting anticipated within-person and person-environment desires of graduating teachers while being grounded in a broader, comprehensive taxonomy of human goals. Conceptualising goals this way enables teacher motivation research to look beyond motivation as a solely cognitive process, and to consider the affective and behavioural dimensions of motivation in the teaching context.

The Goals for Teaching Framework represents a starting point from which goals for teaching at various stages of teaching career can be better understood. Furthermore, as beginning teachers experience the 'real world' of teaching, that 'reality' may trigger other goals not yet illustrated in the framework. Given the dynamic nature of goals and the influence of context on goal pursuit, variations of goals emerging during particular professional life stages can be expected. Currently the goals for teaching of early and mid-career teachers are being analysed and preliminary results show differences in the goals of these three groups. These findings will also be presented at the conference as understanding the content of teachers' goals for the profession, their goal patterns and how goals develop over time may provide useful insights to further contribute to the field.

SYMPOSIUM

Extension of a new achievement goals approach to teacher motivation.

Stuart Karabenick, University of Michigan, United States

There has been surprisingly little research on teachers' motivation for teaching, in part due to the paucity of compelling theoretical frameworks. I have proposed (e.g., Butler, 2007) that achievement goal theory (Ames, 1992; Nicholls, 1989) can be fruitfully applied to the study of teacher motivation because the school is an achievement arena not only for students, but also for teachers who presumably strive to feel successful in their work, but differ in the ways they define success, and thus in their personal achievement goals for teaching. The main aim is to extend my framework by examining the proposal that strivings to create close and caring relationships with students constitute a fifth, relational goal for teaching, which has distinct implications both for teachers' own coping strategies and for their teaching practices. I shall present results from three new studies conducted with 150 student teachers (Study 1), 550 practicing teachers (Study 2), and 74 teacher-class pairs (Study 3). Results converged with my earlier work in confirming that teacher goals matter because they are coherently and differentially associated with more or less adaptive patterns of coping and teaching. They also significantly extended this work by showing that teachers' relational orientation was most conducive to good teaching as reported not only by teachers, but also by their students.

Results from several research programs have confirmed teacher self-reports of their mastery, ability-approach, ability-avoidance, and work avoidance goal orientations (GO's) for teaching (Butler, 2007; Butler & Shibaz, 2008; Retelsdorf, Butler, Streblow, & Schiefele, 2009) were associated with distinct patterns of coping, wellbeing, and teaching. In keeping with research on students' achievement goals, mastery goals for teaching predicted adaptive and avoidance goals predicted maladaptive processes and outcomes; ability-approach strivings to demonstrate superior teaching predicted neither positive nor negative outcomes. Extrapolating from theories of student motivation can be faulted, however, for failing to consider how motivations for teaching and for learning are not only similar, but also differ. Perhaps most important, some consider caring, whereby teachers are oriented to create and maintain close and authentic relationships with students, as the heart of the teacher role and of good teaching (e.g., Noddings, 1986; Rogers & Webb, 1991).

Aims

The main aim of this presentation will be to extend my achievement goal framework to examine the proposal that strivings to achieve close relationships with students constitute a fifth class of relational goals for teaching that has distinct implications both for teachers' own coping strategies and for their teaching practices.

Methodology

Participants included 149 student teachers (Study 1), 550 practicing teachers (Study 2), and 74 teacher-class pairs (Study 3: 74 middle school teachers and 1800 pupils in one randomly selected class per teacher) in Israel. Participants in Study 1 responded to an expanded measure of goal orientations that included items assessing strivings to achieve authentic and caring relationships with students and to an inventory assessing help seeking strategies and preferences. Teachers in Study 2 responded to the expanded measure of goal orientations at the beginning of the year and to measures of instructional practices (mastery-oriented, performance-oriented, promoting mutual respect among students and prioritizing social relations over subject matter) at the end of the year. In Study 3, teachers responded to the GO measure at the beginning of the year. At the end of the year, pupils in one randomly selected class reported on the teacher's instructional practices. Studies thus used different informants (student teachers, teachers, paired samples of teachers and their pupils) and designs (cross-sectional and longitudinal), which required and enabled different data analytic strategies (EFA, CFA, hierarchical regressions, SEM, HLM).

Findings

First, results (EFA) from Studies 1 and 2 confirmed the proposed 5-factor structure for both student and practicing teachers; CFA conducted on half the randomly split sample of Study 2 showed good fit. Relational strivings loaded on a distinct factor, and formed a reliable scale that was moderately, rather than highly correlated with the other "positive" (mastery) GO for teaching. Second, results from all three studies confirmed that the three "approach" GO's for teaching had distinct correlates. Regarding coping strategies, regression analyses of the data from Study 1 confirmed that mastery (but not relational) orientation predicted student teachers' preferences for seeking adaptive help, relational (but not mastery) orientation predicted preferences for seeking emotional support, and ability-approach orientation predicted help-avoidance. Mastery and relational GO's were both negatively associated with burnout at the end of the year, but the former emerged as a more significant protective factor (Study 2). Regarding teaching, a series of SEM models of associations between teacher GO's and teacher reports of instructional practices completed several months later (Study 2) all showed good fit ($NFI > .94$, $CFI = 1$, $RMSEA$

Theoretical and educational significance

The studies provided further evidence that goal orientations for teaching do indeed matter for both the quality of teachers' own coping and engagement and the degree to which they create more or less positive and effective

environments for learning. Perhaps most important, they confirmed the central role of relational strivings to create and maintain close and caring relationships with students in orienting teachers to teach in ways that not only consider and promote students' wellbeing and social relationships, but also emphasize personal progress and learning for understanding. I shall discuss theoretical implications of the present framework for conceptualizing and studying teacher motivation and applied implications for creating training and school environments that can foster positive motivation and engagement for both teaching and learning. I shall also address the ways in which current climates of accountability might undermine both relational and mastery motivations for teaching.

SYMPOSIUM

Deepening our understanding of the deep approach to learning

Chairperson: Anna Parpala, University of Helsinki, Finland

Organiser: Anna Parpala, University of Helsinki, Finland

Discussant: Noel Entwistle, The University of Edinburgh, United Kingdom

University students' deep approaches to learning have been seen as more desirable than the surface approach among the academics because of its relationship with higher level learning outcomes. However, recent studies suggest that the relation between the deep approach and better learning outcomes is not so straightforward. The deep approach to learning refers to different things in different disciplines, because of the way understanding is developed in each discipline. Thus, the processes involved in the deep approach need to be refined within each discipline. This symposium aims to deepen our understanding of the variation in the deep approach to learning by exploring university students' understanding in different disciplines and in different learning environments using qualitative methods. The aim is to clarify the differences in the way students' understanding develops and how students' deeper understanding is related to learning outcomes. The first paper of this symposium provides us with a broader look of the concept deep learning in different disciplines and the two subsequent papers focus on the deep approach in specific learning environments and its relation to students' learning outcomes. The symposium aims to provide important information on what is regarded as deep learning in different disciplines and how deep learning can be promoted in these learning environments.

SYMPOSIUM

Analysing deep learning and understanding: getting the meanings clear first

Erik Jan van Rossum, Twente University, Netherlands; Rebecca Hamer, Platform Science and Technology, Netherlands

In our recent book *The Meaning of Learning and Knowing* we have come to the conclusion that our six stage developmental model of learning and teaching conceptions describes a set of six world views, each characterised by its own unique set of meanings for words such as understanding, knowing, (deep or surface) learning, etc. The six world views, and as such the six languages that students and teachers speak when talking about learning and good teaching, can be grouped in two sets of three languages. Levels one through three focus on reproduction of knowledge and although each higher level increases in complexity of thinking about concepts, in these three ways of knowing understanding is perceived to mean different levels of reproduction. The second set of three languages focuses on learning and knowledge in a more constructive way, and understanding takes on a deeper and more complex meaning. Taking this into account, we propose that there are three types of surface learning and surface type understanding, and at least three different conceptions of deep learning and more complex understanding. To what extent these languages, and thus the different types of understanding, are linked to specific disciplines is as yet unclear. For one thing, often the disciplinary way of knowing is unclear to students, as it is mediated by the way of knowing of the teacher: teachers and their usual teaching practice often fail to provide students with a clear view of the disciplinary way of knowing.

In our recent book *'The Meaning of Learning and Knowing'* we have come to the conclusion that our six stage developmental model of learning and teaching conceptions describes a set of six world views, each characterised by its own unique set of meanings for words such as understanding, knowing, (deep or surface) learning, etc. The six world views, and as such the six languages that students and teachers speak when talking about learning and good teaching, can be grouped in two sets of three languages. We have come to prefer to explain our model in terms of different languages people speak and the resulting types of communication versus miscommunication. However in the international research community many other terms are used to refer to the same phenomenon, such as ways of knowing, orders of consciousness, belief structures, personal epistemologies or ways of meaning making. In the paper we will illustrate the similarities between all these different theoretical approaches.

The six languages we have uncovered all differ not only with regard to the definition of what to know, but in particular they differ in views on how to know. The first three languages focus on reproduction of knowledge. The first language is characterised by an atomistic view on knowing, all knowledge is seen as equally important. Knowledge has no structure. In the second language some things are deemed more fundamental than others, there are main points and "stuff you don't really need to remember for the test." Knowledge now has structure, often based on chronology. In the next language this initial selection skill is perfected and expanded to learning only that which probably will prove to be useful in practical assignments or a future career. Speakers of this language are often sceptical about expert knowledge. Experts often disagree and so it seems natural that everybody is entitled to a personal opinion and all opinions are worthy of respect (multiplist thinking, Perry, 1970). Although each higher level increases in complexity of thinking about knowledge and knowing, in these three ways of knowing understanding is perceived to mean different levels of reproduction. The second set of three languages focuses on learning and knowledge in a more constructive way, and understanding takes on a deeper and more complex meaning. Level-four language is characterised by a focus on deep learning as a technical skill, e.g. looking for relationships between concepts or course content, reconstructing argumentations or lines of thought that may lead to constructing new knowledge (self authoring, Kegan, 1994), and becoming expert in a disciplinary way of thinking.

This language often sounds procedural, analytical and systemic (Belenky et al., 1997; Kegan, 1994). However in becoming an expert, the practitioner cannot as yet examine the (limitations of) the system itself: in the words of Kegan, the speaker is still embedded in the system which itself is still "subject" and not yet "object". The large change that occurs when people learn to speak level-5 language is that they realise that "every way of knowing is a way of not knowing" (Kegan, 1994) and so systems and disciplines are open to analysis as incomplete knowledge structures. Each system or discipline is only a particular, in some way flawed perspective on reality. By changing perspectives, the world changes before the eyes of the beholder (self transforming, Kegan, 1994). If carried too far, this relativist language can evolve into cynicism about the value of all systems and theories. The tone of voice in language-6 is recognisable because speakers of this tongue reject the purely analytical perspective, they feel they need to "think the world together" (Palmer, 1998) to embrace the paradox that knowledge can come from thinking, but also from not-thinking, from turning your mind off (Baxter Magolda, 2001). Where language-5 speakers are skilled in shifting perspectives as a form of deep learning, language-6 speakers are in search of the person behind the perspectives: "...getting to know what it means to be a human being with a soul" (Baxter Magolda, 2001).

Deep learning here takes on the meaning of seeking and developing wisdom in the sense that one realises that there is no perfect solution and one must settle for one that "does the most good while doing the least harm" (Kitchener and Brenner, 1990). Taking this into account, we propose that there are three types of surface learning and surface type understanding, and at least three different conceptions of deep learning and more complex understanding. To what extent these languages, and thus the different types of understanding, are linked to specific disciplines is as yet unclear. For one thing, often the disciplinary way of knowing is unclear to students, as it is mediated by the way of knowing of the teacher: teachers and their usual teaching practice often fail to provide students with a clear view of the disciplinary way of knowing.

SYMPOSIUM

Research on students' approaches to learning and self-evaluations of their learning outcomes

Henna Ryttonen, Faculty of Behavioural Sciences, Finland; Viivi Virtanen, 00014 University of Helsinki, Finland;
Anna Parpala, University of Helsinki, Finland; Sari Lindblom-Ylänne, University of Helsinki, Finland

The studies concerning the relationship between students' approaches to learning and their study success have had contradictory results. The aim of this study is to qualitatively examine what kind of approaches to learning high and low achievers in the Faculty of Biological and Environmental Sciences have and what is the relationship with self-evaluations of their learning outcomes and how they achieve in their studies. The participants of the study were 10 students participating in two bioscience courses. Students' learning outcomes were measured by course grades and the participants were interviewed by semi-structured interviews. The results of the present study indicate that students' achievement tells very little about the quality of student learning. Students who applied a deep approach to learning but are not organised did have trouble achieving the courses. In addition, students applying a surface approach achieved also highly. The assessment in the courses should be more closely examined. Furthermore, student counselling should emphasise students' study skills, such as time management and self-regulation skills, as a part of the programme.

Introduction

The studies concerning relationship between students' approaches to learning and study success have had contradictory results. Some studies have shown a positive relation between deep approach to learning and better

learning outcomes (e.g. Amirali, Huon & Kevin, 2004; Román, Cuestas & Fenollar, 2008). However, Diseth (2003, 2007) has found a connection only with strategic approach and study success. In addition, Lizzio, Wilson & Simmons (2002), for example, found a positive relationship between a surface approach to learning and academic achievement. Assessment seems to have a significant impact on how students engage in learning (Reid, Duvall & Evans, 2007). Furthermore, in the recent studies, the relationship between students' approaches to learning and academic achievement has mostly been explored quantitatively. Qualitative research has been scarce.

Aim of the study

This study explores low and high achievers approaches to learning and self-reported learning outcomes in two courses. The aim is to qualitatively examine the differences between the low and high achievers approaches to learning and their experience of the learning outcomes in the two courses.

Method

Ten students participated voluntarily in the present study. Students were divided into two groups based on their achievement in the examination, namely high achievers and low achievers. The high achievers (n=6) scored highly on the course exam (4 or 5) and low achievers (n=4) failed the test or just passed it (0 or 1) on a scale from 0 to 5. Thus, the average students (2&3) were excluded from the study. The study was conducted in two different bioscience courses: Biomolecules and Gene techniques. The students were distributed in terms of which course they were taking and their way of achieving in the course. The distribution can be seen in the Table 1. The interviews concerning students' approaches to learning were semi-structured and concentrated on what meanings students gave to their learning in the particular course. In addition, students were asked to describe what they had learned in this particular course. The students were also asked about their overall experience about the course, what goals did they have concerning the course, how did they study in the course and did they accomplish their goals. The intention of the analysis was to see how students described their way of learning and studying in a particular course. First the data were coded to fragments which described students learning approaches. Secondly specific themes were comprised to describe individual students and at the same time broad themes were conducted which separated for example deep learning and reproducing learning from each other. Finally, each student profile was conducted according to the categories.

Results

The four student profiles based on students' approaches to learning and their self reported learning outcomes were conducted as follows.

A Deep learning: This profile describes students who had interest in the subject matter and used deep processes in their learning such as developing own summary structures of the knowledge and linking learning matter to his or her prior knowledge. These students felt that the exam was easy and that they have learned and understood the subject matter.

B Deep unorganized: This category describes students who have motivation to (really) understand deeply the content matter and they use deep learning processes. The difference between the previous profile A is that it takes very long time to study and they just do not have enough time to understand. Learning outcomes were experienced to be weak due to poor organising skills.

C Understanding through surface processing: Students representing this profile aimed to understand the subject matter, but they use surface strategies in studying such as reproducing knowledge as many times as it takes to understand. They also felt that they have learned and understood well.

D Surface learning: This category describes students who had little interest in the course, whose aim was to pass the course and they used learning processes such as memorizing and reproducing knowledge. These students also feel that the learning was not very good. High achievers in both courses represented deep learning and understanding through surface processing. In addition, in Gene Technology course, there were also high achievers who applied surface approach to learning in the course. Furthermore, in both courses the low achievers were students who applied deep approach to learning but did not organise their studies well and thus represented the profile B. The distribution of the students according to the categories and their achievement is shown in the Table 2.

Discussion

The preliminary results show that students whose aim to understand but do not organise their studies have troubles achieving well in these bioscience courses. This supports the result of the previous study, which showed a positive relation between organised studying and study success in the Faculty of Biology and Environmental Sciences (Rytkäinen, Parpala, Lindblom-Ylännä, Virtanen & Postareff, submitted). Interestingly, according to Parpala, Lindblom-Ylännä, Komulainen, Litmanen & Hirsto (2010) Unorganised students applying a deep approach is the largest student group in the Faculty of Biosciences. Furthermore, in Gene Techni course, it seems that reproducing learning and

memorising can also result to higher grades. This implies that assessment method used in this course encourages students' rote learning instead of deep learning processes. Results of the present study suggest that students' grades do not necessarily tell anything about the qualitative learning outcomes. Thus, the assessment of the courses should be more closely examined. Furthermore, the results of the present study suggest that students who apply deep approaches to learning but are unorganised should be assisted with their study skills. Student counselling should emphasise students' study skills, such as time management and self-regulation skills, as a part of the programme.

SYMPOSIUM

The enactment of metalearning capacity

Sophie Ward, Durham University, United Kingdom; Roy Connolly, University of Sunderland, United Kingdom;
Jan H.F. Meyer, Durham University, School of Education, United Kingdom

This study investigates understanding of learning amongst a cohort of ten students entering higher education by engaging them, via drama-based activities, with the process of their own learning (metalearning). It combines Meyer's (2004) Reflections on Learning Inventory (RoLI) and Performance Based Research (PBR). In previous studies, the RoLI has demonstrated the capacity to raise students' awareness of the self as learner. PBR casts students as researchers into their own learning, enabling them to create their own knowledge from their experiences. Students entering a BA Honours Drama Programme were invited to: complete the RoLI; 'brainstorm' their conceptions of learning stimulated by the RoLI profiles; produce short monologues about a breakthrough in their learning; work in groups to convert the monologues into dramas; enact their dramas; write 1,500 word reflective essays about what they had learnt about their own learning strategies during the above activities. The triangulation of methods (RoLI; enactment; reflective essay) yielded consistent findings in terms of how the students positioned themselves as learners, for example as 'passive' or 'proactive learners', and the validity of the findings was confirmed in the students' first formative assignment in drama. The enactment provided a dynamic perspective for developing metalearning that was personal and meaningful for the students: it stimulated students to confront their fears about learning in a supportive environment; gave tutors insight into the needs of particular students, and enabled tutors to offer early intervention to support students' learning.

Aims: This study investigates understanding of learning amongst a cohort of students entering higher education by engaging them via drama-based activities with the process of their own learning (metalearning). The aim is to discover how the development of students' understanding of their own learning might aid them in developing learning strategies suited to the demands of undergraduate study, and to help develop study support mechanisms that will enhance the experience of these students for the duration of their time at university.

Methodology:

The present study combines Meyer's (2004) Reflections on Learning Inventory (RoLI) and Performance Based Research, and thus builds upon, and extends, the methodology of research into metalearning (see for example, Meyer, Ward & Latreille, 2009; Ward & Meyer, 2010). a) Reflections on Learning Inventory (RoLI) The RoLI is an instrument used in metalearning research that generates an explicit and graphic colour-coded personal learning profile. The domain of the RoLI 'operationalizes motivations, intentions, conceptions and processes of learning that traverse an accumulative (surface)-transformative (deep) emphasis' (Lucas & Meyer, 2004: 460). In previous studies, the RoLI has demonstrated the capacity to reveal key features of students' approaches to learning and to raise students' awareness of the self as learner by highlighting both un-interrogated assumptions about what constitutes 'learning' and unconscious habits of 'learning'. It thus provides a basis for increasing students' understanding of how their learning strategies resonate with those considered to be effective in higher education. b) Performance Based Research (PBR) employs drama as 'a way of creating and fostering understanding' about everyday life (Pelias, 2008: 185-6). Using PBR, knowledge is represented through 'action, enactment or performance' (Leavey, 2009: 168). The present study made use of PBR to deploy students as researchers into their own learning, thereby enabling the students to 'create their own knowledge from their own experiences' (Llapputtong & Rumbold, 2008: 18) and to bring into focus ideas that may otherwise have been difficult to explore. The present study was conducted with ten students shortly after they entered a BA Honours Drama Programme.

The research method employed did not require knowledge of drama, and it is posited that the methodology could be replicated with students in other disciplines.

1) The students were presented with propositions about learning taken from the university's undergraduate handbook, and were invited to interrogate the dynamic between their beliefs about learning and the model of learning presented in the handbook.

- 2) The students were asked to think about their learning experiences prior to entering university, and to complete the RoLI with these experiences in mind.
- 3) The students were split into groups and 'brainstormed' their conceptions of learning, stimulated by the RoLI profile, and gave a poster presentation about these conceptions.
- 4) The students were asked to write and recite a short monologue about a breakthrough in their learning.
- 5) In groups, the students began the process of taking on roles and acting out incidents from the monologues; telling new stories or sharing ideas that the monologues provoked.
- 6) The students then enacted their dramas.
- 7) The students were then asked to write 1500 word reflective essays about what they had learnt about their own learning strategies during the above activities. Data analysis: The metalearning materials (RoLI profiles; enactments; reflective essays) were analysed qualitatively, using criteria devised by Meyer, Ward & Latreille (2009). The categorisation of the data produced a range of themes and tendencies that were analysed for evidence of potentially effective or ineffective learning engagement in the context of HE, using Meyer's (1991) concept of 'study orchestration'.

Findings:

The triangulation of methods (RoLI; enactment; reflective essay) yielded consistent findings in terms of how the students positioned themselves as learners. For example, students who displayed evidence of reproductive/passive learning engagement in their RoLI profiles enacted dramas in which they were 'rescued' from ignorance by teachers, and wrote about being frightened and confused by learning, while the students who displayed evidence of deep learning engagement in their RoLI profiles enacted dramas in which they took control of a learning experience, and wrote about feeling empowered by conquering their fears. The validity of the findings was confirmed by the relative performance of the reproductive/passive students and the 'deep learners' in their first piece of assessed work in drama.

Theoretical and educational significance:

The enactment provided a dynamic perspective for developing metalearning that was personal and meaningful for the students: it stimulated students to confront their fears about learning in a supportive environment; gave tutors insight into the needs of particular students, and enabled tutors to offer early intervention to support students' learning. This present study contributes to the literature on, and discussion about, how to:

Encourage students to reflect upon their learning strategies.

Enhance students' experience of entering higher education.

Enhance dialogue about learning between teachers and students.

Improve study support strategies.

References:

- Leavy, P. (2009) *Method Meets Art: Art-Based Research Practice*. London: The Guilford Press.
- Llampa, P. & Rumbold, J. (2008) (eds.) *Knowing Differently: Arts Based Collaborative Research Methods*. Hauppauge NY: Nova.
- Lucas, U. & Meyer, J.H.F. (2004) 'Supporting student awareness: understanding student preconceptions of their subject matter within introductory courses' *Innovations in Education and Teaching International*. 41 (4) pp. 495-471.
- Meyer, J.H.F. (1991) 'Study Orchestration: the manifestation, interpretation and consequences of contextualised approaches to studying' *Higher Education*. 22 pp. 297-316.
- Meyer, J.H.F. (2004) 'An introduction to the RoLI' *Innovations in Education and Teaching International*. 41 (4) pp. 491-497.
- Meyer, J.H.F., Ward, S.C. & Latreille, P. (2009) 'Threshold Concepts and Metalearning Capacity' *International Review of Economics Education*. 8 (1) pp. 132-154.
- Pelias, R.J. (2008) 'Performance Inquiry: Embodiment and Its Challenges' In: Knowles, J.G. & Cole, A.L. (eds.) *Handbook of the Arts in Qualitative Research*. Thousand Oaks: Sage Publications. pp. 185-194.
- Ward, S.C. & Meyer, J.H.F. (2010) 'Metalearning capacity and threshold concept engagement' *Innovations in Education and Teaching International* (in press).

SYMPOSIUM

Typical and atypical development of numerical skills

Chairperson: Evelyn Kroesbergen, University of Utrecht, Netherlands

Organiser: Evelyn Kroesbergen, University of Utrecht, Netherlands

Sylke Toll, Utrecht University, Netherlands

Discussant: Johannes E.H. Van Luit, Langeveld Institute, Netherlands

Mathematical learning difficulties have their origin at an early age. However, research on the significant causes and predictors of these difficulties is largely lacking. In this symposium, three papers will be presented that each add a significant contribution to fill this gap. Three large-scale studies were conducted in Finland, Belgium and the Netherlands. The first paper shows, based on a longitudinal study, which early math skills are especially relevant to predict math development. The second paper also describes the role of spelling in children with mathematical learning difficulties. This paper further describes relations with visuomotor skills. The third paper shows that both nonverbal and verbal numerical representation skills are important predictors for later math development. In addition, the results show the important role of verbal and visuo-spatial working memory in the development of early numerical skills. Together, the results of the three papers give important clues for early identification – and possible remediation – of mathematical learning difficulties.

SYMPOSIUM

Mathematical development in kindergarten and first grade: the stability of weak performance

Pirjo Aunio, University of Helsinki, Finland; Riika Mononen, University of Jyväskylä, Finland; Tuire Koponen, Niilo Mäki Institute, Finland

This paper reports a longitudinal study on children's mathematical skills in kindergarten and grade one. The aim of the study was to find out how stable the weak performance is during kindergarten and first grade years. In addition the predictive power of different mathematical skills in this transition phase was studied. The preliminary analysis was done with data from kindergarten and the main analysis will include data on first grade performance (December 2010). There were five performance clusters (based on scores on scale for basic arithmetic) found. The performance clusters were quite stable during the two kindergarten measurements. The preliminary Hierarchical multiple regression analysis revealed that from the eight Early Numeracy Test subscales (time 1) two were significant predictors for the Total Performance (time 2), namely the skills to solve simple math problems and to recite number word sequence. From the Scale for Kindergarten Math Skills (1 time) the best predictors for the Total Performance (time 2) were the skills connecting number symbol with correct number of items, the understanding the concepts of comparison, and the skills to recite the number word sequence forward, and backward. Our preliminary results demonstrate that early math skills have several developmentally relevant skills, which should be regarded in screening for low performance and in designing for interventions. The results also show that it is important to find the weak children in the beginning of the non-formal teaching kindergarten year. They need additional support to be able catch up their normal achieving peers.

Introduction

This paper reports a longitudinal study on children's mathematical skills in kindergarten and grade one. A number of longitudinal studies have been published recently on mathematical development in the transition phase from kindergarten (non-formal teaching) to primary school (formal teaching) among normally developing children. These studies have targeted cognitive antecedents (Aubrey & Godfrey, 2003; Aunola, Leskinen, Lerkkanen & Nurmi, 2004; DeSmedt, Janssen, Browens, Verschaffel, Boets & Ghesquière, 2009; Fayol, Barrouillet & Marinthe, 1998; Passolunghi, Mammarella & Altoè, 2008), family socio-economical status and gender (Aunola et al., 2004), motivational factors related to learning mathematics and teacher's teaching goals (Aunola, Leskinen & Nurmi, 2006), and parents' beliefs and parenting style (Aunola & Nurmi, 2004; Huntsinger, Jose, Larson, Krieg & Shaligram, 2000; Natale, Aunola & Nurmi, 2009) as predictors of mathematical performance and development. However we still lack knowledge of how relevant different mathematical skills are for the development. In addition less attention has been focused on stability of weak performance in the transition from kindergarten to first grade, from informal to formal mathematics instruction. Both of these issues have relevance in screening and intervention wise.

Aims

The aim of the study was to find out how stable the weak performance is during kindergarten and first grade years. We wanted to know if the same children were weak in the beginning of the kindergarten and first grade. In addition we investigated the predictive power of different mathematical skills in this transition phase.

Methodology

Participants. The participants were 169 children (84 girls), aged six years four months. All of the children participated to regular kindergarten instruction in one northern city of Finland.

Methods of data collection. There were two measurement times in kindergarten (one in December and one in April) and one will be in first grade (December 2010). In the data collection three scales were used. Individually used Early Numeracy Test (ENT by Van Luit et al., 2006) takes a developmental perspective on children's early numeracy, and

aims at tapping eight aspects of numerical knowledge, including the concepts of comparison, classification, one-to-one correspondence, seriation, the use of number words, structured counting, resultative counting, and the general understanding of numbers. Basic arithmetic skills were assessed using items from the Mathematics school test (Makeko by Ikäheimo, Putkonen, & Voutilainen, 2002), which is a group test and takes a maximum of 45 minutes to complete. In addition we designed an individual Scale for Kindergarten Math Skills, (SKMS by Authors 2009) to measure number sequence skills and relational skills (concepts of direction, order and comparison). The main idea of SKMS is to supplement ENT and Makeko-K, by measuring core skills in different way or context, or adding some less studied concepts. Children's skills have been measured twice in kindergarten (Makeko-kindergarten and SKMS or ENT) and will be measured once in grade one (Makeko – first grade) December 2010.

Procedure.

A group of kindergarten teachers volunteered to collaborate with the researchers. The educators were trained in one day training to use the instruments. After which they measured the mathematical skills of the children in their own teaching group. The answer sheets were returned to the researcher by mail to be keyed and analyzed.

The preliminary analysis was done with two kindergarten measurements. The presentation in the symposium will be based on measurements done in kindergarten and grade one. For the analysis we had two databases: one including children whose skills were measured twice in kindergarten with Makeko-K and ENT (N= 78, girls n = 38) aged 6 years 4 months (M in months 76.23, SD 3.35) in time of the first measurement, and the other including children whose skills were measured with Makeko-K and SKMS (N=91, girls n= 46) aged 6 years 4 months (M in months 76.13, SD 3.58) in time of the first measurement.

Findings

In the preliminary Cluster analysis there were five performance clusters (based on scores on Makeko-K) found in both data sets. The performance clusters were quite stable during the two kindergarten measurements. The more profound analysis will be done including the third measurement on first grade and with ISAO approach (Bergman & El Khouri, 1999). The preliminary Hierarchical multiple regression analysis revealed that from the eight ENT subscales (time 1) two were significant predictors for the Total Performance (time 2) (Makeko-k + ENT), namely the skills to solve simple math problems ($b = .28$, p

Theoretical and Educational Significance

In comparison to existent research literature the add value of our study is that we have measured early mathematical skills including a variety of subskills, including basic enumeration skills and skills directly related to that (e.g., recite number word sequence, number symbol and number of items connection) and the children's abilities to use and understand concepts related to mathematical problem solving. Our preliminary results demonstrate that early math skills include several developmentally relevant skills, which should be regarded in screening for low performance and in interventions. Our results confirms the results that it is possible to find the weak children in non-formal teaching kindergarten year and that without any intervention their learning is more troublesome than in their normally achieving peers. In addition, our data provides possibilities to discuss about the practical value of using individual and group-based screening methods.

SYMPOSIUM

The profile of children with isolated and non-isolated mathematical problems

Stefanie Pieters, Ghent University, Belgium; Annemie Desoete, Ghent University, Belgium; Ruth Vanderswalmen, University College Arteveldehogeschool, Belgium; Herbert Roeyers, Ghent University, Belgium; Hilde Van Waelvelde, Ghent University, Belgium

The aim of this study was to investigate reading, motor coordination, visual perception and visual-motor integration in children with mathematical and/or spelling problems. Fifty seven children with isolated mathematical problems, 150 children with isolated spelling problems, 113 children with mathematical + spelling problems and 76 age-matched control children without mathematical and spelling problems participated. All 396 children were at least of average intelligence and were assessed with standardized tests for reading, motor coordination, visual perception and visual-motor integration. ANCOVA's showed that children with co-morbid mathematical + spelling problems obtained significantly lower scores than children with mathematical problems and control children on all measured domains. Furthermore, they performed significantly worse in comparison with children with a spelling problem on all measured domains except for visual-motor integration. Children with spelling problems have significantly lower reading capacities in comparison with children with mathematical problems but not for visual perception, motor coordination and visual-motor integration. Spelling does matter in mathematical problems as the co-morbidity implies significantly more problems on all measured domains. Children with mathematical and/or spelling problems are often at risk for additional reading, motor coordination, visual-perceptual and visual-motor integration problems and these problems

may interfere with other scholastic skills. Our data underline the need for the application of carefully selected tests in the diagnostic assessment of children with learning problems in order to develop a STI(mulation), CO(mpensation), R(emediation) and DI(spensation) advice based upon the specific needs of each child.

Aims

Recently, researchers found that the co-morbidity of mathematical learning disabilities with spelling disabilities may have a stronger biological foundation than the co-morbidity with reading disabilities (Landerl & Moll, 2010). Therefore, in this paper we brought mathematical and spelling problems together. Measuring reading is not only important in spelling, but also in mathematical skills. However, research in this domain is rather scarce. Motor coordination, visual perception and visual-motor integration are needed to complete for example a jigsaw puzzle, or to recognize a triangle, a square, a cube... They all are believed to play an important role in scholastic skills (such as mathematics, reading, spelling...), but the association is not fully understood (Cirino et al., 2007; Geary, 2004; Kulp, 1999; Mazzocco & Myers, 2003). Therefore, the aim of this study was to investigate reading, motor coordination, visual perception and visual-motor integration in children with mathematical and/or spelling problems. A better understanding of conditions under which developmental disorders (for example the different learning disabilities and developmental coordination disorder) co-occur is necessary to specify profiles of risk and protective factors useful for diagnosis and assessment.

Methodology

Subjects. Fifty seven children with a score \leq percentile 10 on the KRT-R (procedural calculation) or the TTR (fact retrieval) (mathematical problems), 150 children with a score \leq percentile 10 on the PI dictation (spelling problems), 113 children with a score \leq percentile 10 on the KRT-R or the TTR and on the PI dictation (mathematical + spelling problems) and 76 age-matched control children without mathematical or spelling problems (a score \geq percentile 25 on the KRT-R, the TTR and the PI dictation) participated in this study. All 396 children were at least of average intelligence and were between 6.8 and 12.5 years old ($M=8.9$ years; $SD=0.9$ years). Control children were age matched but differed on intelligence ($F(3,392)=16.8$, p) from other groups. Therefore, IQ will be taken as a covariate in the analyses of variances described below.

Instruments. In order to estimate the intellectual capacities, all children were assessed with the short version of WISC-III (Similarities, Picture Arrangement, Block Design and Vocabulary; Wechsler et al., 2002). For other inclusion criteria, all children were also assessed with Dutch standardized tests for spelling (PI-dictation, Geelhoed & Reitsma, 2000), number fact retrieval (Arithmetic Number Facts Test [TTR], De Vos, 1992) and procedural calculation (Courtrai's Arithmetic Test Revised [KRT-R], Baudonck, et al., 2006). Next, children were tested for reading (One Minute Test (Brus & Voeten, 1999) and Klepel (van den Bos et al., 1994), motor coordination (Movement Assessment Battery for Children -2nd Edition (Henderson & Sugden, 2007) and Beery VMI subtest motor coordination), visual perception (Beery VMI subtest visual perception) and visual-motor integration (Beery VMI copy task) (Beery et al., 2004). Children were assessed by specially trained investigators, on three different moments.

Findings

Analyses of covariances comparing the four groups (mathematical problems, spelling problems, mathematical + spelling problems and a control group) revealed that children with mathematical + spelling problems obtained significantly poorer scores on all domains (reading, visual perception, motor coordination and visual-motor integration) in comparison with the control group and the group of children with mathematical problems. Furthermore, they scored significantly lower on measures of reading, visual perception and motor coordination (both VMI motor coordination and M-ABC 2) in comparison with the group of children with spelling problems. No significant differences were found between those two groups on visual-motor integration. Moreover, children with spelling problems obtained significantly poorer scores than control children for reading, visual-motor integration and motor coordination (both VMI motor coordination and M-ABC 2), but not for visual perception. They had significantly lower scores on reading in comparison with the children with mathematical problems, but not for visual perception, motor coordination skills (both VMI motor coordination and M-ABC 2) and visual-motor integration. Finally, children with mathematical problems performed significantly worse than control children for reading, visual-motor integration and motor coordination (both VMI motor coordination and M-ABC 2) but not for visual perception.

Theoretical and educational significance Spelling does matter in mathematical problems as the co-morbidity implies significantly more problems on all measured domains. These findings underscore that having a co-morbid mathematical + spelling problem is significantly worse in comparison with having an isolated mathematical problem on all measured domains and in comparison with having an isolated spelling problem on all measures except for visual-motor integration. Not mathematical problems or spelling problems are associated with visual-perceptual problems, it is the co-morbidity of both that makes children underachieve in this domain. These findings are thus in

accordance with the cognitive subtype hypothesis of the different co-morbidity models (Pennington, 2006; Rhee et al., 2005; Wilcutt et al., 2005). Finally, children with mathematical and/or spelling problems are often at risk for additional reading, motor coordination, visual-perceptual and visual-motor integration problems. Therefore, the results of this study might also have diagnostic and educational implications. The findings underscore the need for the application of a wide range of carefully selected measures in the diagnostic process and the assessment of the individual child. Individual assessment always aims to develop a STICORDI-advice. STICORDI refers to STimulation, COmpensation, ReMediation and DIspensation. This advice can be adapted based upon the specific needs of children with co-morbid reading, motor coordination or visual-perceptual problems, with regard to their strengths and weaknesses. Examples of such an advice could be a larger font, adjusting the margin of the page, using squared paper to aid in the spatial placement of numbers, replacing complex figures by text, a good position on an adapted chair (for example a Tripp Trapp) or the use of ergonomic pencils.

SYMPOSIUM

The development of early numerical skills in Kindergarten

Meijke Kolkman, Utrecht University, Netherlands; Evelyn Kroesbergen, University of Utrecht, Netherlands;

Paul Leseman, Utrecht University, Netherlands

The development of accurate numerical representations is important for math learning. However, little is known neither about the nature of the developmental changes in basic numerical comprehension nor about the causes of inter-individual differences therein. Therefore, the aim of the present study was to examine the co-development of verbal and visuo-spatial working memory, executive functions, and early verbal and nonverbal numerical representation skills. In this study longitudinal data is presented in which the reciprocal relations between cognitive skills and numerical abilities are examined. A sample of 267 Dutch Kindergartners was tested four times in a two-year period. Numerical tasks were administered to assess non-verbal quantity representations, verbal counting skills and mapping skills. Cognitive abilities were assessed using tasks assumed to measure verbal and visual working memory skills, shifting skills and inhibition. Preliminary hierarchical regression analysis showed that both nonverbal and verbal numerical representation skills, and mapping skills, predict substantial variance in math performance. A direct effect of working memory on math performance, however, remains. These results demonstrate that domain-general cognitive abilities, in particular verbal and visuo-spatial working memory, influence math development at least partly through involvement in the development of domain specific numerical skills.

Introduction

Nonverbal representation of magnitudes emerges already very early in life and is regarded the fundament of math development many years later. Increasing experience in early childhood with verbal numerical skills such as counting and with symbols such as digits for written notation, gives rise to further development of early math competence. The integration (or 'mapping') of verbal and symbolic knowledge with the nonverbal magnitude representation system results in more complex and increasingly accurate cognitive representations of number (e.g. Dehaene, 2001; Mundy & Gilmore, 2009; Krajewski & Schneider, 2009). This novel competence is strongly related to math achievement, as several studies have shown (e.g. Laski & Siegler, 2007). Although the importance of accurate representations of numerical magnitudes has been convincingly demonstrated, still little is known neither about the nature of the developmental changes in basic numerical comprehension nor about the causes of inter-individual differences therein. Several studies have found positive relations between working memory, executive functioning and (early) math performance (e.g., Geary, 2010; Locuniak & Jordan, 2008) but the evidence is still inconclusive. It is not clear, for instance, whether domain-general cognitive functions contribute separately to math development, in addition to the effect of basic domain-specific numerical representation skills, or contribute mainly via a constructive role in basic numerical development, in particular regarding the integration of verbal and nonverbal number representations.

Aims

Therefore, the present study was designed to examine the co-development of verbal and visuo-spatial working memory, executive functions, and early verbal and nonverbal numerical representation skills, and to test reciprocal effects and mediation.

Methodology

The sample of 267 four-year-old Dutch children (124 boys; mean age = 51.60 months; SD = 3.52 at first measurement) was tested four times in a two-year period. The first measurement took place when children entered kindergarten and the last measurement is planned halfway the first grade when the children are approximately six years old. To measure working memory and executive functions, different neuropsychological and cognitive tests of executive functions were used. For the assessment of visual and verbal working memory, we adapted several tasks from the Automated Working Memory Assessment Battery (Alloway, 2007). We used 'Odd One Out' and 'Dot Matrix' to

measure visual working memory skills. 'Word Recall Forward' and 'Word Recall Backward' were used to measure verbal working memory skills. An adjusted version of the 'Flanker task' (Eriksen & Schultz, 1979, as cited in Stins, Van Baal, Polderman, Verhulst, & Boomsma, 2004) was used to measure inhibition and the 'Dimensional Changing Card Sorting' (Zelazo, 2006) task was used to assess shifting. To measure early math skills, different tasks were used for the measurement of non-verbal, verbal and symbolic numerical skills and mapping skills. For the assessment of non-verbal skills, we used a non-symbolic comparison and number line estimation task (adapted from Laski & Siegler, 2007). Verbal and symbolic skills were measured using a counting task and a number identification task. Mapping skills were assessed by symbolic comparison and number line estimation tasks. Math achievement will be measured in first grade, after about a half year of math instruction.

Findings

Growth modeling techniques will be applied to test the developmental relations between the general cognitive skills and the emerging math abilities of the children. However, preliminary hierarchical regression analysis, based on part of the data, show that visual and verbal working memory skills predict substantial variance in a modality specific way in verbal and symbolic numerical representation skills ($R^2 = .13 - .25$); mapping skill is partly predicted by both verbal ($R^2 = .09$) and visual ($R^2 = .15$) working memory skills. Inhibition and shifting do not predict additional variance in numerical representation. Both nonverbal and verbal numerical representation skills, and mapping skills, predict substantial variance in math performance. A direct effect of working memory on math performance, however, remains, although a substantial part of the relationship between working memory and math can be regarded as mediated by numerical representation skills.

Theoretical and educational significance

To conclude, the present study provides tentative evidence that domain-general cognitive abilities, in particular verbal and visuo-spatial working memory, influence math development at least partly through involvement in the development of domain specific numerical skills. A possible explanation, to be addressed in future research, is that basic numerical representation skills rely on the simultaneous and successive processing of multiple sources of information, presented in both the verbal and visual modality, requiring temporary storage and control. Nevertheless, the results of this study contribute to the field of math development in providing knowledge about the early determinants of math development. These understandings will help to identify problems in number skills at an early age and can be used to develop appropriate math programs for normal developing kindergartners or young children experiencing math problems.

SYMPOSIUM

Learning science through participation in its epistemic / symbolic language practices

Chairperson: Russell Tytler, Deakin University, Australia

Organiser: Russell Tytler, Deakin University, Australia

Discussant: Larry Yore, University of Victoria, Canada

This symposium focuses on exploring the development of student understanding and application of the discursive tools of science in order to reason in this subject, as the basis for classroom practices that parallel the knowledge production practices of scientists. We explore how this account of the disciplinary literacies of science can be enabled through effective pedagogies. The papers draw on research from Australia and Sweden that have overlapping agendas and theoretical perspectives including pragmatism (Peirce 1931-58; Dewey 1938/1997), social semiotics (Kress et al. 2001) and socio cultural perspectives on language and learning (Lemke 1990, 2004). The papers will examine the role of language / multimodal representations in generating knowledge claims in science classrooms, the classroom epistemologies that support learning, and what it is to assess knowledge from this perspective. A large body of research in the conceptual change tradition has identified trenchant problems in conceptual learning in science, spawning a long-standing and ongoing program of searching for pedagogies to address this. By redefining the problem in terms of language and representation, we aim to offer a way forward for supporting student engagement and learning in science.

SYMPOSIUM

A representation-intensive pedagogy for school science

Russell Tytler, Deakin University, Australia; Peter Hubber, Deakin University, Australia

This paper will describe the theoretical underpinnings and the key features of a representation-intensive pedagogy developed in a major Australian project, and its relationship to the epistemic practices of science. The pedagogy is

grounded in socio cultural and pragmatist perspectives on learning and cognition that see knowledge as grounded in multi modal representations that are discursively generated, negotiated and coordinated in science classrooms. From this perspective, the learning challenges identified by research in the conceptual change tradition are seen as inherently representational in nature, and the pedagogy centres on students generating representations in response to structured challenges. The paper will use evidence from a range of units designed and implemented by the researchers working in partnership with a small group of teachers, to interrogate the key aspects of the pedagogy and the way it supports learning. The role of representations in supporting learning will be explored in terms of the way they afford and productively constrain knowledge generation, in ways that mirror the knowledge building practices of science. Examples of student artefacts and reasoning will be presented to demonstrate significant learning outcomes.

Aims

There is now a growing consensus that learning science at school entails students learning the literacies of a specific discourse community, one that uses a range of subject-specific and general representational tools to construct and justify evidence-based claims about the natural world (Kress et al. 2001; Lemke, 2004; Moje, 2007). Researchers in classroom studies where students were guided to construct their own representations of scientific ideas (Carolan, Prain & Waldrup, 2008; Greeno & Hall, 1997) have noted the importance of teacher and student negotiation of representational meaning and of students having opportunities to explore, elaborate, re-represent and coordinate representations to interpret science phenomena. There is growing evidence (Hubber, Tytler & Haslam 2010; Hubber 2010) that this can lead to increased student engagement and improved learning outcomes.

This paper will report on aspects of an Australian project that worked with teachers to develop and validate a pedagogy based on student generation and negotiation of representations. It will address the research questions: 1) What are the key features of a pedagogy based on student generation of multi-modal science representations, reflecting the knowledge building practices of science? 2) How does such a pedagogy support student reasoning in science, and 3) What evidence is there that this approach leads to improved conceptual learning? **Methodology**

The research team worked with four experienced primary and secondary teachers to collaboratively develop a series of teaching sequences on science topics that the conceptual change literature has shown to present learning difficulties. The sequences focused explicitly on student generation and negotiation of representations related to key concepts. In working with the teachers over two years, we developed a set of pedagogical principles based on our experience and on theoretical ideas described above.

The teachers' practices, student-teacher interactions, and student activity and discussion were monitored using classroom video capture. Key lessons were coded using an emergent scheme generated using Studiocode software, to make apparent the patterns of pedagogical moves and to explore the key features that could be considered fundamental to a representation-intensive pedagogy. Teaching and learning sequences were selectively transcribed and subjected to ethnographic analysis to identify the extent to which and in what ways the pedagogical principles were exemplified, and for evidence of the ways in which the focus on representations supported reasoning and learning about key science ideas. Students were interviewed about their learning, and teachers about their perceptions of the effectiveness of aspects of the sequence. Student workbooks were collected to provide a continuous record of representational work.

Pre- and post- test data were analysed to look for evidence of improved understanding, flexibility in the generation of representations, and the capacity to transfer ideas to a wider range of phenomena.

Findings

The pedagogy has the following key principles:

1. The sequencing of representational challenges involving students generating representations to actively explore and make claims about phenomena, involving a) identifying appropriate representations underpinning key concepts; b) establishing a representational need and c) working towards alignment of student generated and canonical representations.
2. Explicit discussion of representations, including a) their selective purpose, b) group agreement on generative representations, c) form and function and d) the adequacy of representations.
3. Meaningful learning through representational/ perceptual mapping between objects and representations
4. Ongoing and summative assessment focusing on the adequacy, and coordination of representations.

Moreover, analysis of the patterns of conceptual clarification and orientation, representational challenge, clarification and negotiation of representations, and explanation/resolution showed similar pathways for lessons but differences depending on year level, place of the lesson in the sequence, and topic.

Analysis of the teacher – student exchanges and of student artefacts produced in these sequences demonstrated a strong alignment of the pedagogy with inquiry principles, and evidence of significant reasoning and learning. The analysis of reasoning is linked to the use of representations as epistemic tools in science knowledge – building, and draws on Peirce's (1953) triadic model of meaning making, and notions of affordances (Norman 1999) to identify the way representations selectively focus attention on aspects of the problem space.

Significance

There is increasing acceptance of the view that learning involves a process of induction into specific discipline-based discursive practices, and is mediated by representations as the epistemic tools of science. This research represents a serious attempt to translate these theoretical insights into a practical classroom pedagogy that can effectively frame learning in science. Such a program has both practical significance for teacher practice and teacher education, and theoretical significance in bringing science classrooms and science practice into closer alignment. A re-interpretation of conceptual problems in learning science in terms of representational issues, and a program to translate this into a pedagogy, shows promise of making inroads into the problems in learning science well established in the conceptual change literature.

References

- Carolan, J., Prain, V., & Waldrup, B. (2008). Using representations for teaching and learning in science. *Teaching Science*, 54 (1), 18-23.
- Greeno, J & Hall, R (1997) Practicing Representation: Learning with and about representational forms. *Phi Delta Kappan*, 78 (5), 361-368.
- Hubber, P, Tytler, R., & Haslam, F. (2010). Teaching and learning about force with a representational focus: Pedagogy and teacher change. *Research in Science Education*, 40(1), 5-28.
- Hubber, P. (2010). Year 8 students' understanding of astronomy as a representational issue: Insights from a classroom video study. In D. Raine, L. Rogers, & C Hurkett (Eds), *Physics community and cooperation* (Pp. 45-64). Leicester: University of Leicester.
- Kress, G., Jewitt, C., Ogborn, J., & Tsatsarelis, C. (2001). *Multimodal teaching and learning: The rhetorics of the science classroom*. London: Continuum.
- Lemke, J. (2004) The literacies of science. In E. W. Saul (Ed.), *Crossing borders in literacy and science instruction: Perspectives in theory and practice* (pp. 33-47). Newark, DE: International Reading Association/National Science Teachers Association.
- Moje, E. (2007). Developing socially just subject-matter instruction: A Review of the literature on disciplinary literacy learning. *Review of Research in Education*, 31, 1-44.
- Norman, D. (1999). Affordance, conventions, and design. *Interactions*, 6(3), 38-43.
- Peirce, C. S. (1931-58). *Collected Papers of Charles Sanders Peirce*. 8 Volumes (Eds. Charles Hartshorne, Paul Weiss & Arthur W Burks, Vols 1-6), (Ed., Arthur W. Burks, vols 7-8). Cambridge, MA: Harvard University Press.

SYMPOSIUM

Using pragmatism in making semiotic resources meaningful in the science classroom

Per-Olof Wickman, Stockholm University, Sweden; Annie-Maj Johansson, Stockholm University, Sweden;

In this paper we demonstrate a heuristic based on semiotic and pragmatist educational research results that can be used to support teachers in scaffolding students' learning and agency in the science subjects. Studies on how the use of representations can aid science teaching and learning are supplemented with a study on how the progression of learning could be understood as oriented by ends-in-view (proximate purposes), which the teacher can make continuous with the ultimate purposes of an educational sequence in joint action with the students. The example comes from a Year 5 school class studying friction. The events in the classroom were filmed and transcribed and analysed by using Practical Epistemology Analysis. The study shows how the students and the teacher mainly use semiotic resources on the basis of the more proximate purposes rather than from more ultimate purposes and that there is no continuity created between the language of science and the language that students use during the lesson. We demonstrate how the two kinds of organising purposes can be used to scaffold the lesson better.

Aim and significance

In this paper we discuss how educational research in semiotics and on the use of representations in the science classroom can be supported by some notions developed within pragmatically oriented science education research.

The aim is to demonstrate a heuristic based on research results that can be used to support teachers in scaffolding students' learning and agency in the science subjects. Common to semiotic and pragmatist research is a socio-cultural stance approaching knowledge not as ready made, but as continuously developing in interactions between people, artefacts and semiotic resources (e.g., Chaiklin & Lave 1996; Sfard 1998). The unit of analysis is action and activities, rather than mental entities, and hence important aspects of learning can be studied as visible processes in communication and interaction as mediated by different semiotic resources and artefacts. In science education Lemke's (1990) book *Talking Science* represented a seminal reformulation of the learning processes in these terms. Other pioneering studies in science education are the social semiotic studies by Kress and co-workers (e.g., Ogborn et al 1996; Kress et al 2001), studies of mediation within the group of Säljö (e.g., Säljö & Bergqvist 1997) as well as Roth's (1998) research on learning communities.

In this study we supplement these studies with the pragmatist notion about how the progression of learning could be understood as oriented by ends-in-view, which the teacher can make continuous with the ultimate purposes of an educational sequence in joint action with the students (Wickman & Ligozat, 2011; Johansson & Wickman, in press). The concept of ends-in-view originates from John Dewey's (1938/1997) thinking about progression (growth in Dewey's terminology) as creating continuity between the prior experiences of students, the current situation and the new kinds of practices that students are introduced to. Because the ultimate purposes belong to the new kinds of practices that are not yet familiar to the students, Dewey discusses how situations can be found that have purposes, i.e. more proximate goals that make sense to students. Dewey called such purposes ends-in-view. However, as a teacher it is not enough to give students such ends-in-view. The teacher in joint action with the students has to make the activity with those familiar ends-in-view continuous with the ultimate goals of the lessons using the artefacts and semiotic resources available. The ultimate purposes make sense to the teacher, but the teacher has to translate them and make the students understand how the activity with ends-in-view also deals with the ultimate purposes. The praxis of using ends-in-view is commonplace in teaching, although they are rarely examined by educational researchers. How they can be made continuous with the ultimate purposes are far from clear (Wickman & Ligozat, 2011).

Methodology, and findings

In this paper we use an example from a Year 5 school class studying science (Johansson & Wickman, in press). The ultimate learning purpose for the lessons studied is about how friction facilitates or impedes motion. It is introduced by the teacher through more proximate purposes. We have studied two such proximate purposes used by the teacher: 1) why cars have tyres, and 2) that a vehicle can continue to travel indefinitely if there is no resistance at all. The events in the classroom were filmed and transcribed. As a method for analysis practical epistemology analysis (PEA) is used, which is based on the ideas of John Dewey but also on the late Ludwig Wittgenstein's investigations into language and action (Wickman, 2004; Wickman & Östman, 2002).

The study shows how both the students and the teacher mainly use semiotic resources on the basis of the more proximate purposes rather than from more ultimate scientific learning purposes and that there is no continuity created between the language of science and the language that students use during the lesson. We demonstrate how these two kinds of organising purposes can be used by teachers as an heuristic to better to help students to use friction as an overarching semiotic resource in dealing with and communicating within the proximate activities (why cars have tyres and how a vehicle can continue to travel indefinitely if there is no resistance at all). We also extend our results to how these organising purposes can be related to an Australian study on using representations as semiotic resources in the science classroom (Hubber, Tytler & Haslam, 2010), and so show how they can be applied more generally.

References

- Chaiklin, S., & Lave, J. (Eds.). (1996). *Understanding Practice. Perspectives on activity and context*. Cambridge: Cambridge University Press.
- Dewey, J. (1938/1997). *Experience and education*. In. New York, N.Y.: Touchstone, Simon and Schuster.
- Hubber, P., Tytler, R., & Haslam, F. (2010). Teaching and learning about force with a representational focus: pedagogy and teacher change. *Research in Science Education*, 40, 5-28.
- Johansson, A.-M. & Wickman, P.-O. (in press) A pragmatist approach to learning progressions. In Hudson, B. & Meyer, M. A. (Eds.) *Beyond Fragmentation: Didactics, Learning, and Teaching*. Leverkusen, Germany, Barbara Budrich Publishers.
- Lemke, J. L. (1990). *Talking science: language, learning and values*. Norwood, New Jersey: Ablex Publishing Corporation.
- Kress, G., Jewitt, C., Ogborn, J., & Tsatsarelis, C. (2001). *Multimodal teaching and learning: The rhetorics of the science classroom*. London: Continuum.

- Ogborn, J., Kress, G., Martins, I., & McGillicuddy, K. (1996). *Explaining science in the classroom*. Buckingham, Philadelphia: Open University Press.
- Roth, W.-M. (1998). Learning process studies: examples from physics. *International Journal of Science Education*, 20, 1019-1024.
- Säljö, R., & Bergqvist, K. (1997). Seeing the light: discourse and practice in the optics lab. In L. B. Resnick, R. Säljö, C. Pontecorvo & B. Burge (Eds.), *Discourse, tools, and reasoning: essays on situated cognition* (pp. 385-405). Berlin, Springer.
- Sfard, A. (1998). On two metaphors for learning and the danger of choosing just one. *Educational Researcher*, 27, 4-13.
- Wickman, P.-O. (2004). The practical epistemologies of the classroom: a study of laboratory work. *Science Education*, 88, 325-344.
- Wickman, P.-O & Ligozat, F. (2011) Scientific literacy as action: consequences for content progression. In C. Linder, L. Östman, , D. A Roberts, P.-O. Wickman, G. Erickson, & MacKinnon, A. (Eds.), *Exploring the landscapes of scientific literacy* (pp. 145-159). New York: Routledge.
- Wickman, P.-O., & Östman, L. (2002). Learning as discourse change: a sociocultural mechanism. *Science Education*, 86, 601-623.

SYMPOSIUM

Assessment from a representational perspective

Vaughan Prain, La Trobe University, Australia; Bruce Waldrup, Monash University, Australia

This paper focuses on the effects of a representation-intensive pedagogy for formative and summative student assessment in junior secondary science learning. We report on two case studies of teachers working with students on middle school science topics, noting changes to teacher and student assessment processes and practices. Analysed classroom practices and student examination scripts indicated that this sustained focus on a sequence of student negotiation of representational challenges and refinement resulted in (a) different emphases in formative assessment practices from normal routines, and (b) students integrating more representations in their responses to test questions, writing longer and more comprehensive explanations, and scoring higher in achievement tasks than students normally obtained in these scripts. We consider the implications of these findings for current accounts of effective formative and summative assessment practices in science learning.

Osborne, J. & Dillon, J. (2008) *Science Education in Europe: Critical reflections. A Report to the Nuffield Foundation*. http://www.nuffieldfoundation.org/fileLibrary/pdf/Sci_Ed_in_Europe_Report_Final.pdf

SYMPOSIUM

Classroom scaffolding: conceptualisations and applications

Chairperson: Dolly van Eerde, Utrecht University, Netherlands

Organiser: Dolly van Eerde, Utrecht University, Netherlands

Discussant: Peter David Renshaw, The University of Queensland, Australia

Abstract

Scaffolding is often used in educational studies as a concept for analysing and promoting support provided in classrooms. Some scholars stay close to the metaphor's origin in dyadic adult-child interaction as introduced by Wood, Bruner and Ross (1976) and determine scaffolding in the classroom by focusing on how teachers adapt their support contingently to students' level of understanding. The first presentation (Van de Pol, Volman and Elbers) shows that this is an appropriate way of analysing scaffolding in naturalistic classroom settings. However, different applications show the need for different conceptualisations. In the second presentation Smit and Van Eerde extend the original definition of scaffolding so as to use it for design-based whole-classroom studies that deliberately promote particular scaffolding strategies. Mercer and Warwick broaden the original definition of scaffolding by including the use of an artefact, the interactive whiteboard, as a scaffolding tool in whole-classroom settings. This symposium brings together three studies that redefine and demarcate scaffolding according to specific educational needs and research goals. The discussant will position these contributions within the broad field of scaffolding conceptualisations. The scientific significance lies in substantiating the concept of scaffolding, by thinking through useful interpretations for particular purposes. The studies presented will also provide insight into how teachers can promote productive classroom interaction in order to support learning.

SYMPOSIUM

Measuring Teacher Scaffolding in Classroom Situations: A Contingency Perspective

Abstract

Scaffolding, providing tailored or contingent support aimed at enhancing learning, is a dynamic process that takes place in interaction. This makes scaffolding difficult to measure. No generally accepted measurement framework is available to study teacher scaffolding in naturalistic classroom situations. Therefore this study sought to develop a valid and reliable measurement framework that can be used to measure classroom scaffolding from a contingency perspective. In order to take into account the interactional nature of scaffolding, both student and teacher turns and their relations were considered. Teacher turns were coded with regard to the degree of control they exert. Student turns were coded with regard to their accuracy and mode. Each three-part-sequence of a teacher turn – student turn – teacher turn was considered contingent if it followed one of two rules provided by Wood, Wood, and Middleton (1978): if a learner fails, increase control or cognitive complexity; if a student succeeds, decrease control or cognitive complexity. A body of interaction data collected in Social Studies lessons (7th/8th grade) was used in this study. The instrument appeared valid, in that it enabled measurement of variability in the degree of teacher control and contingency. Moreover, degree of contingency as measured with the instrument appeared to be positively correlated to students' demonstrated understanding. Both interrater and intrarater reliability analyses were performed and showed a substantial reliability.

Summary

The metaphor of scaffolding (Wood, Bruner, & Ross, 1976) provides us with a valuable means to describe contingent or tailored teacher support with the aim of transferring responsibility to the learner. Scaffolding in the classroom has been studied to a great extent since its introduction, mainly in an observational and qualitative manner. Due to its interactional nature, it is difficult to measure scaffolding systematically. No generally accepted measurement instrument that takes into account this interactional nature exists in the classroom-scaffolding literature (Van de Pol, Volman, & Beishuizen, 2010). A solid instrument, however, is needed to be able to study for example the effectiveness of scaffolding; such studies have been rare until now. Therefore, the aim of this study is to develop such an instrument to examine scaffolding in classroom interaction.

Wood et al. (1976) described scaffolding as taking over task parts to enable students to perform a task that they could otherwise not have performed. Later, scaffolding was measured by focusing on contingency, one of the key features of scaffolding (Wood, Wood, & Middleton, 1978). They introduced the contingent shift principle to measure scaffolding in one-to-one interactions on highly structured tasks. This principle consisted of two rules: if a learner fails, increase control; if he/she succeeds, decrease control. Because scaffolding describes a dynamic process, its measurement needs such an interactional approach; both the support of the teacher and the student responses need to be taken into consideration. Few scaffolding researchers take into consideration this interactional nature in their measurements, especially not in naturalistic classroom settings (an exception is Nathan & Kim, 2009). In this study, the contingency framework of Wood et al. (1976; 1978) is adopted to explore its suitability for measuring classroom scaffolding. Additionally to the original framework of Wood et al. (1978), students' response mode is measured; the degree to which students make their understanding clear (i.e., claimed or demonstrated understanding, Sacks, 1992). Only students' demonstrations will give teachers enough information to act contingently upon. Teachers' contingency will be determined according to the accuracy of students' demonstrated understandings only to obtain a more precise measurement of contingency.

The question that will be answered here is: How can scaffolding in teacher-student interactions in naturalistic classroom settings be measured in a valid and reliable way while taking into consideration its interactional nature?

Methods

Twenty-two fragments from a larger study on scaffolding containing teacher – small-group interactions in 7th/8th grade Social Studies lessons were used for this study. First, all teacher turns were coded with regard to the degree of control, ranging from no control (level 0; teacher not present) to high control (level 5; providing an explanation). Second, student turns were coded with regard to accuracy and mode. Accuracy was coded into not-understanding, partially understanding or understanding. Additionally and different from the Wood et al.'s (1978) methodology, each student turn was also coded with regard to mode: claimed understanding ("I get it!") or demonstrated understanding (giving elaborated answers). Only demonstrations provide the teacher with information to give contingent support and therefore teacher's use of claims without asking for demonstrations was seen as non-contingent.

Once all turns are coded, contingency can be determined by applying the contingent shift principle:

1. When a learner fails, increase control

2. When a learner succeeds, decrease control

A rule about partially correct answers was added (because no such rule was provided by Wood et al., 1978); the level of control needs to stay the same or be increased. These rules were applied to each three-part-sequence consisting of a teacher turn, the next student turn, and the subsequent teacher turn. The percentage contingent sequences determined contingency per interaction.

Indicators of construct validity were variability that could be determined with the instrument in the main variables (degree of control and contingency) and the correlation between contingency and students' success.

Results

To illustrate the instrument, we provide a short example here with a contingent sequence. Teacher control increased because the student's understanding was low.

Teacher: What does prosperity mean? (low level of control; 1)

Student: It's about products (low understanding; demonstration)

Teacher: Just think of well-being (higher level of control; 4)

Note that the goal of scaffolding is not to increase or decrease control per se, but to act contingently upon the needs of the students. With this measurement instrument, variability in the main variables was detected which supports the construct validity of the instrument: for teacher control ($M=2.17$, $SD=1.6$), and for contingency ($M=63\%$, $SD=31\%$). To further explore the construct validity, we investigated the correlation between teachers' contingency and students' demonstrated understanding which appeared to be positive and significant ($r(22)=.57$, $p=.01$). Twenty percent of the data was coded by two coders to establish the interrater reliability. With Cohen's Kappa's of .78 for teacher control, .89 for student accuracy, and .78 for mode, the interrater reliability was found to be substantial. The intrarater reliability was performed by the first author by coding 30% of the data two times with one month time in between. With Cohen's Kappa's of .75 for teacher control, .78 for student accuracy, and .80 for mode, the intrarater reliability was substantial.

In conclusion, the presented measurement instrument appeared suitable to analyse scaffolding from a contingency perspective in teacher-student interactions. classroom interactions. The instrument appeared valid and enabled measurement of variability in a reliable way. This measurement instrument might be used in future research on for example classroom scaffolding's effectiveness, which could be beneficial for practice.

References

- Nathan, M., & Kim, S. (2009). Regulation of teacher elicitations in the mathematics classroom. *Cognition and Instruction*, 27, 91-120.
- Sacks, H. (1992). *Lectures on conversation*. Oxford: Blackwell.
- Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher-student interaction: A decade of research. *Educational Psychology Review*, 22, 271-296.
- Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem-solving. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 17, 89-100.
- Wood, D., Wood, H., & Middleton, D. (1978). An experimental evaluation of four face-to-face teaching strategies. *International Journal of Behavioral Development*, 1, 131-147.

SYMPOSIUM

Scaffolding language in a multilingual mathematics classroom

Jantien Smit, Utrecht University, Netherlands; Dolly van Eerde, Utrecht University, Netherlands

Abstract

Dealing with ethnic and linguistic diversity is one of the major challenges in today's education (Gibbons, 2009). Multilingual pupils experience difficulty learning the subject-specific register needed to participate in, say, mathematics education. As a result, their achievement scores are lagging behind those of their native peers. In response to this problem, Gibbons (2009) advocates a content-based language-focused programme across the whole curriculum: teachers need to be prepared to teach content effectively while supporting pupils' development of the academic registers needed for learning throughout the curriculum. In line with Gibbons' approach, we employ the concept of scaffolding to study and promote a primary mathematics teacher's strategies that support language development along a continuum from most spoken-like to most written-like, subject-specific language.

Summary

Theoretical framework

The metaphor of scaffolding was first introduced by Wood, Bruner and Ross (1976) to describe the adults' role in children's problem-solving activities. In most classroom studies the concept is related to one-to-one classroom interaction and regarded as the temporary support provided within the zone of proximal development (ZPD). Some researchers seem to be in favour of applying the idea of ZPD also to group situations. Nyikos and Hashimoto (1997) point at the strengths of what they call 'group zone' by referring to its thought collective and social mediation. Mercer's (2007) concepts of 'interthinking' and 'intermental development zone' both capture a comparable richness of thinking together in whole-classroom interaction.

In analogy, it is argued that scaffolding can be a powerful teaching strategy in whole-classroom interaction (Gibbons, 2009). Such wider application of the concept implies concessions to its original key characteristics such as contingency and handover to independence. As the teacher in whole-classroom interaction is working with multiple ZPD's (Myhill & Warren, 2005), there are multiple levels of understanding involved. Diagnosing, which is a prerequisite for contingency, then seems a difficult task. Handover to independence will inevitably not take place for all pupils at the same time. Moreover, in well-planned instruction, the contingency feature of scaffolding can be called into question. Gibbons (2009), for example, sees the need to distinguish between designed scaffolding (all activities consciously selected and designed to scaffold learning) and interactional scaffolding (unplanned, i.e. contingent support which is spontaneously provided in ongoing classroom talk). Hence, broadening the scaffolding concept to teaching in whole-classroom settings requires rethinking it. The aim of our research is to gain more insight into how scaffolding in whole-classroom situations can be conceptualised.

As a basis for such reconceptualisation we use empirical data from a classroom study focussing on the following research question: How can teachers in multilingual classrooms scaffold in whole-class situations pupils' development of the language required for mathematical learning?

Methods

This study can be characterised as dual design research (Gravemeijer & Van Eerde, 2009), as it studies and promotes both the teacher's and the pupils' learning processes, and experimental lessons had to be specifically designed in order to answer the research question. To design these lessons, we used Gibbons' (2009) teaching and learning cycle in which a particular text genre needed at school – here: description of a line graph – is introduced, modelled and practiced. This cycle constitutes an approach of scaffolding how to speak and write in a subject-specific genre. We presumed that the teacher would demonstrate an increasing frequency and variability in performing interactional scaffolding strategies as a result of the designed scaffolding strategies embedded in the lesson plans and discussions between the teacher and the researchers in between experimental lessons.

Six experimental lessons were carried out by an experienced teacher at a suburban primary school in the Netherlands (22 pupils aged 11-12). Data collection included: video recordings, pupils' pre- and post-tests, their writing tasks, observational data, and pre- and post-interviews with the teacher. Based on the scaffolding strategies suggested by Gibbons and our observations throughout the teaching experiment, an analytical framework for analysing scaffolding was developed. Teacher-class interaction was coded with this framework to detect changes in performed scaffolding strategies. Furthermore, we conducted case studies as to analyse changes in pupils' use of written and spoken language.

Results

The analysis first of all resulted in a conceptual framework for whole-classroom scaffolding, consisting of sixteen scaffolding strategies grouped in three main categories: 'language promoting questions', 'gestures' and 'responding to spoken and written language' (e.g., 'pay explicitly attention to subject-specific words'). In answer to the research question we conclude that there is a broad repertoire of whole-classroom scaffolding strategies from which a teacher can choose. Regarding the teacher's development, the analysis gave insight into the growing frequency and variety of scaffolding strategies throughout the experiment. A threefold increase of performed scaffolding strategies was observed and the teacher's scaffolding repertoire did indeed substantially expand over time. Comparison of pupils' pre- and post-tests and analysis of the case studies of pupils' learning indicated that pupils developed the more subject-specific language needed for participating in mathematical discourse. The results of our research can contribute to the design of professional development on how teachers can perform scaffolding in multilingual mathematics classrooms.

It is hard, perhaps impossible, to attribute pupils' longer-term learning processes in whole-class situations to particular instances of scaffolding. Hence, reconceptualising scaffolding for whole-classroom situations implies explaining pupils' learning processes as the cumulative effect of performed scaffolding strategies over time.

References

- Gravemeijer, K. P. E., & Van Eerde, H. A. A. (2009). Design research as a means for building a knowledge base for teachers and teaching in mathematics education. *Elementary School Journal*, 109, 510–524.
- Gibbons, P. (2009). *English learners academic literacy and thinking*. Portsmouth, NH: Heinemann.
- Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking. A sociocultural approach*. London/New York: Routledge.
- Myhill, D., & Warren, P. (2005). Scaffolds or straitjackets? Critical moments in classroom discourse. *Educational Review*, 57, 55-69.
- Nyikos, M., & Hashimoto, R. (1997). Constructivist theory applied to collaborative learning in teacher education: in search of ZPD. *The Modern Language Journal*, 81, 506-517.
- Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17, 89-100.

SYMPOSIUM

Using the interactive whiteboard to scaffold pupils' learning of science in collaborative activities

Paul Warwick, University of Cambridge, United Kingdom; Neil Mercer, University of Cambridge, United Kingdom

Abstract

Interactive whiteboards (IWBs) are usually used by teachers for whole-class teaching. This paper is based upon a project in which pupils were allowed to use the IWB when working together on science-related activities (designed by the teacher). Using an analysis of video and other data from lessons in UK Year 4 and Year 5 primary classrooms (pupils aged 8-10 years), it focuses in particular on the 'vicarious presence' of the teacher evident in the group interactions at the board. We address the following questions: How does the teacher use the IWB to organise and support children's learning activity? In what other ways does the teacher structure children's activity without actually becoming involved in it? How useful is the concept of 'scaffolding' for interpreting the vicarious influence of the teacher and its effects on children's activity in the context of collaborative interaction at the IWB?

Summary

Our research investigated the potential of the IWB as a resource for assisting collective thinking and learning in the study of science. Focusing on children's collaborative use of the IWB during science curriculum activities, the overarching exploratory research question was 'How do children use the IWB when working together on science-related activities?'. We focused on exploring the distinctive role of the IWB for supporting and contextualising productive dialogue and other forms of interaction amongst students in collaborative science activities in the primary classroom, and on examining how students use the IWB to share relevant ideas and create new joint understanding in science activities.

Twelve teachers and their classes in Year 4 and Year 5 primary classrooms (pupils aged 8-10 years) in England participated in the research. Teachers received some initial professional development, which focused on the organization of collaborative learning and the role of talk in learning, and the use of the IWB for designing science-related collaborative activities. The teachers then developed a series of science activities on the IWB, which allowed their children to consider options, plan their actions and make joint decisions. These activities were designed to exploit features of IWBs that could be expected to help support pupil's collaborative activity, such as the easy and flexible reference to relevant information, easy annotation of pictures and texts, the facility for moving quickly between different images and writing drafts, and the combined presentation of images, text and sound. For each teacher, three lessons based on these activities were video-recorded and the recordings were transcribed. Teachers were also interviewed about their teaching plans and their consequences for the children's activities.

Our observations revealed that the teacher remotely mediated the activity of the pupils at the board in two specific and interlinked ways. Firstly, the vicarious presence of the teacher seems to be 'in the minds of pupils', enabling them to appropriate and use introduced rules and procedures, in this case in relation to group talk. Secondly, it is evident in the ways in which the constructed task environment on the IWB guides and mediates the pupils' actions, enabling them to connect with, interpret and act upon the teacher intentions for the task. Here, the teacher's vicarious presence is 'in' the technology.

We suggest that the concept of 'scaffolding' is useful for understanding how the teacher mediates the group activity, through prior guidance and the design of IWB-based activities – even though (a) this scaffolding is achieved without the teacher being physically present; and (b) we are concerned with the learning activity of a group, not an individual child. As originally defined by Wood, Bruner & Ross (1976), scaffolding is help which provides contingent support for pupils' cognitive and meta-cognitive activity by reducing the 'degrees of freedom' of a task but without supplanting the

child's active performance. Moreover, the contingent nature of scaffolding support means that, if it is successful, the child (or in our case, the group) eventually achieves a new level of independent competence. In our previous work (particularly Warwick, Mercer, Kershner & Kleine Staarman, 2010) we have considered the links between the use of specific IWB affordances and teacher scaffolding of tasks – these suggested links are outlined in the table :

Table 1: Linking teacher use of IWB affordances and scaffolding strategies

We consider this that conceptualisation is potentially important in articulating the ways in which the teacher's vicarious presence links not just with cognitive and meta-cognitive scaffolding intentions, but also with the intention to engage and excite the pupils in their own learning. Our contribution to this symposium takes up this perspective and explores it in more detail.

Reference

Warwick, P., Mercer, N., Kershner, R. and Kleine Staarman, J. (2010) The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers and Education*, 55, 350-362

Wood, D., Bruner, J. and Ross, G. (1976) The role of tutoring in problem-solving. *Journal of Child Psychology and Child Psychiatry*, 17, 89–100.

SYMPOSIUM

Teaching and learning in social science and history

Chairperson: Ola Hallden, Stockholm University, Sweden

Organiser: Cecilia Lundholm, Stockholm University, Sweden

Discussant: Peter Davies, University of Birmingham, United Kingdom

15 years ago, Carretero and Voss presented an edited volume entitled *Cognitive and Instructional Processes in History and the Social Sciences* (1994). The volume was an important contribution and a starting point for further enquiry into the field of teaching and learning in the social sciences and history. During these 15 years, however, the interest for researching teaching and learning in natural science and mathematics seems greater than ever, and we still lack clear evidence of growing interest, recognition and empirical studies for and in other domains.

In this symposia we acknowledge the theme of the conference in addressing students' understanding of society as global and changing, where concepts such as racism and nation need to be put into focus. Researchers from Europe and the US will report results of their findings. The studies focus on; i) teachers' understanding of racism, and their sense-making in terms of repeatedly shifting from structural and institutional interpretations to interpretations that focused on individual deficits (US), ii) Swedish teacher students studying political science and their understanding of the concept of 'nation' in terms of theoretical and ideological contextualisation and the role of personal values, and, iii) findings on students' conceptual understanding in history, where the role of emotions in the learning process is of particular significance and interest from both a teaching and learning point of view.

This symposia is an important step in gathering researchers in the field, and furthering our understanding of teaching and learning in the social sciences domains and history.

SYMPOSIUM

Contextualizing in political science: university students reasoning about the concept of nation

Linda Murstedt, Stockholms universitet, Sweden; Jonas von Reybekiel Trostek, Stockholm University, Sweden

This study focuses on exploring students' learning processes in the discipline of political science by scrutinizing how they understand a given task; an examination of theories about 'nation'. The empirical data consists of written exam papers from 22 students produced within the framework of a first year university course in political science. Previous research on conceptual change has mostly focused on students' (or children's) understanding of concepts in natural science. This study will contribute with knowledge in the area of conceptual change in the social sciences in general and in political science in particular. It is assumed that students may apprehend theories in the discipline of political science as addressing questions of an ideological character. It is therefore likely that students deal with at least two contexts – an ideological and a theoretical – when handling the theories. Our preliminary results confirm this assumption by showing that some students interpret the theories mainly in an ideological context while other mainly reason about them within a theoretical context. A third group of students oscillate between the two contexts. Finally, students in a fourth group do not differentiate between the two contexts, but rather compound these into one

coherent context of interpretation. The results point toward that students solve different kinds of problems depending on how they contextualize the theories. Hence, the study draws attention to significant aspects of knowledge in the political science discipline – the ideological – and elucidates how ideological foundations, like norms and values, relate to the conceptual change process.

Aim

This study focuses on exploring students' learning processes in the discipline of political science. This is done through scrutinizing how they understand a given task; an exam paper. It is assumed that students may apprehend theories in the discipline of political science as addressing questions of an ideological character. The study therefore aims at exploring how the students contextualize the task.

More specifically we explore:

- I. If students contextualize a given task as theoretical and/or ideological, and if so, in what way?
- II. What kind of problems are students solving when reasoning about required theories in a task?
- III. If students/ norms and values are of significance when solving problems, and if so, in what way?

Methodology

The data consists of written material in form of 22 student exam paper, produced within the framework of a first year university course in political science. According to the instructions in the exam paper, the students were assigned to "problematize and analyze how nation, ideas of Swedishness, of communion and identity are constructed" in Swedish newspaper articles covering the Nobel Prize Award Ceremony. Furthermore, the students were instructed to use Billig's theory (1995) on 'banal nationalism' and Brune's theory (2004) on 'story types' as benchmarks in the analysis.

A crucial methodological assumption is that the students may deal with theories within different conceptual contexts of interpretation (Caravita & Hallden, 1994). Therefore it is reasonable to make a distinction between the task introduced and the problem, i.e. the interpretation of the task given (Hallden, 1988; Hallden et al, 2008). As a result, the analysis focuses on what the students are doing in their exam papers, i.e. what kind of problems they are solving (cf. Hallden et al, 2007). Since the aim is to investigate how the students deal with two specific contexts – the theoretical and the ideological – the analysis focuses in particular on students' problems within these contexts of interpretation.

Findings and conclusions

The findings point to four different ways of contextualizing the task. Some students mainly interpret the theories within an ideological context while other mainly reason about them within a theoretical context. A third group of students oscillate between the two contexts. Students in a fourth group do not differentiate between the two contexts, but rather compound these into one coherent context of interpretation.

In terms of problems, the results indicate that students solve different kinds of problems depending on how they contextualize the theories. Problems within a theoretical context of interpretation seem to concern the link between theoretical concepts and the empirical material that was included in the instruction for the exam paper. On the contrary, problems within an ideological context seem to presuppose a personal world view as a starting-point for valuing the theories. Within a compounded context of interpretation, theoretical reasoning seems to solve ideological problems and arguing for certain values seems to be a way of dealing with a theoretical problem.

Theoretical and educational significance

As the study focuses on students' learning in higher education and as the participants are teacher students the results have an educational significance in a double sense; partly with regard to teaching at university level and partly to increase knowledge on future teachers' understanding of the political science discipline. A greater understanding of this aspect contributes to the possibility of improving the teacher education.

Regarding research on students' conceptual change the study contributes with increased knowledge concerning how values and norms relate to the conceptual change process (cf. Lundholm, 2005; Sinatra & Pintrich, 2003). In the study it is assumed that students may apprehend theories in political science discipline, like Billig/s (1995) on 'banal nationalism' and Brune's (2004) on 'story types', as addressing questions of an ideological character. The study explores how these norms and values become aspects of the conceptual change process and aims at elucidating these relations.

The findings of this study make it reasonable to question the traditional description of the conceptual change process as abandoning and replacement of concepts in a linear fashion (cf. Posner et al 1982). Here, instead some students

show that they are capable of differentiating and oscillating between different contexts of interpretation (Caravita & Hallden 1994).

References

- Billig, M. (1995). *Banal Nationalism*. London: Sage publications.
- Brune, Y. (2004). *Nyheter fran gransen. Tre studier i journalistik om "invandrare", flyktingar och rasistiskt vald*. [News from the border. Three studies in journalism on immigrants, refugees and racist violence.] Doctoral dissertation, Department of Journalism and Mass Communication, Goteborg University, Sweden.
- Caravita, S., & Hallden, O. (1994). Re-framing the Problem of Conceptual Change. *Learning and Instruction*, 4, 89-111.
- Hallden, O. (1988). Alternative frameworks and the concept of task. *Cognitive constraints in pupils/ interpretations of teachers/ assignments*. *Scandinavian Journal of Educational Research*, 32, 123-140.
- Hallden, O., Haglund, L., & Stromdahl, H. (2007). Conceptions and Contexts: On the Interpretation of Interview and Observational Data. *Educational Psychologist*, Vol. 42(1), pp. 25-40
- Hallden, O., Scheja, M., & Haglund, L. (2008). The Contextuality of Knowledge: An Intentional Approach to Meaning Making and Conceptual Change. In S. Vosniadou (Ed.), *International Handbook of Research on Conceptual Change* (pp. 509-532). New York and London: Routledge.
- Lundholm, C. (2005). Learning about environmental issues: postgraduate and undergraduate students/ interpretations of environmental contents in education. *International Journal of Sustainability in Higher Education*, 6(3), 242-253.
- Sinatra, G. & Pintrich, P. (Eds.). (2003). *Intentional Conceptual Change*. Mahwah, NJ: Lawrence Erlbaum Associates.

SYMPOSIUM

The importance of intuitive knowledge in teachers' sense-making of race, racism and racial justice

Thomas Philip, UCLA, United States

Through a framework that synthesizes theories of ideology and intuitive knowledge and through the examination of in-depth interviews with teachers, this paper explores the importance of ideological intuitive knowledge in teachers' sense-making of issues of race and racism within their larger historical, social, political and economic context. It explores how intuitive knowledge has been undertheorized, glossed over and often conflated under the category of beliefs, resulting in limited understandings of how teachers make sense of racial equity and justice. This study contributes to the literature on teacher preparation and development and also contributes more generally to how students make sense of issues of equity and justice in the social sciences.

Aims

Through a framework that synthesizes theories of ideology and intuitive knowledge and through the examination of in-depth interviews with teachers, this paper explores the importance of ideological intuitive knowledge in teachers' sense-making of issues of race and racism within their larger historical, social, political and economic context. It explores how intuitive knowledge has been undertheorized, glossed over and often conflated under the category of beliefs, resulting in limited understandings of how teachers make sense of racial equity and justice.

Educational significance

The equity implications for how teachers understand the nature and purpose of their work, particularly when there are stark differences between teachers' and students' racial, ethnic, class and immigration backgrounds has been well documented (Hollins & Guzman, 2005; Sleeter 2008). This study contributes to the literature on teacher preparation and development, particularly for teachers from dominant backgrounds who teach historically marginalized students. It also contributes more generally to how students make sense of issues of equity and justice in the social sciences.

Theoretical framework and significance

In this paper, I argue that a theory of "ideology in pieces," which builds on diSessa's (1993) theory of "knowledge in pieces" and Stuart Hall's (1996) theory of ideology, offers new possibilities in understanding the intersections between teacher learning and issues of race, racism and racial justice through a focus on ideological intuitive knowledge. By synthesizing these traditionally disparate fields, "ideology in pieces" contributes to the "cognitive, sociocognitive, sociocultural and systems-oriented perspectives" (Fishman & Davis, 2006) that the learning sciences offer in studying questions that cut across teacher learning and social processes and structures. Working toward this synthesis, I have three primary objectives in this paper. First, I introduce the key characteristics of an "ideology in pieces" framework. Second, acknowledging that it is not possible to survey the entire literature on teachers' racialized beliefs and sense-making, I focus on four approaches to this issue, outlining the contributions they have made to the field, and highlighting their limitations that arise from an inattention to intuitive knowledge. These approaches are:

- a) A learning sciences approach to teacher knowledge and teacher identity (e.g., Enyedy, Goldberg & Welsh, 2005)
- b) Perspectives on teacher identity outside of the learning sciences (e.g., Phillion & Connelly, 2004)
- c) Perspectives that emphasize relatively fixed beliefs (e.g., McFalls & Cobb-Roberts, 2002)
- d) Approaches that emphasize critical theories of race (e.g., Picower, 2009).

Third, I examine interview data with a teacher to demonstrate how an “ideology in pieces” perspective might analyze and interpret such data differently from the other approaches discussed in the paper.

Methods and data sources

The data examined in this paper include in-depth, open-ended interviews with teachers in the United States. Extending empirical analyses in conceptual change (diSessa, 1993; diSessa & Sherin, 1998; Wagner, 2006) and the study of ideology (Bonilla-Silva, 2003), the transcripts were analyzed line by line particularly for existential, propositional and value assumptions (Fairclough, 2003), and for shifts in teachers’ interpretations and explanations of disparities from structural and institutional emphases to emphases on individual choices and behaviors.

Results

Shifting salience, as defined in this paper, is the phenomenon in which one’s interpretation of a context shifts to another interpretation with distinct ideological meaning without apparent notice or unease. Shifting salience was evident in the data examined here as teachers’ sense-making shifted repeatedly from structural and institutional interpretations to interpretations that focused on individual deficits. This phenomenon is examined in light of ideological intuitive knowledge and the framework of “ideology in pieces.” The importance of shifting salience in understanding teachers’ racialized reasoning as well as the limitations of other approaches in explaining this crucial phenomenon is explored through a discussion of the data.

References

- Bonilla-Silva, E. (2003). *Racism without racists: Color-blind racism and the persistence of racial inequality in the United States*. New York: Rowman and Littlefield Publishers.
- diSessa, A. A., & Sherin B. L. (1998). What changes in conceptual change? *International Journal of Science education*, 20(10), 1155--1191.
- diSessa, A. (1993). Toward an Epistemology of Physics. *Cognition and Instruction*, 10 (2&3), 105-225.
- Enyedy, N., Goldberg, J., and Welsh K. (2006). Complex dilemmas of identity and practice. *Science Education* 90(1) 68-93.
- Fairclough, N. (2003). *Analysing Discourse: Textual Analysis for Social Research*. London: Routledge.
- Hall, S. (1996). The problem of ideology: Marxism without guarantees. In D. Morley and K. Chen (Eds.) *Stuart Hall: Critical dialogues in cultural studies*. London: Routledge.
- Hollins, E. R., & Guzman, M. T. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the aera panel on research and teacher education* (pp. 477-548). Mahway, New Jersey: Lawrence Erlbaum Associates, Inc.
- McFalls, E., & Cobb-Roberts, D. (2001). Reducing resistance to diversity through cognitive dissonance instruction: Implications for teacher education. *Journal of Teacher Education*, 52(2), 164-172.
- Picower, B. (2009). The unexamined Whiteness of teaching: how White teachers maintain and enact dominant racial ideologies. *Race, Ethnicity and Education*, 12(2), 197-215.
- Phillion, J. & Connelly, F. M. (2004). Narrative, diversity, and teacher education. *Teaching and Teacher Education*, 20 (5), 457-471.
- Sleeter, C. E. (2008). Preparing white teachers for diverse students. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (pp. 559-582). New York: Routledge.
- Wagner, J. (2006). Transfer in pieces. *Cognition and Instruction*, 24(1), 1–71.

SYMPOSIUM

Conceptual change in history: responses to a concept related to present and historical situations

Carla Van Boxtel, University of Amsterdam, Netherlands; Albert Logtenberg, University of Amsterdam, Netherlands

In History students come across many concepts they know from everyday life, but have a different meaning when applied to a historical situation. In order to understand the past, students need to build a different representation for the different –historical- situation.

Building upon research on conceptual change in the domain of science, this process study aims at gaining more insight into students' reactions when they come across these concepts. To what extent and how do students apply their present and historical representations to the past situation and differentiate between past and present meanings? Participants of the study are 12 students from a larger sample of 33 who read a text about the situation in a factory in Manchester in the nineteenth century. Participants were instructed to underline text elements that are striking, (un)familiar or (un)clear to them. At each underlined text element they were asked to verbalize why they underlined it and to (further) explain their thoughts. Protocol analysis of the episodes on factory work shows that many students respond emotionally, mostly with indignation or amazement. After expressing their emotion and using present meanings, some students use their historical knowledge of factory work, differentiate between the present and historical situation and try to contextualize the situation and events described in the text.

The study contributes to conceptual change theory and shows that in history the conflict students experience often goes together with emotions. These emotions, however, not necessarily obstruct differentiation between present and historical meanings and contextualization.

Theoretical framework

The discipline of history uses many general concepts students come across in everyday life or other subjects, such as trade, democracy, war and Christianity. These concepts have received little attention in research on the learning of history, although they are important tools to contextualize, one of the key components of historical thinking and reasoning (van Drie & van Boxtel, 2008). For example, students can only understand the act of a pope in the late Middle Ages when they know that the Church in that period differed from the Church nowadays and when they have an idea of the organization, role and characteristics of the mediaeval Church.

From research within the domain of science, we know that terms that are used within the discipline and overlap with terms used in everyday life, give rise to particular problems (e.g. Carravita & Hallden, 1994). From a conceptual change perspective it is emphasized that students must experience that their conceptions are not adequate in explaining certain phenomena.

To what extent are these insights applicable to how students deal with concepts used in history, but also in everyday life? There seems no need for a profound revision or transformation of the everyday ideas, since students' present meanings are mostly functional and not problematic when confronted with present phenomena. Trade in the Middle Ages, however, differs from trade in our present society. Conceptual change in this case means that in order to understand past phenomena, students need to build a qualitatively different representation for the different – historical- situation and learn to differentiate between present meanings and meanings used in a specific historical context.

Constructing a historical representation and making a distinction between the present and historical situation are, however, not unproblematic. From studies in the domain of history we know that students are inclined to apply to the past situation what they know from the present (e.g. Limon, 2002; Hartmann & Hasselhorn, 2008). Students often experience the past as strange and react with indignation or amazement, especially when they read or hear about people who suffered oppression, bad economic circumstances or a lack of freedom. This emotional engagement may obstruct the construction of a historical representation and differentiation between past and present meanings, which are important to contextualize situations, events and acts of people in the past.

Research question

The question we address in this paper is: How do students respond when they read about a historical phenomenon that is described with a term that has a different meaning in the present?

Method

We conducted a process study to answer our question. The data we used are a sample from transcripts of the thought processes of 33 secondary school students (15/16 years) engaged in reading an introductory text about the Industrial Revolution. The text contains vivid descriptions of 19th century Manchester and describes conditions of women and children working in a factory. Students were asked to read the text and underline text elements that are striking, (un)familiar or (un)clear to them. At each underlined text element participants were asked to verbalize why they underlined it and to explain their thoughts. We transcribed protocols of all students and divided the data into episodes. An episode is defined as the utterances of the student after a text segment is underlined. We selected the episodes in which students underlined sentences with information about the factory and factory work(ers), since factory and factory work(ers) are also concepts they come across in daily life. Twelve students (4 boys and 8 girls)

underlined text fragments about the factory and factory workers and verbalized their thoughts. We analysed a total of 15 episodes. First, episodes were coded on the appearance of prior knowledge (knowledge deficit, knowledge conflict, association or no prior knowledge). Second, we coded each episode on appearance of affect (no affect, interest, indignation, astonishment, empathy or boredom). Third, episodes were coded on the appearance of historical reasoning (no historical reasoning, contextualization, comparing, causal reasoning, argumentation). Inter-rater reliability was acceptable (Cohen's kappa reached from .65 to .90).

Results

Our analysis shows that most students respond emotionally, mostly with indignation or amazement. Part of the students only responds emotionally and doesn't verbalize any prior knowledge nor tries to contextualize. After expressing their emotion and verbalizing present meanings and ideas, some students verbalize their historical knowledge of factory work in the nineteenth century, differentiate between the present and historical situation and try to contextualize the historical situation and events described in the text. Some students seem to lack the historical knowledge to adequately contextualize but still attempt to contextualize. Sometimes their questions show that students try to get their prior knowledge more explicit or are aware of a knowledge gap.

Theoretical and educational significance

This study contributes to the idea that conceptual change is not always a matter of changing or transforming preconceptions, but may also consist of building multiple representations and knowing when to apply which representation. It also shows that in history, the conflict that students experience is expressed by showing emotions such as amazement or indignation. Identification of similarities and differences between past and present, contextualization and development of the awareness that terms change meaning over time and across societies may be important ingredients of an instructional strategy that helps students overcome problems that may arise when students come across concepts in history they know from everyday life. Further research is needed to investigate the effectiveness of such a strategy.

References

- Caravita, S., & Hallden, O. (1994). Re-framing the problem of conceptual change. *Learning and Instruction*, 4, 89-111.
- Hartmann, U., & Hasselhorn, M. (2008). Historical perspective taking: A standardized measure for an aspect of students' historical thinking. *Learning and Individual Differences*, 18, 264-270.
- Limon, M. (2002). Conceptual change in history. In M. Limon and L. Mason (Eds.), *Reconsidering Conceptual Change. Issues in Theory and Practice* (pp. 259-289). Dordrecht, NL: Kluwer Academic Publishers.
- van Drie, J., & van Boxtel, C. (2008). Historical reasoning: towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review*, 20 (2), 87-110.

SYMPOSIUM

Errors and their role for the development of negative knowledge

Chairperson: Christian Harteis, Universitat Paderborn, Germany

Organiser: Christian Harteis, Universitat Paderborn, Germany

Discussant: Hans Gruber, University of Regensburg, Germany

This session aims at providing theoretical concepts and empirical evidence for conditions which support learning from errors and the development of negative knowledge. The contributions from three different domains comprise empirical studies investigating different aspects of learning from errors. They analyze environmental and personal influences on how individuals utilize errors for the development of negative knowledge – also in relation to other knowledge stocks. The contributors emphasize erroneous events as well as almost-mistakes, and they investigate reflective processes of knowledge creation. By discussing almost-mistakes as well as errors and considering several kinds of knowledge for the development of individual competencies, this symposium applies a wider perspective than usual research on learning from errors.

SYMPOSIUM

Towards a theory of Negative Knowledge: Almost-mistakes as amplification-motor for remembering

Fritz Oser, Universitat Freiburg, Switzerland; Albert Dueggeli, PH (FHNW), Switzerland; Catherine Naepflin, University of Fribourg, Switzerland

In past, theoretical research on the phenomenon and function of Negative Knowledge has advanced substantially. Educational psychologists as well as educational philosophers, researchers in the field of pedagogical content knowledge and practitioners in education made attempts to circumscribe and operationalize this construct. Most of these oeuvres do however not address how NK is retrieved and actualized in a new, similar situation, even though actualization seems to be a key issue related to the concept. To date, the reconstruction of NK can only be understood by using special situational elements like the fear of committing the same mistake again and/or the hunch of suffering from consequences of similar mistakes. In this article we explore the phenomenological possibilities on NK and introduce the concept of almost-mistakes (nearby-mistake or near-miss) and its nonlinear relationship to NK as a new important dimension. We carried out a qualitative small pilot-study in which we asked subjects to remember what kind of almost-mistakes they experienced, what they learned from them and how they felt about them. We used a semi-standardized questionnaire to interview children, adolescents and adults. In the health sector, any mistake can have fatal consequences. For nursing staff and doctors it's not easy to talk about their mistake, even if it is "only" a near-miss. If a platform gives them the possibility to discuss their concerns while remaining anonymous, this might help them the reluctance to discuss these negative experiences.

Negative knowledge (NK) refers to memories related to events, things, procedures or strategies that are experienced as false, as inadequate or even as ineffective, the linked consequences and memories such as feeling ashamed, and being blamed or exposed in ones own intimacy.

Therefore we think NK have the functions

- a) to create a useful alert against committing the same mistake again (protection),
- b) to distinguish between contrasts (bad and good),
- c) to find orientation between opposite characteristics (high versus low),
- d) to produce certainty in addressing a problem following a particular procedure.

Schumacher (2007) names a kind of pedagogical functions whereas Bauer (2008) sees the function in the sense of pragmatics, such as helping to prevent from damaging engines in a factory etc. In this presentation we ask how almost mistakes (AM, mistakes that happen near-by) help to remembering real mistakes and its negative consequences. AM produce the same activity but with protected agitation and projected consequences. If the norm to which the mistake relates is important (personally and/or publicly) the remembering is strong; if not we adapt ourselves without further consequences.

To become mentally aware of a mistake in the past helps to avoid its repetition in the future. It is related to the ability of traveling back mentally and use personal memory to prevent the same mistake or error again from happening (see Wheeler et al., 1997). Tulwing (2000) calls this "autonoetic" remembering. The application of these remembering lead to our notion of NK on the one hand, whereas the difference to AM lies in the fact, that NK is only active if the new situation recalls the mistaken one and thus protects us from a new similar case.

There is a kind of ambiguity: on the one hand the AM seem not to be important but on the other no one does forget. Peoples told an AM is like an alarm clock to show that you're not attentive enough. The dimension of sharing the experience with others shows that elderly persons keep the AM for themselves arguing that sharing wouldn't help and cannot be shared. For younger persons sharing has a different meaning. It is just telling.

In the medical field it is very important to discuss AM-situations. Aspden speaks about a protected reporting system (CIRS-System) which is used by clinics to promote a collection of AM helping others to prevent them and to break the taboo.

Hence, towards our definition of NK, AM are an actualization of NK that we become aware of risks, consequences and pains of something negative that happened once before, but now, in a new near-by situation, we think, belief, fear that it happens again, finally it doesn't.

Studies

In a first study we gained insights about peoples reactions to AM (in general N=15, between 9 and 85 years old and specific profession N=3 between 38 and 52 years old). Each person was asked 14 questions. First they had to describe one or two "AM-situations" with its real and imagined consequences they suffered (emotionally and materially), the way they cope with the situation, the intensity of remembering it (NK) and the difference between a real mistake and a AM. Finally, questions on sharing this experience with someone, effects and functions of the AM for the future closed the interview process. We analyzed the answers in a co judgment and found, that children mostly described situations in school, teenagers mentioned AM-situations on a moral level like friendship risks and that it is important to keep a promise. Adults told their experience with AM in the job or leisure activities. The imagined consequences

were probably greater than would have been possible in a real situation. In the medical field very profound responsibilities and reactions were found. It seems that subjects connect a deep commitment with the wish not to fail, but to do the best for each patient. The higher the stakes the deeper the experience and the less the re-actualized NK becomes.

In a second study (Hofer, 2009) we analyzed the error culture through near-miss in firms (N=455). The super-ordinate target of this study is to analyze how the (1) personality traits, (2) self-efficacy, (3) achievement motivation, (4) professional self-esteem, and (5) personal handling of errors –are correlated with the firm-error-culture. It seems that females in a professional setting react less sensitive to a full mistake culture than males. For males the relationship between self-efficacy belief and mistake culture ($r = .41^{**}$) or between professional self-esteem and mistake culture is a highly positive one ($r = .36^{**}$).

In a third study different situations (moral, conventional and social) were presented in a questionnaire to four-member-families (Ntotal=399, Nkids=147, Nmothers=135, Nfathers=117). It showed that they discussed a lot about conventional and social mistakes, but not about moral ones. That is self-evident.

Discussion

AM are drivers for the reanimation and amplification of NK. The question of how we re-actualize the NK in a similar situation is accompanied by the question of how strong we are touched by the AM. The more NK someone has collected without being taped in, as more positive knowledge is possible. AM are always related to real mistakes, and the experience of an AM needs as a precondition the NK in relation to a real mistake.

As seen in the previous paragraphs AM are effective means for extending NK, but also for generating it in a tense situation in order to prevent the same mistake from happening again.

There are a couple conclusions to be drawn from our presentation. First, AM refer always to a prior event in which the adverse incident was either realized or experienced advocatorily by seeing others doing the same errors. Therefore we argue that AM actualize and deepen the respective NK. – Second, in daily life we often cannot speak about very serious AM; whereas in professional settings, within a reporting system, very serious situations are presented, reflected and used to protect us from doing such things again. Third, the emotional reaction to AM can be even stronger than the reaction of real adverse mistake events, because the feelings are double bounded, namely positive and negative.

SYMPOSIUM

Development of positive and negative knowledge in a professional community

Els Boshuizen, Open University, Netherlands

The term 'negative knowledge' is rather new in educational research. Earlier it was used in legal and in the logical-mathematical contexts where it depicts knowledge about errors and failure, about things not to do. Gartmeier, Bauer, Gruber and Heid (2008) applied this concept in the educational domain and position it in the higher levels of expertise development.

A requirement for learning from errors in professional communities is a 'learning culture', which requires that its members seek feedback, face errors, and are committed to improve their knowledge and working procedures. This means that both the process and the outcomes have to be shared with colleagues, which makes it relevant to the community and to the profession as a whole.

The present paper approaches learning of negative knowledge from the perspective of the professional community by analysing a case of knowledge development in a community, extending over several decades, i.e., knowledge development about Lyme's disease.

Negative knowledge developed in this community mainly regarded the sensitivity and specificity of the patient findings and diagnostic tests used. To move further more knowledge was needed about the underlying immune processes and how these affect the course of the disease and the test outcomes. It is suggested that in this case negative knowledge is not the most important knowledge developed in the learning process of the community from failure and error.

The term 'negative knowledge' is rather new in educational research. In the literature, it has a legal and logical-mathematical background rather than a cognitive-epistemological one. In the legal context a concept exists called

'negative know-how' – knowledge about failures and mistakes; under the US Uniform Trade Secrets Act this negative know-how can be considered a commodity and the property of a business (Graves, 2006). In the logical-mathematical context negative knowledge is depicted as a negative evaluation of two propositions, e.g., This cake is made with paraffin AND this cake is tasty IS FALSE. Together with its counterpart, positive knowledge which is defined by the positive evaluation of the combination of two propositions (e.g., This cake is made with butter AND this cake is tasty IS TRUE) it belongs to the same knowledge base (Booth & Paris, 1998). This might be a fair assumption for artificial knowledge bases, but research from personality psychology has shown that positive and negative knowledge about self can also be compartmentalised in two sub systems that have hardly any relation. Gartmeier, Bauer, Gruber and Heid (2008) hypothesised that negative knowledge is learned from errors, an opinion closely related to the legal meaning. Furthermore they conclude that "The concept of negative knowledge augments existing theories of professional knowledge by emphasizing knowing about what to avoid as part of experts' effective actions. During routine actions, negative knowledge enhances professionals' certainty of how to proceed and increases the efficacy through the avoidance of impasses and suboptimal problem-solving strategies. Quality and depth of reflective processes after actions are related to the development of negative knowledge." (p. 2). In all domains where the concept is used it is a part of a dichotomy.

Learning from errors is often approached from the perspective that this requires a 'learning culture' in a company, a culture that requires its members to seek feedback, face errors made, and the commitment to improve one's own knowledge and the working procedures in terms of when to do what and when not, that is, of positive and negative knowledge. This means that both the process and the outcomes have to be shared with colleagues, which makes it relevant to the community and to the profession as a whole.

These conclusions generate some new questions: 1) Gartmeier et al (2008) describe negative knowledge as an end product of the learning process; what kind or pre-existing knowledge is required for that goal and what kind of errors is required for building negative knowledge? and 2) is negative knowledge an end-product or is it 'just' a step in further knowledge building?

Method

To answer this question I will analyse a historical case in which individual doctors and the medical profession as a whole in the Northern hemisphere struggled with a new disease. I approach this from the perspective of the profession, not of the individual doctor. It regards Lyme disease (borreliosis) that had been very rare and only partially described until in 1975 a small epidemic broke out in the village of Lyme (Connecticut). In the period following clinical errors, failures and improvements were reported on the one hand, while biomedical research was reported focussing the features of the micro-organism involved, the associated immunological reactions, and diagnostic strategies. Historical documents, especially diagnosis and treatment protocols were analysed (e.g., , to investigate the sequence of triggering events.

Results and conclusions

Negative knowledge that was developed in this field mainly regarded the sensitivity and specificity of the patient findings and diagnostic tests used. The associated misconceptions in part of the medical community has led to many errors and failures. At the positive site of the same coin is the emerging knowledge how these test qualities can be improved in the able hands of laboratories and specialists especially devoted to Lyme's disease. Evidence-based guidelines for diagnosis and treatment protocols have been developed; yet there is debate about the correctness of these protocols as two conflicting theories about the disease dynamics and expression lead to different evaluation of the results of the underlying studies.

The case does not yield an answer to the question what kind of knowledge is needed to develop negative knowledge. It is suggested that in this field negative, dichotomous knowledge is not the most important knowledge developed in the learning process of the community from failure and error. More important was the recognition of the reasons for these failures that had to be resolved that formed the key to solutions. The community has moved a step toward fewer failures and better knowledge of reasons for these failures; a new learning cycle has started influenced by specialised Lyme specialists, patients, and the health insurances who have different concerns, which will add new dimensions to the knowledge generation process.

References

- Booth, R & Paris, JB (1998). A Note on the Rational Closure of Knowledge Bases with Both Positive and Negative Knowledge. *Journal of Logic, Language and Information*, 7(2), 165-190, DOI: 10.1023/A:1008261123028
- Graves, C. T. (2006). The law of negative knowledge, a critique. *Texas Intellectual Property Law Journal*, 15(1), 387-417

Waterhouse, J.C. (2010, 26 Oct.). The Marshall Protocol for Lyme disease and other chronic inflammatory conditions, Part One: overview and implementation. Townsend Letter for Doctors and Patients. FindArticles.com. http://findarticles.com/p/articles/mi_m0ISW/is_285/ai_n19170371/
RIVM (2010). Infectieziekten [Infectious diseases]. <http://www.rivm.nl/cib/infectieziekten-A-Z/infectieziekten/lymeborreliose/index.jsp>
Showers, C. (1992). Compartmentalization of Positive and Negative Self-Knowledge: Keeping Bad Apples Out of the Bunch, *Journal of Personality and Social Psychology*, 62(6), 1036-1049

SYMPOSIUM

Learning from errors through computer-supported guided reflection

Johannes Bauer, TU Munchen, Germany; Stefan Ufer, University of Munich, Germany

Recent research on learning from errors has shown the importance of a learning-oriented 'error culture' in the classroom, involving teachers' ways of dealing with students' errors and the corresponding classroom atmosphere they establish for making errors. Theory claims that causes of errors need to be reflected and appropriate conclusions for future tasks must be drawn. Whereas many existing studies focus on describing error-culture in the classroom, less is known about how and under what conditions reflections on students' errors lead to changes in knowledge, and how this helps to improve performance in similar tasks. Moreover, we need a more thorough understanding of how students can be supported in learning from errors.

We aim at investigating the effect of guided reflection on errors in 6th-grade students' learning. As content area we use fraction addition and subtraction tasks. We conduct a randomized field-experiment, in which students' learning is embedded in a computer-supported learning environment. The one-factorial design involves three treatment conditions that offer increasing guidance in students' reflection on errors through providing computer-generated feedback and prompts that invite the students to reflect on their errors, when they occur.

We are collecting qualitative data concerning students' reflection as well as quantitative achievement data from pre- and post-tests. With regard to our hypotheses, we expect to find that increasing guidance enhances the quality of reflection and students' performance in solving fraction addition and subtraction tasks.

Aims

In our study, we aim at investigating the effect of guided reflection on errors in 6th-grade students' learning. As content area we use fraction addition and subtraction tasks. The issue of learning from errors is receiving increasing attention in educational research (Gartmeier et al., 2008; Harteis et al., 2008). Theory claims that errors in the classroom provide a fruitful source for learning if causes of errors are reflected and appropriate conclusions for future actions are drawn (Keith & Frese, 2008; Oser & Spychiger, 2005). There are few studies, however, that directly investigate the actual potential of learning from errors for students' competence development and how students can be supported in learning from their errors (Grosse & Renkl, 2007). In our study, we contribute to this line of inquiry by addressing research questions whether providing students with feedback and guidance in the reflection of errors (a) enhances the quality of reflection on errors and (b) has an impact on their achievement in subsequent similar tasks.

Methodology

To answer our research questions, we are conducting a randomized field-experiment in a middle track secondary school class (6th grade). Students' learning is embedded in a computer-supported learning environment on fractions. The design of the fraction addition and subtraction tasks is based on a long tradition of research from mathematics education on typical student errors in fraction addition and subtraction (e.g. Tatsuoaka, 1984; Brown & Quinn, 2006). The one-factorial study-design involves three treatment conditions that offer increasing guidance in the reflection on errors through computer-generated feedback and prompts. Using the prompts, students are asked to think about why an error occurred, what general rule underlies the error, and how they can avoid it next time. In all treatments the students are asked to solve fraction addition and subtraction problems of varying complexity and to document their solution steps in the computer-based learning environment. Treatment condition 1 provides a specific feedback pointing at the operational step containing the first error. However, while being asked to reflect on the error, students do not receive any guidance. Condition 2 provides specific guidance on the reflection process through electronic prompts. Here, the students receive only the general feedback if an error occurred and they have to figure out the wrong operational step by themselves. Finally, condition 3 combines specific feedback and guided reflection. Data collection involves pre- and post-tests on achievement in fraction addition and subtraction tasks that vary in complexity and degree of required transfer. Furthermore, we collect qualitative data concerning the quality of reflection through the answers the students give to the electronic prompts.

Expected Findings

As data collection is in progress, the findings are not available yet. We hypothesize that there is an advantage of the combination of specific feedback and guided reflection for the quality of reflection and students achievement in the post-test, over the two other conditions. The underlying assumption is, firstly, that the specific feedback reduces cognitive load that is required when searching for the error in the general feedback condition (Grobe & Renkl, 2007). Therefore, cognitive resources are available for the reflection process in the specific feedback conditions. Secondly, the guidance through prompts should enhance the quality of students' reflection process. We assume that the students require this assistance because the cognitive strategies needed for reflection are not easy to apply and perhaps even unknown to the students.

Theoretical and educational significance of the research

Recent research on learning from errors has made a case for a learning-oriented 'error culture' in the classroom, involving teachers' ways of dealing with students' errors and the corresponding classroom atmosphere (Harteis et al., 2008). Whereas many existing studies focus on describing error-culture in the classroom, less is known about how students' can be supported in learning from errors (Oser & Spychiger, 2005). Our study aims at gaining a more thorough understanding of how and under what conditions reflections on students' own errors lead to changes in knowledge and how this helps to improve performance in similar tasks.

Brown, G. & Quinn, R.J. (2006). Algebra students' difficulty with fractions, an error analysis. *Australian Mathematics Teacher*, 62, 28-40.

Gartmeier, M., Bauer, J., Gruber, H. & Heid, H. (2008). Negative knowledge: understanding professional learning and expertise. *Vocations and Learning: Studies in Vocational and Professional Education*, 1, 87–103.

Grobe, C. S. & Renkl, A. (2007). Finding and fixing errors in worked examples: Can this foster learning outcomes? *Learning and Instruction*, 17, 612-634.

Harteis, C., Bauer, J., & Gruber, H. (2008). The culture of learning from mistakes. *International Journal of Educational Research*, 47, 223–231.

Keith, N. & Frese, M. (2008). Effectiveness of error management training: a meta analysis. *Journal of Applied Psychology*, 93, 59-69.

Oser, F. & Spychiger, M. (2005). *Lernen ist schmerzhaft [Learning is painful]*. Weinheim: Basel.

Tatsuoka, K. (1984). Analysis of errors in fraction addition and subtraction problems, final report. Illinois University, Computer-Based Education Research Lab. Retrieved from <http://www.eric.ed.gov/PDFS/ED257665.pdf> Oct. 20th, 2010.

SYMPOSIUM

Understanding achievement and participation in STEM subjects

Chairperson: Terezinha Nunes, University of Oxford, United Kingdom

Organiser: Peter Bryant, Oxford University, United Kingdom

Beno Csapo, University of Szeged, Hungary

Discussant: Elsbeth Stern, ETH Zurich Institute for Behavioral Sciences, Switzerland

It is a matter of concern for many technologically advanced countries that participation in STEM (Science, Technology, Engineering and Mathematics) subjects is declining. Longitudinal studies are particularly suited for the investigation of possible reasons for this decline. In this symposium, studies in three different countries (Australia, Hungary and the UK) consider three types of factors that affect participation and achievement in STEM subjects: cognitive, affective and socio-economic status. A variety of analyses is used, which show the power of longitudinal research and provide an opportunity for methodological discussions. The main results from these papers indicate that: (a) the relationship between cognitive factors related to achievement in science and mathematics remains constant over time; (b) a model that investigated whether mathematical reasoning can be seen as a mediator of SES effects in the prediction of mathematical achievement provides a better fit to this prediction than an alternative one, in which the predictors are treated as independent; (c) the up-take of science in secondary school is related to previous enjoyment and interest in science.

These results point to actions at primary school level that could lead to better achievement and participation in STEM subjects. These should include greater attention to promoting reasoning skills in mathematics and science in order to raise achievement and to increase participation of under-represented SES groups and supporting students' perception of these subjects as relevant and enjoyable.

SYMPOSIUM

How Mathematical Reasoning mediates the Relationship Between SES and Mathematical Achievement

Peter Bryant, Oxford University, United Kingdom; Terezinha Nunes, University of Oxford, United Kingdom;
Rossana Barros, Department of Education, University of Oxford, Peru

Socio-economic status (SES) predicts mathematical achievement, but the mediators of this relationship are not yet understood. We analyzed whether two factors, knowledge of arithmetic and mathematical reasoning, can be mediators of this relationship. If SES effects are mediated by these factors, then schools could intervene to attenuate SES effects on achievement.

In a longitudinal study of children (N=3,458) born in the UK in 1991-2, knowledge of arithmetic and mathematical reasoning were measured at age 8. SES was assessed by mothers' and of fathers' occupation and mother's education. The outcome measures of mathematical achievement were state mathematical tests given to students at approximately 11 (Key Stage 2 – KS2) and 14 years (Key Stage 3 – KS3).

In multiple regressions, knowledge of arithmetic, mathematical reasoning and SES made significant and independent contributions to predicting KS2 and KS3 mathematics; mathematical reasoning was the strongest predictor. Structural equation models established a strong indirect pathway from SES via mathematical reasoning to both measures of mathematical achievement (KS2 & 3). SES had a powerful effect on children's mathematical reasoning, which in turn strongly affected their mathematical achievement.

SES effects can be better understood through the mediators that intervene between family background and educational achievement. This has major consequences for how schools can proactively address SES differences and aim to attain equity in education.

Objectives

Socio-economic status (SES) predicts mathematical achievement well. This paper analyzes mediators of this relationship. Two cognitive factors were considered: knowledge of arithmetic and mathematical reasoning. If SES effects are mediated by these factors, then schools could intervene to attenuate SES effects on achievement.

Framework

Researchers (e.g. Ginsburg & Russell, 1981; Lee & Bryk, 1989; Reyes & Stanic, 1988; Sacker, Schoon, & Bartley, 2002; Tate, 1997) recognize that SES differences can be mediated by home activities that create cultural capital as well as by choices in school curriculum, among other things. This study analyzes whether mathematical knowledge developed in the first school years mediates the relationship between SES and mathematics achievement later on, at the end of primary and in secondary school. Two sorts of knowledge are considered: knowledge of arithmetic, which can be reinforced at home through drill and practice, and mathematical reasoning, which can be encouraged at home through discussions of mathematical ideas in context. If these factors mediate the relation between SES and mathematical achievement, the relation between SES and achievement should be attenuated when the mediators are taken into account. Longitudinal studies are crucial in testing this hypothesis.

Method

In a longitudinal study of children (N=3,458) born in the UK in 1991-2, knowledge of arithmetic and mathematical reasoning were measured at age 8. SES was assessed by a factor, composed of mothers' and of fathers' occupation and mother's highest qualification. At the school level, a composite SES score was used, based on the SES of children attending the same school. The outcome measures of mathematical achievement were state mathematical tests given to students at approximately 11 (Key Stage 2 – KS2) and 14 years (Key Stage 3 – KS3).

Results

In multiple regressions, knowledge of arithmetic, mathematical reasoning and SES did make significant and independent contributions to the prediction of KS2 and KS3 mathematics. The b coefficients for SES when the analyses were run before entering mathematics reasoning into the equation were .467 for the analysis with KS 2 Maths as the outcome variable and .418 for the analysis with KS 3 Maths as the outcome variable. When mathematics reasoning was added to the equation, the b values for SES were reduced to about one half in each analysis; they were .159 for KS2 and .245 for KS3. These were much lower than the b coefficients for the relation between reasoning and mathematical achievement (.62 at KS2 and .71 at KS3). Entering knowledge of arithmetic did not affect the relationship between SES and achievement as much. Therefore, mathematical reasoning, but not arithmetic, could mediate the relationship between SES and achievement in mathematics.

This idea was supported by structural equation models, which established a strong indirect pathway from SES via mathematical reasoning to both measures of mathematical achievement (KS2 & 3). SES had a powerful effect on children's mathematical reasoning, which in turn strongly affected their mathematical achievement. The coefficient for SES in this mediational model remains significant but goes down to .13 for KS2 and .23 for KS3. The model in which mathematical reasoning was entered as a mediator of attainment explained more variance in KS2 (53%) than a model in which reasoning was not a mediator (42%); the same was true about KS3 attainment, where the linear model explained 52% of the variance and the mediator model explained 59%.

Multi-level analyses were used to take into account the schools' social composition (through the mean SES for the school) and the individual SES, in order to investigate how SES affects mathematical reasoning. This analysis was possible because there were over 2,200 children in 86 schools, with a range of 6 to 65 children in the same school. The analysis showed that SES had an effect at the individual and school level; the interaction between these levels was not significant.

Conclusions and significance

SES effects can be better understood through the mediators that intervene between family background and educational achievement. The mediator effect of mathematical reasoning between SES and mathematical attainment observed here should be very stimulating for educators. They suggest that the negative effects of coming from less privileged homes can be offset by an approach to education that offers teaching which improves children's mathematical reasoning. Therefore, this study has major consequences for the way schools can proactively address SES differences and aim to attain equity in education.

References

- Ginsburg, H. P., & Russell, R. L. (1981). Social class and racial influences on early mathematical thinking. *Monographs of the Society for Research in Child Development*, 46(6), Serial No. 193.
- Lee, V. E., & Bryk, A. S. (1989). A Multilevel Model of the Social Distribution of High School Achievement. *Sociology of Education*, 62(3), 172-192.
- Reyes, L. H., & Stanic, G. M. A. (1988). Race, Sex, Socioeconomic Status, and Mathematics. *Journal for Research in Mathematics Education*, 19(1), 26-43.
- Sacker, A., Schoon, I., & Bartley, M. (2002). Social inequality in educational achievement and psychosocial adjustment throughout childhood. *Social Science and Medicine*, 55, 863-880.

SYMPOSIUM

Using Longitudinal Data to Investigate Influences on the Uptake of Science Studies

John Ainley, Australian Council for Educational Research, Australia; Mary Ainley, University of Melbourne, Australia

Many developed economies have experienced a decline in participation in science, technology, engineering and mathematics (STEM) studies over the past two decades. One of the responses proposed in relation to this decline in STEM participation has been to make school science studies more attractive. We argue that longitudinal data are essential for understanding the relationship between interest in, and enjoyment of, science studies at school and subsequent uptake of specialist science-based studies. This paper makes use of multivariate analysis (principally structural equation modelling) of data based on a follow through of the PISA 2006 sample in Australia. As a result of analysing these longitudinal data from 2006 to 2009 we conclude that taking up specialist science-related studies in the final year of secondary school is associated with higher levels of science achievement and stronger interest in science. Science education that is perceived by students to be personally important and enjoyable will be associated with stronger interest in science and a greater likelihood of taking up science-related studies. The paper also shows that different patterns of influence apply to biology, physics and chemistry and that an appreciation of these differences is important in understanding science participation.

Objectives

As observed by the Global Science Forum, many developed economies have experienced a decline in participation in science, technology, engineering and mathematics (STEM) studies over the past two decades (OECD, 2006). One of the responses proposed in relation to this decline in STEM participation has been to make school science studies more attractive. This paper makes use of multivariate analysis (principally structural equation modelling) of longitudinal data to investigate the relationship between interest in, and enjoyment of, science studies in middle secondary school and subsequent uptake of specialist science studies in the final year of school. The data are based on a follow through of the nationally representative PISA 2006 (OECD, 2007) sample in Australia.

Perspective

A number of previous research studies have indicated the influence of generic interests on school subject choice (Elsworth, Harvey-Beavis, Ainley, & Fabris, 1999). In this paper we focus specifically on interest in science and, adopting Ajzen's (2001) theory of planned behaviour, we see intentions to study science as a mediating influence on the uptake of science-related studies. Our argument is that interests in science influence the uptake of science-related studies mainly through their influence on intentions. Science achievement operates both indirectly through intentions and directly on the uptake of science studies. Our investigations of PISA 2006 data have shown the centrality of enjoyment of science for interest in science and intended future participation in science-related activities (Ainley & Ainley, accepted).

Data

The sample of 15-year-old students for PISA 2006 in Australia consisted of 14,000 students from 356 schools (Thomson & De Bortoli, 2007). Those students completed an extensive assessment of science literacy as well as a questionnaire that provided measures of interest in science, enjoyment of science, current and future planned science activities, future-oriented motivation to learn science as well as family and social background (OECD, 2009). The interest measures included general interest in science (measured through response to a series of statements recorded on a Likert scale) as well as more situated measures based on expressed interest in 31 science topics through questions embedded in the achievement test.

These students then formed the basis for a cohort of the Longitudinal Studies of Australian Youth. They were contacted each year using computer-assisted telephone interview (CATI) and provided information about their educational (including the subjects that they studied), employment and social activities. Our analyses are based on the 8,400 respondents to the 2008, interviews and the 7,300 respondents who continued into 2009, as these are the years in which students would have taken up the study of specialist science disciplines or not. Our analyses compensate for the effects of sample attrition by the use of post-stratification weights.

Analysis

Our analyses are part of the "event occurrence" stream of longitudinal data analysis (Singer & Willett, 2003) and we use structural equation modelling to examine the ways in which interest (and its antecedent of enjoyment) operates in conjunction with achievement to predict the uptake of specialist science studies in senior secondary school. Our previous analyses have examined the structure of science interests and factors that shape planned science participation. This paper extends those investigations to focus on actual uptake of science studies. In these analyses we focus on three dichotomous outcome measures of uptake of science representing studying biology (20% of the full cohort), chemistry (13% of the full cohort) and physics (12% of the full cohort) respectively (using logistic regression methods).

Educational and scientific importance

As a result of analysing these longitudinal data from 2006 to 2009 we conclude that taking up science-related studies in the final year of secondary school is associated with higher levels of science achievement and stronger interest in science. Science education that is perceived by students to be personally important and enjoyable will be associated with stronger interest in science and a greater likelihood of taking up science-related studies. The paper also shows that different patterns of influence apply to biology, physics and chemistry and that an appreciation of these differences is important in understanding participation in specialist science studies. It is important to know the strength of the relationships of the uptake of specialist science studies with interest and achievement in science as well as the factors that shape interest such as personal valuing of science. Longitudinal data are essential for understanding these relationships.

References

- Ainley, M., & Ainley, J. (accepted). A cultural perspective on the structure of student interest in science. *International Journal of Science Education*,
Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology*, 52, 27-58.
Elsworth, G., Harvey-Beavis, A., Ainley, J., & Fabris, S. (1999). G. *Educational Research and Evaluation*, 5 (3), 290 - 318.
OECD. (2006). *Evolution of student interest in science and technology studies: Policy report*. Paris: OECD Global Science Forum.
OECD. (2007). *PISA 2006: Science competencies for tomorrow's world (Vol. 1: Analysis)*. Paris: OECD.
OECD (2009). *PISA 2006 Technical Report*. Paris: OECD.
Singer, J., & Willett, J. (2003). *Applied longitudinal data analysis*. Oxford: Oxford University Press.
Thomson, S. and De Bortoli, L. (2007). *Exploring Scientific Literacy: How Australia measures up. The PISA 2006 survey of students' scientific, reading and mathematical literacy skills*. Melbourne: ACER.

SYMPOSIUM

The Impact of Inductive Reasoning on Educational Achievements

Beno Csapo, University of Szeged, Hungary; Gyongyver Molnar, University of Szeged, Hungary

Previous research identified the roles inductive reasoning plays in acquiring and applying knowledge. The present analysis (1) estimates how well the developmental level of inductive reasoning predicts the later achievements at other areas of cognition; (2) compares the impact at several ages; and (3) examines if the observed relationships are based on internal processes or external factors. Data were collected in the framework of the Hungarian Educational Longitudinal Program (HELP). Representative samples (nth and a 10th grader sample and a problem solving test administered a year later the correlations were .47 and .52., while with a test of the application of science knowledge administered at the same second measurement point the correlations were .44 and .45. English reading test administered two years after the inductive reasoning test correlated with it at .46 and .48. The comparable correlations of the middle and oldest sample were almost identical, indicating that the relationships are not age dependent. When the correlations were controlled for mothers' education, partial correlations were only slightly lower. These observations suggest that the relationships may be attributed in a major part to internal cognitive mechanisms.

Theoretical framework

Previous research described the development of inductive reasoning (e.g. Csapo, 1997) and showed the role it plays in learning, in organization and in application of knowledge. It has also been shown that inductive reasoning is modifiable by systematic training, especially in young children (e.g. Klauer & Phye, 2008). Improving inductive reasoning may transfer to other areas of cognition and improves learning at distant areas like language development (Marx & Keller, 2010) and second language acquisition (Csapô & Nikolov, 2009; Marx, 2009). Most previous research studied the development and impact of inductive reasoning by cross-sectional data-collection, while longitudinal research offers the possibility of analyzing the predictive value of assessing inductive reasoning. Aims

The present analysis aims at (1) estimating how well the developmental level of inductive reasoning predicts the success at other areas of cognition in the following years. Using data from a multi-cohort longitudinal program, (2) we compare the impact at several ages. Furthermore, (3) we analyze if the observed relationships between inductive reasoning and other areas of achievements are based on internal cognitive processes or can be attributed to external factors.

Methods

This analysis utilizes the data of the Hungarian Educational Longitudinal Program (HELP) which was launched in 2003 in three cohorts. Representative samples of students entering grade 1, 5 and 9 were selected from the school populations of Hungary. The initial sizes of the samples were 5286, 3881 and 3131 respectively. Students' achievements at a variety of curricular and general cognitive domains were assessed at the end of the school years by paper-and-pencil tests; furthermore, questionnaires were administered to collect data about students' affective characteristics and social backgrounds. In this analysis, the results of an inductive reasoning test (composed of number series, number analogy and word analogy tasks), a problem solving test, a test for application of science knowledge, and reading in English as a second language will be used.

Analysis and results

Several correlation coefficients were computed for analyzing the relationship between inductive reasoning and later cognitive achievements. An inductive reasoning test was administered to the youngest sample at the end of grade 4, and a mathematics test at grade 6. The correlation between them was .56 ($n=3306$). When the relationship was controlled for mothers' highest qualification, the partial correlation still remained high, .5.

For the middle and oldest sample, the same test results are available. An inductive reasoning test was administered to them when they were at the 6th and 10th grade. A problem solving test administered a year later, at grade 7 and grade 11 correlated with its result at .47 ($n=3059$) and .52 ($n=1794$). After controlling for mothers' education, the remaining partial correlations were .44 and .49.

A test of the application of science knowledge was also administered to these samples at this second measurement point, the correlations were .44 ($n=3066$) and .45 ($n=1832$), while the partial correlations were .40 and .45 respectively. We have data from a third measurement point for these samples as well. A part of the entire sample (those studying English as a second language) solved English reading test at grade 8 and 12. The correlation between inductive reasoning and English reading was .46 ($n=1708$) and .48 ($n=866$), while the partial correlations were .41 and .45. (Due to large sample sizes each correlation coefficient is significant at least at $p=0.0001$.)

As for age differences, the comparable correlations of the middle and oldest sample were almost identical, indicating that the relationships do not depend on the age at the observed age range. Comparing the correlation coefficients with the corresponding partial correlations, only minor differences can be seen. These observations suggest that the relationship may be attributed in a major part to internal cognitive mechanisms.

Educational and scientific importance

The results of the analyses of the longitudinal data suggest a strong link between inductive reasoning and the subsequent educational achievements. In this way, assessment of inductive reasoning may offer an early indicator of later learning success. Inductive reasoning can be relatively easily measured, and on the bases of the results of this project, more suitable instruments can be devised. As the longitudinal data collection with the youngest sample continues, and a large number of further cognitive and background data are available, more sophisticated models can be developed for understanding the role inductive reasoning plays in school learning.

References

- Csapo, B. (1997). The development of inductive reasoning: Cross-sectional assessments in an educational context. *International Journal of Behavioral Development*, 20(4), 609–626.
- Csapo, B. & Nikolov, M. (2009). The cognitive contribution to the development of proficiency in a foreign language. *Learning and Individual Differences*, 19(2), 209–218.
- Klauer, K. J., & Phye, G. D. (2008). Inductive reasoning: A training approach. *Review of Educational Research*, 78(1), 85–123.
- Marx, E. (2009). Does fostering inductive reasoning promote children's language acquisition? *Educational & Child Psychology*, 26(3), 40–58.
- Marx, E., & Keller, K. (2010). Effekte eines induktiven Denktrainings auf die Denk- und Sprachentwicklung bei Vorschulkindern und Erstklasslern in benachteiligten Stadtteilen. *Zeitschrift für Pädagogische Psychologie*, 24 (2), 139–146.

SYMPOSIUM

K 19 02 September 2011 09:00 - 10:00 Room Building 1 Matrix Lecture Theatre

Advancing research on shared regulation in collaboration: Juxtaposing empirical approaches

Chairperson: Sanna Jarvela, University of Oulu, Finland

Organiser: Sanna Jarvela, University of Oulu, Finland

Allyson Hadwin, University of Victoria, Canada

Discussant: Nancy Perry, University of British Columbia, Canada

Socially-shared regulation of learning refers to processes by which group members regulate their collective activity. Successful individuals regulate their motivational, cognitive, and metacognitive engagement (Winne & Hadwin, 1998). Similarly, successful groups share in regulating group processes. Implicit notions of socially shared regulation are often embedded in collaborative learning research (e.g. Barron, 2000; Janssen, Erkens & Kirschner, 2010). However, there is a paucity of empirical research systematically examining how students collectively share in the regulation of learning toward a collective outcome (Hadwin, Järvelä & Miller, 2011). Recent empirical research has shown that it has been especially challenging to empirically distinguish between shared regulation and shared knowledge construction. This may be because of dominance of discourse and observation data of inter-individual dialogue and transactions between group members and lack of methods and analytical techniques for examining solo and collaborative performance outcomes associated with interactional processes. The aim of this symposium is to advance our understanding about shared regulation by contrasting the findings from shared metacognition, socially-shared regulation and communicative perspectives.

SYMPOSIUM

Socially-shared metacognition: Convergence and co-construction CSCL planning

Allyson Hadwin, University of Victoria, Canada; Mariel Miller, University of Victoria, Canada; Philip Winne, Simon Fraser University, Canada

The purpose of this cross case comparison was to examine shared regulation of task perceptions and goals in three consecutive collaborative tasks. Specifically we compared groups with strong versus weak collaborative task performance in terms of three indicators of shared regulation: (a) co-constructed planning statements (task perceptions and goal statements), (b) convergence of group members' individual planning statements (task understanding and goal statements), and (c) metacognitive calibration between the goal efficacy and goal

performance ratings of both individuals and groups. We hypothesize that groups who achieved collaborative success would demonstrate: (a) The convergence in their individual task perceptions and goals by the end of the task, (b) co-construct accurate and complete task perceptions and high quality goals, (c) demonstrate efficacy for achieving both individual and co-constructed goals, and (c) self-report high attainment of individual and co-constructed goals.

Ideal collaboration is coordinated and interdependent work during which learners strive to achieve a shared goal or solve a shared problem (Roschelle & Teasley, 1995). In contrast to cooperative work where labor is divided among group members, collaboration involves dynamic, mutually interdependent interaction toward a joint outcome or goal (Dillenbourg, 1999). A collaborative team leverages each members' unique and distributed knowledge and expertise to achieve something that could not be achieved by the individuals alone (Johnson & Johnson, 1989).

Success in collaboration depends on: (a) strategies and self-regulatory skills individuals contribute to the group, (b) support members provide to one another that facilitates individuals' self-regulatory competence (co-regulation), and (c) shared or collective regulation of learning involving metacommunicative awareness and successful coordination of strategies (Barron, 2003). From this perspective, collaborative work fuses individuals' distributed metacognitive work with shared and coordinated metacognitive work of the group. Full collaboration implies meta-awareness of the coordinated whole. Successful groups unite their individual metacognitive information and regulatory actions to negotiate consensus about task perceptions, goals, knowledge about group processes, evaluations of collective progress and outcomes, and regulatory decisions.

We posit that successful collaboration emerges when teams collectively regulate learning (SSRL) across four phases outlined by Winne & Hadwin (1998): (a) task perceptions, (b) goal setting/planning, (c) task enactment, and (d) evaluation/adaptation. This study focuses shared regulation in planning phases (task perceptions and goal setting/planning). Much like individual regulation, this shared regulatory process is metacognitive in nature. Shared regulation involves continually planning, monitoring, evaluating and updating within and across phases of regulation. In order to achieve collaborative potential, group members must align individual task perceptions and co-construct a shared understanding of what they are being asked to accomplish. Without shared task perceptions, group members are more likely to work at cross purposes and less likely to achieve interdependence. Similarly, developing consensus about task goals is essential for collaboration. Goals are the translation of task perceptions into standards that guide collaborative work. Without these shared standards, it is challenging for groups to achieve consensus about plans and strategies, as well as accurately predict, monitor and evaluate their collective progress.

The purpose of this cross case comparison was to examine shared regulation of task perceptions and goals in three consecutive collaborative tasks. Specifically we compared groups with strong versus weak collaborative task performance in terms of three indicators of shared regulation: (a) co-constructed planning statements (task perceptions and goal statements), (b) convergence of group members' individual planning statements (task understanding and goal statements), and (c) metacognitive calibration between the goal efficacy and goal performance ratings of both individuals and groups.

Participants included 120 undergraduate students enrolled in a first year elective course at the University of Victoria (ED-D 101). Students worked in 30 collaborative teams of 3 or 4 over a 13-week semester on three collaborative tasks. Collaborative tasks were constructed to be challenging and require multiple student perspectives. The Moodle learning management system (Dougiamos, 2001) was used for individual and collaborative synchronous and asynchronous planning and task work. Tools included a text based chat, collaborative forum tool, and an editable wiki space, and a planning-reflection activity. Moodle captured records of the timing of nature of individual contributions to the shared wikispace, forum, and chat.

Data was examined for evidence of (a) individual group members' perceptions of task requirements and task goals completed prior to collaboration, (b) groups co-constructed perceptions of the task and task goals, (c) groups' collaborative engagement and reflection on the task evidenced in the wiki workspace, forum, and chat, and (d) individual group members' reflections on goal achievement. .

We hypothesize that groups who achieved collaborative success would demonstrate: (a) The convergence in their individual task perceptions and goals by the end of the task, (b) co-construct accurate and complete task perceptions and high quality goals, (c) demonstrate efficacy for achieving both individual and co-constructed goals, and (c) self-report high attainment of individual and co-constructed goals. Upon completion of a shared tasks, if group members maintain different task perceptions, hold dramatically different task goals, or have disparate perceptions of the degree to which task goals were achieved, it suggests the group did not achieve shared metacognition and should be

characteristic of poor collaborative task performance because group members were monitoring and evaluating performance against different standards than other members of the group.

SYMPOSIUM

Emerging shared regulation in collaboration:

Sanna Jarvela, University of Oulu, Finland; Hanna Jarvenoja, University of Oulu, Finland; Jonna Malmberg, University of Oulu, Finland; Allyson Hadwin, University of Victoria, Canada

The aim of this study was to investigate socially shared regulation of learning in the context of collaborative groups. Our hypothesis is that successful collaboration emerges when teams collectively regulate learning. Following our earlier conceptual and empirical work on social aspect of motivation and regulation of learning (Hadwin & Järvelä, 2011; Järvenoja & Järvelä, 2009; Järvelä, Volet & Järvenoja, 2010) we aim to answer : How individual students in collaborative groups construct shared regulation and how successful groups are in their sharing regulation? We present an empirical study where 18 graduate students worked in collaborative teams of 3 to 4 over an 8-week period. The nStudy (Winne et al., 2008) software was used for collaborative planning and work, as well as face-to-face and online collaboration between team members. Data included: (a) individual and collaborative statements about collaborative challenges, (b) collaborative statements of contextual and future regulation strategies and (c) collaborative learning performance and (d) collaborative chat discussions. The results indicated three kinds of "regulation over time profiles": strong, progressive and weak shared regulation and emerging shared regulation was linked to the collaborative learning results. The three groups also differed in terms of activated shared regulation strategies so that the strong shared regulation group showed more deep level strategies than routine level regulation strategies.

Introduction

Socially-shared regulation of learning refers to processes by which group members regulate their collective activity. Successful individuals regulate their motivational, cognitive, and metacognitive engagement (Winne & Hadwin, 1998). Similarly, successful groups share in regulating group processes. Implicit notions of socially shared regulation are often embedded in collaborative learning research (e.g. Barron, 2000). However, there is a paucity of empirical research systematically examining how students collectively share in the regulation of learning toward a collective outcome. How shared and individual regulations interact in the process is also unknown. Following our earlier conceptual and empirical work on social aspect of motivation and regulation of learning (Hadwin & Järvelä, 2011; Järvenoja & Järvelä, 2009; Järvelä, Volet & Järvenoja, 2010) we aim to answer : How individual students in collaborative groups construct shared regulation and how successful groups are in their sharing regulation? From our perspective (Hadwin, Järvelä & Miller, 2010) empirical research should recognize the following perspectives if it is about regulated learning: (a) regulated learning is intentional, goal directed and metacognitive, (b) learners regulate motivation, behavior, and/or cognition and it is always embedded in social context and influences, (c) research should target challenge episodes since they invite strategic regulation of learning.

Aims

The aim of this study was to investigate socially shared regulation of learning in the context of collaborative groups. Our hypothesis is that successful collaboration emerges when teams collectively regulate learning. The research questions are:

- a) What are the individual and shared statements of challenges experienced in collaborative group work?
- b) How do students collectively regulate the contextual challenges and their future challenges?
- c) What are the collaborative learning results compared to the emerging shared regulation among the different groups?

Methods

Participants and context

Participants included 18 graduate students in a Learning and Educational Technology Masters Program (mean age = 43, SD = 6,3; 17 females and 1 male). The students participated in a six weeks course titled Cognitive, Motivational and Emotional Bases in Learning for Understanding. Students participated in three learning cycles each consisting of: (a) one day face to face meeting (b) one week virtual solo studying period, and (c) one week virtual collaborative task period. Course materials and workspaces for solo and collaborative work were accessed through nStudy (Winne, Hadwin, & Beaudoin, 2010).

Data Collection

Data for this study included

- (a) individual and collaborative statements of challenges for the collaborative task,

(b) collaborative strategies the students used for regulating the contextual tasks and future tasks,
(c) collaborative task performance and
(d) collaborative chat discussions. The students filled in the solo and collaborative planning notes in nStudy in the beginning of each solo or collaborative learning phase.

Solo and collaborative notes consisted of two parts:

(a) Reflection on last collaborative session, and
(b) Planning for this collaborative session. In this paper we focus specifically on the following questions on challenges: What was the main challenge you encountered achieving your goal last week? and What was the main challenge your group encountered during this collaborative task? and on regulation strategies: What did you (as a group) do to address that challenge?, What could you (as a group) do differently or better next time? Collaborative Task Performance was scored on a 5 point scale based loosely on Bigg's Solo Taxonomy.

Results

Based on the collaborative planning note responses we created "regulation over time group profiles" which consist of 1) groups' challenges and 2) their statements of situated regulation strategies and 3) their reported future regulation strategies. All together, seven different strategies were coded from the data: Performing (Pe), Planning (PI), Cognitive processing (C), Asking for external help (H), Task and environmental structuring (T), Motivation (M) and No strategies expressed (O).

The cross case analysis among the six groups resulted three kinds of collaborative regulation profiles which were labeled; strong shared regulation (group 1), progressing shared regulation (group 3, 5 and 6) and weak shared regulation (groups 2 and 4). Each of these characterizations will be described in details in the presentation.

When the groups' performance on the collaborative tasks was compared to their emerging shared regulation it was seen that the group which showed strong shared regulation succeeded in collaboration task. Also progressive shared regulation among the three groups contributed to strong or improving collaborative learning results. Instead, weak shared regulation resulted weak or improving collaborative learning results.

Conclusions

The aim of this study was to investigate socially shared regulation of learning in the context of collaborative groups. Our hypothesis was that successful collaboration emerges when teams collectively regulate learning. The results confirmed our hypothesis since three kinds of "regulation over time profiles" were found and emerging shared regulation was linked to the collaborative learning results. The three groups also differed in terms of activated shared regulation strategies so that the strong shared regulation group showed more deep level strategies than routine level regulation strategies.

With this data set we are unable to elaborate the progress of group and individual regulations skills, but we will continue the analyses with the other data. However, we assume that group challenges provide an opportunity for developing both group and individual self-regulation skills. Opportunities for sharing regulation will be a chance to develop individual self-regulation skills (e.g. weak study skills) because the skills will be compensated by the group competence. We could assume that shared regulation is a kind of "test bed" for individual self-regulation and an opportunity to train collaborative learning skills. The kind of shared regulation emerges in groups' seem to contribute to the success in collaborative learning.

SYMPOSIUM

Regulation of Team Activities and its Effects on Learning

Bert Slof, +31 (0)503636611, Netherlands;Jeroen Janssen, Utrecht University, Netherlands;Paul A. Kirschner, Open Universiteit, Netherlands;Gijsbert Erkens, Utrecht University, Netherlands

This contribution examines regulation of collaborative learning from a communicative perspective. During collaboration, group members must explicate their knowledge and ideas. This implies that they must coordinate their collaboration process. Three different coordination activities are distinguished: (1) focusing (maintaining common focus during discussions), (2) checking (making sure group members have shared understanding), and (3) argumentation (convincing others using arguments and explanations). To examine whether coordination activities contribute to team and individual learning, 102 secondary education students collaborated in 34 teams in a computer-supported collaborative learning environment. Analyses of the groups' discussions, their performance on the group task, and students' performance on a knowledge post-test revealed that focusing negatively affected team performance and checking positively affected team performance. No effect of coordination on individual learning was found however.

Introduction

Collaboratively carrying out a learning task is often regarded as an effective method for group and individual learning. The premise is that through a dynamic process of eliciting one's own knowledge, discussing this with peers, and establishing and refining the group's shared understanding, students acquire new knowledge and skills and process them more deeply (Hmelo-Silver, Duncan, & Chinn, 2007). Meaningful discussions are, however, difficult to achieve when teams do not properly regulate their activities (Barron, 2003). Collaborative learning situations require that team members coordinate their collaboration process by carrying out specific coordination activities. Three important coordination activities are; (1) focusing, (2) checking, and (3) argumentation (Erkens & Janssen, 2008). Team members must make their own knowledge and ideas explicit to other team members. When made explicit, learners must maintain a shared topic of discourse (i.e., achieve a common focus) and repair that focus if they notice divergence. Team members also must maintain the coherence and consistency of their shared understanding by checking (Van der Linden, Erkens, Schmidt, & Renshaw, 2000). Furthermore, they must reach agreement about relevant concepts, principles and procedures. Through argumentation they try to convince others by elaborating on their own point of view and by explaining, justifying and accounting for them (Andriessen, Baker, & Suthers, 2003). This contribution examines whether the aforementioned coordination activities contribute to team and individual learning during computer-supported collaborative learning (CSCL).

Method

Participants

Participants were students from 6 classes in three secondary schools in the Netherlands. The sample consisted of 102 students (61 male, 41 female, mean age = 15.7 years; SD = .56, Min = 14, Max = 17). The students were randomly assigned to 34 learning teams (i.e., triads).

Learning-environment and Learning-task

Working in a CSCL-environment called Virtual Collaborative Research Institute, the teams had to solve a business-economics problem. Team members communicated through a chat-tool.

Procedure

All 34 teams spent four, 45-minute lessons solving the problem during which learners worked on separate computers. All actions and decisions in the environment were logged.

Measurements

Team learning

To measure team learning, a 28 item assessment form was developed. Items were coded as; 0, 1 or 2, whereby a '2' was coded when the answer given was of high quality and '0' when it was of low quality. Items addressed criteria such as the suitability of team decisions, correctness of the use of business-economics concepts, and the quality of the formulated advice. Reliability of this measurement was .84.

Individual learning

Recall and understanding of the knowledge domain was measured with a multiple-choice pre-test (20 items, $\alpha = .46$) and post-test (20 items, $\alpha = .48$).

Coordination

Each chat message was coded for the type of dialogue act used (see Table 1). A dialogue act was regarded as a communicative action which is elicited for a specific purpose representing a specific function in the dialogue (Erkens & Janssen, 2008). Coding was based on the occurrence of characteristic words or phrases indicating the communicative function of an utterance. This was done automatically using 1,250 'if-then' decision rules that uses pattern matching to find typical words or phrases. When compared to hand-coding, a Cohen's Kappa of .75 was found.

Table 1: Overview of coordination activities.

Results

Multiple regression analysis was used to examine the impact of coordination on team learning. Results showed that focusing negatively affected the score obtained by the groups ($b = -.92$, $p = .04$), whereas checking positively affected team learning ($b = 1.18$, $p = .03$). No effect of argumentation on team learning was found. In addition, the impact of coordination on student performance on the post-test was examined using multilevel analysis. No significant effects of focusing, checking and argumentation were found.

Discussion

The results provide insight into the effects of regulation of team activities on team and individual learning. More research is, however, needed to explain why no effect of regulation on individual learning was found. An explanation

may come from cognitive load theory, which posits that regulative activities increase the cognitive demands placed on students, thus preventing them from learning (F. Kirschner, Paas & Kirschner, 2009). Interestingly, a negative effect of focusing on team learning was found. Possibly, when groups must devote much time and energy to maintaining shared focus, this may distract from discussing the domain concepts or appropriate strategies.

SYMPOSIUM

Engagement in learning History. Argumentation, questioning and controversial topics.

Chairperson: Jannet van Drie, University of Amsterdam, Netherlands

Organiser: Albert Logtenberg, University of Amsterdam, Netherlands

Discussant: Matthias Nuckles, University of Freiburg, Germany

This symposium brings together three recent empirical studies that investigate how different students reason historically. Empirically based research in historical reasoning, a key activity in history learning (Van Drie & Van Boxtel, 2009), is a growing field of research. This research is aimed at a better understanding of cognitive and affective activities that foster and stimulate historical reasoning. Examples of engaging students in History are student inquiry, historical narratives, controversial topics and topics that connect to student present-day experiences. The first paper reports about student interest and engagement triggered by discussing a controversial issue in the history of Israel and by composing a group of 12th grade (aged 17/18) students (N=49) with different ethnic backgrounds. Differences in identity (Middle-eastern/Western) fostered and influenced historical argumentation. The second study deals with 33 students (aged 15/16) reading a historical introductory text that triggers interest and student questions. In order to study students' questioning different types of student perplexity in terms of prior knowledge, affect and historical reasoning is described. The final study investigated the role of popular historical narratives in shaping undergraduate students' historical consciousness. The study describes student interest in History of pre-service history teachers and their ability in formulating historical questions. Different models of historical thinking are compared and used for analysing progress in historical reasoning in student learning journals. The discussant will reflect on the different empirical approaches in research in history education and the relationship between student engagement in History and historical reasoning processes as asking historical questions and argumentation.

SYMPOSIUM

Identity, interaction and historical distinction of students discussing a charged historical issue

Tsafrir Goldberg, University of Haifa, Israel; Baruch Schwarz, Hebrew University, Israel

Forty nine Israeli students of two Jewish ethnic groups (23 Mizrahi, 26 Ashkenazi) completed a multiple source historical learning task about Israel's "Melting Pot" policy. Following it participants conducted self led small group discussions in ethnically mixed and homogenous groups. Prior to and following the learning students wrote short essays presenting their opinion about the policy's goals and outcomes. Students' level of argumentative writing, group discussion style and historical consciousness in discussions were analyzed. Findings reveal influence of group composition over improvement of argumentative writing – with ethnically mixed discussion groups presenting a significantly higher frequency of improvement. In discussions students frequently used historical distinctions reflecting an elaboration of agent and action complexity. Distinctions such as the differentiation between intended goals and unintended outcomes, while reflecting more nuanced understanding, were many times used as part of identity oriented apologetics. Non conflictual discussion style appears to have had a significant positive correlation to expressions of historical consciousness such as historical distinction and to the final level of argumentative writing. These phenomena were more pronounced in the ethnically mixed discussion groups. The above results were interpreted as reflecting a possible intersection of contact theory and situated learning theory. Acquisition of disciplinary practice tools such as agency based distinctions apparently occurred in directions which serve identity needs aroused by encounter. However, findings seem to contradict some of argumentative theories' assumptions about the role of conflict and disagreement in fostering argumentation

Introduction

Growing attention is given to diversity and multiculturalism in curriculum planning, teacher education and research. However, it is not accompanied by ample research into the ways social identity and intergroup contact influence actual learning (Epstein, 1998). The learning activity which our study explores centers on a historical controversy whose relevance to students' diverse social identities makes it a charged issue. As such it is meant to promote interest, inquiry and argumentation (Barton & Levstik, 2004). Contact theory assumes heightened group loyalty accompanying intergroup encounter may impair reasoning (Fiske, 2002). Collective memory may function in a similar way to delimiting students' processing of historical information (Reference removed for review). However,

participation in the disciplinary practices of a professional community may help acquiring its impartial tools and norms (Lave & Wenger, 1991). These influences have been studied at the level of the individual. However, since diversity of identity or opinion is experienced through encounter, this study seeks to explore the effects of a discussion group's ethnic composition on learning. Aims The purpose of this study was to explore the influence of the ethnic and attitudinal composition of a discussion group on written outcomes in the learning of a charged identity relevant historical issue.

Research question

What are the effects of the ethnic identity on discussion dynamics, historical consciousness and argumentation? Method Participants Participants were 49 12th grade students. 26 of the participants were Ashkenazi (descendants of Jews from Western countries) and 23 were Mizrahi (descendants of Jews from Muslim or Asian countries). Students participated in discussion groups, which were ethnically mixed or homogeneous (comprising 33 and 16 students respectively).

Procedure

Following an historical argumentative study of conflicting sources about the melting pot policy, students engaged in self administered discussions assessing the policy's impact. Discussions were audio taped by participants. Prior to the learning intervention and following the discussion students wrote individual compositions on the topic (Reference removed for review)

Analysis

Group discussion style Each turn in discussion was coded on a continuum between agreement and rejection. Categories started with agreement, followed by development, challenge, response to challenge, opposition and rejection. Historical distinction Propositions which expressed distinction of complexity within an event or process were coded in relation to Shemilt's (2000) hierarchy of narrative construction. These include distinctions of intentionality (between ends and means and between ends and outcomes) distinctions of perspective (between the perspectives of different groups, between short and long term or between present and past perspectives) Written outcome variables Students' level of argumentative writing was assessed on a 5 point scale (unwarranted, absolutist-one sided, multiplist- two sided, arbitrary-decided, evaluativist), based on Deana Kuhn's (1993, 2001) classification of arguments and epistemological stances. Results Effects of ethnic composition of discussion groups on written argumentation

The frequency of argumentative writing improvement in the mixed groups was twice as high as in the ethnically homogeneous groups. A chi square test proved the differences in frequency of change to be significant $\chi^2=29.01$, p Ethnic composition of groups and Group discussion style Mixed groups presented a somewhat higher frequency of agreement oriented group discussion style. Historical argumentation in discussion and writing Historical distinction. In all 65 % of the students used some kind of historical distinction. The most frequently used, by 39% of the students ($N=19$) was the distinction between historical agents' goals and their actions' outcomes. Following that was the distinction used by 31% of the discussants ($N=15$) between ends and the means taken to realize them. The more historically elaborate distinctions were used by less than quarter of the discussants (between perspectives of different groups (13%), between short and long term (26%) or between present and past perspectives (16%)). Some influence of identity can be seen in the fact that the (apologetic) 'goals – results' distinction was used twice as much by the Ashkenazi students compared to their Mizrahi peers. Group discussion style and historical consciousness In the whole sample historical distinction was positively related to developments ($r=.37$ $p=.014$) and negatively related to challenges ($r=-.43$, p Group discussion style and argumentative writing In the mixed groups agreement discussion style was positively related to the level of argumentative writing in final composition ($r=.40$, $p=.028$).

Discussion

Our findings align to some degree with current theory and research findings, while diverting from them to a certain extent. Contact theory led us to assume inter-group encounter will arouse in-group loyalty and intergroup conflict in mixed groups and lead to mastering better arguments to maintain in-group image. Apparently, more elaborate historical practices and arguments indeed appeared, many times in directions possibly reflecting identity needs. However, quite surprisingly, it was agreement oriented group discussion style that promoted both historical distinction and higher level of argumentative writing. It seems that historical distinction, which indicates an ability to perceive historical complexity was used not in intergroup confrontation but in the context of mutual development of knowledge. However, it may also indicate evasion of conflict limiting the potential of critical discussion to promote argumentation.

References

Epstein, T. (1998). Deconstructing differences in African American and European American adolescents' perspectives on United States history. *Curriculum Inquiry*, 28, 397-423.

Fiske, S. T. (2002). What We Know Now About Bias and Intergroup Conflict, the Problem of the Century. *Current Directions In Psychological Science*, 11(4) 123-128.

Kuhn, D. (1991). *The Skills of Argument*. Cambridge: Cambridge University Press. Kuhn, D. (2001). How Do People Know? *Psychological Science*, 12(1), 1-8.

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

Shemilt, D. (2000). The Caliph's coin: The currency of narrative frameworks in history teaching. In P. N. Stearns, P. Seixas and S. Wineburg (Eds.), *Knowing, Teaching, and Learning History: National and International Perspectives* (pp. 83-101). New York: New York University Press.

SYMPOSIUM

The onset of students' questioning in History

Albert Logtenberg, University of Amsterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Gonny Schellings, University of Amsterdam, Netherlands; Bernadette Van Hout-Wolters, University of Amsterdam, Netherlands

This study aims at deeper insight into processes underlying student questions in History. A process study is carried out to investigate the characteristics of the onset of questions when students read a historical introductory text. Thirty-three secondary school students are instructed to read the text and underline striking text segments. At the point of underlining, students verbalize their thoughts and may spontaneously ask questions. In our protocol analysis, we focus on the role of prior knowledge, the role of affect and on students' domain-specific reasoning. Verbalizing prior knowledge with associations is done most frequently. It appears that in half of the 251 utterances, when reading has stopped, students verbalize affective thoughts and show historical reasoning. Characteristics of the onset of questioning appear to come together in profiles of perplexity. We describe four profiles that occur most. Questions were mostly asked in cases in which students express a knowledge deficit without verbalizing any affect and without historical reasoning. In some of the cases questions were connected to affective reactions or to the attempt to reason historically (e.g., contextualizing, explaining or comparing). Implications of the role of affect and domain-specific reasoning in the onset of questions for research and practice are discussed

Introduction

In order to design an instructional method that uses students' questions to develop their historical thinking adequately, it is important to have more knowledge of the origin of student questions. Van der Meij (1994) describes a componential model of questioning. Three stages characterize the process of questioning: (1) the onset of questioning (perplexity), (2) the development of a question (asking) and (3) the search for and processing of an answer (answering). In our study we focus on the stage of perplexity in the domain of history. What types of perplexity (cognitive or affective) do students experience when reading a text about a historical topic and does this perplexity spontaneously generate historical questions? Perplexity can be triggered internally and externally. Students may experience that the presented information contradicts their prior knowledge (internal cue) or students experience curiosity triggered by the text (external cue). Students, when confronted with historical content, especially controversial issues, tend to judge historical agents and situations from a present-oriented perspective or use stereotypes to describe and explain historical actions or events (Hartmann & Hasselhorn, 2008). Students experience difficulties in seeing persons, events and developments in the past in their own historical context (Barton & Levstik, 2004). Students may be perplexed when they experience disequilibrium between the information that is given about the past and what they know from their experience and present-day standards. This perplexity may also be characterized by emotions, such as interest or indignation. In a previous study (Reference removed for review) we found that only a small part of the questions contained presuppositions that may be the result of taking a present-oriented perspective and reflect emotions such as indignation or empathy. Part of the students was able to ask higher order questions about the historical context, processes of change and continuity and causes and consequences, which can be considered important components of historical reasoning (Reference removed for review). So, besides cognitive processes, emotions and historical reasoning may underlie the perplexity students experience when reading a text about history. In this study we want to investigate whether students are able to formulate questions when they are confronted with this state of perplexity that can be characterized by cognitive, affective and historical reasoning characteristics.

Research questions:

- 1) What type of perplexity do students experience while reading a historical introductory text?
- 2) What type of questions do students spontaneously ask?

Method and Analysis

Participants 33 students in higher secondary education (15 years, 10 boys, 23 girls) are recruited from 6 different classes from 3 different schools aiming for maximum variation (N=174). Students are selected in order to compose an equally divided sample concerning the variables prior knowledge and school subject interest. Prior knowledge was measured with a paper-and-pencil test.¹ (N= 174; 8 items; $\alpha = .74$). Interest in History was measured with a questionnaire (N=174; 32 items; $\alpha = .92$). 33 students from different schools were selected from groups of low interest/prior knowledge, medium interest/prior knowledge and high interest/prior knowledge.

Task and procedure

The historical introductory text (770 words) about the Industrial Revolution contains narrative and problematising characteristics that trigger both situational interest (engagement and emotions) and different types of historical questions. Participants are asked to read the text and underline text elements that are striking, (un)familiar or (un)clear to them. At each underlined text element participants were asked to verbalize why they underlined it and explain their thoughts.

Analysis

The protocols are divided in episodes that consist of the underlined text, and student reasoning. We developed a coding scheme in order to label each episode on 1) prior knowledge (knowledge deficit, contradiction with prior knowledge or association), 2) affect (indignation, interest, empathy, astonishment, boredom) 3) historical reasoning (no historical reasoning, historical reasoning) and 4) type of spontaneous questions (descriptive, comparative, explanative and evaluative questions). For each category interrater reliability was calculated in terms of Cohen's kappa. ($\kappa > .60$ for each category).

Results

251 episodes were generated by 33 students and a total of 129 questions were spontaneously formulated. Table 1 describes the coding outcomes; Table 1: Frequencies and percentages of categories prior knowledge, affect and historical reasoning.

Prior knowledge is an important dimension in the characterization of students' perplexity. We found that students often (74.1%) stopped reading when text fragments triggered prior knowledge. In 57 (22.7%) cases students verbalized a knowledge deficit. However, students did hardly express a knowledge conflict (21%), whereas such conflicts are considered important sources of student questions (Graesser & McMahan, 1993). In regard to affective dimensions of perplexity, we can conclude that in explaining their perplexity, students quite often verbalized affect (51%) in terms of indignation (23%), astonishment (11%) and interest (10%). 48% of the episodes contained historical reasoning, mainly contextualization (32%). Out of these descriptions, 4 profiles of perplexity were most prominent. Association combined with historical reasoning with affect or no affect are combinations that occur most. Questions are especially asked when students experience a need for more information (and thus a knowledge deficit). This need for information is sometimes grounded in the attempt to contextualize, which is an aspect of historical reasoning. Although indignation and astonishment occur in a third of all episodes, these emotions gave not much rise to the asking of questions.

Knowledge of the onset of a question can provide us with more information in determining the quality of a question asked by students.

References

- Barton, K. C., & Levstik, L. S. (2004). *Teaching history for the common good*. Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Graesser, A.C., & McMahan, C. L. (1993). Anomalous information triggers questions when adults solve quantitative problems and comprehend stories. *Journal of Educational Psychology*, 85, 136-151.
- Hartmann, U. & Hasselhorn, M. (2008). Historical perspective taking – A standardized measure for an aspect of students' historical thinking. *Learning and Individual Differences*, 18, 264-270.
- Van der Meij, H. (1994). Student questioning: a componential analysis. *Learning and Individual Differences*, 6(2), 137-161.

SYMPOSIUM

Fostering undergraduate history teacher students' skills in asking reflective historical questions

Nicola Brauch, University of Freiburg, Germany, Germany

This study aims to assess the stage and progress in pre-service history teachers' ability in asking reflective historical questions during a course in medieval history. Nineteen pre-service history teacher students (undergraduates) were

six times instructed to write weekly prompted learning journals referring to six scientific historical research narratives. A coding scheme precisising three levels of asking historical questions by types of historical reasoning was generated to assess levels and changes in the quality of asking historical questions. Results underline the assumption to reach more detailed approach in assessing competencies of historical asking by defining the levels according to types.

Moreover the prompted learning journal method was proofed as a tool in assessing competencies of historical reasoning and to some extent in bringing forward students achievement in asking scientific historical questions. What kind of similarities can be identified between the two author's narratives and how can these be explained? Time, argumentation, interpretation

Results

85 learning journals have been written, students created in total 182 questions (highest mean learning journal 2: 2.53). Most questions were generated in the second learning journal (N=48), fewest in the third and fifth one (N=31 each). The mean amount of questions is between 1 and 2. The results show increasing levels of standard deviations and variances in the learning journals concerning levels of historical questions. As preliminary results (data analysis in progress) can be argued the prompted learning journal as a reliable tool for individual achievement analysis. Furthermore students' achievement mirrors a correlation between the complexity of the given research narrative and the level of asking historical questions in the learning journals dealing with those text. Eleven students (58 %) show a progression in the quality of their historical asking, four (21 %) remain on the level represented in the first learning journal, and four (21%) students' questions quality degrade. This results can be seen by using the detailed levels coding scheme, while weak advancement and degradation could not been documented by using the classified levels coding scheme.

References

- King, P. M. & Kitchener, K. S. (2004). Reflective Judgment: Theory and Research on the Development of Epistemic Assumptions Through Adulthood. In: *Educational Psychologist* 39 (1), 5-18.
- Körber, A., Schreiber, W. & Schöner, A. (Eds.) (2007). *Kompetenzen historischen Denkens. Ein Strukturmodell als Beitrag zur Kompetenzorientierung in der Geschichtsdidaktik*, Neuried: ars una.
- Kuhn, D., Iordanou, K., Pease, M. & Wirkala, C. (2008). Beyond control of variables: What needs to develop to achieve skilled scientific thinking? In: *Cognitive Development*, 23, S. 435-451.
- Nýckles, M., Hübner, S., Dýmer, S. & Renkl, A. (2010). Expertise reversal effects in writing-to-learn. *Instructional Science*, 38, 237-258.
- Rýsen, J. (1997). Historisches Erzählen. In: Klaus Bergmann et al. (Eds.), *Handbuch der Geschichtsdidaktik*, Seelze-Velber: Kallmeyer'sche Verlagsbuchhandlung, 57-63.
- Van Drie, J., & Van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing student's reasoning about the past. *Educational Psychology Review*, 20(2), 87-110.

SYMPOSIUM

Analyzing important components of self-regulated learning

Chairperson: Franziska Perels, Saarland University, Germany

Organiser: Franziska Perels, Saarland University, Germany

Bracha Kramarski, Bar-Ilan University, Israel

Discussant: Roger Azevedo, McGill University, Canada

Self-regulated learning is important for life-long learning and academic achievement. Therefore, it is important to analyse the different components of self-regulation to find possibilities to assess and support self-regulated learning in different learning contexts. In this symposium, we present three approaches, which focus on different aspects of academic self-regulation in the context of different target groups. The symposium starts with a methodological contribution by Whitebread et al. (UK) who present the results of an international study. In this project they developed and validated an observational instrument to identify and measure self-regulated learning in young children (age 3-6). After that Olay et al. (Germany) present a study in Primary school. In their study they try to predict first graders' school achievement in mathematics by their self-regulated learning. We close the symposium with a study conducted by Bellhäuser (Germany) who developed and evaluated a web-based training to foster self-regulated learning among prospective students. The presented studies will be discussed regarding their theoretical and educational significance (Azevedo, USA).

SYMPOSIUM

Predicting first graders' school achievement in mathematics by their self-regulated learning

Nadja Olyai, Frankfurt University, Germany; Barbara Otto, Institut of Psychology, Germany; Gerhard Buettner, University of Frankfurt, Germany; Kristin Krajewski, Giessen University, Germany

This study examined, whether self-regulated learning (SRL) is a significant predictor of first grade students' achievement in mathematics. Particularly, it was of further interest, whether first graders' SRL could even account for math achievement beyond students' cognitive abilities. Based on a process model of SRL, data of 674 students were collected. Cognitive abilities were assessed by the CFT Scale 1. Moreover, two measures for students' mathematics achievement were assessed: (1) Students solved an objective mathematics test (MBK); and (2) Mathematics teachers graded their students' mathematic achievement. Accordingly, SRL was assessed by two measures: (1) students filled in a questionnaire; (2) teachers rated their students' self-regulated learning behavior. Firstly, regression analyses were conducted using both SRL measures separately as predictors in order to predict math achievement. These analyses revealed that teachers ratings of SRL but not students' self-report could indeed predict both measures of math achievement. Regarding the second research question, blockwise analyses of regression were conducted including cognitive abilities (first block) as control variable and the teachers' rating of SRL (second block) as predictors. The results confirm that teachers' ratings of SRL significantly accounts for the prediction of both measures of math achievement beyond students' cognitive abilities. These results suggest that SRL indeed significantly contributes to students' math achievement already at the beginning of their school career. However, students' self-report measure did not work as predictor. These findings lead to several theoretical and practical conclusions which will be discussed at the end of the presentation.

Objectives

Individual differences in cognitive abilities are a very good predictor for academic achievement (e.g. Walberg, 1984). The prognostic validity of cognitive variables is so strong that some researchers even doubt that other psychological constructs could have any additional contribution to the variance of school performance (cp. Gagné & St.Péère, 2002). However, several studies show that for instance motivation also has an impact (e.g. Kreidler, Zigler, Kagan, Olsen, Weissler & Kreidler, 1995; Schicke & Fagan, 1994; Spinath, Spinath, Harlaar & Plomin, 2006). In line with these findings, Helmke and Schrader (2001) assume that not only cognitive abilities determine academic achievement but also students' motivation, volition, and metacognition. All of these three constructs are considered in most of the well-known process-models of self-regulated learning (SRL) (e.g. Schmitz & Wiese, 2006; Zimmerman, 2000). Even though a large number of recent studies on SRL show that high self-regulation is accompanied by high academic performance (Hidi & Ainley, 2008; Pintrich & Zusho, 2002; Ruban, McCoach, McGuire & Reis, 2003; Zimmerman & Bandura, 1994), most of these studies are purely correlative. Due to the potential combined variance of self-regulation with other variables (e.g. cognitive variables) these correlation studies might overrate the exclusive influence of SRL on academic achievement. Thus, regression analyses including SRL as one potential predictor should help to explain the variance of school performance data. If self-regulatory competencies truly are crucial, then they should show a substantial contribution in the prediction of the academic performance even beyond cognitive abilities. A recent study of Otto, Kistner, Perels & Býttner (submitted) revealed that this is indeed the case for secondary school students. However, no empirical study exists so far, which examines whether this is also true for students at the beginning of their school career. Thus, this empirical study addressed the research question whether or not SRL significantly contributes to the prediction of first grade students' math achievement even beyond their cognitive abilities.

Theory

The present study is based on a process model of SRL, which is basically consistent with the theoretical assumptions of Schmitz and Wiese (2006). According to Zimmerman (2000) the learning process is divided into three consecutive phases: The pre-action phase, the action phase, and the post-action phase.

The learning process begins with the pre-action phase which refers to the preparation of the learning. The given assignment and the particular conditions in the learning environment initiate the beginning of the SRL processes by evoking certain motivational and emotional tendencies within the learner. If the learner is not intrinsically motivated or shows low self-efficacy he needs to apply self-motivating strategies. Under these affective-motivational conditions the student has to set goals for his learning. Moreover, the learner will have to plan the application of learning strategies as well as the time he will invest for finishing the task.

Afterwards, the learner starts with learning (action phase). In order to complete his assignment he will apply different learning strategies. Moreover, he has to apply volitional strategies in order to avoid internal or external distraction and maintain concentration, effort, and motivation while performing academic tasks (Corno, 2001). In case the learner deviates from his planned learning behavior it is beneficial if he self-monitors his actual behavior. Finally, a learning outcome results.

In the post-action phase the student has to compare his actual final result with his prior set goal (ideal result). Hereby, he also has to evaluate whether the final result can be interpreted as success or failure. Furthermore, he will also reflect how he approached the given task. As a consequence of comparing, evaluating, and reflecting, certain emotions (e.g. satisfaction) will arise depending on whether the task was successfully solved or failed. These subsequent emotions and evaluations have an impact on future learning, as they can lead to modifications in planning strategies and time or in setting goals.

Methods

In order to answer the research questions data of 674 German first grade students were collected. Cognitive abilities were assessed by the CFT Scale 1 (Cattell, Weip & Osterland, 1997). Moreover, two measures for students' mathematics achievement were assessed: (1) Students solved an objective mathematics test (MBK, Krajewski, in press); and (2) Mathematics teachers graded their students' mathematic achievement. Accordingly, SRL was assessed by two measures: (1) students filled in a questionnaire concerning their self-regulated learning behavior (25 items; $\alpha=.86$); (2) mathematics teachers rated their students' self-regulated learning behavior (13 items, $\alpha=.91$).

Results

Firstly, regression analyses were conducted using both SRL measures separately as predictors in order to predict math achievement. These analyses revealed that teachers ratings of SRL could indeed predict math achievement with regard to the objective test MBK ($R^3=.12$; $\beta=.347$; $T=9.50$; p

Regarding the second research question, blockwise analyses of regression were conducted including cognitive abilities (first block) as control variable and the teachers' rating of SRL (second block) as predictors. The results confirm that teachers' ratings of SRL significantly accounts for the prediction of both measures of math achievement beyond students' cognitive abilities. With regard to the objective math test MBK cognitive abilities accounted for 28% of the variance in the criterion, which could be significantly enhanced up to 33% by including SRL as second predictor. The same is true for the variance of the second criterion math grade: Cognitive abilities accounted for 18% of the variance whereas the additional inclusion of SRL significantly increased the prediction up to 21%.

These results suggest that SRL indeed significantly contributes to students' math achievement already at the beginning of students' school career. However, students' self-report measure did not work as predictor. These findings lead to several theoretical and practical conclusions which will be discussed at the end of the presentation.

SYMPOSIUM

Fostering Self-Regulated Learning Online

Henrik Bellhauser, Technical University of Darmstadt, Germany; Thomas Loesch, Technical University of Darmstadt, Germany; Bernhard Schmitz, Technical University of Darmstadt, Germany

Trainings on self-regulated learning (SRL) have been shown to be effective both in improving self-regulation skills and in objective measures of performance (Benz, 2010). However, human trainers can only reach few people at the same time. Web-based trainings (WBT) could improve efficiency as they can be distributed to unlimited numbers of participants. Furthermore, users are more flexible in time and space when trained in a WBT, enhancing opportunities to participate.

Aiming at prospective students in a mathematics e-learning course we developed a WBT based on the process model of learning (Schmitz & Wiese, 2006). 170 participants were tested in a randomized control evaluation study. The experimental group had access to the WBT that consisted of three online lessons, each including presentations, exercises and group discussions. In both pre and post test a test of mathematical knowledge, a test of knowledge about learning strategies and self-regulation questionnaires were applied. Objective data was collected by recording log-files from users' online behavior.

Results showed that students highly appreciated the WBT and reported significant changes in subjective measures of SRL. Furthermore, participant of the experimental group significantly improved their knowledge about learning strategies and invested significantly more time on learning than the control group.

Theoretical Framework

Self-regulated learning (SRL) is defined as students' self-generated thoughts, feelings and actions that are systematically oriented toward the attainment of their learning goals (Zimmerman & Schunk, 2001). SRL competencies are regarded as crucial especially for students as academic learning oftentimes craves more self-determination than learning in school does.

Many studies report positive effects of SRL interventions on learning outcomes (e.g., Kramarski & Mizrachi, 2006, Azevedo & Cromley, 2004). However, most SRL trainings are effective yet not efficient as trainings in presence can only reach a certain number of participants at a time.

An alternative to human trainers could be to involve computers as instance of delivery. But as Benz (2010) could show in a meta-analysis, scaffoldings provided by computer were less successful than human trainers in improving learning outcomes. In this comparison though, the instance of delivery (human vs. computer) is confounded with the type of support (process support via scaffoldings during learning vs. strategy support via trainings before learning). So far, there is a lack of web-based trainings (WBTs) that try to equip learners with SRL strategies.

Thus, the aim of this study is to develop a WBT on SRL and to evaluate its effect on SRL competencies and objective learning outcomes.

Methods

170 prospective students (130 male, 40 female) with a mean age of 20.11 (SD = 2.23) participated in the evaluation study. They were enrolled in an e-learning course at a Technical University in Germany in which they prepared themselves for mathematically oriented fields of study (computer science, civil engineering, mechanical engineering or mathematics). The e-learning course (built with the learning management system Moodle) covered mathematical knowledge from all school grades and provided learners with definitions, arguments, examples, assignments and visualizations. Duration of both the course and the study was four weeks in which all participants had the freedom to decide for themselves what to learn, when to learn and how to learn.

The study design was a pre-post test evaluation with participants randomly assigned to one of two study groups: The experimental group attended a web-based training on self-regulated learning while the control group was not supported in their learning process.

The three lessons of the WBT were constructed with Moodle and were free to be attended each within a two-day time frame with intervals of one week between two lessons. The content of the lessons was based on the process model of self-regulated learning (Schmitz & Wiese, 2006). The first lesson ("Before Learning") focused on the preactional phase and included the topics goal setting and time management. Lesson 2 ("During Learning") dealt with the actional phase and included the topics volition, cognitive learning strategies and metacognitive learning strategies. The third lesson ("After Learning") highlighted the postactional phase and included the topics attribution and reflection. Each lesson applied presentations, tests, exercises and group discussions in an online forum. Mean time necessary to attend one lesson was 90 min.

In both pre and post test a test of mathematical knowledge and a test of knowledge about learning strategies were applied. Furthermore, self-regulation questionnaires were applied, including scales from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993) and the Volitional Components Questionnaire II (VCQII; Kuhl & Fuhrmann, 1998). Additionally, an evaluation form was used and objective behavioral data (log files from the Moodle mathematics course) were recorded.

Results

Results of the evaluation form showed that participants highly appreciated the WBT (e.g., mean consent to the item "It was worth investing the time for the lessons" was $M = 4.67$ (SD = 1.14) on a 6-point Likert-scale). A repeated measures ANOVA on the test of mathematical knowledge did not show significant interaction effects between groups and time, but the majority of questionnaires showed significant improvements from pre to post test of the experimental group compared to the control group, for example: Metacognitive Strategies: $F(1, 168) = 16.251$, $p = 0.008$ and Positive Self-Motivation: $F(1, 168) = 18.890$, $p = 0.010$. Furthermore, the test of knowledge about learning strategies showed a significant increase of knowledge in the experimental group but not in the control group: $F(1, 168) = 107.089$, $p = 0.000$. In the behavioral data a one way ANOVA showed that participants from the experimental group spent more days per week on learning mathematics: $F(1, 166) = 4.418$, $p = 0.037$, $d = 0.322$.

Theoretical and educational significance

The results of this study show that SRL competencies can be trained by means of a web-based training and that such a training can influence not only subjective but also objective measures of learning behavior. As WBTs are more flexible in time and space than trainings in presence, students can access these competencies more easily. Additionally, WBTs are more efficient because once they are constructed they can be administered to an unlimited number of students

without further effort. In the future we plan to develop an adaptive version of the WBT that diagnoses users' SRL competencies and only administers content that optimally fits the individual needs.

SYMPOSIUM

Identifying and measuring self-regulation in young children: the development and validation of the CHILD

David Whitebread, University of Cambridge, United Kingdom; Deborah Pino Pasternak, University of Cambridge, United Kingdom; Donna Bryce, University of Cambridge, United Kingdom; Laura Vuillier, University of Cambridge, United Kingdom; Gerhard Buettner, University of Frankfurt, Germany; Franziska Perels, Saarland University, Germany; Zemira Mevarech, Bar-ilan University, Israel; Adina Shamir, Bar-Ilan University Tel Aviv, Israel; Tamar Levi Reich, Bar-Ilan University Tel Aviv, Israel; Josephin Simchen, University of Frankfurt, Germany

The established orthodoxy within metacognition research has been that metacognitive skills emerge around the age of 8 to 10 years. However, this position has been challenged by recent research at both the methodological and theoretical levels. While experimental and self-report methods have been shown to under-estimate the abilities of younger children, recent evidence from observational studies has established that emergent cognitive, emotional, motivational and social aspects of self-regulation can be identified in the performance and behaviour of young children. This paper reports the development and validation of the CHILD observational instrument, which has been developed for use by teachers and includes items relating to significant self-regulation developments in the 3-6 age range. Exploratory factor analysis, based on a sample of 274 children in the 3-6 age range from different studies in the UK, has revealed a two factor structure with items relating to cognitive, emotional and motivational self-regulation loading on Factor 1, termed Individual Self-Regulation, and items relating to Social Self-Regulation loading on Factor 2. Both factors show high levels of internal consistency. Evidence is presented from the various studies within the UK, which measured the children's self-regulatory skills directly by analysis of their performance on a train track construction task, of the external validity of the instrument. Further validation of the instrument is also reported, based on a sample of 120 children in Germany and Israel. This international evidence consists of a confirmatory factor analysis examining the two-factor model, together with further evidence from the train track task.

This paper focuses on the use of observational methodologies in the investigation of metacognition and self-regulation in young children. While there are significant methodological challenges in this kind of approach, recent research using observational techniques has successfully questioned the established orthodoxy within the literature that metacognitive skills emerge around the age of 8 to 10 years (Stipek et al, 1995; Perry, 1998; Boekaerts, 1999, Whitebread et al, 2005, 2007). As a consequence, it is increasingly recognised that research relying on self-report or verbally-based experimental methodologies may significantly underestimate the metacognitive and self-regulated performance of young children (Van Hout Wolters, 2000; Whitebread et al, 2005), and that there are clear advantages in the use of observational methods (Winne and Perry, 2000; Whitebread et al, 2009). Recent evidence from a range of studies has established that emergent cognitive, emotional, motivational and social aspects of self-regulation can be identified in the performance and behaviour of young children (Bronson, 2000; Rothbart, Posner & Kieras, 2006; Whitebread et al, 2005, 2007, 2009).

This paper reports the development and validation of the CHILD (Children's Independent Learning Development) observational instrument, which has been developed for use by teachers and includes items relating to significant self-regulation developments in the 3-6 age range. It is argued that the development of a valid observational instrument which could be reliably used by teachers of children in this age range would be highly beneficial. This claim is based on the now extensive evidence of the significance of developments in cognitive and other aspects of self-regulation for learning (Wang, Haertel & Walberg, 1990; Veenman & Spaans, 2005) and of the effectiveness of a wide range of interventions designed to encourage them (Hattie, Biggs & Purdie, 1996; Swanson et al, 1999; Dignath, Buettner & Langfeldt, 2008). A number of observational instruments have been developed in related areas (Ponitz et al., 2008; Rothbart, Ahadi, Hershey & Fisher, 2001; Gioia, Isquith, Guy & Kenworthy, 2000), but none which cover the various aspects of self-regulation comprehensively and which are designed to be used by teachers in the assessment of typically developing children in the younger age range.

The CHILD instrument was originally developed within the C.Ind.Le (Cambridgeshire Independent Learning) project, and was derived from an original list of 35 statements extracted from the existing literature. As part of this project, 32 teachers made three assessments, at 3-4 month intervals, of approximately 200 children in the 3-5 age range. The details of the procedures whereby this data was used to refine the original list of statements down to a 22-item instrument covering cognitive, emotional, motivational and social aspects of self-regulation have been previously reported (Whitebread et al, 2009). The final 22 statements were identified as those which discriminated most between high and low self-regulated children, which showed the clearest progression between the first and third assessments, and which were perceived as the most significant and easily observable by the teachers in relation to the

children in their class. The 22 item scale achieved a high level of internal consistency (Cronbach alpha = .97) and, in tests of reliability, very high levels of agreement were achieved, between teachers. The use of this scale in a number of subsequent studies also demonstrated clear external validity, with scores significantly correlating with direct measures of metacognitive and self-regulatory skills, inhibition and theory of mind (Perels, Merget-Kullmann, Wende, Schmitz & Buchbinder, 2009; Demetriou, 2009).

Subsequent use of CHILD in a range of studies, within which metacognitive and self-regulatory abilities have also been measured directly, however, has led to further psychometric analysis, refinement and validation of the instrument. This paper reports these further analyses, based on a total sample of 274 children in the slightly extended age-range of 3-6 years in the UK, across 4 studies, and a sample of 120 children in the 5-6 age range in studies in Germany and Israel.

Exploratory factor analysis of data from the UK sample has revealed a two factor structure with 16 items relating to cognitive, emotional and motivational self-regulation loading on Factor 1, termed Individual Self-Regulation, and 5 items relating to Social Self-Regulation loading on Factor 2. Both factors show high levels of internal consistency (Cronbach alpha = .97 for Factor 1 and .89 for Factor 2), and significant levels of test-retest reliability and external and predictive validity. In three of the studies within the UK, for example, the children's self-regulatory skills were also measured directly by analysis of their performance on a train track construction task. Correlation and regression analysis showed strong relationships between these measures and the CHILD factors. In one of the UK studies scores on both factors have also been shown to be significantly related to a range of other direct measures of metacognitive skill and executive functioning (working memory and inhibitory control).

Further validation of the instrument is also reported, based on a sample of 120 children from Germany and Israel. Paralleling one of the UK studies, these children were assessed by their teachers using the CHILD instrument, and were also observed while they completed the train track construction task. This international evidence was used as the basis of a confirmatory factor analysis examining the two-factor model. The relationships between the CHILD factor scores and the direct measures of metacognitive skill from the train track task were once again analysed, and provided clear evidence of the instrument's external validity.

This new data and analysis has resulted in the construction of a revised CHILD instrument, consisting of 21 items, and providing two measures of self-regulation: Individual Self-Regulation relating to cognitive, emotional and motivational aspects (Factor 1) and Social Self-Regulation (Factor 2). The potential of this new instrument as a research tool, and as a diagnostic instrument within educational contexts, is clearly supported by the growing evidence of its external and predictive validity.

SYMPOSIUM

Evaluating and comprehending conflicting information on scientific issues

Chairperson: Joerg Wittwer, University of Goettingen, Germany

Organiser: Joerg Wittwer, University of Goettingen, Germany

Discussant: Panayiota Kendeou, Neapolis University Pafos, Cyprus

When dealing with scientific issues in both formal and informal learning settings, we usually read a multitude of information. This information often directly conflicts with each other and, thus, requires careful evaluation. Such an evaluation can be roughly described as being the result of the interplay between reader-related and information-related characteristics. To understand how such characteristics specifically operate in evaluating conflicting and science-related information, the work presented in this symposium puts emphasis on those reader-related and information-related characteristics that can be assumed to be crucially important for evaluating conflicting and science-related information. On the part of the reader-related characteristics, we focus, for example, on epistemological beliefs and need for cognition. On the part of the information-related characteristics, we focus, for example, on the plausibility and the source of information. The goals of the symposium are threefold. From a methodological perspective, the goal of the symposium is to present various methods for studying evaluation processes. From a theoretical perspective, the goal of the symposium is to deepen our understanding about mechanisms operating in processing information from multiple sources. From an educational perspective, the goal of the symposium is to inform how learning from conflicting information on scientific issues might be improved.

Multiple-documents comprehension strategies, trustworthiness, sourcing and argumentation in essays.

SYMPOSIUM

Comprehension of Text and Graphics, Discourse processing

Oistein Anmarkrud, Department of Educational Research, Norway; Ivar Braten, University of Oslo, Norway; Helge Stromso, University of Oslo, Norway

This study examined how strategic processing of multiple contradictory documents on a social-scientific issue was related to the evaluation of document trustworthiness, as well as to the source citations included in essays. Fifty-one undergraduates thought aloud while reading six different documents about potential relationships between cell phone use and health risks. After having read the documents, participants ranked their trustworthiness and wrote essays where they judged the health risks of cell phone use on the basis of the documents. The think-alouds were coded into episodes of strategic processing, and explicit and implicit references to the six source documents were identified in the essays. Students' overall level of strategic processing while reading the documents was positively related to the total number of source citations included in the essays, the number of explicit source citations, and the number of source citations linking source to content. Positive relations between strategic processing and source citations in the essays were also found for subcategories of multiple-documents comprehension strategies, in particular, intertextual linking strategies and evaluation strategies. Results also showed that the more students engaged in evaluation strategies during reading, the more trustworthy they considered a popular science document presenting a balanced view on the issue and the less trustworthy they considered a textbook excerpt and a document presenting alarming, yet undocumented, information. Further analyses will be performed to investigate the role of source citations in students' argumentation in the essays.

Aims

We examined how strategic processing of multiple contradictory documents on a social-scientific issue was related to the evaluation of document trustworthiness, as well as to source citations and argumentation in essays. Active, deeper-level, and flexible strategic processing seems to be a hallmark of expert reading (Alexander, 2006). Research on strategic text processing has mainly studied individuals trying to comprehend single texts or documents. Essentially, comprehending multiple documents differs from comprehending single documents because it requires that readers build "documents models" by keeping sources apart (i.e., noting and remembering "who says what") and, at the same time, integrating information from textual materials expressing diverse and even contradictory viewpoints (Britt et al., 1999).

Drawing on work on the reading of multiple documents (e.g., Strömsö et al., 2003; Wineburg, 1991), Afflerbach and Cho (2009) developed a taxonomy of strategies involved in the reading of multiple documents, consisting of three categories: 1) identifying and learning important information, for example, comparing and contrasting the document being read with related documents and connecting information from current document with previous document contents; 2) monitoring, for example, detecting a comprehension problem with a particular document and trying to solve the detected problem by searching for clarifying information in other available documents and perceiving that multiple documents related to the same topic can provide diverse views about the topic; and 3) evaluating, for example, perceiving and distinguishing the characteristics of different documents (e.g., document types, authors) and evaluating documents' trustworthiness based on these features. Thus far, very little is known about how such strategic processing of multiple documents may be related to the building of documents models encompassing both source information and integrated understandings.

Methodology

Fifty-one undergraduates read the following six documents presenting different views on cell phones and health risks while thinking aloud: 1) a science textbook excerpt explaining the functioning of cell phones and electromagnetic radiation, 2) a document from the National Radiation Protection Authority (NRPA) stating that research has not documented a link between cell phones and cancer, 3) a popular science article presenting a review article written by a brain surgeon who argued that there is solid evidence for the link between cell phone use and brain tumours, 4) a debate article in a health care magazine written by an engineer who took issue with the brain surgeon's view, 5) a document from a power critical magazine claiming that proven links between the use of cell phones and cancer are concealed from the public by the telecom industry and dishonest politicians, and 6) a newspaper article about a musician diagnosed with brain tumour. Source information (author, publisher, document type, and date) was given for each document.

The documents were read in a Google-like environment for the purpose of advising a friend who experienced discomfort using her cell phone. After reading and thinking aloud, participants ranked the trustworthiness of each document and wrote essays where they judged the potential health risks of cell phone use.

Verbalizations were coded as episodes of strategic processing and categorized according to the taxonomy of Afflerbach and Cho (2009). In addition, we created an overarching category of episodes involving the linking of

different documents, which was called intertextual linking strategies. The essays were coded for explicit and implicit references to the six source documents, as well as for argumentation integrating the different views on cell phones and health risks, as opposed to taking a strong, one-sided stance on the issue.

Results

Results showed that the more students engaged in evaluation strategies during reading, the more trustworthy they considered the document from the NRPA which presented a balanced view on the issue ($r_s = .32$, p $r_s = -.41$, p $r_s = -.36$, p

Moreover, students' overall level of strategic processing while reading the documents was positively related to the total number of source citations included in the essays ($r_s = .29$, p $r_s = .31$, p $r_s = .30$, p $r_s = .33$, p $r_s = .32$, p

Finally, students' overall level of strategic processing while reading the documents was positively related to their use of arguments integrating the different views on cell phones and health risks in the essays ($r_s = .37$, p $r_s = .35$, p

Theoretical and educational implications

First, the findings suggest that multiple-documents comprehension strategies may be associated with more trust in balanced information sources and less trust in sources judged to be biased. Interestingly, strategic processing may also be related to less trust in the textbook, that is, with a reduction in the "blind trust" that students often have in this particular information source (Paxton, 2002). Second, strategic processing was found to be related to students' remembering and distinguishing between different information sources as evidenced by their essays. Third, the positive relation between strategic processing and integrated arguments in essays indicates that such processing may also be linked to the construction of a representation combining contradictory viewpoints. Theoretically, this set of findings is consistent with the view that multiple-documents comprehension strategies may facilitate the building of documents models in the sense of Britt et al. (1999). Practically, they suggest that students should be taught such strategies to promote their multiple-documents literacy.

SYMPOSIUM

The role of plausibility and coherence in evaluating competing explanations on scientific issues

Natalie Wahl, Educational Institute at the Georg-August-University of Göttingen, Germany; Joerg Wittwer, University of Göttingen, Germany

In daily life, laypersons often encounter information about controversial scientific issues on the internet. An important characteristic of such controversial scientific issues is that there are competing explanations for a scientific phenomenon. Thus, laypersons need to evaluate the quality of the explanations to understand which explanation best explains the scientific phenomenon. Although theories in the philosophy of science postulate criteria for evaluating the quality of explanations, empirical investigations of the psychology reality of these criteria in a layperson's evaluation are rare. Similarly, it is not clear how characteristics of the internet come into play when evaluating explanations. For example, explanations on the internet are often not presented in a coherent fashion. Against this background, we conducted a study in which we manipulated the plausibility and the coherence of competing explanations for scientific phenomena. A total of $N = 240$ university students were asked to critically read the explanations and to evaluate their quality. The plausibility significantly affected the evaluation of explanations in that plausible explanations were preferred over implausible explanations. The coherence affected only the evaluation of implausible explanations in that implausible explanations that were coherent were preferred over implausible explanations that were not coherent. The results suggest that laypersons tend to routinely check explanations for implausible information. However, when evaluating implausible explanations, their evaluation seems to be contaminated by factors that are not related to the content.

Aims

In daily life, laypersons often encounter information about controversial scientific issues on the internet. A characteristic of such controversial scientific issues is that competing explanations for a scientific phenomenon exist. Thus, laypersons need to evaluate the quality of explanations to understand which explanation best explains the scientific phenomenon.

Theories in the philosophy of science postulate different criteria, such as logical consistency, for evaluating the quality of explanations. However, whether these criteria are used by laypersons as a basis to evaluate explanations has not been the object of much research. Similarly, the criteria formulated in the philosophy of science are assumed to be context-free. Thus, the context in which an explanation is given is expected not to affect explanation evaluation. However, when evaluating explanations on the internet, characteristics of the internet are likely to influence the

evaluation process. For example, information about a scientific issue is often not complete and provided on a single website. Instead, laypersons have to collect information from different websites to arrive at a coherent understanding about a scientific issue. Accordingly, the coherence of information provided on the internet might influence explanation evaluation. For example, research has shown that information is evaluated differently depending on the degree to which information is presented coherently.

Against this background, we examined the role of plausibility and coherence in explanation evaluation. We made the following predictions:

- (1) Laypersons assign a higher quality to plausible explanations than to implausible explanations.
- (2a) Laypersons assign a higher quality to plausible explanations that are coherent than to plausible explanations that are not coherent.
- (2b) Laypersons assign a higher quality to implausible explanations that are not coherent than to implausible explanations that are coherent.

Methodology

A total of $N = 240$ university students participated in the experiment. Their mean age was $M = 21.90$ years ($SD = 3.30$). Of all university students, 71% were female and 29% were male.

We used two independent variables. The first independent variable was difference in plausibility between explanations. The second independent variable was difference in coherence between explanations. Plausibility was manipulated by varying whether the explanations were logically consistent (i.e., plausible) or logically inconsistent (i.e., implausible). Coherence was manipulated by varying whether the explanations were presented as stemming from one website (i.e., coherent) or stemming from several websites (i.e., incoherent). The manipulation resulted in six experimental conditions in which the two explanations differed in their plausibility and/or in their coherence. The dependent variable was the difference between the quality scores that participants assigned to the two explanations. If the difference score was greater than zero, the perceived quality of the explanation expected to be preferred (e.g., plausible explanation) was higher than the perceived quality of the explanation expected not to be preferred (e.g., implausible explanation). If the difference score was smaller than zero, the perceived quality was lower.

The experimental procedure was as follows: First, the participants reported their prior knowledge about the scientific phenomena under study. Second, they read a description of the scientific phenomenon to be explained. Third, they read two competing explanations for the scientific phenomenon. Fourth, they evaluated the quality of the two explanations on a 5-point-scale ranging from good to bad. Fifth, their need for cognition was measured by a questionnaire. In total, participants read explanations for the following scientific phenomena: biological aging, ball lightning, and dinosaur extinction.

Results

First, we tested the plausibility hypothesis that participants would prefer plausible explanations over implausible explanations. We calculated an ANCOVA with the difference in plausibility and coherence as independent variables, prior knowledge and need for cognition as covariates, and the difference scores as dependent variable. The results showed a significant main effect for the difference in plausibility between the two explanations, $F(1, 167) = 5.23$, $p < .05$, $\eta^2 = .03$. As expected, plausible explanations were assigned a higher quality than implausible explanations.

Second, we tested the coherence hypothesis that plausible explanations would be assigned a higher quality and implausible explanations would be assigned a lower quality when they were coherent. We computed two planned contrasts comparing explanations that differed in their plausibility and in their coherence against explanations that differed in their plausibility but not in their coherence. The first contrast with plausible and coherent explanations vs. implausible and not coherent explanations as reference condition was not significant, $F(1, 167) = 0.00$, ns, $\eta^2 = .00$. Hence, coherence made plausible explanations not significantly better. The second contrast with implausible and coherent explanations vs. plausible and not coherent explanations as reference condition was significant, $F(1, 167) = 3.82$, $p = .05$, $\eta^2 = .03$. Contrary to expectation, coherence made implausible explanations not worse but better.

Theoretical and educational implications

The experiment demonstrated the psychological reality of a preference for plausibility in processing competing explanations. Participants evaluated the quality of plausible explanations as higher than the quality of implausible explanations. Hence, even though participants possessed little knowledge about the scientific phenomena, they were able to detect the logical inconsistencies in the implausible explanations. However, albeit significant, the effects of plausibility on perceived quality were rather small. This suggests that participants did not have a strong preference for plausible explanations. It might be assumed that, due to their low knowledge, it was difficult for the participants to

identify all logical inconsistencies in the explanations. The results also showed that coherence operated differently in evaluating explanations depending on their plausibility. First, coherence did not make plausible explanations better. Obviously, the plausibility of the explanations mainly guided the evaluation process and, thus, devaluated coherence as an explanatory virtue. Second, coherence made implausible explanations better. This result indicates that, in evaluating implausible explanations, laypersons were erroneously influenced by a superficial characteristic of explanations like their coherence. From an educational perspective, the findings suggest that laypersons need to be supported in critically evaluating explanations. From a theoretical perspective, the findings suggest that models of multiple-documents comprehension might take into account explanations as a specific type of texts influencing the evaluation process.

SYMPOSIUM

Author attributes and adaptivity of epistemological beliefs as predictors of source evaluation

Torsten Porsch, WWU Munster, Germany; Rainer Bromme, Universitat Muenster, Germany

Scientific information in online environments is often conflicting and fragmentary. Laypersons have to take attributes of authors and their own beliefs about nature of knowledge into account in order to evaluate the sources of conflicting information. The purpose of our studies is to consider attributes of author (expertise and trustworthiness) and student's adaptivity of epistemological beliefs when dealing with conflicting information in online environments. In the first study, 118 high school students read an online information text about plans for a tidal power plant. Afterwards, an online blog entry contradicts with the information in the text and demands a different version of the power plant. Author's attributes are varied experimentally. Students had to make a decision for one version of the tidal power plant or abstain from a decision and look for further information. Results show that a less trustworthy expert causes students to abstain from a decision and look for further information. A moderate qualified but trustworthy layperson with less expertise induces students to decide for one of the tidal power plant versions. Additionally the adaptivity of epistemological beliefs mediates the impact of author attributes on student's decision or abstaining from a decision. The study indicates effects on online participation and extends the scope on author attributes with regard to change in epistemological beliefs.

Aims

Social and political participation in modern societies entails making decisions about themes which we – as laypersons with regard to most of these issues – cannot understand in detail ("socio-scientific issues"; e.g., energy politics), instead we have to rely on experts. Modern societies offer a great variety of such experts, and access to expert knowledge has become easy, particularly, via the Internet (Bromme, Kienhues, & Porsch, 2010). Experts often disagree and provide conflicting information. Especially dealing with science information requires strong abilities to evaluate sources (Rouet, Britt, & Perfetti 1997; Stadler & Bromme, 2007). The capabilities of evaluating sources are an essential element of "digital literacy" (Coiro et al. 2008; Goldman et al. 2010; Rouet 2006; Wiley et al. 2009), but it is still not exactly known what these capabilities consist of and how they relate to other student variables. Individual parameters such as the awareness of context and situation as well as features of the sources are crucial, and there is a great need for empirical research on these variables (e.g. Baram-Tsabari et al. 2009; Porsch, Bromme, & Pollmeier, 2010; Porsch & Bromme, accepted). Attributes of authors (e.g., expertise or trustworthiness) in online environments are multidimensional and often inconsistent and incomplete. Authors can be experts in a domain but biased in reasons for providing information (e.g., by money givers). Trustworthy authors are not always experts. We ask for the influence of author's attributes on students' decisions or abstaining from a decision to look for further information. In addition to attributes of authors, reader's epistemological beliefs play an important role in source evaluation and we also include this variable. We focus on readers' adaptivity of epistemological beliefs. Whitmire (2004), Bråten, and Strömsö (2010), Mason and Boldrin (2008), Hofer (2004), and Stadler and Bromme (2008) report about the relationship between epistemological beliefs and how people search the Web and deal with conflicting information. Within these research accounts it has been assumed that someone who conceives knowledge as being static and as a collection of clear but separated facts, evaluates sources less elaborated than a person holding more dynamic beliefs about knowledge (i.e., conceiving knowledge as dynamic, interrelated, and constructed). We bear on this research, but we focus on the adaptivity of epistemological beliefs. There are topics and circumstances where a static view on knowledge is more appropriate than a dynamic one (Bromme, Kienhues, & Stahl, 2009; Hammer & Elby, 2002). In preceding studies we have found (Kienhues, Bromme, & Stahl, 2008) that some students change their epistemological beliefs on single topics when they are confronted with information highlighting controversies and conflicts. We assume that this change in epistemological beliefs (here called "adaptivity of epistemological beliefs") mediate the impact of author's attributes on students' willingness to make a decision or to look for further information and thereby to abstain from a decision. In some cases, it is crucial to choose the one most appropriate and trustworthy source (Iding et al. 2009; Metzger & Flanagin 2008). But, there are also cases in which it is reasonable to abstain from a decision and look for further information.

Methodology

In a first study, 118 (99 female) high school students were randomly recruited during an open day at the university. Mean age was $M = 17.9$ ($SD = 0.82$). Students read online an information text about a city planning a tidal power plant. Functions and mechanisms of the tides and the tidal power plant were explained in the text, figures illustrated the text. Afterwards, students read an online blog entry exemplifying that the tidal power plant should be build in a more expensive version caused of scientific findings about the change of the tides in the long run. Students were assigned by a random generator to two subsamples receiving one of two different descriptions of the author's attributes. One subsample ($n = 55$) received a description depicting the author as an expert on this topic but as less trustworthy. The second subsample ($n = 63$) received a description depicting the author as a moderate qualified layperson with less expertise but as very trustworthy. As a dependent variable, students had to decide for which version of the tidal power plant they would vote or if they would abstain from a decision and look for further information. Students' adaptivity of epistemological beliefs about the topic was determined by administering an epistemological questionnaire (CAEB; Stahl & Bromme, 2007) before and after reading the texts. In a second study, we used the same materials, but conducted the experiment with a bigger sample. Furthermore we added three further versions of the description of the author's attributes (author is an expert and trustworthy; author is neither an expert nor trustworthy; no information about the author).

Results

The results of the first study show that a less trustworthy expert causes students to abstain from a decision and look for further information. The moderate qualified but trustworthy layperson with less expertise induces students to decide for one of the tidal power plant versions ($\chi^2 = 7.31$; $df = 2$; p Theoretical and educational implications). The results indicate that online participation (e.g., in blogs) is influenced by author's attributes. Laypersons are encouraged to share their decisions by – sometimes amateurish – comments of other laypersons. In contrast a less trustworthy but expert authors make student laypersons to act with reserve and look for further information. Furthermore the studies extend the scope on effects of author's attributes with adaptivity of epistemological beliefs. Next to a direct impact of author's attributes, adaptivity of epistemological beliefs mediates the influence on students' decision or abstaining from a decision.

SYMPOSIUM

Bridging the Different Worlds of Teachers and Students in the Same Learning Environment

Chairperson: Karen Konings, Maastricht University, Netherlands

Organiser: Karen Konings, Maastricht University, Netherlands

Tina Seidel, Technische Universitat Munchen, Germany

Discussant: Christine Pauli, University of Zurich, Switzerland

People involved in education all have their own perspectives: Teachers and educational designers (as developers and providers of a learning), and students as "consumers" of these environments. Although it is mostly common practice that teachers/designers predominantly operate from their own "world", we argue that it would be beneficial to enhance the integration of student perspectives. Human factors engineering and human-computer interaction studies stress the importance of including users of any system in its design phase. The Combination-Of-Perspectives (COOP) model of Konings et al. (2005) proposes feedback loops between students and teachers/designers and between teachers and designers. This symposium is aimed to focus on decreasing the discrepancies in perceptions between students and teachers on education. In the first presentation, a study will be presented investigating existing differences between teachers' and students' perceptions on a learning environment. Using latent class analyses, profiles are defined of students and teachers being at risk experiencing adverse discrepancies in perceptions. After specifying the problem during the first presentation, the second and third presentation will provide different possible ways to reduce these discrepancies. Jan Zottmann and colleagues will present a study on improving teachers' ability to become immersed in multiple perspectives. Finally, Eleni Kyza and colleague will present a study on participatory designing an innovative web-based learning environment, including teachers, researchers, and designers in the design phase, and incorporating students' input. Challenges and realities of including students in the design process will be discussed.

SYMPOSIUM

Students' and Teachers' Perceptions of Education: Differences in Perspectives

Karen Konings, Maastricht University, Netherlands; Tina Seidel, Technische Universitat Munchen, Germany; Saskia Brand-Gruwel, Open University, Netherlands; Jeroen Van Merriënboer, Maastricht University, Netherlands

Teachers and students have their own perspectives on education. Congruent perspectives contribute to facilitating teaching-learning processes and help to achieve optimal learning outcomes. This study investigates both teachers' and students' perceptions on a learning environment in Dutch secondary education. It is aimed to define which students are at risk experiencing adverse discrepancies to their teachers' perceptions. Additionally, teacher profiles are defined on their discrepancies to students' perceptions. All tenth graders (N = 994) of four schools and their teachers (N = 136) filled out the Inventory of Perceived Study Environment Extended. In addition, students filled out the Inventory Learning Styles (ILS-SE) and teachers completed the Approaches to Teaching Inventory (ATI). By using Latent Class Analyses profiles in difference scores were defined. Profiles were characterized by analyzing differences on the ILS-SE and ATI. Teachers' perceptions were mostly more positive than students' perceptions. LCA profiles showed a 'distal' student profile which was at highest risk and experienced most motivational problems. Also, for the 'intermediate' student profile the discrepancy between perceptions was related to negative learning-related characteristics. Analyzing teacher profiles, 'idealistic' teachers were at risk to cause destructive friction. This study stresses the importance of improving congruence between perceptions. Future research has to focus on effective interventions. Improving teachers' immersion in the students' perspective or including students in the instructional design process to better account for their perceptions might be beneficial.

Aims

Teachers and students have different perceptions of the same learning environment. Teachers tend to perceive it more favorable than their students do (Fraser & O'Brien, 1985). A good fit between students' competences and interests, and the design of the learning environment influences effectiveness of learning and commitment to study (Neuenschwander, 2008). Some friction between students' learning strategies and teacher's teaching strategies can have a positive effect by stimulating students to develop more mature learning strategies (i.e., constructive friction). But friction can also cause a decrease in learning and thinking skills when discrepancies are too large (i.e., destructive friction; Vermunt & Verloop, 1999). In today education, there has to be mutual adaptation of teachers' and students' responsibilities and tasks. This requires more collaboration between teachers and students, which stresses the importance of congruence between their perspectives on education. The problem with existing studies on differences between students' and teachers' perceptions is that it is difficult how to improve instruction on global information about differences in perceptions. Therefore, the main goal of the current study is to investigate the existence of meaningful student profiles with respect to their difference in perceptions compared to their teachers. At the same time, it is aimed to determine profiles for teachers. Comparing these subgroups with respect to learning-related characteristics (for students) and approaches to teaching (for teachers) enables to define which students and teachers are at highest risk to experience large discrepancies that might cause destructive friction.

Methodology

Participants were 994 tenth grade students and 136 teachers from four schools for secondary education. Students filled out two questionnaires: The Inventory of Perceived Study Environment Extended (IPSEE) and the Inventory of Learning Styles for Secondary Education (ILS-SE). The IPSEE (Könings et al., 2008) includes eight scales: Fascinating contents, productive learning, integration, student autonomy, interaction, differentiation, clarity of goals, and personalization. The ILS-SE (Picarelli et al., 2006) measures students' learning-related characteristics and consists of 16 scales about processing strategies, regulation strategies, motivational orientations, conceptions of learning, and affective processing strategies. Teachers filled out two questionnaires: (1) a parallel version of the IPSEE (teacher version), measuring perceptions with respect to the learning environment, and (2) Approaches to Teaching Inventory (Prosser & Trigwell, 1993), measuring teaching approaches: Information-transmission/teacher-focused and conceptual-change/student-focused. For each student, difference scores were computed between perception scores and the mean teachers' score on the corresponding scale (called 'student differences'). Additionally, difference scores were computed between the teacher's perception scores and the mean of student scores (called 'teacher differences'). Using Latent Class Analysis (LCA) we defined profiles with respect to both student differences and teacher differences.

Results

Student Differences. The LCA solution with three latent classes fits the data best. These three student profiles vary in the degree to which student perceptions differ from teacher perceptions. All students predominantly perceived the learning environment less positive than teachers did. Students in the 'closest match profile' showed smallest differences between students' and teachers' perceptions. Difference scores in the 'intermediate profile' were larger than in the closest match profile, but smaller than in the third profile, called 'distal profile'. ANOVA's on differences with respect to student characteristics (ILS-SE) yielded a number of significant differences so that results with $d \geq .40$ are summarized. Closest match students reported more use of self-regulation strategies than intermediate students. They were more vocation-oriented, more intrinsically motivated, and less ambivalent motivated than all

other students. They conceived learning more as construction and use of knowledge than others. Finally, closest match students experienced less motivation/concentration problems than distal students. Teacher Differences. LCA yielded a two class solution. Teachers in the 'idealistic profile' perceived the learning environment as much more powerful than their students. Teachers in the 'adaptive profile' had smaller discrepancies with students' perceptions and, additionally, they showed mixed differences across scales. Teachers with idealistic profile had lower scores on information transmission ($d = .53$) and higher scores on conceptual change ($d = .69$) than teachers with adaptive profile.

Discussion

This study aimed at identifying students and teachers who are at risk for experiencing large discrepancies in their perspectives on education. LCA enabled us to define student' and teacher' profiles that provide a comparative picture of the situation. It showed that the distal student profile is at highest risk and experience most motivational problems. Substantial differences were found between student characteristics of closest match students and distal/intermediate students, but not between distal and intermediate students. This implicates that, also, for the largest group of students (i.e., intermediates; 59 %) the discrepancy related to negative learning-related characteristics. From the teachers' perspective it is shown that idealistic teachers are at risk to be too progressive and to cause destructive friction, especially for distal and intermediate students. Otherwise, adaptive teachers may cause destructive congruence (i.e., too little challenge) for closest match students. This study stresses the importance of improving congruence between perspectives of students and teachers, since the majority of the students experience substantial discrepancies. Teachers' immersion in the students' perspective and adaptation of instruction may prevent losing them during educational innovations. Another possibility would be to include students in the instructional design process (i.e., participatory design) to be able to better account for students' perspectives. Future research has to focus on finding effective interventions to decrease discrepancies.

References

- Kl nings, K. D., Brand-Gruwel, S., van Merri nboer, J. J. G., & Broers, N. (2008). Does a new learning environment come up to students' expectations? A longitudinal study. *Journal of Educational Psychology*, 100, 535-548.
- Neuenschwander, M. P. & Garrett, J. L. (2008). Causes and consequences of unexpected educational transitions in Switzerland. *Journal of Social Issues*, 64, 41-57.
- Picarelli, A., Bouhuijs, P. A. J., & Vermunt, J. D. (2006). Learning style and learning environment in secondary education: The Netherlands and Flanders compared. *Pedagogische Studi n*, 83, 139-155.
- Prosser, M., & Trigwell, K. (1993). Development of an approaches to teaching questionnaire. *Research and Development in Higher Education*, 15, 468-473.
- Vermunt, J. D., & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction*, 9, 257-280.

SYMPOSIUM

Enhancing Computer-Supported Case-Based Learning for Pre-Service Teachers - A Matter of Perspective?

Jan Zottmann, University of Munich, Germany; Annika Goeze, University of Tuebingen, Germany; Frank Fischer, Universitat Munchen, Germany; Josef Schrader, University of Tuebingen, Germany

The ability to understand and analyse classroom situations can be seen as a central aspect of the professional competency of teachers. While case-based learning is considered to have great potential for the promotion of the analytical competency of teachers, attempts to investigate the effects of corresponding instructional support have been scarce. Hence, an empirical study was conducted to investigate the effects of instructional support in the form of hyperlinks to conceptual knowledge and multiple perspectives in a computer-supported case-based learning environment based on the principles of the Cognitive Flexibility Theory. 97 prospective foreign-language teachers participated in this field study with a 2x2-factorial design. The study was realised as a four-day university course with individual and collaborative phases of case-based learning. Individual learning outcomes reveal that specific components of analytical competency could be fostered by the different treatments: participants who were supported with hyperlinks to conceptual knowledge (i.e., pedagogical models and theories of learning and instruction) drew on conceptual knowledge more often in the post-test case analyses, while participants supported with hyperlinks to multiple perspectives (i.e., authentic comments of the teachers and learners from the cases) adopted teacher and learner perspectives more often at the end of the course. Process analyses show that particularly the hyperlinks to multiple perspectives affected the small group discussions of the cases as they helped case-based learners to adopt the relevant perspectives. These results underline the importance of adequate instructional support for effective case-based learning in teacher education.

Aims

The professional competency of teachers is strongly connected to their competency of being able to understand and analyse classroom situations (Goeze & Hartz, 2008). Analytical competency can be structured into (1) the ability to portray pedagogical situations in a differentiated way, (2) the ability to become immersed in multiple perspectives (especially those of teachers and learners, see Oser & Baeriswyl, 2000), and (3) the ability to apply conceptual knowledge to case information in order to better understand the situation at hand. Case-based learning is considered to have great potential for promoting analytical skills in teacher education (Lundeberg, 1999) and is also expected to enable learners to broaden their viewpoint beyond their own perspectives (Fitzgerald et al., 2009). Recent empirical studies, however, have demonstrated that learners do not get the most out of case-based learning without additional instructions (e.g., Moreno & Valdez, 2007). Cognitive Flexibility Theory (CFT) can be drawn upon as a basis for instructional support that seeks to further flexible knowledge application in different real situations, increase awareness of one's own perspective, and allow for the construction of connections to alternative perspectives (Spiro, Collins, Thota, & Feltovich, 2003). Against this backdrop, the study presented here aimed to answer the following research question: how do hyperlinks to conceptual knowledge, hyperlinks to multiple perspectives, and a combination of both facilitate the analytical competency among pre-service teachers in a computer-supported case-based learning environment? Moreover, collaborative learning processes were investigated to find out if instructions like these may help counteract known deficits of case-based learning, i.e. learners tending to get sidetracked instead of analyzing the case in a goal-oriented way, and insufficient immersion of case-based learners (Zottmann et al., in press). We hypothesised for learning process and outcomes that the availability of conceptual knowledge would have a positive effect on the application of conceptual knowledge, and the availability of multiple perspectives a positive effect on immersion.

Methodology

A total of 97 prospective foreign language teachers participated in this field study with a 2x2-factorial design, the factors being "conceptual knowledge" and "multiple perspectives". The case-material for the study was recorded in regular English lessons for intermediate learners. Authentic case sequences of up to 15 minutes were implemented in a computer-supported learning environment that was developed for this study based on the ideas of the CFT. The study was realised as a four-day university course for prospective foreign language teachers. On day one, the participants were introduced to case-based learning within the scope of a lecture, before control variables and demographic data were assessed. Subsequently, learners wrote a pre-test case analysis without instructional support. For the following four training cases on days two and three, the experimental conditions were realised: the factor "conceptual knowledge" was varied by providing / not providing hyperlinks to pedagogical models and theories of learning and instruction (Cognitive Apprenticeship being of them, for instance), while the factor "multiple perspectives" was varied by providing / not providing hyperlinks to authentic comments made by the teacher and learners from the video. These comments were generated from interviews conducted a few weeks after the course. For quantifying the dependent variable analytical competency, a complex coding scheme for the measurement of analytical competency was developed that incorporated its aforementioned three components. Regardless of the condition, learners analysed each training case individually (40 min.) and in groups of three (65 min.). The small group interactions were recorded on video to investigate the learning processes. On day four, learners had to write a post-test case analysis individually, without instructional support.

Results and Conclusions

Individual learning outcomes show that learners drew on conceptual knowledge more often in their post-test case analyses when hyperlinks to conceptual knowledge were available to them throughout the course, $F(1;92)=9.97$; $ph2=.10$. Learners supported with hyperlinks to multiple perspectives adopted teacher and learner perspectives more often in the post-test than participants who did not have this support, $F(1;92)=6.04$; $ph2=.06$. With respect to the learning processes observed in the small groups, the hyperlinks to multiple perspectives led to an increase of immersion, $F(1;92)=4.90$; $ph2=.05$. With respect to sidetracking, however, a significant interaction between the two factors was found, $F(1;92)=4.43$; $ph2=.05$. Learners in the combined condition made fewer case-related statements than learners in any other experimental condition. In summary, results of this study provide evidence that additional instructional support in the shape of hyperlinks to conceptual knowledge and multiple perspectives embedded in a computer-supported environment can enhance the effectiveness of case-based learning by fostering specific components of analytical competency - a competency that is crucial for teachers' professional performance.

References

- Fitzgerald, G., Koury, K., Mitchem, K., Hollingshead, C., Miller, K., Park, M. K., & Tsai, H. (2009). Implementing case-based instruction in higher education through technology: what works best? *Journal of Technology and Teacher Education*, 17(1), 31-63.
- Goeze, A., & Hartz, S. (2008). Die Arbeit an Fällen als Medium der Professionalisierung von Lehrenden. *Report. Zeitschrift für Weiterbildungsforschung*, 31 (3), 68-78.

Lundeberg, M. A., Levin, B. B., & Harrington, H. L. (Eds.)(1999). Who learns what from cases and how? The research base for teaching and learning with cases (pp. 3-23).
 Mahwah, NJ: Erlbaum.

Moreno, R., & Valdez, A. (2007). Immediate and delayed effects of using a classroom case exemplar in teacher education: the role of presentation format. *Journal of Educational Psychology*, 99(1), 194-206.

Oser, F. K., & Baeriswyl, F. (2000). Choreographies of teaching: Bridging instruction to learning. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 1031-1065). New York: Macmillan.

Spiro, R. J., Collins, B. P., Thota, J. J., & Feltovich, P. J. (2003). Cognitive flexibility theory: hypermedia for complex learning, adaptive knowledge application, and experience acceleration. *Educational Technology*, 42(5), 5-11.

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SYMPOSIUM

Participatory Design for Effective Web-based Learning Environments

Eleni Kyza, Cyprus University of Technology, Cyprus; Iolie Nicolaidou, Cyprus University of Technology, Greece

Participatory design is widely used in studies of human-computer interaction and less so in cognitive and educational studies. The premise upon which it is based is simple: for a design to address the users' needs, users should be part of the design process. This premise is beginning to be acknowledged in relation to teachers but is still in nascent form when it comes to students, who are the end users of the instructional materials. In this paper, we present data from a longitudinal design-based research study, during which teachers, researchers, designers, and science content experts participated in a two-year effort to design an innovative web-based learning environment. Teacher data were collected from design planning meetings, classroom enactment planning sessions, and teacher interviews. Students' input was gathered through tasks, classroom observations, pre- and post- tests and motivation measuring instruments, and interviews. The data were analyzed using qualitative and quantitative methods. Results indicate that the teachers' perspective on the design strongly influenced the design and the enacted experience while students' feedback served as a guiding structure for the redesign of the learning environment. The implications of the teachers' and students' participation in the design process is discussed with particular emphasis on a critical, reflective analysis of open questions that pertain to the involvement of these two key categories of actors in the design process.

Aims

Modern societies call for radical changes in how people learn, moving away from industrial models of teaching and learning and embracing constructivist ideas. Many educational systems are at the center of heated discussions about what needs to change and how, with researchers actively being involved in reform- and research-based instructional design. These efforts have led to success stories, usually at the level of a teacher or a school but have also documented many problems. Failed innovations, lethal mutations, lack of scalability, loss of student interest are all challenges which have been documented in the literature. Teachers' uptake of reform-based innovations has been a recent focus in the reform literature, as teachers are seen as a decisive factor in the successful implementation of an innovation, resulting to calls to include teachers in the design of educational materials. However, the role of the student has been traditionally largely ignored: even though students' perceptions are often measured as part of evaluation studies not much attention has been given to students' role as a key stakeholder during the design process. In this proposal, we describe a design-based research program and present data about the role of the teacher and of the students in participatory design. Qualitative and quantitative data, collected over a period of two years, provide empirical validation of the effectiveness of the participatory design processes but also provide the opportunity to problematize the construct of participatory design.

Methodology

To examine the role of teachers and students in participatory design we collected various data, following the design-based research methodology, during which development and research take place through continuous cycles of design, enactment, analysis, and redesign (Brown, 1992). A team consisting of two university researchers and three practicing teachers participated in a two year-long design of a web-based environment to support secondary students' inquiry-based learning. The role of the teacher was examined by analyzing data from design sessions, lesson planning sessions, and teacher interviews throughout the design process. Twelve students participated in the pilot enactment and 21 students participated in the second enactment of the learning environment. Students' input was solicited through an analysis of usability testing, students' interactions with the instructional materials, formative assessment of students' learning processes, pre-post achievement tests, and two motivation surveys. The FAM motivation instrument (Vollmeyer & Rheinberg, 2003) addressed challenge, interest, probability of success, and anxiety factors. The FKS motivation instrument (Rheinberg, Vollmeyer & Engeser, 2003) measured flow, defined as a working state in which a person is fully absorbed in a task.

Findings

The teachers' role Findings indicate that the effectiveness of the teachers' participation in the design process depended on the role the teacher held during enactments: during the pre-enactment design phase all three teachers engaged in conversations about content and pedagogy, which could not have been possible if only one teacher was included in the design team. The ability of the non-enacting teachers to provide input about the design during the enactment phase was constrained because of the lack of first-hand experience of what was happening in the class. The enacting teacher's participation in the design process led to increased feelings of ownership of the materials. These results suggest that it is important to involve more than one teacher in the participatory design process but that their capacity to meaningfully inform iterative design will be mediated by the opportunities they have to experience the interactions during enactment.

The students' role

The examination of the students' learning processes, learning products, and the teacher's feedback from classroom enactments guided the revision of the learning environment. This analysis was necessary, despite statistically significant learning gains during the pilot enactment for both conceptual understanding and assessing the credibility of data. The qualitative analysis indicated that students had difficulties focusing on methodological issues of the studies they evaluated. Building on the results of the pilot study, the design team emphasized methodological issues to better support students. A paired samples t-test indicated significantly better results in post-tests in conceptual understanding, $t(17) = -2.60$, $p = .019$, $d = .61$ and credibility skills, $t(17) = -5.97$, $p = .001$, $d = 1.40$. Results from the analysis of students' motivation using the FAM and FKS questionnaire during the pilot enactment showed statistically significant results for the "probability of success" factor, $z(12) = -2.09$, $p = .04$. Significance Involving teachers in the design process and soliciting students' input led to a successful learning environment, as measured by the results of the pre-post tests on conceptual understanding, credibility skills, and motivation. An open question is the extent to which we could increase student involvement in the design process. This approach was not adopted due to logistics. Even though it appears that the effectiveness of the designed learning environment was not compromised we believe that future studies should explore the potential of ongoing student feedback in improving designs and enactment experiences. The teacher's self-reports about increased motivation to engage in the curriculum and the teacher's sense of ownership are encouraging, in light of the challenges reported in the literature regarding the sustainability of reform-based efforts. These results also raise concerns about existing curriculum development frameworks and suggest a need to revisit policy frameworks on scaling up innovations.

References

- Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences*, 2(2): 141-178.
- Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die Erfassung des Flow-Erlebens [The assessment of flow]. In J. Stiensmeier-Pelster & F. Rheinberg (Eds.), *Diagnostik von Motivation und Selbstkonzept* [Diagnosis of motivation and self-concept] (pp.261-279). Gottingen, Germany: Hogrefe.
- Vollmeyer, R., & Rheinberg, F. (2003). Aktuelle Motivation und Motivation im Verlauf [Current motivation and on-line motivation]. In J. Stiensmeier-Pelster & F. Rheinberg (Eds.), *Diagnostik von Motivation und Selbstkonzept* [Diagnosis of motivation and self-concept] (pp. 281-295). Gottingen, Germany: Hogrefe.

SYMPOSIUM

The eye in the web: Investigating web search with eye tracking with cued retrospective reports

Chairperson: Halszka Maria Jarodzka, Open University of the Netherlands, Netherlands

Organiser: Halszka Maria Jarodzka, Open University of the Netherlands, Netherlands

Discussant: LADISLAO SALMERON, UNIVERSITY OF VALENCIA, Spain

The WWW has become an important source for retrieving novel information. Hence, it is increasingly used for educational purposes, although, students search information often in a superficial manner (Stadtler & Bromme, 2007). The aim of this symposium is to get a better understanding of processes involved in web search to state recommendations for educational scenarios.

The task of searching information on the WWW is composed of overt actions that can be investigated by logging data, like mouse clicks (Kammerer & Gerjets; Argelagôs, Jarodzka & Pifarré; both this symposium). More important, however, this task is composed of covert processes of perceptual and cognitive nature. Perceptual processes, i.e.,

information on where a person paid attention to, for how long, and in which order, can be investigated by eye tracking. This method captures processes that are difficult to express verbally due to their fast speed, high automatization, or visual representation in working memory (Ericsson & Simon, 1993). On the other hand, this method does not provide information on why a person paid attention to an area, i.e., on cognitive processes. Thus, to interpret eye tracking data, it should be combined with a method that captures cognitive processes, like cued retrospective reporting.

The presentations in this symposium address the advantages of methodological triangulation to investigate WWW search in evaluating found information depending on expertise (Brand-Gruwel, Van Meeuwen & Van Gog) or on search list design and epistemic beliefs (Kammerer & Gerjets) and as a methodological comparison to single data sources (Argelagôs, Jarodzka, & Pifarré).

Effects of search interface and epistemic beliefs on source evaluations during medical Web search

Yvonne Kammerer, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

This study examined the impact of the interface design of search engines as well as of Internet-specific epistemic beliefs on laypersons' source evaluations during Web search for a complex medical issue. Participants either received search results provided in a Google-like list interface with search results presented in a rank-ordered list or in a grid interface with search results presented in a 3x3 matrix, thus possessing no clear ranking order of the search results. Furthermore, participants' epistemic beliefs about the Web as a knowledge source were assessed. To examine participants' source evaluations, search results were presented either in an optimal order with the most trustworthy search result being on top of the list or in the upper left corner of the grid, respectively, or in a reversed suboptimal order with the most trustworthy search result being at the bottom of the list or in the bottom right corner of the grid, respectively. Results revealed that in the suboptimal order university students using the grid interface fixated significantly shorter on search results of low trustworthiness and selected significantly more search results of high trustworthiness than students using the list interface. Furthermore, grid interface users verbally reflected more on the quality of search results and less on their ranking-position than list interface users. Additionally, with regard to Internet-specific epistemic beliefs eye-tracking data and verbal reports revealed that the naïve belief that the Web is a reliable source of certain and correct knowledge was related to less source evaluations on SERPs and on Webpages.

The WWW has become a major source for laypersons to search for medical and health information. However, as anyone can publish virtually anything on the WWW, the trustworthiness of Web information varies considerably, with many medical Websites containing misleading or even false information. Despite this fact, previous research has shown that during Web search for medical issues laypersons often do not spontaneously engage in source evaluations to verify the reliability and trustworthiness of information (e.g., Stadtler & Bromme, 2007). Furthermore, when using search engines, searchers usually direct most attention to the search results in the top of the search engine results page (SERP) and also predominantly select these first few results (e.g., Pan et al., 2007). In the present study we examined two potential reasons for these findings: the interface design of SERPs and searchers' epistemic beliefs. Standard SERPs might not provide sufficient affordances for searchers to engage in own evaluations, as search results are presented in a rank-ordered list (cf. Google) which suggests to start reading at the top of the list and simply to follow its order. Therefore, we compared a Google-like list interface to a grid interface that presented search results in a 3x3 matrix.

We hypothesized that the grid interface which provided no clear ranking order would increase the awareness of the selection process, and thereby would stimulate users to evaluate search results, for instance in terms of trustworthiness. Furthermore, searchers' epistemic awareness of the varying trustworthiness of Web-based information might be an important precondition for realizing the necessity of source evaluations during Web search. Searchers with naïve epistemic beliefs about the Web as a knowledge source might see no need to critically evaluate the trustworthiness of Web-based information (e.g., Bråten, Strömsö, & Samuelstuen, 2005). Thus, we administered participants the "certainty and source of knowledge" scale (8 items; Cronbach's alpha = .84) of the Internet-Specific Epistemological Questionnaire (ISEQ, Bråten et al., 2005).

High scores represented the view that the Web provides certain and correct knowledge. Low scores indicated doubts that the Web is a reliable source of certain and correct knowledge. We hypothesized that naïve beliefs in certainty and source of Web-based knowledge would relate to less source evaluations. To investigate the extent to which participants evaluated the trustworthiness of search results, search results were presented either in an optimal order with the most trustworthy search result being on top of the list or in the upper left corner of the grid, respectively, or in a reversed suboptimal order with the most trustworthy search result being at the bottom of the list or in the bottom right corner of the grid, respectively. Search result trustworthiness was determined in a pilot study where 24

students rank-ordered the search results according to their trustworthiness. In the experiment 80 university students (63 female, mean age: 24.04) were randomly assigned to one of four conditions with trustworthiness order (optimal vs. suboptimal) and search results interface (list vs. grid) varied as between-subjects factors.

Participants' task was to seek information on the WWW about two competing therapies for Bechterew's disease in order to give informed advice to a fictitious friend. For this purpose, participants were presented with two SERPs, each containing nine search results linked to nine Webpages. Participants' eye movements and mouse clicks were registered during task performance which was limited to eight minutes. In addition, cued retrospective verbal protocols were obtained by presenting participants with their gaze recordings and asking them to report what they were thinking during SERP inspection. As indicators of evaluation processes on SERPs we measured the total dwell time on search results and the selection frequency of search results as a function of their trustworthiness, as well as verbal utterances concerning the quality, trustworthiness, type of source, and position of the search results. Furthermore, on the Webpages total dwell times on Webpage logos as well as on source information were assessed. Results of ANCOVAs revealed that when the top search results were of low trustworthiness (suboptimal order) students using the grid interface fixated significantly shorter on the five least trustworthy search results ($p = .06$) than list interface users, whereas there were no differences regarding the more sophisticated criteria trustworthiness and type of source.

Additionally, eye-tracking data and verbal reports revealed that the naïve belief that the Web is a reliable source of certain and correct knowledge was related to shorter dwell times both on search results ($p = .09$). Furthermore, in the suboptimal order condition the respective belief was related to shorter dwell times on the Webpage logos ($p = .09$). To conclude, across different types of processing data the study provides indications that both the interface design of SERPs and Internet-specific epistemic beliefs influence source evaluations during Web search on a complex medical issue. From a practical point of view, these findings may inform the development of concrete interventions, such as design guidelines for search interfaces or trainings addressing the varying trustworthiness of information on the Web.

Bråten, I., Strömsö, H.I., & Samuelstuen, M.S. (2005). The relationship between Internet-specific epistemological beliefs and learning within Internet-technologies. *Journal of Educational Computing Research*, 33, 141-171.

Pan, B., Hembrooke, H., Joachims, T., Lorigo, L., Gay, G., and Granka, L. 2007. In Google we trust: users' decisions on rank, position, and relevance. *Journal of Computer-Mediated Communication*, 12, article 3

Stadtler, M., & Bromme, R. (2007). Dealing with multiple documents on the WWW: The role of metacognition in the formation of documents models. *International Journal of Computer Supported Collaborative Learning*, 2, 191-210.

SYMPOSIUM

Measuring processes in web search: logfiles, eye-movements and cued retrospective reports compared

Esther Argelagos, University of Lleida, Spain; Halszka Maria Jarodzka, Open University of the Netherlands, Netherlands; Manoli Pifarre Turmo, University of Lleida, Spain

Students often use the WWW for searching information to accomplish school assignments. To design instruction to foster student's web searching skills insight in the involved cognitive processes is needed. This study compares Logfiles (LOG), Eye-movements (EYE), and Cued Retrospective Reports based on eye movements records (CRR) to evaluate how different kind of data help to gain insight in the involved cognitive processes. Fifteen participants searched the WWW for information on the planet Mars. LOG and EYE were collected during and CRR data after tasks performance. Results revealed that LOG provided information on the overt actions (web-pages visited, search terms used, answers performed, etc.) and that analysing these actions can give insight in the main cognitive processes involved in web searching. However, when scoring participants regulation activities the coding was more interpretative. EYE-data which combines loggings and eye-movements showed a more fine grained insight in the cognitive processes. Not only could be seen on which web-page participants looked at, but also where they looked at. For instance if they were reading or scanning the page. Also the allocation of attentional processes could be analysed. It showed for instance that students spent much attention on reading the assignment. Results of the CRR in with the other two data-types were included revealed that especially on the regulation of the process more fine grained information could be obtained. It can be concluded that to gain insight in cognitive processes the methods are complementary, but they also provide different kinds of information.

Solving information-based problems on the WWW involve complex cognitive activities. The model by Brand-Gruwel, Wopereis, & Vermetten (2005) makes a distinction between five involved processes: defining the information problem, searching for information, scanning information, processing information in depth and organizing and presenting information. These processes are divided in sub-processes, as for instance generating search terms, or sourcing. Furthermore, emphasize is put on regulation processes during solving information-based problems. To

measure the involved processes different methods can be used. In this study three methods will be compared: Logfiles only (LOG), Eye-movements in combination with logfiles (EYE), and Cued Retrospective Reports based on eye movements records in combination with logfiles (CRR). LOG are digital recordings of the changes over time on the screen. LOG provide information on overt actions made on the screen during the task, i.e.: web-pages visited, search terms used, results selected in a search engine results page (SERP), answers provided in the web-based activity by each participant, etc. EYE can provide overt actions but also provide unique information concerning what is visually attended to, in what order, and for how long. CRR is a method to capture verbalizations of thought processes after task performance cued by a replay of one owns eye-movements (Van Gog, Paas, Van Merriënboer, & Witte, 2005). The methods are complementary, but also provide different kind of data. The questions answered in this research are: 'In what way can cognitive processes involved in web searching be described using different kind of methods?' and 'What are the differences and similarities between these methods?'

Method

Fifteen participants (5 men, 10 women; age $M=33.47$, $SD=4.47$) accomplished a web-based activity (WebQuest) composed of two tasks in 45 minutes, where they had to search for information about the planet Mars. During task performances, logfiles were captured, and eye-movements were tracked. Afterwards, participants reported on their thoughts during both task performances for five minutes each while reviewing their overt actions and eye-movements.

To gain insight in the cognitive processes involved in web searching when analysing the different data types, a coding scheme based on Brand-Gruwel, Wopereis, and Vermetten (2005) was developed. The scheme gives an overview of the involved main processes ('Defining problem', 'Web searching', 'Scanning and processing', 'Organizing and presenting information'), sub-processes, and regulation (e.g., orientation, monitoring-steering, testing). The scheme was used to analyse all three data types. Furthermore, to analyse the EYE data also areas of interest (AOI) were defined to get grip on the allocation of attentional processes. The preliminary results described below are based on 5 participants. During the presentation all results will be available.

Results and conclusions

The information provided by LOG was an average of 67.57 actions per task. 14% of these actions were coded as regulation (in an interpretative way). Considering the four main processes, LOG could provide the actions' frequencies: 17%, 27%, 45%, 11%, respectively; and the time spent on each process: 16%, 24%, 47%, 13%. EYE provided an average of 76.57 actions per task. Furthermore, this method gave qualitatively more information, as EYE revealed more different sub-processes than LOG. For instance, the code 'Select result in SERP' from LOG could be differentiated into two categories in EYE: 'Select by reading title-description' and 'Select by reading url'. This kind of fine graining happened on average of 7.86 times per task. Furthermore, EYE could revealed that the 15% of the actions were considered as regulation (in an interpretative way), and also the actions' frequencies performed in each process (22%, 24%, 42%, 12%), and the time spent in each one (20%, 24%, 46%, 11%). Moreover, EYE could provide additional information about the 'Defining problem' and 'Organizing and presenting information' processes, by analyzing the allocation of participants' attention on the assignment web-page in one task. Therefore, the assignment web-page was divided into the following AOIs: 'header and navigation', 'problem statement', 'response field'. In terms of mean time to first fixation, participants looked first at 'problem statement' (1.47 seconds), then at 'response field' (44.40 seconds), and last at 'header and navigation' (1:35.34 minutes). In terms of total fixation duration, participants looked the longest on 'response field' (5:04.50 minutes), shorter on 'problem statement' (2:04.00 minutes), and the shortest on 'header and navigation' (6 seconds). Thus, the added value of EYE compared to LOG was information about attentional processes. CRR, delivered even more quantity (mean 78.29 actions per task) and quality of information in terms of cognitive processes, considered behind certain actions. For example, the code 'Scanning' provided by EYE, could be differentiated into two categories in CRR: 'Scanning' and 'Elaborating on the content while scanning'. This kind of fine graining happened on average of 1.29 times per task. The total amount of cognitive processes was the 43% and the 31% of the actions were coded as regulation (e.g.: 'I need information about Mars!' was coded by Orientation; 'I couldn't find it!' as Monitoring-Steering). Furthermore, CRR could provide the actions' frequencies performed in each main process: 22%, 25%, 42%, 11%, but could not provide the time spent in each process, because utterances' duration were not related with actions or process' duration performed. The added value of CRR in respect to EYE was the more grained information about cognitive processes and regulation. In sum, all three methods provided similar action frequencies performed in each process. LOG and EYE provided similarly the time spent for each process and the percentage of regulation. CRR, however, did not reveal the time spent. Most important is the added value that each method can provide to LOG only, particularly EYE (with attentional processes) and CRR (with cognitive processes and regulation). Already these initial results showed that each method provides different kinds of information and that these may be used complementarily.

Brand-Gruwel, S. Wopereis, I. & Vermetten, Y. (2005). Information problem solving by experts and novices: analysis of a complex cognitive skill. *Computers in Human Behaviour*, 21, 487-508.

Van Gog, T., Paas, F., Van Merriënboer, J.J.G., & Witte, P. (2005). Uncovering the problem-solving process: Cued retrospective reporting versus concurrent and retrospective reporting. *Journal of Experimental Psychology Applied*, 11, 237-244.

SYMPOSIUM

Evaluation of information while searching on the Internet: Differences between experts and novices

Saskia Brand-Gruwel, Open University, Netherlands; Ludo van Meeuwen, Open Universiteit Nederland, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands

Searching for information using Internet means that one has to evaluate and select appropriate information or solving a task. However, evaluating and selecting sources and information is not always done based on clear criteria, but on intuition. To gain more insight in the criteria domain experts and novices use when evaluating information, in the study presented in this paper twenty psychology students and 17 psychology university teachers searched for information about a psychology topic on the Internet while their eye movements were tracked. These eye movements were used for the method of cued retrospective reporting. Results revealed that experts use more criteria to question the reliability of information and Websites. Furthermore, a correlation was found between the used evaluation criteria and the quality of the selected information.

Presently using the Internet for searching information of any kind is an activity almost everyone does. Especially in education students frequently use the World Wide Web (WWW) for selecting information to accomplish assignments such as writing an essay or preparing a presentation. The evaluation of sources and information found on the WWW is an important skill, because the amount of information is enormous and there are no gatekeepers that filter information on the web (Brand-Gruwel et al., 2005).

Research reveals that when evaluating Web-based information instead of looking for the author or organization behind the site superficial criteria are used, such as the presence of pictures on a website (Walraven et al., 2008). But research also shows that prior knowledge concerning the subject matter can influence the use of criteria when evaluating information (Britt & Aglinskas, 2002). However, methods used in research about the use of criteria when evaluation information found on the Internet are often retrospective recall and thinking aloud. These methods give some insight, but in this study we will go a step further by using cued retrospective reportings with eye-tracking as the cue. Thereby, we aim at gaining more detailed insight in criteria domain novices and domain experts use. Furthermore, a central goal is to determine whether the use of more sophisticated evaluation criteria leads to the selection of higher-quality information. Method Twenty psychology students act as domain novices (age $M=20.2$, $SD=4.07$) and 17 university teachers in psychology (age $M=39.5$, $SD=12.33$) as domain experts. They worked on a task for 10 minutes, while their eye movements were recorded. Then, they reported their thoughts while reviewing their own eye movements on half speed (20 minutes). This method is called Cued Retrospective Report. Two tasks were developed (topic1: reliability of human memory, topic2: altruism) to ensure that results (i.e., the evaluation criteria participants mention) are not related to the subject matter of the task. Tasks were of equal complexity according to the complexity level of Mosenthal (1998). For each task a Google-like search engine results page (SERP) with 17 links (i.e., hits) was composed (including a mix of different types of Websites). Participants selected and ranked five sites.

To score the quality of the participants selection each site (in the SERP) got a value (10-point scale) based on different evaluation criteria. Two raters independently scored all sites (correlation was $r=.99$, p). The coding scheme from Brand-Gruwel et al. (2005) was adapted to score the criteria participants use. The main classification is an evaluation of a hit in a SERP, of a site, or of information. Within this classification three levels of exactness in participants' evaluations are distinguished: 1) superficial evaluations (Hmm, no, not this one!); 2) an evaluation on a global level of usability, and reliability (I don't think this information is very useful); 3) specific evaluations based on a certain criterion. Results and conclusions The criteria are categorized by the evaluation of the usefulness and reliability of the hits in the SERP, the sites, and the information found on a site.

Concerning the evaluation of hits in a SERP all participants judged the hits on usefulness for solving the problem. A significant difference between experts and novices was found on the criterion 'usage of language' ($p=.03$). In contrast to novices, experts did not judge on the language in terms of that it is written in a popular or scientific way. When evaluating the reliability of the SERP, the reputation, the kind of source, and the familiarity is questioned more than once by the novices and the experts. Only on the use of the criterion 'familiarity' a significant difference with regard to domain expertise was found ($p=.045$) (in favour of the experts). Furthermore, a difference on the criterion 'position in the SERP' was found ($p=.022$). The novices used this criterion more often than the experts.

Concerning evaluating information a difference was found on the kind of information ($p=.012$). The novices more often gave their judgment on the fact, that, for instance, the information was found in a blog or forum. When evaluating a site in particular the reliability was judged. Experts used the following criteria more often than novices: reputation of the organization behind the site ($p=.05$); kind of source ($p=.05$), familiarity ($p=.028$). Furthermore, the novices judged the appearance of the site (colours, pictures, lay-out) more often than experts ($p=.021$). Furthermore, results revealed that the novices evaluated sites more in a superficial way ($p=.007$). It means that the novices used more utterances like 'no not this site'. No criteria were mentioned. To determine the relation between the use of criteria and task performance (selection of sites) correlations were calculated (Pearson). Results revealed a correlation of .35 ($p=.016$) between the quality of the selection and the amount of evaluations concerning the reliability of a site. The more participants evaluated the reliability of sites, the higher was the score on the quality of the selected sites. Furthermore, a negative correlation ($r=-.61$, $p=.000$) was found between the quality of the selected sites and how often information was judged in a superficial way. More superficial evaluations lead to the selection of lower-quality sites. To conclude, as expected domain experts used more criteria to evaluate the reliability of information and sites, and they also selected sites of a higher quality than the novices. So, more prior domain knowledge and the use of sophisticated evaluating criteria helps to find information of a higher quality. This result does have its implication for the design of education in order to help students to become critical web searchers.

References

- Brand-Gruwel, S., Wopereis, I., & Vermetten, Y. (2005). Information problem solving: Analysis of a complex cognitive skill. *Computers in Human Behavior* 21, 487-508.
- Britt, M.A., & Aglinskias, C. (2002). Improving student's ability to identify and use source information. *Cognition and Instruction*, 20, 485-522.
- Mosenthal, P.B. (1998). Defining prose task characteristics for use in computer-adaptive testing and instruction. *American Educational Research Journal*, 35, 269-307
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H.P.A. (2008). Information problem solving: A review of problems students encounter and instructional solutions. *Computers in Human Behavior*.24, 623-648.

SYMPOSIUM

Quality and development in all-day schools in Europe and in afterschool programs in USA

Chairperson: Marianne Schuepbach, University of Bern, Switzerland

Organiser: Marianne Schuepbach, University of Bern, Switzerland

Discussant: Hans Guenther Rossbach, University of Bamberg, Germany

Traditionally Germany, Austria and Switzerland differ from most (European) countries and the USA with regard to their length of a school day and their curricular and extracurricular activities in the afternoon. In answer to a societal change and the unfavourable results of the PISA studies the establishment of all-day schools is now starting. These all-day schools suggest positive effects on the development of the students not only on the level of academic achievement, but also with regard to their social and emotional development. USA afterschool programs, specifically intervention programs for children at risk, have been known for a long time. In the last years there has been an increasing interest in afterschool programs with high quality that can provide youths with a safe and supportive adult-supervised environment and offer them activities and experiences that promote academic, personal, social, and recreational development. As little empirical research exists regarding the effectiveness of all-day-schooling in Europe and the quality in afterschool programs in USA. The aim of this symposium is to bring together current studies addressing these research deficits conducted in Switzerland, Germany, and in the USA. Schuepbach presents data comparing the effects of all-day-schooling with the traditional schooling on the development of Swiss children. The German paper from Gogolin et al. focuses on the question of whether all-day schools make a difference to immigrant minority children's integration and success. Finally Vandell and Pierce present results from the Study of Promising After-School Programs and look into the quality of afterschool programs in USA.

SYMPOSIUM

Quality and effectiveness of all-day schools for primary school age children in Switzerland

Marianne Schuepbach, University of Bern, Switzerland

The research project EduCare presented in this paper takes place in 11 cantons of the German-speaking part of Switzerland. This longitudinal study addresses questions relating the quality of different settings of education and care to their effects on children's cognitive and socio-emotional development in the first years of school (age 6-9). As a conceptual framework of these study we developed a model on quality and effectiveness of school curricular and

extracurricular activities based on Radisch et al. (2008) developed and applied in the StEG-Study, Helmke (2004) and Pekrun and Helmke (1991). The hypotheses will be tested using a longitudinal survey with a quasi-experimental design using one test group (students attend all-day schools) and one control group (students attend schools with core times) (N=43 classes; N= 295 students). In our paper we are going to focus on the following questions: How do students in all-day schools develop compared to the control group (students in schools with core times) at the end of grade 1, 2 and 3? How do these students develop in addition in consideration of the school setting's educational quality in cognitive and social/emotional areas? The results concerning the children's achievement in mathematics and in language show, that at the end of grade 3 children in all-day schools tend to do better than children in schools with core times. Findings concerning the non-cognitive area indicate a better development in socio-emotional behavioural strengths of children attending all-day schools. The same result can be found for the daily living skills.

The performance of Swiss school children in PISA 2000 alarmed both the public as well as education experts. As a response, action measures in various areas have been put forward with the aim of addressing weak points in the Swiss education system. One recommendation is the expansion of school-age careprograms. The need for these programs is also supported by societal and economic changes and consequent political demands. At present, Switzerland is debating the future priority of out-of-school and extracurricular programs and how they should be developed concerning the aspects of education and care for primary-school children. An important education policy argument for the expansion of these offers is that extracurricular activities can better facilitate a positive development of children with their individual strengths and competencies. There is no research on the effectiveness or the effects extracurricular programs in Switzerland yet. The international situation is similar. There are a few studies investigating these effects in relation to students' outcomes. These few studies focusing on afterschool programs are mostly evaluations of specific intervention programs in the USA. Several studies concerning afterschool programs for school-age children show positive effects on the cognitive outcomes such as higher achievement in reading, and science as well as doing better in standardized tests (e.g. Blau & Currie, 1984; Brooks et al., 1995).

A lot of studies that focus on the effects of family and out-of-family care in relation to developmental outcomes of children are set in the pre-school age. Overall most published studies on presumably high quality pre-school-care programs show positive effects on children's cognitive and social development independent of the families' social background. At the same time, there is a focus on the program's quality. However, the results of these studies and those of the afterschool sector cannot be generalised or applied without examining the varying Swiss circumstances. In comparison to other countries, such as the United States, England, or France, school-age education and careprograms in Switzerland are very different regarding their structure. There are offerings at different times of the day. It is not the rule in Switzerland that children are at school for the whole day. The research project EduCare presented in this paper is funded by the Swiss National Science Foundation and takes place in the German-speaking part of Switzerland. It is designed to provide empirical evidence and therefore a basis for decisions pertaining to (Swiss) educational policies. This longitudinal study addresses questions relating the quality of different settings of institutional (all-day schools and schools with core times [Blockzeiten]) and family care to their effects on children's cognitive and socio-emotional development in the first years of school (age 6-9). The research findings available emphasise the importance of the quality of childcare and education programs. As a conceptual framework of these study we developed a model on quality and effectiveness of school curricular and extracurricular activities based on Radisch et al. (2008) developed and applied in the StEG-Study, Helmke (2004) and Pekrun and Helmke (1991). For measuring quality, our study starts out from a structural/process model by Tietze (1998). The model attempts to combine dynamic and dimensional approaches. An important study that is based on models of this kind is the international comparative European Child Care and Education Study (ECCE 1999).

The hypotheses will be tested using a longitudinal survey with a quasi-experimental design using one test group (student attend all-day schools) and one control group (students attend schools with core times). Based on current forms of school hours and extracurricular programs in the Swiss cantons, we asked the cantonal education ministries of 11 cantons for permission to conduct the study. In drawing the sample, we asked all of the all-day schools - our smallest basic experimental group - that met our criteria to participate. Based on socio-demographic data on the municipalities in which the schools are located, we selected schools in comparable municipalities in the 11 German-speaking cantons of Switzerland (N= schools= 35; N=43 classes; N= 295 students). The municipalities are mainly urban or part of agglomerations. In order to gather information on quality aspects questionnaires, interviews, and observations were made use of. To measure quality the German version of the "School-Age Care Environment Rating Scale" (Harms et al. 1996) "HUGS" (Tietze et al. 2005) was applied. Cognitive and socio-emotional development was measured with standardised and non-standardised tests. These tests measure the developmental-psychological characteristics of primary-school children in the different settings (Schuepbach 2010). In our paper we are going to focus on the following questions: How do students in all-day schools develop compared to the control group (students

in schools with core times) at the end of grade 1, 2 and 3? How do these students develop in addition in consideration of the school setting's educational quality in cognitive and social/emotional areas?

Overall it is expected (general hypothesis) that primary-school children attending extracurricular activities have better developmental outputs compared to children with regular school-education and no specific institutional extracurricular activities (control group). The results of the univariate analysis of covariance concerning the children's achievement in mathematics and in language show, that at the end of grade 3 children in all-day schools tend to do better than children in schools with core times whereas up to grade 2 no advantage can be found. This effect at the end of grade 3 is found independent of the intensity of attendance of extracurricular activities. Findings concerning the non-cognitive area indicate a better development in socio-emotional behavioural strengths of children attending all-day schools at the end of grade 1, 2 and, 3. A positive overall picture for students in all-day schools completes the results concerning the daily living skills. The results of this study are consistent with the research overview and tend to be more favourable towards the cognitive area compared to previous results in Switzerland and Germany. Already after three years the available findings show amazingly concise effects of the different school forms. Future research with a larger sample is needed to validate these findings.

SYMPOSIUM

Do all-day schools make a difference to immigrant minority children's integration and success?

Deborah Vandell, University of California, Irvine, Germany; Jule Boehmer, Universität Hamburg, Germany; Nina Bremm, Universität Hamburg, Germany; Heinz Reinders, Universität Würzburg, Germany; Kim Pierce, University of California, Irvine, United States; Ingrid Gogolin, University of Hamburg, Germany

The paper reports on preliminary results from a research project that compared full-time and part-time schooling in Germany with regard to the integration and success of immigrant minority students. Due to a national investment program, the number of full-day schools in Germany doubled in the last decade. The project contributes to the identification of effects of this program. It is embedded in a theoretical framework of school effectiveness research, following the major idea to combine an evaluation model with school, classroom and student characteristics. We assume that intended curricula on the input level, measured by conditions and intentions, relate to school and classroom characteristics which show the degree of implemented curricula. Student's output measures are seen as appropriate for realized curricula. Contextual factors, such as age and duration of exposure to the language of schooling, are controlled. The school sample (70 schools, 2100 students) was selected via screening, identifying full-day and half-day schools with comparable intake of students. We will focus on preliminary results from secondary schools. Whereas positive effects were found with respect to interethnic friendships and social integration, the linguistic data did not show the expected effects. Language performance of the students shows a differentiation of "colloquial" and "academic language". Whereas the students in full-day schools performed significantly better in "colloquial language", no significant difference could be identified with respect to "academic language".

The paper reports on results from a research project that compared full-time and part-time schooling in Germany with regard to the integration and success of immigrant minority children. The increase of all-day schools in Germany was one of the education reforms that were initiated by the so called "PISA-shock". By PISA-results it became evident that the German school system was less prepared than expected to succeed in international knowledge-based competition. One assumption about improvement of the situation was that more all-day schools could be a powerful instrument, especially for the benefit of students who are in need of additional support – such as children and adolescents with a migration background. In 2003, the German Federal Ministry of Education and Research (BMBF) launched an investment program "Zukunft Bildung und Betreuung" (IZBB) (Engl. "A Future for Education and Care"). The funding allowed for a considerable increase of all-day schools since then. Their number more than doubled; today, roughly 40% of all schools in Germany are all-day schools. The investment program was accompanied by a number of research projects on questions of efficiency and effectiveness of the reform (see <http://www.ganztagsschulen.org/10249.php>). The research project presented in this proposal was carried out in this context. The overall aim of the project "Ganztagsschule und Integration von Migranten" (GIM) (Engl. "All-day school and integration of migrants") is to uncover effects of all-day schools on social integration, the development of intercultural competences and on second language achievement of children with a migration background in a longitudinal perspective. The guiding question is: Do all-day schools lead to positive effects on the performance of these children? The project is embedded in a theoretical framework of school effectiveness research (Scheerens & Bosker, 1997). The major idea is to combine evaluation models according to Stufflebeam's CIPP-model (Stufflebeam, 2000) with school, classroom and student characteristics. We assume that intended curricula on the input level, measured by conditions and intentions, relate to school and classroom characteristics which show the degree of implemented curricula. Student output measures (performance in home and school language, academic performance and interethnic relations) are seen as appropriate measures for realized curricula (Ditton, 2000). This model allows to

assort available and gathered data and enables to identify conditions of effective support of migrant students (Scheerens, 1990). Contextual factors, such as the age and time of exposure to the language of schooling, were considered.

The proposed presentation will focus on the language related aspects of the project. Performance in German (i.e. the language of schooling) is considered (a) as the basis for the acquisition of intercultural competence and social integration; (b) as an indicator for social integration. In the project, innovative instruments for bilingual language assessment have been applied (for language pairs German-Turkish and German-Russian); the same, but monolingual testing was carried out with monolingual German students of the sample schools as control group. The language related hypothesis of the project is that school achievement is less dependent on general (everyday) language competence ("basic interpersonal language skills") than on academic language competence ("cognitive academic language proficiency"; cf. Cummins 1991; Gogolin 2009; Schleppegrell 2004).

The tests applied were constructed and validated with reference to the differentiation of the two respective registers.

- Linguistic performance was controlled by (a) individual background variables (cognitive competence, social background, linguistic and migration background) and (b) school and classroom variables (input characteristics, intended curriculum). The longitudinal design of the project was realized by two measurements, each carried out in primary schools (1st and 2nd grade) and secondary schools (5th and 6th grade). The sample was selected via a screening, identifying full-day and half-day schools with comparable intake of students (with respect to social and migration background) in two German Federal States. The sample consists of 71 schools/ roughly 2100 students. Our presentation will focus on preliminary results of the data analysis from secondary schools. Whereas all-day schools seem to have positive effects on social integration, the language performance data showed a clear differentiation of "general" and "academic language" performance. Whereas the students in full-day schools performed significantly better in "general language" than those in half-day schools, no significant difference could be identified with respect to "academic language". This result leads to the hypothesis that time of exposure in full-day schools may not adequately be transferred to time on task (with respect to language education). Our further analyses of individual background, school and classroom variables will shed light on this assumption.

SYMPOSIUM

Student Outcomes Linked to Participation in High-Quality After-School Programs

Deborah Vandell, University of California, Irvine, United States; Kim Pierce, University of California, Irvine, United States

Associations between different sets of after-school contexts and relative changes in student functioning across 2 years were assessed in a large sample of elementary school ($n = 1,796$, M age = 8.7 years) and middle school ($n = 1,118$, M age = 11.7 years) youth. In contrast to students who regularly spent time with unsupervised peers during the after-school hours, elementary students who regularly attended high-quality after-school programs (either alone or in combination with other structured activities) had better math achievement test scores, work habits, task persistence, social skills, and prosocial behavior with peers, and less aggressive behavior and misconduct, controlling for baseline performance. Elementary students who participated in both programs and other activities also posted gains in teacher-reported academic performance relative to unsupervised students. Middle school students who attended high-quality after-school programs (either alone or in combination with other organized activities), compared to students who spent large amounts of their after-school time in unsupervised settings, earned better math achievement test scores and reported less misconduct and substance use and higher work habits, controlling for baseline performance. These findings are consistent with a developmental-contextual perspective in which after-school programs alone and in combination with other organized activities are posited to promote more positive developmental outcomes for economically disadvantaged students.

Substantial numbers of youth in the United States grow up in poverty. Studies suggest that education remains a critical pathway out of poverty for these young people, but activities within the school classroom alone cannot provide youth with the educational, social, and personal resources they need to overcome economically disadvantaged backgrounds. Children and youth also need varied opportunities, experiences, and supports after school. Programs that provide constructive, supervised activities during the after-school hours can help to meet this need. Some investigations have indicated that participation in after-school programs can improve academic and behavioral outcomes, whereas others have reported no effects or, in some cases, negative consequences of program participation. Critiques of the extant research have identified several factors that may contribute to these differences: investigation of a small number of programs, the quality of the programs, how frequently students attend the programs, availability of other types of after-school activities, family and child selectivity bias, and failure to use longitudinal designs that track outcomes over time. The Study of Promising After-School Programs was designed to

address many of the limitations of the prior research. The 2-year longitudinal study examined relations between participation in high-quality programs and academic and social outcomes for low-income, ethnically diverse students. It focused on high-quality programs, rather than a representative sample of programs, in order to assess the potential for programs to have positive effects on students. Nineteen elementary and 16 middle school programs located in 14 cities in 8 states across the U.S. participated in the study. All of the programs were characterized by features identified in other research as key to promoting positive youth development outcomes: positive relations (students-staff, peers), high student engagement, skill-building activities, mastery orientation, and appropriate levels of structure and organization.

A total of 2914 students (1796 in Grades 3-4, 1118 in Grades 6-7) were studied. Some were enrolled in the participating after-school programs, whereas others attended the same schools but not the programs. Daily attendance records were obtained from the programs over a 2-year period. In addition, students reported how often they participated in other types of organized activities and in unsupervised settings during the after-school hours. Academic and social outcome data were collected from students, teachers, and school records at baseline, at the end of Year 1, and at the end of Year 2. Using cluster analysis, groups of students who shared similar sets of experiences during the after-school hours were identified:

- (1) Program Only, comprised of students who regularly attended the high-quality programs;
- (2) Program + Activities, comprised of students who regularly participated in both the programs and other enrichment activities; and
- (3) Self-Care + Activities, including students who had high amounts of time in unsupervised settings (especially hanging out with peers), low attendance at the programs, and moderate involvement in other organized activities.

A fourth group was comprised of students who had low program and activity involvement, and low amounts of unsupervised time. HLM analyses controlled for multiple personal and family characteristics (child gender and ethnicity, family income, family structure, maternal education, and maternal work status) as well as school-level variation and baseline performance on the outcome measures.

Analyses were conducted separately for the elementary and middle school samples. Effect sizes were calculated for the statistically significant findings. Effect sizes for the 2-year analyses. Elementary students who regularly attended the after-school programs across 2 years, either alone or in combination with other structured activities, posted significant gains in math achievement test scores, work habits, task persistence, social skills, and prosocial behavior, and reductions in aggressive behavior and misconduct, compared to students who were routinely unsupervised by adults after school. Students who participated in both programs and other activities also posted gains in teacher-reported academic performance relative to unsupervised students. Middle school students who attended the programs, either alone or in combination with other activities, posted gains in math achievement test scores and work habits, and reductions in misconduct and substance use, compared to their unsupervised peers. Effect sizes were on par with or larger than those found in studies of the impact of instruction by Teach for America teachers and class size reductions. These results will be discussed in relation to other findings of the potential benefits of participation in high-quality after-school programs.

SYMPOSIUM

Creative methods for researching teachers' teacher identity in higher education

Chairperson: Anne Nevgi, University of Helsinki, Finland

Organiser: Vesa Korhonen, University of Tampere, Finland

Markus Weil, University of Zurich, Switzerland

Discussant: Kirsi Pyhalto, Helsinki University, Finland

This symposium aims to explore in what ways visualisations, metaphors and stories can be used as an empirical research material when exploring university lecturers' teacher identity and teacher self-concept. The symposium will involve discussions how to develop research methods to explore teacher identity by applying metaphors, visualisations and narrative approach in research. The first paper discusses the theoretical background of a narrative approach and the use of non-active role-playing assignments. The second paper focuses on the use of photos to probe for unconscious thoughts about teaching, and how these helped the interviewees to view their professional identity. The third paper discusses the use of visualisations in exploring university teachers' identity and what kinds of emotions are related to teacher identity and teacher self-concept. With the help of metaphors we may bring visible our thinking, our principles of action and the delimitations which are related to it (Johnson & Lakoff, 1980; 1999). The use of images and stories can give for the teacher a reflective tool to examine more consciously conceptions concerning their teacher role in different settings, like in intercultural teaching and learning situations. Images and

stories could be seen as metaphoric tools for representing the conceptual, experiential and self-regulative knowledge of teaching practice (Bereiter & Scardamalia 1993; Korhonen & Koivisto 2007).

SYMPOSIUM

Narrative role-playing as a means of researching lecturers' roles within internationalisation

Vesa Korhonen, University of Tampere, Finland; Markus Weil, University of Zurich, Switzerland

Teaching and learning in higher education has been influenced by increasing Internationalisation and cross-culturality. For many lecturers factors such as teaching in English, mobility, international study contents and cultural diversity challenge beliefs about their role as teachers and create needs for changing learning environments. These complex shifts have also been reflected by innovations within research methodologies taking lecturers' roles into account. The main aim of this theoretical presentation is to discuss possibilities of a narrative role-playing methodology when making visible different influences of internationalisation for university teachers' self-concept and practice. The idea of this methodology is to investigate the capacity of university teachers regarding their role as actors in an international higher education environment. However, finding and forming suitable sample episodes for research setting seems to be a critical factor when using narrative role-playing.

Introduction

Internationalisation and increasing cross-culturality have had an impact on universities in recent years, especially on teaching and learning settings. University lecturers have to engage in new tasks in these global changes like facing increasing student and staff mobility, taking part in international teacher exchange programs, participating in international co-operation networks of research and teaching and increasing „internationalisation at home“, e.g. teaching in English and dealing with multi-national student groups. The practices of teaching and learning have to be re-thought in intercultural learning situations. Kraus & Sultana (2010) discuss how multifaceted internationalisation within higher education learning and teaching environments is and that research methodologies have to take that into account. Additionally the research target group of university teachers face the challenge of internationalisation as severely testing beliefs about their role as teachers and of the for changing teaching and learning environments (Bodycott & Walker 2000; Svensson & Wihlborg 2007).

The set of innovative research methodologies, that aim to make the different influences of internationalisation visible, is an important resource for investigation (Vulliamy 2004). In this presentation we discuss reflections on the lecturers' roles in internationalisation of university teaching and learning with the help of a narrative methodology. Narrative approaches have become more general and popular in qualitative research – also in university teaching and learning related investigations (Lyons & LaBoskey, 2002; Moon, 2010). The idea of this methodology is to consider the capacity of lecturers regarding their role as actors in an international higher education environment. "Narrative role-playing" as a methodology has traditionally two versions: active (drama) and non-active (writing) role-playing (Cohen, Manion & Morrison, 2000). In an active version the person is asked for example to improvise a character and perform it in practice. In a non-active version the individual may perform a certain role merely by reading a description of a social episode and writing a possible continuum for it. This non-active version could be called "narrative role-playing", because it is based on personal stories – in the research setting they are written according to research instructions. For the non-active version also pictures can serve as a basis for story writing and reflection. Pictures can more easily make emotions – like anger, fear, compassion, anxiety and others – visible in an imaginary social setting (Cohen, Manion & Morrison, 2000).

An essential characteristic of the narrative role-playing method is that it produces cultural knowledge and representations on the phenomenon under investigation. Typical for the method is also the variation of role-playing instructions (i.e. positive and negative episode). With variations of instructions the researcher can reach a fuller understanding on (sub) cultural meaning making. The personalisation and the use of the subjective point-of-view include a narrative perspective for the story writing. The methodology has also a comparative potential for reaching a broader understanding of different cultural settings, which are all dealing with the internationalisation of higher education from lecturers' perspectives. Theoretical and educational considerations Narrative role-playing stories seem to be an appropriate methodology for research, which aims to investigate thinking, emotions, social relationships and personal self-conceptions (Moon, 2010). It is also quick, fairly comfortable and considering the ethical questions in data collection. However, finding and forming suitable sample episodes for stories seems to be a critical factor when using the narrative role-playing methodology. The sample episodes are also a crucial point for a comparative approach with data collection in different countries. Nevertheless the stories enhance understandings what demands internationalisation bring to teaching practice, and how university teachers deal with this regarding the conception of themselves. Preliminary findings of our cases show how on the surface level internationalisation and cross-culturality might be realised in curricula, in presentations and discussions, in teaching methods, practical experiences and group

dynamics. However, in the deeper level it might facilitate another significant learning perspective, that it sensitises to other cultural backgrounds and leads to deeper reflection of a cultural dimension of the study content as well (Weil et al. 2010). This is noteworthy and it is something what Boyer (1997) called the scholarship of discovery, meaning a new form of scholarship in university teaching that would contribute to a knowledge of teaching and transform and extend it (Boyer, 1997; also Lyons & LaBoskey, 2002).

Future perspective

So far, there has been little systematic reflection or data-collection on the effect of internationalisation for one's role and self-concept as a university teacher. The narrative role-playing methodology seems to provide means to make visible the possible influences of internationalisation and cross-culturality in higher education. Narrative role-playing might be developed towards being a reflective tool in the pedagogical training of university teachers. The research findings and the role-playing methodology both have the potential to support university teachers who are concretely facing the demands of internationalisation (teaching in English, working with exchange students, planning to participate into international teacher exchange etc.) in the near future.

References

- Bodycott, P. & Walker, A. (2000) Teaching Abroad: lessons learned about intercultural understanding for teachers in higher education. *Teaching in Higher Education*, 5(1), 79 – 94.
- Boyer, E.L. (1997) *Scholarship reconsidered: priorities of the professoriate*. New York, NY: Carnegie Foundation.
- Cohen, L., Manion, L. & Morrison, K.R.B. (2000) *Research methods in education*. 5th edition. London: Routledge.
- Kraus, K. & Sultana, R. (2010) Problematising 'cross-cultural' collaboration: critical incidents in higher education settings. In V. Korhonen (ed.) *Cross-cultural Lifelong Learning*. Tampere: Tampere University Press, 225 – 259.
- Lyons, N. & LaBoskey, V.K. (eds.) (2002) *Narrative inquiry in practice: advancing the knowledge of teaching*. New York: Teachers College Press.
- Moon, J. (2010) *Using story: in higher education and professional development*. London: Routledge.
- Svensson, L. & Wihlborg, M. (2007) Internationalisation in the Swedish nurse education from the perspective of teachers involved: An interview study. *Higher Education*, 53, 279 – 305.
- Vulliamy, G. (2004) The impact of globalisation on qualitative research in comparative and international education. In *Compare*, 34(3), 261-284.

SYMPOSIUM

Photo-interviews as a source for understanding university teachers' professional identity

Mari Karm, University of Tartu, Estonia; Marvi Remmik, University of Tartu, Estonia; Anu Haamer, University of Tartu, Estonia

The current research aims at developing understanding of Estonian early career university teachers' concepts of teaching and professional identity by using photo-interview as a one possible research instrument. Our research is based on the assumption that visual research methods have given good results for investigating professional identity and underlying concepts. The presentation is based on qualitative research of 15 teachers who specialize in various scientific fields in higher education. On the basis of the analysis we found that photos provided a tool for both for us as researchers to probe for unconscious thoughts about teaching, but they also helped the interviewees to view their professional identity and formulate their teaching concepts.

Background and aims

Professional development depends on several factors including teachers' psychological, social and career life histories, which fashion their attitudes, expectations and behaviours and also opportunities for professional development (Day, 1993). Teachers' knowledge includes connections within and between different domains: knowledge about the teaching processes (content knowledge, pedagogical knowledge, students' learning) as well as knowledge of academic life and pedagogical development (including the development of self awareness of teaching and pedagogical issues) (McAlpine, Weston, Berthiaume & Fairbank-Roch, 2006; Postareff & Lindblom-Ylänne, 2008). The previous research has shown that it is very complicated to investigate individual's ideals, concepts, beliefs and values that influence the professional development, because very often people aren't aware of the concepts their professional development is based on. Using visual research methods have given good results for investigating professional identity and underlying concepts, as well for investigating several other areas connected with meanings in one's philosophical background (Leitch 2006, Schuller 2004, Taylor 2002, Weber, Mitchell 1996). Photo-interviews give richer data than just verbal interviews: photos focus on and guide the process of interview (Tucker, Dempsey 1991). Photos also give the impulse for interviewees to conceive and verbalize their understandings. The current presentation focus on two questions: how photo-interviews open different aspects of university teachers' professional identity and teaching concepts? What limits us as researchers have to declare during the data collection and analyzing processes?

Methodology

We used photo-interviews as a research method for studying formation of professional identity and teaching concepts of novice university teachers. First, 15 professional biographical interviews were carried out. These interviews focused on novice university teachers' studies and professional career. With the same participants the next step was a photo-interview. The participants were requested to find photos that illustrate the answers to the questions on learning, teaching and the image of a university teacher (for example: what is your vision about teaching? Who is the university teacher?). Indirect analysis was used in interpretation of photos: interviewees selected and interpreted themselves the photos that they had brought along. All interviews were transcribed. In the process of analysis, the interpretations and explanations of interviewees were analysed but we didn't analyse photos as an independent material.

Findings

The analysis revealed that novice teacher's interpretation of university teachers' roles and identity is vague and undefined. Ideas of ideal self, ought self and actual self could be in conflict. University teachers' conceptions of teaching are not clearly stated. Photo-interviews proved to be muddled. Controversial statements were given on learning-centred versus teaching-centred axis. Contradictory statements appeared while comparing the results of in-depth and photo-interviews. Photo-interviews brought forward that on the one hand novice teachers might aspire for learning-centred teaching; on the other hand they might feel insecure and have the need for approving feedback which could drive them towards teacher-centred teaching. Theoretical and educational significance Photos appeared to be a tool for both researchers and novice teachers. Researchers got an opportunity to get a glimpse of novice teachers' unconscious thoughts about teaching, but they also helped the interviewees to view their professional self and their values in teaching.

References

- Day, C. (1993). A Necessary but Not Sufficient Condition for Professional Development. *British Educational Research Journal*, 19(1), 83-93.
- Leitch, R. (2006). Limitations of language: developing arts-based creative narrative in stories of teachers' identities. *Teachers and Teaching: theory and practice*, 12(5), 549-569.
- McAlpine, L., Weston, C., Berthiaume, D. & Fairbank-Roch, G. (2006). How do instructors explain their thinking when planning and teaching? *Higher Education*, 51, 125-155.
- Postareff, L., Lindblom-Ylänne, S. (2008). Variation in teachers' descriptions of teaching: Broadening the understanding of teaching in higher education. *Learning and Instruction*, 18, 109-120.
- Schuller, T. (2004). Visual imagery, lifecourse structure and lifelong learning. *Studies in the Education of Adults*, 36(1), 72-85.
- Taylor, E. W. (2002). Using still photography in making meaning of adult educators' teaching Beliefs. *Studies in the Education of Adults*, 34(2), 123-139.
- Tucker, S., Dempsey, J. V. (1991). Photo-Interviewing: A Tool for Evaluating Technological Innovations. *Evaluation Review*, 15(5), 639-654.
- Weber, S., Mitchell, C. (2002). Drawing ourselves into teaching: studying the images that shape and distort teacher education. *Teaching and Teacher Education*, 12(3), 303-313.

SYMPOSIUM

Visualisations as means to explore university teachers' teacher identity, and related affects

Anne Nevgi, University of Helsinki, Finland; Erika Lofstrom, University of Helsinki, Finland

University teachers' teacher identity and teacher self-concept is a relatively sparsely explored area. In our paper we aim to explore university teachers' teacher identity and teacher self-concept through analysis of visual metaphors which university teachers use for describing themselves as teachers. Furthermore, we explore the affective connotations teachers attach to their teacher identity. The data consists of university teachers' drawings of themselves as a teacher (N = 90). The participants are university teachers who have attended basic courses of university pedagogy. The data were content analysed. First, the drawings were classified according to the composition as a metaphorical versus a realistic composition and as a whole image versus a fragmented composition. Secondly, the drawings were classified by applying as the theoretical framework for analysis the concepts related to approaches to teaching. A wealth of emotions could be identified in the drawings.

Introduction

Teacher's professional identity and its development has been largely explored (e.g. Sugrue 1997; Beijaard, Verloop & Vermunt, 2000; Walkington 2005; Flores & Day 2006;). However, research focusing on the university teachers' teacher identity and teacher self-concept has been only scarcely explored. Teachers' self-perceptions as a university teacher

have been explored from the perspective of teacher identity (Kreber 2010), teacher self-efficacy (Dunkin, 2002), teaching self-concept (Roche & Marsh; 2002), and teaching self (Olson & Einwöhner 2001). Åkerlind (2005; 2008) has approached academics' professional identity from the perspective of growth and development as a researcher (2008) and as an academic (2005). Furthermore, there is a long research tradition focusing on teachers' conceptions of teaching and approaches to teaching (Kember & Kwan, 2000; Prosser & Trigwell, 1999). Sfard and Prusak (2005) see identity as narrative and they claim that narratives are the discursive counterparts of one's lived experiences. If we assume this to hold true, discursive expressions, such as personal stories and metaphors can serve as a window to teacher identity. According to cognitive metaphor theory (known also as a conceptual metaphor theory), our everyday language is filled in metaphors, and human thinking and understanding is deeply metaphorical in nature (Lakoff & Johnson, 1980). Metaphors are not only figurative or descriptive ideas, instead, they structure our thoughts and actions, and the ways in which we perceive the world and us. There is research evidence that metaphors can be used to access and analyse personal beliefs (Lßfstrßm, Anspal, Hannula & Poom-Valickis, 2010; Lßfstrßm, Hannula & Poom-Valickis, 2010; Saban 2010; Saban, Beyhan & Aslihan 2007; Martinez & al. 2001). Our aim is to explore university teachers' teacher identity by applying analysis of visual data which university teachers have produced by drawing pictures of themselves as teachers.

Method

University teachers participating in the basic pedagogical development courses at the University of Helsinki between 2006-2010 were asked to visualise themselves as teachers and to draw an image describing their visual idea about themselves as a teacher. A total of 90 drawings were available for this exploration. The drawings were collected as a part of the workshop "Myself as a Teacher", which introduces the participants to the course and each other. Drawings were scanned into digital format and content analysed. For each picture a detailed description was written as a first step in the analysis. The descriptions helped to identify the symbols teachers used and allowed the researchers to classify the drawings based on the basic themes. The teacher symbols and metaphors were listed and arranged in categories. The categories were rearranged according to what kind of approaches to teaching the metaphors in the category represented. The symbols and metaphors of emotions were identified and classified as positive, negative and contradictory emotions.

Results

Teacher metaphors visualised in the drawings varied from realistic and traditional teacher image towards metaphorical, abstract and fragmented compositions. The most common metaphor was an information-transmission/teacher-focused approach metaphor as a lecturer in front of students or a teacher leading a seminar. In these images teachers were transmitting and delivering information to students who were passively sitting and listening or who were not included in the pictures at all, in which case the focus was solely on the teacher's actions. Second category was labelled as a conceptual change/student-focused metaphor. In these images teachers were pictured as a member of a group working together, or travelling with the students. The teacher could also be pictured in a traditional lecturing setting, but with other symbols like think balloons and arrows included in the drawing. The focus in these pictures was on the interaction and communication with the students and not on the delivery of information to students. By dividing the compositions as whole picture and as fragmented images, the teacher identity could be interpreted as expressions of a whole-person teacher-identity or a fragmented idea of being a teacher. The emotions in the images expressed as positive emotions arousal and happiness, stable positive emotions, contemplation, curiosity, anticipation, and neutral emotions. The negative emotions were identified as feelings of loneliness and isolation, uneasiness, anxiety, and faintheartedness. The contradictory emotions included insufficiency, tension, sense of control, security versus insecurity, separation vs belonging, a mix of various emotions, and anticipation. Theoretical and educational significance of the research Visualisations, such as drawings can be used as research data in order to explore teachers' teacher self-concept. However, drawings as data are challenging to analyse and interpret. In order not to over interpret, data were quantified and compared to the results of the qualitative analysis. The teachers' drawings varied greatly and the teacher identity and teacher self-concept revealed to be multifaceted and involving diverse affects related to teaching. The teacher images revealed that many teachers saw that being a teacher meant to be a lonely and isolated deliverer of information and separated from the students. This finding is in line with the findings from the research tradition focusing on teachers' conceptions of teaching and approaches to teaching (e.g. Kember & Kwan, 2000; Prosser & Trigwell, 1999). Most of the teachers participating in pedagogical development courses see teaching as information delivery in which emotions are not desirable or even allowed. In pedagogical development courses the aim is to help teachers to become more aware of student learning and to adapt more a student-centred approach to teaching. Drawings can be used as a tool in pedagogical development courses to help teachers explore their underlying beliefs about teaching and themselves as university teachers.

SYMPOSIUM

Social Capital as a Resource in Heterogeneous Educational Contexts

Chairperson: Markus Szczesny, University of Goettingen, Germany

Organiser: Markus Szczesny, University of Goettingen, Germany

Rainer Watermann, University of Goettingen, Germany

Discussant: Robert Brown, Toronto District School Board, Canada

The theory of social capital emphasizes the influence of group membership, social networks, social norms and trust for individual and social outcomes. It is a well known phenomenon that social capital plays a significant role in the psychosocial and cognitive development of adolescents.

The aim of the symposium is to explore the impact of social capital in heterogeneous social settings focusing on childhood and adolescence.

Emmanuel Acquah, Koen Veermans & Kaarina Laine (Finland) explore structural aspects of social capital in childhood. Their study uses Social Network Analysis of friendship ties of ethnic minority and majority children to identify bonding and bridging networks. Robert Brown, Erhan Roula & Roula Anastasakos (Canada) investigate the interplay of social capital embedded in neighbourhood and school districts. Their key research question is: which is the more important context for school achievement: school or neighbourhood? Markus Szczesny & Rainer Watermann (Germany) analyze the differential role of structural and process-based features of families' cultural and social capital for reading achievement and social competencies within academic (Gymnasium) and non-academic (Hauptschule) secondary schools.

SYMPOSIUM

Schools Make a Difference..... And so Do Neighbourhoods

Robert Brown, Toronto District School Board, Canada; Erhan Sinay, Toronto District School Board, Canada;

Roula Anastasakos, Toronto District School Board, Canada

We are looking at a cohort of approximately 19,000 Toronto District School Board (TDSB) students in their second year of secondary school (Grade 10) who completed the provincial literacy test (as a requirement for graduation it is the only truly 'high stakes' test in Ontario schools). Toronto is considered one of the most diverse cities in the world: over three quarters of our secondary students are first or second generation immigrants to Canada, and Toronto schools and neighbourhoods include both the most socio-economically advantaged and disadvantaged in the province.

Many of these students attend schools in a different neighbourhood from where they live. We have information on which of the 117 secondary schools attended by, and 140 City of Toronto neighbourhoods lived in, for each student. We also have a wide range of survey, demographic, and school variables providing key information on school and neighbourhood social capital. Our key research question is which is a more important influence on achievement: school or neighbourhood? We would use HLM as our key regression technique.

Background and Rationale

The question of why some schools seem to be better able to produce more positive educational outcomes than others is essential in education. It has been pointed out (Raudenbush & Willms, 1995) that "school effects" usually refers to the extent to which attending a particular school modifies a student's outcome. The term "school effects" is found throughout educational literature, and numerous studies have been done to identify effective schools and factors associated with the success and failure of schools.

There seems to be growing consensus that comparing schools by raw achievement scores is unfair. The achievements that students bring with them to the school, often linked with their access to social and cultural capital, can affect subsequent performance. Although schools are held accountable for the performance of their students, there are many factors influencing student performance that are not within school control. Other social institutions also influence student motivations, engagement, and success; therefore school effects on student performance need to be detangled from the effects of the other social contexts in which students are embedded.

In general, school effectiveness studies have focused on student academic achievement in the context the school provides for the student but without consideration of the ecological and social context in which school itself is situated. In other words, there has been little research that looks at school and neighbourhood characteristics coincidentally.

The public board of Toronto, the Toronto District School Board (TDSB), describes itself as one of the most "multiracial, multicultural and multilingual school boards in the world", and there is much to support this. Toronto is the largest

city in Canada and the TDSB is the largest board in Canada and among the largest in North America. Over a quarter of students were born outside of Canada in more than 175 countries; over half speak a language other than English; and over three quarters belong to a visible minority group. In addition, Toronto has great social diversity with among the most socio-economically advantaged, as well as among the most disadvantaged, communities in Canada.

While this diversity has been embraced as a strength, it provides challenges in providing school-level achievement results for the TDSB's elementary and secondary schools. An additional challenge is the mobility of the TDSB population: close to two thirds of the oldest Grade 12 students do not live in the immediate vicinity of the secondary school they attend. Given that Toronto secondary students are not necessarily attached to the geography of their school, this provides an opportunity to look at test results from both a school and neighbourhood perspectives. This may allow the convergence of multiple theories of capital. Discussions of neighbourhood disadvantages are often rooted in social disorganization theory or epidemic theory, whereas explanations for the advantages of living in higher-status neighbourhoods usually follow social capital theory (Pong and Hao, 2007).

Neighbourhood studies have consistently found that neighbourhood characteristics have effects on individual outcomes even after controlling for individual and family effects but usually neglected the school specific outcomes; school research has found that schools have effects on student achievement after controlling for individual and family characteristics but usually neglecting the neighbourhood contextual effect. This research will attempt to bring neighbourhoods, schools and students into the same model using advanced multilevel analytical techniques. The basic assumption of this research is that neighbourhoods differ in their effect on the schools and individuals embedded in them.

Methodology

Close to 19,000 students in their second year of secondary school wrote the Ontario Secondary School Literacy Test (OSSLT) for the first time in Spring 2010. The OSSLT is Ontario's only 'high stakes' standardized test in that passing the test is required for graduation. While students may retake the test, passing the test the first time it is offered is highly connected to on-time graduation and post-secondary access. For the most recent administration, Ontario's Education, Quality and Accountability Office (EQAO) released for the first time student-level scores for all students—previously we knew only who passed or failed. This score will serve as the dependent variable of our analysis.

This information has been connected to the TDSB's Student Information System. Consequently we have a number of important variables including: School attended when the student wrote the test City of Toronto neighbourhood that the student was living in when the student wrote the test. There are 140 City of Toronto neighbourhoods, compared to 117 secondary schools: see the attached map for a related example (http://www.tdsb.on.ca/wwwdocuments/about_us/external_research_application/docs/CSSE%202005%20Paper--%20Secondary%20SSI.pdf) Demographic information (gender, age, region of birth, arrival date in Canada, home language) Special needs status of the student Responses of a detailed survey written by the student during the test administration School level information including socio-economic challenge of the school Information on the 140 City of Toronto neighbourhoods including socio-economic data from the 2006 Canadian federal census.

At the heart of much educational research are hypotheses about the influence of policies or practices implemented at the school or district level and their effect on processes occurring within schools. Such hypotheses are implicitly multilevel. Methodologists have warned that the use of traditional linear models to study multilevel phenomena can produce misleading results (Raudenbush and Bryk, 1986). Therefore, in this research the hierarchical linear model (HLM) method will be utilized which enable researchers to utilize mean achievement and certain structural parameters.

References:

- Brown, R. (2005). The TDSB secondary success indicators as part of school improvement planning (SIP). Paper presented at the CSSE Conference, London, Canada.
- Pong, S., & Hao, L. (May 2005). Neighbourhood and school factors in the school performance of immigrants' children. *The International Migration Review*, 41(1), 206-241.
- Raudenbush, S. & Bryk, A.S. (1986). A hierarchical model for studying school effects. *Sociology of Education*. 59(1), 1-17.
- Raudenbush, S.W., & Willms, J.D. (1995). The estimation of school effects. *Journal of Educational and Behavioral Statistics*. 20(4), 307-335.

SYMPOSIUM

Bonding or Bridging: Examining the Social Capital of Ethnic Minority and Majority Children

Emmanuel Opoku Acquah, University of Turku, Finland; Koen Vermaans, University of Turku, FINLAND, Finland;

The essence of social capital lies in networks that allow members to benefit from resources shared by the collective. Often, networks are organised around some key interest shared by members of a group or based on socio-demographic factors such as gender, race, age and social class. Relationship among members (bonding) are more numerous and often more important than relationships between members and non-members (bridging). This study uses Social Network Analysis of friendship ties to identify cohesive subgroups and analyse their bonding (within group) and bridging (between groups) networks by estimating the proportions of friendship ties they give out (outgoing ties), the friendship ties they receive (incoming ties) and the mutual ties (reciprocal friendship ties). The participants were 748 children, 7-8 years old (boys=52%, girls=48%, language minority=8%) from 49 classrooms in the Turku Municipality of Finland. The results indicate that friendship ties were concentrated within groups (bonding) with less bridging ties. However, the languages differed in terms of ties received from within group and from outside group as well as ties given out to own group members but did not differ in ties given to members outside group. In addition, the languages differed in all categories of nominations for bullying and victimization except for nominating members of other groups.

Introduction

Friendship and social standing in the classroom have strong effects on a variety of outcomes in a child's life, within and beyond the academic realm (Gifford-Smith & Brownell, 2003). There is consensus among social developmental researchers that children's peer relations provide unique and significant contribution to their social and emotional development (Asher & Coie, 1990).

Theories of friendship have identified elements that attract two persons to one another including homophily, propinquity, status and reciprocity (McPherson, Smith-Lovin & Cook, 2001). Homophily and propinquity have been found to produce high racial homogeneity in social networks (Feld, 1982). Of course, individuals come together to form groups when they share a common interest such as sports, debating etc. The reasons why people join groups are multifaceted. One such reason that has been highlighted in recent studies is that, by investing into social ties, individual actors pursue social capital (Frank & Yasumoto, 1998).

In this paper, we extend this view by investigating the social structure of cohesive subgroups within the classroom and how language background influences one's position within the group. Our model focuses on the child as an active actor who invests into social ties with members of his or her own subgroup (bonding) while establishing ties with members of other subgroups (bridging) in their quest for social capital.

Data

Data stems from the Origins of Exclusion Project, a longitudinal study of Finnish children's risk of social and academic exclusion in childhood (Laine, Neitola & Auremaa, 2003). This study uses data from 748 7-8 years-old children (boys=52%, girls=48%, language minority=8%) from 49 classes at 35 public schools. The mean class size is 15.3 (SD=3.56). In the spring of the first school year children were asked to rate their interest in playing with each of their classmates while being shown a class picture. Rating alternatives were: "always (Friendship), sometimes (Neutral), or never (Exclusionary) like to play. The resulting square matrix forms the basis for all analyses.

Analysis

A two step approach was followed to conduct our analysis. First, Frank's (1995) Klugefinder algorithm was used to identify cohesive subgroups in classrooms by looking at the social structure in terms of friendship ties within and between subgroups. Frank's algorithm uses a stochastic definition of cohesion; emphasising ties within subgroups relative to actors' propensities for engaging in ties and sizes of subgroups. For running the algorithm, we used ties based on both children's willingness to play with each other; either as "willing to play with sometimes" or as "always like to play with". Group membership is then categorized into "same group" and "other group" subgroup relative to the individual to show the boundaries between bonding and bridging ties. These results are then used to perform an Analysis of Variance (ANOVA) in which language background is used as independent variable for within group and across group friendship ties, within group and across group nominations for bullying, victimization, exclusion, and social withdrawal.

Results

Overall, the results indicate that both majority and minority students receive and give out more friendship ties to members of their own group than they receive from and give out to members of other subgroups but differ in terms of ties received and given out across all directions of flow of friendship ties.

When looking at bullying, the languages differ. Majority students receive less nominations from within and from outside one's own group whilst minority students received more nominations both from within and from members of other groups. Further, the findings indicated that majority students received fewer nominations for victimization

within and from outside one's group than did the minority indicating that minorities were more susceptible within the subgroup.

In other results, minorities received and gave out more exclusionary nominations within own group than did the majorities. They also received more from members of other groups but gave out less in return whilst a majority student received less but gave more to members of other groups. The languages did not differ in terms of nominations received within one's group for social withdrawal but differed in what they gave out to group members (minorities gave more). Considering other groups, minorities received more but gave out less whilst majorities received less and gave out more.

Discussion

We drew on a developing theory (Frank & Yasumoto, 1998) to argue that children pursue a single resource, social capital, by engaging in close social ties with their peers. The findings suggest that minorities are 'introverts', they focus more on their own group and less on the other group(s). Favours are not returned though so they are less well embedded/nested in their own group. Thus, although not excluded, they are in 'weak' positions (limited social capital) compared to their majority peers. Their 'weaker' position in the own group is also illustrated by the fact that they are more often identified as bullies not only from outside their own group, but also from within their own group. And probably in relation to their own 'weaker' position, they seem also more aware of, or willing to qualify, others in their own group as victims. Our findings underscore the basic fact that the minority student has limited social capital within the classroom and this has been found to have serious implications for their social and emotional wellbeing as well as academic success in school.

References

- Asher, S. R., & Coie, J. D. (Eds.) (1990). *Peer rejection in childhood*. New York: Cambridge University Press.
- Feld, Scott L. (1982). Social Structural Determinants of Similarity among Associates, *American Sociological Review*, 47:797-801.
- Frank, K.A. (1995). Identifying cohesive subgroups, *Social Networks*, 17, 27-56.
- Frank, K.A. & Yasumoto J. Y. (1998). Linking Action to Social Structure within a System: Social Capital Within and Between Subgroups, *American Journal of Sociology*, 104:642-86.
- Gifford-Smith, M.E. & Brownell, C.A. (2003). Childhood Peer Relationships: Social Acceptance, Friendships and Peer Networks, *Journal of School Psychology*, 41, 235 – 284.
- McPherson, M., Smith-Lovin, L. & Cook, J. (2001). Birds of a Feather: Homophily in Social Networks, *Annual Review of Sociology*, 27:415–44.

SYMPOSIUM

Effects of Social and Cultural Practices on Educational Outcomes in Different Academic Tracks

Markus Szczesny, University of Goettingen, Germany; Rainer Watermann, University of Goettingen, Germany

The relationship between students' social background and their educational outcomes is a rather universal phenomenon. In stratified school systems with different school types in secondary school, the link between structural features of the family background (socio-economic, level of education, migration status) and educational attainment was shown to be particularly strong. For Germany, it was shown that most effects of family background structures are mediated by process-based features of families' cultural capital (cultural practices), whereas process-based features of families' social capital (social practices) appear to play a minor role. However, the contribution of such family characteristics on educational outcomes within different school types in stratified school systems as well as their role for the acquisition of social competencies has rarely been studied together.

Drawing on data from 15783 students of the German extension of the PISA-2000-study and taking into account mechanisms on the individual and the institutional level we analyzed the relationship of structural features of the family background, process-based features and educational outcomes (reading literacy and social competence) by means of multilevel multi-group structural equation modeling.

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Theoretical framework

Our theoretical framework combines elements of capital theory (Bourdieu, Coleman), a bio-ecological perspective (Bronfenbrenner) as well as – with regard to varying learning environments in different school types – an institutional perspective on development.

In Bourdieu's theory of capital the social reproduction can be explained by family transmission processes. While Bourdieu sees social capital among the members of groups, Coleman suggests social capital not only on the availability of social networks. At the individual level, Coleman locates social capital in the structure of mutual expectations and obligations that are accumulated as trust or in the availability of relevant information. On the collective level social capital is seen as a social norm and their effective sanction.

Unlike Bourdieu and Coleman, Bronfenbrenner's theory of bio-ecological development includes individual forms of interaction with the environment of an organism to be designated as 'proximal processes'. Bronfenbrenner proposes to distinguish between the development of 'dysfunctions' and 'competencies'. While dysfunctions are understood as manifestations of social adjustment problems, competencies would be the ability to demonstrate knowledge and skills. Proximal processes are expected to have an effect on competencies in advantaged environments and on behavioral dysfunctions in disadvantaged environments.

Beyond curricular competencies school is also relevant for the acquisition and development of socially competent behaviors. In constant interaction with classmates, fellow students and teachers students can test their behavioral repertoire. For their social behavioral offers they immediately get feedback in the form of praise and blame, acceptance and rejection. Social competence is a complex combination of skills, ability and knowledge, attitudes and values. Furthermore it includes the basic capability to the decoding and interpretation of social information.

In Germany students are assigned to different school types already at the age of ten, where the lowest (non-academic) track and the highest (academic) track differ remarkably: Even though these tracks are comparable in quantitative terms (i.e., in the number of lessons timetabled), they differ markedly in qualitative terms. Specifically, there are differences in the compositional (e.g., mean achievement, parental SES) and institutional (e.g., lesson design, curriculum, teacher training) characteristics of the different tracks. The academic track seems to provide qualitatively better conditions for academic success: the learning group is positively selected in terms of social background and cognitive abilities, instruction achieves higher levels of cognitive activation, and there is less disruption in the classroom.

Research questions

Are the effects of structural features of family background on educational outcomes mediated by families' social and cultural practices?

1. Specifically, is there an independent effect of social practices on the development of social competencies?
2. Can differential effects of cultural and social practices be found in non-academic (Hauptschule) and academic (Gymnasium) schools? On the one hand we expect a positive association between cultural practices and reading literacy in academic schools. On the other hand, we expect a positive association between social practices and social competencies in non-academic schools.
3. Will the individual effects of cultural and social practices remain stable after controlling for compositional effects?

Method and Design

For the analysis, data from the national extension of the German PISA 2000 study was used. Overall, the sample consists of 15783 students that were 15 years old (10115 students from academic schools (Gymnasium) and 5668 students from non-academic schools (Hauptschule)). Missing values were imputed.

Multilevel multi-group structural equation models are computed. In a second step the analysis is reproduced with propensity-score matched data to estimate compositional effects.

Results

A random intercept model was specified, so the intercepts may vary between classes. The model had a very good fit (χ^2 [df = 323] = 3598, CFI = .96, TLI = .94, RMSEA = .036, SRMR = .032).

As was expected, at the individual level a mediating effect of cultural practices on reading achievement was only found in academic schools. A significant relationship between social practices and social competence appears in both, academic and non-academic schools. For non-academic schools there was no influence of cultural practices, but an effect of social practices on reading achievement. The individual effect of familial social and cultural capital remains stable even under the control of compositional effects.

Analyses with propensity-score-matched data indicate the stability of the findings: Although the differences between academic and non-academic school students regarding their family background are (statistically) eliminated, the differential effects of the school form persist.

Conclusions

Educational outcomes are mediated in a significant way through process-based features of families. The parental social practices in particular have an effect on the development of social competencies. The influence of cultural capital was only found in the academic-track. Relevant for the mediating effect of family capital on reading achievement and social competence are the differential school environments represented by less or more demanding school types.

SYMPOSIUM

Knowledge formation and use of language

Chairperson: Jesper Haglund, Linköping University, Sweden, Sweden

Organiser: Elsie Anderberg, Jonköping University, Sweden

Discussant: Tamer Amin, Lebanese American University, Lebanon

The problem focused in the present symposium is the function of language used in the development of (personal) knowledge: the epistemological role of language use in learning. The current dominance in socio-cultural research on learning of focus on the function of language use in communication and interaction has to some extent led to the neglect of inquiry into the interplay between language use and content of subject matter in terms of agency. Individuals' reproduction and the tendency to use scientific terms without any deeper understanding is nevertheless a well known problem in teaching and learning. The number of disciplinary concepts and vocabulary, as well as the various ways in which these concepts interrelate, increase dramatically in interdisciplinary contexts. This, in turn, is a serious challenge to pupils' and students' knowledge formation. The main aim with the symposium is to present and discuss theoretical and methodological approaches, as well as empirical findings relating to the research field, considering both individual, socio-cultural and disciplinary/theoretical aspects of language use, in relation to knowledge formation.

SYMPOSIUM

Resistance to Conceptual Change – the Role of Language

Tommy Tang and Tim Robinson, School of Economics and Finance, Queensland University of Technology, Australia

A lecturer often takes key concepts for granted in their organisation and presentation of a topic when the concepts can be quite problematic for the students. While students can reproduce and apply the concepts in academic settings, studies of student learning show that many still possess serious misunderstanding about these concepts. And they often relate to lay conceptions in everyday life situations. It is therefore important that we identify barriers to their conceptual acquisition. The paper reports on an empirical study of commencing economics students' understanding of the fundamental concept of efficiency. The data are written responses taken from 90 exam scripts to a structured final exam question. Phenomenographic analysis of the data reveals six conceptions of efficiency with five of them representing misunderstanding of the concept. These six conceptions are related but distinct, each dealing with a critical aspect of the process of production and exchange. Further examination of the structural and referential aspects of these misunderstandings provides insights into why and how students' everyday usage of the language can become barriers to understanding of this technical concept in economics. The results inform teachers to better design learning experiences for conceptual development.

Summary

Studies across disciplines at secondary and tertiary levels have shown that students can amass enough knowledge to perform well within the assessment standard but still possess a lot of misunderstanding about the topic. For example, students who have successfully completed university physics courses still hold the laymen's view that that on release, heavy objects will reach the ground before lighter ones because "heavy things have a bigger force" than light objects (Biggs 1989), and that an object travelling at a constant velocity implies a resultant net force acting in the direction of

motion (Marton 1988). In economics, students, who have passed economics 1, still believe it is the inherent value residing in a product that determines its price (Dahlgren 1997). In another study comparing the use of analytical skills and economics knowledge in the solving of economics problems, Voss et al (1986) found that students with formal training in introductory economics (the novice) and those without (the naïve), demonstrated similar economics knowledge and informal reasoning skills. The novice performed better than the naïve only on questions involving the use of technical knowledge. In the case of non-technical economic issues that provided opportunities for the novice to demonstrate economic knowledge acquired in formal training, no such knowledge transfer took place, and their answers were not qualitatively superior to the naïve. These findings suggest that to these students, the learning in the academic world has little impact on their thinking in real world in which they function.

In student learning research, students are found to possess multiple conceptions of a concept, and they can shift from one conception to another in different contexts to explain a phenomenon (Pong 1999). This leads educational researchers to propose that learning, as a process of conceptual development, is not a simple process of taking in a new conception, and replacing it for the old one. If we want to facilitate conceptual development and knowledge transfer, we need to find out what students have understood (or misunderstood) about a topic or concept, how they have come to acquire the various ways of making understanding it, and what the barriers are to students' conceptual development.

The paper reports on the findings of an empirical study of the ways economics students understand the concept of efficiency (or allocative efficiency as used in many economics textbooks). The data are written responses taken from 90 exam scripts to a structured final exam question in an introductory economics course. The question assesses students' understanding of the conduct and performance of a market under different market conditions. Phenomenographic method (Marton 1981) was used to analyse the data to investigate students' interpretations of the concept of efficiency from a second order perspective. Six conceptions of efficiency emerged from the data with five of them representing misunderstanding of the concept. These six conceptions are related but distinct, each focusing on a different, critical aspect of the process of production and exchange. Further examination of the structural and referential aspects of these misunderstandings provides explanations as to why and how students acquire various misunderstandings. For example, some misunderstandings arise out of interference from the everyday usage of language, where students replace the technical meaning of a term with their everyday life interpretations of it. Furthermore, the study shows that a student's misinterpretation of the concept can be 'meaningful' and 'logical' from their perspective. Thus, language interference can explain the resistance to conceptual change, and hence, inertia of student misunderstandings. This inertia was also found to be due to the student's ability to shift and/or distort the meaning of a concept to justify their explanation of the reality.

This paper argues that the knowledge of student learning product obtained from research utilising the second order perspective can inform teachers to better structure learning experiences for the facilitation of conceptual change and knowledge transfer. The implications from this study for teaching and learning apply to other disciplines.

SYMPOSIUM

The role of the referent in the history of science and in science education

Haglund, J., Strömdahl, H., and Jeppsson, F., Linköping University, Sweden

One way of approaching the interplay between language use and content of subject matter is to use methods from linguistics and philosophy of science in the analysis of central terms in science. Reference of concepts, an important question in the philosophy of science, has for a long time not been on the agenda in educational research. Taking a realist stance on the incommensurability controversy has meant that the referent is generally taken for granted as being invariant. Thus, the invariance and the current referents of concepts are not even explicitly stated in educational scientific studies on conceptual change. The present piece of research aims at demonstrating the importance of discerning and being explicit about the referent. To illustrate this claim, we use the example of the change of the meanings of central terms in the history of thermodynamics, particularly 'heat' and 'entropy'. Resting on post-Kuhnian research on incommensurability we concur with the idea that the communication between earlier and later uses of a term in consecutive theories is maintained by a continuous chain-of-reasoning against a background of accumulated knowledge. In that vein the incommensurability problem is a result of comparing the endpoints of a long process and not taking into account the fine structure in between. Adding the idea of science as the endeavour to explore 'the world as perceived', we show that the referents of 'heat' and 'entropy' have changed throughout the historical progression many times.

From an educational point of view it is essential to sort out how scientific terms are attached to 'the world-as-perceived' (cf. Andersen, 2001). One way to analyse this connection is to identify three semiotic elements of a term: word, concept and referent. Very briefly, a concept may be regarded as something that is in a person's mind, a word is a symbol for the concept and the referent is the corresponding entity in 'the world-as-perceived' outside ourselves. The aim of the present piece of research is to establish a 'working definition' of what a referent for physical quantities is and to bring to the discussion the following questions: Do the referents of the terms 'heat' and 'entropy' change or remain invariant during the historical development of the corresponding concepts? Does the referent of 'heat' change or remain invariant when a student makes a change from an everyday conception of 'heat' to the contemporary scientific concept of 'heat'?

Strömdahl (2009, under review) has proposed a two dimensional semantic semiotic analysing schema (acronym 2-D SAS), in order to analyse science terms for educational purposes. The schema shows on the horizontal axis the semiotic elements word, concept and referent. The vertical axis depicts semantics with the different meanings of a term. In this respect, a single term may correspond to several different, but related, concepts and referents, which may be used in different contexts and cultures. In the present study, 2-D SAS is used for an investigation of the character of referents for science terms. Literature on the issue of reference in the fields of history and philosophy of science, linguistics and science education has been reviewed and terms from the domain of thermal phenomena are used as examples.

Kuhn (1962) launched the idea that the scientific theories before and after a revolutionary change are incommensurable. As a consequence, a common standpoint in science education has been that the referent must remain unchanged, in order to save a realist assumption and therefore the focus had been exclusively on the conceptual domain. As a contrast, in philosophy of science the question of reference is an ongoing issue, and, in line with Arabatzis and Kindi (2008), we will argue that it may be interesting also for science education. Kripke (1972) and Putnam (1975) developed the 'causal theory of reference' partly as a response to Kuhn, but also as a criticism of prior views on reference, where reference of a term was assumed to be fixed by necessary and sufficient conditions. Kripke and Putnam claim that reference in the physical world of a term may be fixed by linking the term to the cause of an event in a baptizing moment. In this way, once a term is coined, there will always be a link to its referent in the physical world, regardless of theory changes about it. However, also the causal theory of reference has been criticised, primarily in two respects. First, it does not account for the 'qua problem', i.e. when you point to an object, phenomenon, etc., and claim that 'this is a giraffe', how can you convey that you have in mind the animal species, and not the classes of mammals or tall objects? Second, it does not provide a mechanism for how words may lose their reference. For example, in science the term 'caloric' was abandoned when it was found to lose its explanatory power of physical phenomena and therefore lost its reference.

Shapere (1989) claims that the communication between earlier and later uses of a term in consecutive theories is maintained by a continuous chain-of-reasoning. A term is not determined by some essence or necessary and sufficient conditions fixed once and for all, but by ascribed properties that are changing over time due to the scientific development in the form of empirical evidence from our interplay with the 'world-as-perceived'. The provisional character of scientific advances admits a seamless chain of reasoning, making incommensurability an obsolete feature independent of the change of concept and referent of a term. Hence, there is no objection any longer to the possibility for the referent of a scientific term to change when the concept changes. As examples, we show that the referents of 'heat' and 'entropy' have changed throughout the historical progression many times.

Andersen and Nersessian (2000) argue that theoretical concepts (like heat) cannot be pointed out in isolation, but rather as interacting participants in complex structures, understood in relation to each other by a theory or a law. This may be seen as an example of the 'qua problem', in that if you point to a model of particles in motion in a box and declare that 'this is entropy', how can a learner know what aspect of the model you have in mind? As a response to this challenge, in our views, the referent of a physical quantity is an aspect of a scientific model of the world-as-perceived, against a background of a particular theory.

Amin (2001) shows that laypeople share conceptions of heat, including heat as a verb, related to the process of causation of hotness, and heat as a noun, typically a spatially localised entity that is the causal source of hotness. In education, the challenge is to make the students expand their repertoire of interpretations of the term heat with the inclusion of the scientific ones. Carey (2009) states that if "our concepts of real entities (in contradistinction to fictional ones) are not appropriately connected to the world, they would not support learning about it." In other words, the establishment of the referent of a concept is crucial in the learning situation. In the case of heat, the intended referent would be an aspect of a model of two systems in thermal contact.

SYMPOSIUM

Learning to understand

Elsie Anderberg, Jönköping University, Sweden; Annika Åkerblom, Lund University, Sweden; Lennart Svensson, Lund University, Sweden

The aim of the paper is to introduce, describe and discuss a theory of learning to understand. The different ways that individual learning and understanding are described in various research traditions reflect differences, regarding how relationships between object, content, language and meaning are treated. In this paper, these entities are described as components in the intentional activity of the individual, having the character of internal relationships. These relationships are constituted in the process of discernment, through factors such as: variations, seeing and seeing-as, figure-ground, and part-to-whole relationships. These factors will be described as they have been developed in phenomenographic research on learning. They are related to an expressive conception of language meaning, developed in the intentional-expressive approach. This approach has been used in research on the epistemological role of language use, in regard to the function of language use in developing and expressing understanding of the object referred to. Research carried out in different subject matters, educational contexts and involving learners of different ages has shown that the constitution of relationships between the components object and content need to be related to the functions of key expressions' meanings in terms of agency. Such relationships need to be examined more thoroughly than has usually been the case. The proposed relational theory on learning to understand will also be related to research on conceptions, and approaches to learning and studying in phenomenography. The discussion will focus contributions of the theory regarding theories on learning in conceptual change and socio-cultural research.

How understanding of complex knowledge is developed is a central question in different perspectives and theories on learning. In theories on conceptual change, there is an analytical approach, primarily focusing competition between conceptual systems involved in knowledge construction (Vosniadou 1994). In socio-cultural theories (Wertsch 1990) there is a discursive approach. If individuals learn to appropriate patterns of talk in a specific discourse, it is considered that they also construct knowledge. These theories have in common that it is to some extent assumed that an identity exists between; language and content, and/or between content and object or/and between word and meaning. At the same time, the question of how to deal with the common reproduction of "knowledge" in education constitutes a fundamental challenge. Instead of seeing these issues separately, considering them together, as central components in the learning activity, allows us to address these questions more effectively. We need to consider how the relationships between these components are constituted and how this functions to build up the central core of learning. The aim with this paper is to introduce and present a theory on learning, where content, meaning, language and object are treated as important components.

The aim is formulated on the basis of the strong need to describe learning activities that deal with the problem of developing understanding of complexities from an individual point of view. The theory is an alternative to already well established traditions and theories in research on learning. Its contribution concerns shortcomings in those theories when focusing the relationships between language meaning and content of understanding. The main contribution of the theory concerns the epistemological role of language use, where the relationships between word meaning and content of understanding seem to play an more important role. The dynamic, contextual and ambiguous function of language meaning used in expressing content of understanding must be better accounted for in terms of the agency of the learner. The main point of departure is research developed both within phenomenographic perspective on learning (Marton 1981) and the intentional-expressive approach on the role of language in learning (Anderberg 2000; Anderberg et al. 2008).

Phenomenography as a perspective on learning involves a relational view of understanding parts of the world: "objects" referred to. Learning to understand is seen as an intentional activity involving the constitution of internal relationships (Svensson 1997). Learning is always about something, is directed and has to be understood in terms of the activity of constituting relationships, mainly between the components content and object, through the factors in the process of discernment; variations, seeing and seeing-as, figure-ground and part-to-whole relationships. These factors will be described in the paper, regarding how they have been developed in phenomenographic research on learning. In phenomenography, these factors in the intentional activity have mostly concerned the relationships between an object and content of understanding. In the intentional-expressive approach on intentional activity these factors are captured also with regard to language use.

The intentional-expressive approach to language use in learning was developed in phenomenography, based on the need to also focus how the intentional activity is constituted in learning, with regard to the function of language use in developing and expressing understanding of complexities. Research carried out in different subject matters,

educational contexts and ages of learners using the Intentional-expressive approach has shown that the constitution of relationships between the components object and content need to be related to the functions of key expressions and with which meanings these are used. How these functions are developed appears to be a central aspect of how the object referred to is constituted, in terms of content of understanding. In phenomenography, this is described as "ways of experiencing" or "conceptions". The factors described in phenomenography as involved in the intentional activity of the learner therefore also need to involve the intended language meaning used. This is important, since this knowledge can be used to minimize the use of language in reproducing "knowledge". The paper will draw on these results when outlining and suggesting a theory of learning to understand.

The intentional-expressive approach captures that language meaning used is expressing understanding, compared to the common view in research on learning that language meaning is representing (Vosniadou 1994) or mediating understanding (Wertsch 1990). In the paper, we will present empirical evidence, showing how pupils and students have major problems in their learning activity, regarding the function of language use. This particularly affects how the relationships between word meaning and content are constituted, illustrated by the base line of the Broken triangle (Anderberg et al. 2008).

We are then able to describe how understanding develops, also involving the use of language in the intentional activity. In the paper, the interplay between the components; expression, meaning, content and object will be clarified in terms of the agency of the learner. The paper will in detail describe what is meant with these components, and how internal relationships between them are constituted in the process of discernment, through factors such as; variations, seeing and seeing-as, figure-ground and part-to-whole relationships.

This paper on a relational theory on learning to understand will conclude with discussions of the theoretical and educational implications, concerning the common problem with reproduction in the learning activity. The theoretical implications will be discussed particularly regarding theories developed in conceptual change and socio-cultural theories on learning. Also, the theory will be related to different conceptions of understanding and research on conceptions of learning developed in phenomenography.

Anderberg, E. (2000) Word meaning and conceptions. An empirical study of relationships between students' thinking and use of language when reasoning about a problem. *Instructional Science*. 28: 89-113.

Anderberg, E., Svensson, L., Alvegård, C. & Johansson, T. (2008). The epistemological role of language use in learning. A phenomenographic intentional expressive approach *Educational Research Review*, 3(1), 14-29

Vosniadou, S. (1994). Capturing and modelling the process of conceptual change. *Learning and Instruction*, 4, 45-69.

Wertsch, J.M. (1991). *Voices of the mind. A socio cultural approach to mediated action*. Hertfordshire: Harvester.

SYMPOSIUM

Teachers' work lives: Australian and international perspectives

Chairperson: Judy M. Parr, University of Auckland, Faculty of Education, New Zealand

Organiser: Christine Gardner, University of Tasmania, Australia

John Williamson, University of Tasmania, Australia

Discussant: Debra Myhill, Exeter University, United Kingdom

The studies described in this panel of papers focus chiefly on investigations of the perspectives and experiences of work lives of teachers and/or principals in two Australian states, New South Wales and Tasmania. The papers adopt a variety of foci. The first three studies each were conducted in one of two Australian States: the 'fractured' experiences of many beginning teachers; challenges faced by principals (head teachers) in remote schools; and, school leadership displayed by teachers during the course of one major curriculum change. The fourth paper reports data and findings from a 10-country study of teachers and principals' perspectives of teachers' involvement in responsibility-taking in school-based change. This final paper addresses two aspects of the study (1) data and findings from the Australian study, and (2) broader findings from the entire 10-country study. Use of qualitative and quantitative methods in each study enables the authors to report findings that are statistically significant and to provide rich data gathered from participants.

SYMPOSIUM

Beginning teachers: Great expectations, unfulfilled dreams

Marilyn Pietsch, Charles Sturt University, Australia

This presentation explores the work lives of beginning primary teachers in New South Wales (NSW), Australia, where a majority of beginning teachers enter their chosen profession in short-term employment as substitute or “casual” teachers. Initial employment situations vary significantly in the level of fragmentation in terms of the duration, location, status and expectations of responsibility of teachers’ employment.

Research has shown that the context in which beginning teachers enter the profession affects significantly the way in which they are able to extend their professional knowledge base (Grossman, 1990), acquire professional competency and negotiate professional identity. This paper suggests that the concept of “context” requires some adaptation in order to take account of contemporary employment circumstances now may include accommodating often daily changes in the schools and classrooms where teachers work.

This presentation focuses on how new primary teachers in both secure and fragmented employment contexts conceptualise their personal understandings of teaching. It examines the influence of differentiated contexts on teacher progress through the early phases of professional competency (Day, Stobart, Sammons, & Kington, 2006) and on the interplay of professional socialisation, practical classroom teaching and both formal and informal (Eraut, 2004) teacher learning. It considers the effect of differentiated employment contexts on the integration of personal and professional identity, on the level of teacher satisfaction and resulting professional commitment (Boreham, Gray, & Blake, 2006) and addresses the concomitant implications for retention of graduates in the teaching profession (Ewing & Manuel, 2005).

Aims:

The aim of the research on which this presentation is based was to examine the effect of differentiated employment context on the development of beginning primary teachers’ knowledge of teaching during the first two years in the profession. It aimed to extend the conception of the knowledge base of teaching beyond constructs of personal practical knowledge (Clandinin & Connelly, 1995) to include knowledge of the context of teaching and knowledge of self-as-teacher. The effect of differentiated employment circumstances on the development of each of these knowledges formed the primary focus of the research. In addition, empirical research was directed towards developing a more nuanced understanding of models of teacher development which related phases of experience, represented by time in teaching to stages of development of teaching expertise context (Berliner, 1995) and the effect on developmental progression of the employment context.

Methodology:

The study utilised both qualitative and quantitative methods of data collection and analysis. A collective case study (Stake, 1995) of the perceptions of eight beginning teachers provided data from a focus group interview and three individual, semi-structured interviews per participant over the following two years. The question-response format was complemented by classroom observation, stimulated recall from a photographic record of classroom events, document and artefact analysis and participant completion of graphic organisers. Case study data was complemented by numerical and non-numerical data obtained from a postal survey-questionnaire of beginning primary teachers (n=241) employed in public primary schools across the state of NSW.

Findings:

The findings of this research were as follows:

- Teachers who were employed in permanent positions, in one school, and on their own class for the first two years of teaching were able to acquire personal practical knowledge of teaching, participate in professional socialisation and negotiate and strengthen their professional identity. Their level of knowledge development was well beyond that of the novice stage by the end of the first year.
- Those whose employment remained fragmented?holding casual status, working in many schools, and teaching other teachers’ classes rather than working?were unable to extend their professional knowledge base. In many cases, they perceived themselves to have lost some of the skills they had demonstrated at the conclusion of their initial teacher education, and they remained “stuck” at the novice stage throughout the initial two years.

Significance:

Theoretical significance

The findings of this research suggest that differentiated employment experience, as an aspect of the contemporary context of career entry, led to significantly different levels of practical knowledge acquisition, professional socialisation, professional satisfaction and personal commitment to the profession and, in turn, to varying personal conceptions of teaching, schools and self-efficacy as a teacher, as teachers in fragmented or cohesive teaching situations responded very differently to the exigencies of their teaching situations.

This research expands existing studies of the work lives of beginning teaching by adding contextual detail from an Australian setting to the investigations of other researchers such as Bullough (1992) and Huberman (1993). It suggests that British, North American and European models of "learning to teach" are not immediately transferable to the current context in NSW, Australia, where fractured initial employment? that is, employment as a casual teacher? denies a majority of beginning teachers a supported, structured and sequenced induction to the profession, a situation which remains largely unacknowledged by employing authorities or researchers in Australia and elsewhere. It provides evidence that the employment context itself, as the location of early teaching experience in both place and time, is the site wherein the processes of professional socialisation, professional identity formation and practical knowledge acquisition occur and as such, is a critical factor in the development of knowledge and competence in early career.

In addition, this study moved beyond many present and previous conceptions of the process of learning to teach and of the concepts of experience and expertise and explored the extent to which the presumed nexus between experience and the development of expertise was disrupted by appropriate and cohesive or inappropriate and fragmented initial employment experience.

Educational significance

The above findings suggest that there are implications for teacher practice, especially in the work of schools in mentoring new teachers; for educational policy in relation to accreditation and employment of new teachers; for teacher education in preparing students adequately for a multiplicity of teaching roles; for systems in maintaining teaching quality; and for workforce planners in addressing issues of attrition and retention of beginning teachers.

References:

- Berliner, D. C. (1995). Teacher expertise. In L. W. Anderson (Ed.), *International encyclopaedia of teaching and teacher education* (pp. 46-52). Oxford: Pergamon.
- Bullough, R. V., Knowles, J. G., & Crow, N. A. (1992). *Emerging as a teacher*. London: Routledge.
- Clandinin, D. J., & Connelly, F. M. (1995). *Teachers' professional knowledge landscapes*. New York: Teachers College Press.
- Day, C., Stobart, G., Sammons, P., & Kington, A. (2006). Variations in the work and lives of teachers: Relative and relational effectiveness. *Teachers and Teaching: Theory and Practice*, 12(2), 169 -192.
- Ewing, R., & Manuel, J. (2005). Retaining quality early career teachers in the profession. *Change: Transformations in Education*, 8(1), 1-16.
- Grossman, P. (1990). *The making of a teacher*. New York: Teachers College Press.
- Huberman, M., Gronauer, M. M., & Marti, J. (1993). *The lives of teachers*. London: Cassell.
- Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.

SYMPOSIUM

Change and decline in remote Australian towns: Changing work lives of remote area school principals

Bruce Pietsch, University of Tasmania, Australia

This study elicited and analysed perceptions of principals in remote central schools in Australia's most populous state, New South Wales. In NSW, central schools enrol all ages of primary/elementary and secondary students and nearly all are located in remote inland areas and can be up to 1000 km from the major population centres in NSW. Typically, they require up to two hours driving to access the facilities of the nearest, small provincial town or city. The study investigated the leadership practices and work lives in the context of both remote area decline and devolution reforms of government schools in NSW. A global trend to decentralisation of public school systems has been reflected in Australian states and territories. Reasons provided for this devolution include reduction of costs and limitations of bureaucracy; increasing the responsiveness of public (government) schools (Scott, 1989) and educational advantages (Caldwell & Hayward, 1998). The study invited remote area principals to share their perceptions of the trend to school-based management and the effects of this trend on the length of time they worked and the nature of their work.

Aims:

International studies (PricewaterhouseCoopers, 2001; Smith, Brice, Collins, Matthews & McNamara, 2000) and studies in other states in Australia and in New Zealand (Gardner & Williamson, 2004; Hatton, 1995; Sahid, 2004; Saulwick Muller Social Research, 2004; Whittall, 2003) have pointed to an increase in stress and in hours worked. This study aimed to compare and contrast the work lives of the remote area principals with the work lives of principals in other areas and jurisdictions.

Methodology: A mixed-mode [qualitative and quantitative] approach (Burns, 2000) was utilised. A state-wide survey of central school principals in New South Wales in 2006 and a series of case studies of 12 of these principals (18% of this classification of principal) were conducted. This research focused on the principals' perceptions of their flexibility in their decision-making and perceived benefits in the quality of teaching and educational outcomes for students. All 64 rural central school principals were invited to complete the survey. Completed surveys were received from twenty-seven principals (42% of those sent surveys). Of these 27 principals, 12 were invited to participate in interviews. The survey was used to seek principal's perceptions of which of 28 typical tasks performed by principals contributed to their view of the ideal self-managing school and which of these tasks were carried out to meet department of education expectations. The interviews were used to investigate in more depth themes that emerged from the survey data.

Findings: The paper will report some of the data from the study. It will include: (i) The survey responses indicated that principals' self-perceptions of their duties (endogenous pressures) combined with the principals' perceptions of the employer's expectations (exogenous pressures) would combine to create a total pressure on principals to work significantly longer hours. (ii) The increasing pressure on principals and schools to be the central location of support in communities in which population and services were declining. In many cases the school was the only location of support to its community. (iii) Significant changes in the social life of the population brought about both by generational change and by demographic changes in the population, for example, people choosing these areas because they could afford to live there. One principal spoke of the "urban poor" and the "socially displaced" as comprising the school-age population. The principals mentioned physical and social decline and violence and child protection issues frequently. (iv) Tensions between expectations of the up-to-the-fifth-generation inhabitants and the newer arrivals. (v) A range of issues associated with the role of principal in a small community including: being viewed as the "department"; being vulnerable to community perceptions, particularly in the case of female principals; and professional and personal (family) isolation. (vi) The perceptions that schools had more flexibility respectively in student discipline, student welfare and teaching the core curriculum; however, flexibility in properties and maintenance was reduced. Mandated school reports (ostensibly designed to provide schools and their communities with useful data to improve educational programs) were seen as less helpful (rather than helpful). (vi) Despite describing a range challenges and tensions in their work principals reported positively and with enthusiasm and optimism about their schools and their schools' achievements and about solving school-level problems.

Significance: Theoretical concepts of leadership, such as distributed leadership and collegial support networks and communities of practice, need to be adapted considerably to provide for the special context of principals who lead schools in remote locations, especially in systems of education in which responsibilities have been at least partially devolved to the local school level. Concepts of school leadership in rural schools need to be disaggregated to consider some very different rural contexts. School leaders in larger provincial cities have many more features in common with their counterparts in suburban schools in the metropolitan area than they do with their colleagues in remote villages and townships. For principals of schools in remote and declining townships in inland New South Wales, the educational issues are very different to those being dealt with by their colleagues in larger towns or the growth areas along the coast.

References:

- Burns, R. (2000). *Introduction to Research Methods*. Thousand Oaks, CA: Sage.
- Caldwell, B. J., & Hayward, D. K. (1998). *The future of schools: Lessons from the reform of public education*. London: Falmer Press.
- Gardner, C., & Williamson, J. (2004). *Workloads of government school teachers and allied educators in Tasmania*. Launceston: A report commissioned by the Australian Education Union Tasmanian Branch.
- Hatton, E. (1995). Corporate Managerialism, Intensification and the Rural Primary Principal. *Education in Rural Australia*, 5(2), 25-32.
- McGinn, N., & Welsh, T. (1999). Decentralization of education: Why, when, what and how? In J. Hallak (Ed.), *Fundamentals of educational planning*. Paris: UNESCO - International Institute for Educational Planning.
- PricewaterhouseCoopers (2001). *Teacher workload study*. London: Department for Education and Skills (DfES).
- Saulwick Muller Social Research (2004). *The privilege and the price: A study of Principal Class workload and its impact on health and wellbeing - Final report*. Melbourne, Australia: Victoria Department of Education and Training.
- Scott, B. W. (1989). *Schools Renewal: A strategy to revitalise schools within the New South Wales state education system*. Milsons Point, Australia: Management Review: NSW Education Portfolio.

SYMPOSIUM

Australian teachers' and principals' perspectives on teacher responsibility-taking in school change

John Williamson, University of Tasmania, Australia

This paper reports findings from an Australian study of teachers and principals' perspectives on teachers' involvement in responsibility-taking in change, which was part of a series of linked international studies conducted under the auspices of the Consortium for Cross-Cultural Research in Education (CCCCE). The Australian component of this study occurred in a context in which the Australian Federal (National) Government wields ever-increasing policy power over Government (Public) Schools whilst State Governments retain constitutional responsibility for state education. Principals were asked to indicate their preference, and their estimates of teachers' preferences, for teacher involvement in responsibility-taking in school change and were invited to comment on their responses during telephone interviews. Teachers were asked to indicate their preference, and their estimates of their principal's preference, for teacher involvement. Differences, some significant, emerged between actual preferences of teachers and principals for teacher involvement and between teachers and principals' beliefs about the preferences held by each other.

Aims:

The study is situated among a broad array of research on collegial approaches to school change, micropolitics and leadership (Achinstein, 2002; Ball, 1987; Blase, 1991; Fullan, 1993, 1999; Little, 1990; Henchey (1999) showed the early success of a teams-based approach to implementing a cross-curricula approach to learning valuing coherence, adaption, participation, flexibility and diversity. This study focuses on elements that strengthen a school through empowering teachers and fostering teacher leadership. Interpretive, comparative case study (Stake, 1995; Yin, 1994) framed this investigation with principals and teachers at each of the two participating schools, comprising the primary unit of analysis. Such an approach was deemed appropriate as a means of investigating the research questions which focused on teachers' perceptions (Yin, 1994) of factors affecting their professional autonomy and control.

Methodology: The participants for this study were two principals and 48 teachers from two rural government schools in Tasmania. The teacher numbers at each site were 36 and 12. Semi-structured interviews of 45 minutes to 90 minutes were the major method of collecting data from all participants and additional information was gleaned by observation, document analysis and participant survey questionnaire. Data gathering took place over the course of a full school year and follow-up interviews extended into the following year.

Findings: The paper will report on some of the data from the study. This will include:

1. The effect of principal leadership styles on empowering/encouraging teachers to lead. The way that formal school leaders operate helps to set the culture and ethos of the school (Williamson & Galton, 1998). Such culture helps to define levels of teacher autonomy and control (Mulford & Silins, 2009). Recent research has described how leadership style may have facilitating or hindering consequences for a particular group (Silins, Zarins & Mulford, 2000; Mulford & 2003). This pattern of impact was found at both school-sites investigated in this study.
2. Types of teacher leadership emerging within the two schools Aside from the principal, there were teachers in both schools who were identified by their colleagues as having leadership roles or behaviour. Types of leadership varied from formal roles , less formal roles arising for a particular purpose or mentoring. Whether collaborative activities generated distributive leadership depended on the spread of skills among the group, the extent to which group activities were focused on educational change and development and the way formal leaders nurtured and harnessed the leadership capacities within the organisation (Harris, 2004). Educational change initiatives mean little unless supported by those who are invited to implement them, as teachers actively decide for themselves what they will take into their classrooms (Churchill, Williamson & Grady, 1997). Churchill, Williamson and Grady found that, for teachers, the negative effects of educational changes were felt most strongly when new practices usurped existing ones, when they were externally mandated, multiple and when simultaneous innovations were implemented or when timelines were short. Extremes of work intensification may well run counter to teacher professional engagement in and control of change initiatives (Williamson & Myhill, 2008). Hurried or ill-conceived change initiatives fail to allow the school as a learning organisation to move forward as a community of professional learners (Mulford & Edmunds 2010).

Significance: Studies of this distributed kind of leadership in action until recently have been few (Bennett et al., 2003), yet it is important because it is the 'glue' of a common task or goal-improvement of instruction-and a common frame of values for how to approach that task" (Elmore, 2000). It is thus a powerful way to sustain school improvements. Teachers feeling empowered through distributed leadership have better self efficacy and morale (MacBeath, 1998; Mitchell & Sackney, 2001). It is important also to ensure that distributed leadership is not simply misguided delegation (Harris, 2002).

- References: Achinstein, B. (2002). Conflict amid community: The micropolitics of teacher collaboration. *Teachers College Record*, 104(3), 421-455. Ball, S. J. (1987). *The micro-politics of school: Towards a theory of school organization*. London: Methuen
- Bennett, N., Wise, C., Woods, P., & Harvey, J. A. (2003). *Distributed leadership: Full report (A review of the literature)*: National College of School Leadership. Retrieved Feb 15, 2006, from <http://www.ncsl.org.uk/media/F7A/87/bennett-distributed-leadership-full.pdf>
- Blase, J. (1991). *The Micropolitics of educational change*. In A. Hargreaves (Ed). *Extending Educational Change*. The Netherlands: Springer.
- Churchill, R., Williamson, J., & Grady, N. (1997). Educational change and the new realities of teachers' work lives. *Asia-Pacific Journal of Teacher Education*, 25(2), 141-159.
- Elmore, R. (2000). *Building a new structure for school leadership*. Washington: The Albert Shanker Institute. Harris, A. (2002). *Leadership in schools facing challenging circumstances*. Paper presented at the International Congress of School Effectiveness and School Improvement, Copenhagen.
- Harris, A. (2004). Distributed leadership and school improvement: Leading or misleading? *Journal of Education Management and Administration*, 32(1), 11-24.
- Henchey, N. (1999). The new curriculum reform: What does it really mean? *McGill Journal of Education*, 34(3), 227.
- Little, J. W. (1990). Teachers as colleagues. In A. Lieberman (Ed.), *Schools as collaborative cultures: Creating the future now* (pp. 165-193). New York: Falmer.
- MacBeath, J. E. (1998). *Effective school leadership: Responding to change*. London: Paul Chapman Publishers. Mitchell, C., & Sackney, L. (2001). *Profound improvement: Building capacity for a learning community*. Lisse: Swets and Zeitlinger.
- Mulford, B. (2003). *School leaders: Changing roles and impact on teacher and school effectiveness*. Retrieved 21 July, 2003, from <http://www.oecd.org/dataoecd/20/36/1839878.pdf>
- Mulford, B., & Edmunds, B. (2010). *Educational investment in Australian schooling: Serving public purposes in Tasmanian primary schools*. Launceston, Tasmania: Faculty of Education, University of Tasmania.
- Mulford, W.R. & Silins, H., 2009. Transformational leadership and organizational learning. In *Transformational leadership in educational excellence: Learning organisations in the information age*. Rotterdam, The Netherlands: Sense, pp. 139-164.
- Silins, H., Mulford, W.R., Zarins, S., & Bishop, P., 2000. Leadership for organisational learning in Australian secondary schools. In *Understanding schools as intelligent systems*, Volume 4. Stamford, CT: JAI Press, pp. 267-291.
- Stake, R. (1995). *The art of case research*. Thousand Oaks, CA: Sage Publications.
- Williamson, J. C., & Galton, M. (1998). The primary school in changing times: The Australian experience. In T. Townsend (Ed.), *Building a school culture*, pp. 120-138. London, UK: Routledge.
- Williamson, J. & Myhill, M. (2008) Under 'Constant bombardment': Work intensification and the teachers' role. In D. Johnson & R. Maclean (Eds.) *Teaching: Professionalisation, development and leadership*. Springer: The Netherlands.
- Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Beverly Hills, CA: Sage Publishing.

SYMPOSIUM

Teachers' and principals' perspectives on teacher responsibility-taking in school change

Christine Gardner, University of Tasmania, Australia, John Williamson, University of Tasmania, Australia

This paper reports broad findings from a 10-country study of teachers and principals' perspectives on teachers' involvement in responsibility-taking in change (about which a specific report of the Australian research is contained in the previous paper). The research reported in this paper was conducted in response to the findings of a previous study. The attitudes of teachers towards a particular change had been found to be most powerfully influenced by teachers' involvement in that change; that is, by their ownership of, interest in and receptiveness to change and satisfaction with their work lives (Collet, Menlo & Rosenblatt, 2005). The current study sought to investigate attitudes of teachers and of principals to teacher participation in responsibility-taking with respect to change decision and processes in schools. Key findings will be presented and discussed from an international perspective about first, teachers and principals' preferences for teachers' involvement in responsibility-taking in change processes in their schools and second, each group's beliefs about the others' preferences. Countries that participated in this research are located in Europe (Hungary, Israel and the Netherlands), Africa (South Africa), Asia/South East Asia (Australia, China, Japan and Singapore) and North America (Canada and the USA). Findings that emerged from the research are presented against a backdrop of political, cultural and educational circumstances in each of the participating countries.

Aims:

The research reported in this paper was conducted in response to the findings of a previous study. The attitudes of teachers towards a particular change had been found to be most powerfully influenced by teachers' involvement in

that change; that is, by their ownership of, interest in and receptiveness to change and satisfaction with their work lives (Collet, Menlo & Rosenblatt, 2005). The current study sought to investigate attitudes of teachers and of principals to teacher participation in responsibility-taking with respect to change decision and processes in schools.

Methodology:

Mixed mode methods (Burns, 2000) were used in the international and the Australian (Tasmanian) components of this study. The researchers sought to investigate first, teachers and principals' preferences for teachers' involvement in responsibility-taking in change processes in their schools and second, each group's estimates about the preferences of the other. Each country study was conducted in its individual political, cultural, and economic context. For example, in Australia, despite constitutional responsibility for education residing with State and Territory governments the Federal Government's increasing power is achieved through making available financial resources subject to systems and schools' adoption and implementation of national priorities (Hardy, 2008; Jaensch, 1997; Stillwell, 2000; Taylor, 2009). Australian trends include politicisation of education policy, curriculum change, conflict over roles, and mandated testing. The international study sought quantitative and qualitative data from 100 to 176 teachers and from 50 to 64 principals in each of the participating countries. Participants in the Australian study were 50 principals and 106 teachers. A questionnaire was developed comprising 20 items relating to school-level changes in which teachers could potentially take varying levels of responsibility. These items were grouped into four categories: administration and coordination, human relations, teacher support, classroom learning. The development and validation of these categories was underpinned by an examination of role theory (Guthrie & Reed, 1991; Hoy & Miskel, 1987; Sergiovanni, 1987). Fifty principals and 105 teachers completed questionnaires; all principals and 15 teachers were invited to contribute additional comments. Numerical data were analysed for reliability using Cronbach's alpha procedure. Qualitative data were used to provide richer accounts of participants' perspectives.

Findings:

Cross-country analyses will be presented including means for each of the four measures (teacher preference, teacher estimate of principal support, principal preference, and principal estimates of teachers' preference). Similarities and differences between individual countries and groups of countries and an exploration of possible cultural, political and historical influences on the results of this study will be presented. The Australian study revealed that teacher preferred a higher level of involvement in responsibility-taking than they estimated principals would support. Principals in the Australian sample preferred a higher level of teacher-involvement in responsibility-taking than they believed that teachers preferred. Means for the A, H, T and C indices revealed first, that the principals estimated that teachers preferred less involvement and second, that principals preferred teachers to have least to most involvement in the categories of activities of A, H, T and C in that order. Teachers' preferences, and estimates of principal support, reflected this rank order, although their preferences for involvement were to a lesser extent than either principals' estimates or principals' preferences. Both sets of principal means were higher than the teachers' preference means. Furthermore, these three means were higher than the teachers' estimates of principal preference, which were the lowest means of all four sets. Individual reference will be made to a variety of correlations between demographic data and some of the findings. A challenge that arises from these variations is to explore conditions that will facilitate sharing perceptions in order that the combined expertise of principals and teachers may be exploited: first, to augment the quality of change processes in schools; second, to enrich ongoing development of school leadership qualities and skills of teachers; and finally, to enhance and optimise progression towards shared goals.

Significance:

Implications for practices were identified as a result of this study. The study provided an opportunity for comparison between perspectives of teachers and principals about with respect to teachers' involvement in responsibility-taking that has not been addressed by other research about teacher involvement, teacher participation, teacher leadership and teacher-principal relationships (e.g., Chrispeels, 2004; Grubb & Tredway, 2010). Investigation of differences between teachers' and principals' perspectives of both groups' actual preferences for teacher involvement, and each group's estimates of the other's preference provides a new approach to identifying strategies that have potential to enhance school change processes.

References:

- Burns, R. (2000). *Introduction to Research Methods*. Thousand Oaks, CA: Sage Publications.
- Chrispeels, Janet H. (2004). *Learning to lead together: The promise and challenge of sharing leadership*. Thousand Oaks, CA: Sage Publications.
- Collet, L., Menlo, A., & Rosenblatt, Z. (2005) How educational change affects secondary school teachers. In P. Poppleton & J. Williamson (Eds.), *New realities of secondary teachers' work lives* pp. 245-290.
- Grubb, W. N., & Tredway, L. (2010). *Leading from the inside out: Expanded roles for teachers in equitable school*. Boulder, CO: Paradigm Publishers.

Guthrie, J. W. & Reed, R. J. (1991). Educational administration and policy. Needham Heights, MA: Allyn and Bacon.

Hardy, I. (2008). Competing priorities in professional development: An Australian study of teacher professional development policy and practice. *Asia-Pacific Journal of Teacher Education*, 36(4), 277-290.

Hoy, W., & Miskel, C. (1987). Educational administration. New York, NY: Random House.

Jaensch, D. (1997). The politics of Australia (2nd ed.). South Melbourne, Australia: Macmillan Education.

Sergiovanni, T. J. (1987) The principalship: A reflective practice perspective. Boston, MA: Allyn & Bacon.

Stillwell, F. (2000). Changing track: A new political economic direction for Australia. Anandale, Australia: Pluto Press Australia.

Taylor, T. (2009) Howard's End: A narrative memoir of political contrivance, neoconservative ideology and the Australian history curriculum. *Curriculum Journal*, 20(4), 317-329.

SYMPOSIUM

Competence, Value, Achievement, and Interest: How Are They Related in Academic Motivation?

Chairperson: K. Ann Renninger, Swarthmore College, United States

Organiser: K. Ann Renninger, Swarthmore College, United States

Discussant: K. Ann Renninger, Swarthmore College, United States

Panelists from differing research and/or methodological traditions will use data from current projects to discuss their understanding of the relation among four variables that, while essential to academic motivation, have only recently begun to be considered in relation to each other: competence, value, achievement, and interest. Each panelist will provide a brief overview of the studies on which he or she is drawing and will then address the following session questions:

1. How are we defining our terms theoretically and how do we operationalize them in this study (-ies)? Related questions might include: How can the link between value and interest be theoretically explained? Is feeling competent a precursor for appreciating value? What is the relation between interest and intrinsic motivation (are situational and individual interest the same as situational and dispositional intrinsic motivation)? Does competence matter if you do not value a task? Is discovering value different from learning about value?
2. What is the role of content in the relation of competence, value, achievement, and interest? Related questions might include: Are the kind or type of values you pursue differentially predicting interest, achievement, and competence—and, what is the role of content? Does competence promote interest or does interest promote competence, or can both be true?
3. What can we say now and what are the next steps in the research needed in order to address these questions? A related question might include: What research methods are necessary for exploring these issues?

SYMPOSIUM

Who Continues to Pursue STEM in College? The Roles of Competence, Value, Achievement, and Interest

K. Ann Renninger, Swarthmore College, United States; Lynne Steurle Schofield, Swarthmore College, United States;

Margaret W. Nam, Swarthmore College, United States

Two current studies will be used to address session questions. Both studies address questions being posed by colleges and universities seeking to support their students to pursue majors in science, technology, engineering, or mathematics (STEM), especially women, underrepresented minorities (URM), and first generation students (e.g., Hill, Corbett, & St. Rose, 2010; Planty, Hussar, Snyder, Provasnik, Kena, et. al., 2008). For those working directly with students who could but do not elect to continue in STEM, understanding more about their motivational needs and preferences, and those of the students who do continue, is a priority. In the two studies on which this presentation draws, standardized achievement and institutional data are complemented by data on the students' perceptions of competence, value, achievement, and interest. Findings from these studies suggest that interest is a key indicator of academic motivation, and the decision to continue to major in STEM, when interest is assessed in terms of feelings, value, and knowledge. Those with more developed interest are those who continue in STEM. They value the content and they are willing to reorganize their learning strategies to be able to continue to engage with the discipline.

This presentation will address session questions by drawing on two current studies. The first is a study of 4182 (2317 f, 1672 m, 193 unidentified) first semester senior undergraduate students that suggest (using logistical regression analysis) that interest variables are far more predictive than those with the motivational orientation factors and that demographic variables become less significant when interest is also analyzed. In addition, the error rates of the logistic regressions with interest variables are much lower (17.9% compared to 29.9%) than those with the

motivational orientation factors. The second is a combined survey and interview study of 100 undergraduates (8 m, 8 f from each of 6 STEM disciplines, plus 4) who continued to pursue STEM disciplines in a rigorous academic setting. Discussion of session questions will focus on interest as a key indicator of academic motivation, when interest is assessed based on feelings, value, and knowledge. The coupling of survey and interview findings provides insight into the roles of competence, value, achievement, and interest for those who continue in STEM.

In the first study, confirmatory and exploratory factor analysis was used to determine the number of factors for each of five areas: career plans and choices (4), choice of major (4), instructional practices (3), motivational orientation (3), and interests and attitudes (4). On average, Cronbach's alpha was high for all 18 of the factors; the only alpha below 0.50 was the third factor in the motivational orientation and it was subsequently deleted from analyses.

Logistic regression and classification-tree analysis was employed. Findings suggest that for students who report beginning their college career with a plan to major in a STEM discipline, none of the motivational orientation factors (performance and learning goals) predict their continuing. Even when controlling for gender, URM, and first generation status, these variables are insignificant. Classification-tree analysis confirmed these findings.

Regressions conducted with interest variables are far more predictive than those with the motivational orientation factors and their error rates are much lower (17.9% compared to 29.9%). Moreover, the demographic variables become less significant when interest is also analyzed. The logistic regression model was no better at predicting whether students had decided to stay in STEM when demographic variables were analyzed alone, again suggesting that the predictive power of the demographic variables is small. This suggests that while race, gender, and first-generation status differentials remain among those who stay in STEM and those who leave, the choice to leave may be based more on interest factors and less on specific demographic variables suggesting that policy and practice might focus on exploring more the relation among interest and the choice to stay in STEM across different genders, races, and first generation statuses.

In the second study, results from the institutional data, surveys, and follow-up interviews revealed that those who continue in STEM have developed interest for their discipline, share demographic profiles based on institutional data, and reported changed perceptions of what it meant to achieve in STEM following their first STEM course work. Their stated reasons for choosing their major included interest (85.71%), career (34.69%), competence (28.57 %), experiences with professors in the department (21.51%), positive experiences prior to college (22.45%), practicality (13.27%), family influences (11.22%), no other options for a major (11.22%), the desire to succeed as a role model for others (6.12%).

The interview data suggest that these students' self-confidence as learners can be characterized by their comfort with their own ability levels and while they may have questioned whether they should pursue a STEM discipline on the basis of how much time this type of major requires, they did not question whether they could do the required work of the discipline. All of the students reported entering college highly confident in their abilities and while many had their confidence challenged in their first STEM course, they reported comfort with their present level of achievement (87.76%).

Many students identified their beliefs upon beginning undergraduate classes that competent students complete their work independently. The importance of transitioning to being able to work with others was mentioned by 57.14% of the students. Many (50.4%) also identified the need to shift learning strategies: to learn to work with others, to ask questions of professors, and to learn to put work down and return to it rather than expecting to get it correct the first time.

Findings such as these suggest first that the phase of student interest for a STEM discipline impacts the decision to continue. Despite the challenges associated with mastery of rigorous content, it is mastery that students who continue to pursue STEM value. They revise their understanding of achievement so that this is not only associated with grades, and change their learning strategies.

SYMPOSIUM

The Relation of Expectancy and Value to Outcomes, Is this Additive or Interactive?

Herb Marsh, University of Oxford, United Kingdom; Benjamin Nagengast, University of Oxford, United Kingdom;

L. Francesca Scalas, University of Cagliari, Italy; Man xu, Oxford University, United Kingdom; Kit-Tai Hau, Chinese University of Hong Kong, Hong Kong

Understanding why students are motivated to engage in specific subjects and fields of study and why they excel in them in terms of achievement is one of the most important questions in education. For more than half a century, expectancy-value theory (EVT) has been influential in understanding how motivation is related to effort, choice and achievement-related behaviour. Historically, a core assumption of EVT was that expectancy and value interact synergistically. However, in modern EVT approaches, this critical interaction term has been largely excluded from the model. Our large-scale study of science motivation ($n = 400,000$ 15-year-old students from 57 countries based on PISA2006) shows that the ExV-interaction contributes to the prediction of both science-related career plans and activities; the ExV interaction is statistically significant, highly reliable, generalizable over countries and supports the need to reinstate the ExV interaction into EVT.

Students' enrollments in sciences are declining worldwide. Previous research shows that self-concept, interest and achievement are reciprocally related and important predictors of coursework selection and career choice. In this presentation, session questions will be addressed by considering the methodology employed in and the findings from a study in which Expectancy Value Theory (EVT) is applied/extended. EVT posits that academic choice is a function of E = Expectations of Success (ASC =academic self-concept), V =Value (ENJ = enjoyment), and their interaction ($ExV = ASC \times ENJ$). The ExV interaction implies that students are most motivated when both E and V are high. However, this critical interaction has been largely dropped as non-significant from applied EVT research. We argue that the failure of modern EVT research to find ExV interactions is largely due to methodological limitations. We posit that new multilevel structural equation models (M-SEM) with latent interactions could help to resolve the problem of the missing ExV interactions in EVT.

Drawing on work with the OECD-PISA-2006 database that allows comparisons of educational outcomes across 57 countries ($n = 400,000$ students), the presence of the ExV interaction in EVT was assessed. Measures from this database that included science-related independent (ASC -expectancy; ENJ -value; $ASC \times ENJ$; achievement- ACH) and dependent (career plans; activities) variables were used. M-SEM with latent interactions was used to evaluate the presence of the ExV interaction in EVT.

The results show significant positive effects of ASC , ENJ and $ASC \times ENJ$ on both science-related career plans and activities in the sample as a whole. Multiple-group models (57 countries) further show that $ASC \times ENJ$ is statistically significant in the prediction of science-related career plans in 45/57 countries and in the prediction of science-related activities in 48/57 countries. In addition, the results show that $ASC \times ENJ$ is substantially related to country level values of individualism. Consistent with early EVT, but contrary to subsequent versions, the ExV interaction is statistically significant, highly reliable, and supports the need to reinstate the ExV interaction into EVT.

Theoretically, the results from this study demonstrate the need to re-introduce the expectancy-value interaction into expectancy-value interaction theory and to consider some of the reasons why it had been dropped. The notion of a multiplicative combination of expectancy and value has almost completely vanished in discussions of EVT. Analysis of surveys and questionnaires shifted the focus from within-person differences in the motivation to engage in different tasks to between-person comparisons of the engagement in identical subjects and tasks. Multiple regression and path analyses with scaled scores became the analytical techniques of choice—but both approaches make the detection of interaction effects unlikely. In the present study, we use models with latent interactions to provide strong and powerful tests of the interaction between expectancy and value in a large cross-cultural database—a substantive methodological synergy (Marsh & Hau, 2007).

Methodologically, the findings from this study are important in demonstrating new and evolving approaches to measure latent interactions in ways that control for measurement error. The large number and variety of countries that participated in PISA allow demanding tests of its universal generalizability and applicability (Matsumoto, 2002; Segall, Lonner & Berry, 1998). Although the EVT-model explicitly includes cultural background variables and hypothesizes that they influence academic motivation and choice, most tests of the model have been conducted in Western cultures (Wigfield, Tonks, & Eccles, 2004). Findings from this study are also important to substantive educational understanding. They demonstrate the importance of the intrinsic motivation component of interest, academic self-concept, and their interaction in predicting proximal (undertaking science activities) and distal (science-related career plans) of practical significance.

The present study addresses the critical issue of declining science enrollments, has profound implications for motivation theory, is based on cutting-edge, emerging methodology, uses the best available data, and fits well with our program of substantive-methodological synergy development. Each of these aspects will provide the basis of addressing the questions of the session.

SYMPOSIUM

The Relation of Utility Value, Competence Value, and Lesson Value to Interest

Carol Sansone, University of Utah, United States; Tamra Fraughton, University of Utah, United States; Jonathan Butner, University of Utah, United States; Joseph Zachary, University of Utah, United States; Sungchoon Sinclair, University of Utah, United States

The Self-regulation of Motivation (SRM) model suggests that both goals-defined motivation (i.e., value and expectancy of learning), and experience-defined motivation (i.e., whether the learning experience is interesting) are important for maintaining behavior. These motivations can be distinct but reciprocally related over time, and this reciprocal relation impacts both subsequent motivation and achievement. To illustrate, we used data from the Regulating Motivation and Performance Online (RMAPO) project. Undergraduates worked on an online HTML programming lesson, and their engagement behaviors (i.e., use of optional examples and exercises) were assessed. Initial lesson descriptions just described skills to be learned (no added utility value), or further described how these skills could be used when creating personal or organizational web-pages (added utility value). We examined whether the utility value information directly predicted value at lesson conclusion, or depended on the experience students created during the lesson via engagement behaviors. We compared two kinds of value at lesson conclusion: competence value (value doing well) and lesson value (value lesson content). Added utility value directly predicted subsequent competence value, and indirectly predicted subsequent lesson value by way of higher engagement levels. In turn, competence value was related to greater lesson interest, whereas lesson value was associated with greater interest AND learning, as well as greater future likelihood of learning more about HTML. We use these results to discuss the panel questions, noting that the relationships among value, interest and competence are complex, depend on which aspects of each construct are measured, and are reciprocal over time.

The Self-regulation of Motivation (SRM) model (Sansone & Thoman, 2005) suggests that both goals-defined motivation (i.e., the value and expectancy of learning), and experience-defined motivation (i.e., whether interesting while working towards those goals) are important for sustained learning. Rather than particular goals being associated automatically with interest, our model suggests that what is critical is whether the environment enables work toward those goals in ways that create or maintain an interesting experience. This is true even if the goal is to experience interest.

Goals-defined motivation is one source of the interest experience. Initial actions directed by goals also affect the experience. Subsequent (maintenance) actions may thus be in service of reaching goals or in service of making the experience more interesting, particularly over a longer time period. When applied to learning, the SRM model suggests that although initial goals-defined motivation is important, its effect on motivation and performance outcomes may depend on maintenance actions.

As part of the Regulating Motivation and Performance Online (RMAPO) project, Sansone and colleagues created a paradigm for examining this proposed regulatory process, implemented via an online HTML lesson. They varied the initial lesson description such that it just described the skills to be learned (control), or further added how these skills could be used when creating personal or organizational web pages (added utility value). Initial results (Sansone, Zachary, et al. 2010) suggested that adding utility value did not directly affect motivation (interest) and performance (quiz on HTML knowledge) outcomes. Rather, as compared to the control, the added utility value was associated with more manipulating and modeling of sample HTML codes in optional examples and exercises. Mid-level engagement (modeling only) predicted higher quiz scores, and higher level engagement (manipulating and modeling) predicted greater interest at the end of the 1 ½ hour session.

These previously reported results suggest that greater value for learning at the outset can lead to creating a more interesting experience, which, in turn, can lead to greater interest at the conclusion. However, the model also suggests that value and interest can be reciprocally related over time. To examine potential reciprocal relationships, we examined whether the utility value information added at the outset directly predicted value at lesson conclusion, or depended on the experience students created during the lesson via engagement behaviors. We also compared two kinds of value at lesson conclusion: Competence Value (value doing well) and Lesson Value (value lesson content).

Participants were undergraduates (n=108; 67% female) who came into the lab and worked on the online HTML programming lesson for 1 ½ hours. Students were randomly assigned to one of the three conditions described previously (control, personal applications, and organizational applications).

The lesson included optional examples and exercises that individuals could click on to see sample HTML codes. We measured patterns of engagement via the degree to which students: 1) clicked on the examples and exercises that showed sample HTML codes (Accessed); 2) further clicked on a button that displayed what the HTML codes would look like when published (Modeled); and 3) further clicked on a button that allowed them to modify the given HTML codes and then display the effects (Modified/Modeled). At lesson conclusion, learning was assessed via a quiz of HTML knowledge. Students also completed a questionnaire where students rated on 1 to 5 scales: Competence Value (4 items; e.g., It was important to me do well on the lesson), Lesson Value (3 items; e.g., Completing this lesson was very worthwhile), and Lesson Interest (5 items, e.g., I found the lesson very interesting). Finally, students were given a chance to request a code that would allow them to access the full online programming course (-1, no request; 1, request).

A hierarchical regression model was created that included two contrast codes for the manipulation of utility value (Value added v. No added value, Personal v. Organizational Value) (Step 1). When Competence Value was regressed on this model, there was a significant positive main effect of the Value Added contrast; for Lesson Value, there was a marginally positive effect of the Value Added contrast. Previously, we found that the Value Added contrast was significantly associated with greater Degree Modeled and Degree Modified/Modeled. In Step 2, therefore, we added the main effects (centered) of the three engagement behaviors (Degree Accessed; Degree Modeled; Degree Modified/Modeled) (Step 2). For Competence Value, the main effect of the Value Added contrast was unchanged, and none of the engagement behaviors were significant. For Lesson Value, in comparison, the effect of the Value Added contrast was reduced, and the effect of Degree Modified/Modeled was significant and positive. We then regressed the other outcome measures on the model to which we added Competence Value and Lesson Value (both centered) (Step 3). Both Competence and Lesson Value significantly and positively predicted Lesson Interest. In contrast, when Request Code and Quiz Score were each regressed on the same model, only Lesson Value was significantly related.

Results suggest that the added utility value at the outset of the lesson directly contributed to the importance of doing well, and indirectly contributed to valuing what was learned, by motivating higher levels of engagement during the lesson. Caring about achievement was related to finding the lesson interesting. In contrast, seeing the lesson content as valuable to learn was associated with greater interest and learning, and also greater likelihood of engaging the material again in the future. We will use these results to discuss the panel questions, noting that the relationships among value, interest and competence are complex, depend on which aspects of each construct are measured, and are reciprocal over time.

SYMPOSIUM

Goal-content, Intrinsic Motivation, Self-Regulated Learning and Performance

Maarten Vansteenkiste, Gent University, Belgium

Within Self-Determination Theory (Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2010), it is maintained that not all goals are created equal because the content of individuals' goal pursuit matters in terms of predicting intrinsic motivation, well-being, and performance (Ryan, Sheldon, Kasser, & Deci, 1996). Specifically, a distinction is made between intrinsic goals (e.g., self-development, community contribution, affiliation) and extrinsic goals (e.g., wealth, fame, physical attractiveness) which are said to be differently related to the satisfaction of individuals' basic psychological needs for autonomy, competence, and relatedness. In this panel discussion, I will present findings from (a) a questionnaire study in which students' reported on their personal goal pursuit and (b) experimental study in which different goal contents were experimentally induced. Collectively, these studies suggest that intrinsic and extrinsic goals differently predict the enjoyment and interest in school work, self-regulated learning and students' performance, which is herein considered as a proxy for competence-building (Vansteenkiste, Lens, & Deci, 2006). These findings are discussed in light of expectancy-value theories and self-determination theory which are grounded in different meta-theoretical assumptions.

Within Self-Determination Theory (Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2010), it is maintained that not all goals are created equal because the content of individuals' goal pursuit matters in terms of predicting intrinsic motivation, well-being, and performance (Ryan, Sheldon, Kasser, & Deci, 1996). Specifically, a distinction is made between intrinsic goals (e.g., self-development, community contribution, affiliation) and extrinsic goals (e.g., wealth, fame, physical attractiveness) which are said to be differently related to the satisfaction of individuals' basic psychological needs for autonomy, competence, and relatedness. In this panel discussion, I will present findings from (a) a questionnaire study in which students' reported on their personal goal pursuit and (b) experimental study in which different goal contents were experimentally induced.

In a first questionnaire-based study, we examined the relation between adolescents' intrinsic and extrinsic life goals, their achievement goals, intrinsic motivation, grades and self-regulated learning. Vansteenkiste, Soenens and Duriez (2008) argued that the valuation of extrinsic life goals at the expense of intrinsic life goals might shift students' attention away from the learning activity, thereby becoming less focused on mastering the activity at hand. Instead, because the pursuit of extrinsic goals yields an ego-validating character, the pursuit of extrinsic relative to intrinsic goals would be associated with a performance orientation as outperforming others is viewed as instrumental to bolster one's self-worth. Because of their different linkage to mastery-approach and performance-approach goal pursuit, intrinsic and extrinsic life goals would yield a different relation to students' academic intrinsic motivation, performance and indicators of self-regulated learning (e.g., time management). Regression analyses largely confirmed this pattern, even after controlling for several important teaching dimensions, including perceived autonomy-support and perceived structure. Further, person-centered analyses (i.e., cluster analyses) complemented these dimensional analyses, thereby indicating that different types of students could be retained depending on the type of life goals they value. The group of students valuing intrinsic goals alone was found to score highest on academic intrinsic motivation, self-regulated learning, and performance, even in comparison to students valuing both intrinsic and extrinsic goals.

A second experimental study build on this questionnaire based study by framing a specific learning activity in terms of the attainment of intrinsic and extrinsic goals. This allowed answering the question whether different goal-contents has causal impact upon achievement goals, intrinsic motivation, and performance. In line with the questionnaire-based study, intrinsic relative to extrinsic goal framing was found to produce more task-involvement, greater intrinsic motivation, better performance and more free-choice persistence. These two single goal conditions were also compared to a double goal condition in which the learning activity was framed in terms of the attainment of both an intrinsic and extrinsic goal. According to expectancy-value theories, increasing the utility value of a learning activity by indicating its instrumentality to attain two goals rather than only one of those two should result in higher motivation and more optimal learning. In contrast, self-determination theory posits that it is also important to take into account the content of the goal (intrinsic versus extrinsic) next to the quantity of provided goals. Contrast-cell analyses showed that the double goal condition fell in on several outcomes in between the two single goal conditions.

Collectively, the findings these two studies suggest that it is critical to consider the type of goals learners pursue or teachers refer to when increasing the utility value of a learning activity. Both the personal valuation of more goals (Study 1) and the experimental induction of more goals (Study 2) does not necessarily relate to more adaptive academic functioning. Intrinsic goals will primarily relate to higher intrinsic motivation and better performance, while extrinsic goals even tend to undermine the learning process, presumably because these goals are differently linked to the satisfaction of one's basic psychological needs.

SYMPOSIUM

Moral and democratic education within the context of science education

Chairperson: Jean-Luc Patry, Universitat Salzburg, Austria

Organiser: Jean-Luc Patry, Universitat Salzburg, Austria

Jostein Saether, NLA University College, Norway

Discussant: Dimitris Pnevmatikos, University of Western Macedonia, Greece

Teaching and teacher education are typically focused on content (subject matter). However, the society requires that teaching addresses also issues of moral and democratic education, as documented, for instance, in the curricula. Nevertheless teachers and teacher educators are reluctant to address these topics given the content pressure and because they do not have the appropriate methods to do so; further, they fear to interfere with the parents' moral convictions. The three papers in this symposium show conditions and ways for dealing adequately with this problem. The first paper addresses the conditions for the discourse on human dignity in teacher education with particular focus on life science, the second paper reports on an experiment about critical thinking as related to teaching about the greenhouse effect, and the third paper presents details on the Values and Knowledge Education (VaKE) concept that combines moral and content related teaching; the focus is on viability checks as a means to overcome the disadvantage low achieving students have in open teaching.

Human Dignity in Life-Science Research Practice: A Matter of Critical Socio-Historical Literacy

Anna Tapola, Linnaeus University, Sweden

The protection of human dignity (HD) is assumed to be a central task in education; no matter if we are talking about teacher education (TE), training for life-science research practice, or education for a global networked society (EGNS). However, the notion of HD can have different meanings. The aim of the study was to scrutinise the relationship between the notion of HD in life-science research practice, and discourse of HD within TE. Previous studies show that the discourse of HD within TE to a high degree was permeated by themes and arguments associated with life-science subject matters, for example, anatomy and physiology, but rarely in terms of an absolute and universal value that belongs to all people. The question is whether emphasise on bodily functions also denotes discourse of HD within life-science research practice. The study was a critical discourse analysis. The data (published articles and student theses that related to HD) consisted of more than two million words, which were analysed qualitatively. The findings show that it is accepted to discuss HD in terms of life-science subject matter, not least in terms of bodily (dys)functions. Notwithstanding this key finding, researchers and students of life-science rarely published articles, or wrote theses, which concerned HD. Conclusion: The modest number of contributions written by scholars and students of life-science might be explained by lack of a Critical Socio-Historical Literacy (CSHL), which is a new concept. It is also suggested that CSHL should be a crucial precondition for EGNS.

The aim of the study was to scrutinise the relationship between the notion of human dignity (HD) in life-science research practice, and discourse of HD within teacher education (TE).

Research questions: Does HD in life-science research practice relate to discourse of HD within TE? If so, how, why and under what circumstances, does HD in life-science research practice relate to discourse of HD within TE? If not, how can such findings be explained?

The background and relevance for the domain of EARLI is that protection of HD is a central task for any educational activities, as required, for example by the Universal Declaration of Human Rights (United Nations' General assembly, 1948), or the European Convention on Human Rights and Biomedicine (Council of Europe, 1997) – not least in terms of education for a global networked society (EGNS). To a significant extent, the documents above are grounded on insights from, and consequences of, atrocities committed by 'life-scientists' during WWII, for example, medical experiments (Proctor, 1988). Therefore, HD is assumed to be of importance for TE, as well for life-science research practice, especially since both spheres are grounded on educational activities, and thereby also related to learning and instruction – not least in terms of moral and democratic education.

Previous studies (Tapola, 2010) show that discourse of HD within TE to a high degree is permeated by themes and arguments that are associated with life-science subject matter, for example, anatomy and physiology. According to these studies, full HD is linked to what is considered to be a 'perfect' body and 'non-disturbed' bodily functions, and all the argument were assumedly grounded on outcomes of life-science research. The focus on the unproblematic body as a carrier of full-fledged HD can have severe consequences on how, for example, teachers may treat colleagues and pupils with disabilities. For an appropriate discourse in TE, it would be necessary to be based on contemporary discourse of HD within life-science research practice. However, so far, little has been known about this discourse. Therefore it is justified to analyse how this particular HD discourse is constructed by various categories of constituents.

The data comprised of four categories of constituents: * 91 university student theses at bachelor's or master's level (Swedish data);* 24 peer-reviewed published scientific articles within the area of science education research (International data);* 22 scientific articles published in peer-reviewed life-science journals (International data);* 43 articles published in popular scientific magazines (International data).

All constituents included any of the search terms (see below). In total, the data exceeded two million words, which were analysed qualitatively.

The data collection method constituted of searches at digitalised databases. Search terms: 'människovärde' (Swedish) and 'human dignity' (English). All theses and articles that included any of the search terms were incorporated in the data.

The methodology is grounded on critical discourse analysis (for example, Fairclough, 2010) and the discourse-historical approach (DHA) (Reisigl, & Wodak, 2009; Wodak, 2001a, 2001b). DHA is based on a Habermasian emancipatory knowledge interest in the sense that the analysis serves to reveal phenomena that, at a previous staged in the process, hindered the insights and meaning-making achieved after the analysis. Within DHA, three dimensions are of particular interest: (i) immanent dimensions that focus on functional linguistic characteristics of the constituents; (ii) socio-diagnostic dimensions that focus on properties related to power, democracy, morality, various

rationalities that inform our choices to act in certain ways, etc.; and (iii) historical dimensions, i.e. dimensions that focus on variations over time (the past, the present, and the future) of the phenomena under study. The analytical methods consisted of (i) transitivity analysis, (ii) argumentation analysis, and (iii) contextual analysis.

Ethical considerations: This study never included direct research on humans, or any other living creatures. All data consisted of open-access texts only. All findings were reported in a de-identified form.

The findings show, among others, that the thematic patterns of the discourse within TE reappear in student's theses, life-science articles published in scientific journals, and in articles published in popular scientific magazines, but hardly ever in scientific articles within the area of science education research. Findings showed there was a clear relationship between HD in life-science research practice, and discourse of HD within TE. However, there was a major difference. Ethicists and legal experts discussed HD in terms of human rights, which was highly unusual in the discourse of HD within TE. Furthermore, professional scholars of life-science rarely published articles that concerned life-science subject matter and the notion of HD. Therefore, it is suggested that the modest number of contributions written by scholars of life-science research can be explained by lack of Critical Socio-Historical Literacy (CSHL), which is a conclusion that may have great importance – not least in view of the dark history of 'life-science' during the last century. CSHL is a new concept that will be further clarified at the conference, but CSHL should also be a crucial precondition regarding education for a global networked society.

References

- Council of Europe, (1997). Convention for the protection of human rights and dignity of the human being with regard to the application of biology and medicine: Convention on human rights and biomedicine. Strasbourg: Council of Europe.
- Fairclough, N. (2010). Critical discourse analysis (2nd ed.). Harlow: Pearson Education Limited.
- Proctor, R. N. (1988). Racial hygiene: Medicine under the Nazis. Cambridge MA: Harvard University Press
- Reisigl, M. & Wodak, R. (2009). The Discourse-Historical Approach. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis*. Second Edition (pp. 87-121). London: Sage.
- Tapola, A. (2010). Human Dignity – A multifaceted discourse in teacher education. In C. Klassen & N. Maslovaty (Eds.). *Moral courage and the normative professionalism of teachers*. Rotterdam: Sense Publishers.
- United Nations' General Assembly. (1948). Universal Declaration of Human Rights (217 A III). New York: United Nations.
- Wodak, R. (2001a). What CDA is about – a summary of its history, important concepts and its developments. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis* (pp. 1-13). London: Sage.
- Wodak, R. (2001b). The Discourse-Historical Approach. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis* (pp. 63-94). London: Sage.

Stimulating autonomous thinking and learning intentions related to the greenhouse effect topic

Jostein Saether, NLA University College, Norway; Kristian Skaaraas, NLA University College, Norway

The hypothesis of this pilot study is that communicating relevant information, stimulating general independent/critical thinking, and academic self-concept and the use of learning strategies might strengthen the immediate intention to learn and act regarding the man-made greenhouse effect. In a four-groups posttest-only randomized experiment 89 16 year old students were randomly assigned to one of four groups. Each group had their own version of a questionnaire to answer which differed with regard to the introductions. Group 1: introduction (i) given to strengthen knowledge based attitudes. Group 2: (i), and (ii) given to effect general independent and critical thinking. Group 3: (i), (ii), and (iii) to stimulate academic self-concept and the use of learning strategies. Group 4 was the control group. The questionnaire was distributed without any opportunity for further elaboration, and in this way illustrates poorly elaborated subject matter. The experiment illustrates that stimulating general critical or autonomous thinking (group 2) might seem to function counterproductive as to increase the strength of the behavioural intentions we wish to promote. When divided into males/females this tendency is only significant among the males. The conclusion is that our efforts to stimulate critical thinking should be subject matter related rather than abstract and general. The study also exemplifies that social norms (e.g. the willingness to listen to experts) are of particular importance for learning intentions.

Stimulating autonomy is fundamental in moral and democratic education, which in this context is related to controversial conceptual change theory (Säther and Maridal, 2005) and to "the reasoned action approach" (Fishbein and Ajzen, 2010).

The aim is to show that the following factors might strengthen the immediate intention to learn and act regarding the man-made greenhouse effect:

- (i) communicating relevant information,
- (ii) stimulating general independent/critical thinking, and
- (iii) stimulating academic self-concept and the use of learning strategies.

Methodology: The project is at a pilot stage. It is based on the four-groups posttest-only randomized experiment presented below. A sample of 16 year old students from 4 classes were randomly assigned to one of four groups as follows:

Group 1 (Academic group, N=22): Introduction 1 & test; Purpose: To strengthen knowledge based attitudes (A);

Group 2 (Autonomy group, N=22): Introductions 1 & 2 & test; Purposes: A & to effect social norms regarding general independent and critical thinking (B);

Group 3 (Academic self-concept and learning strategies supported, N=22): Introductions 1 & 2 & 3 & test; Purposes: A & B & Stimulating academic self-concept and the use of learning strategies (the control factor) (C)

Group 4 (Control group, N=23): Only test.

Influenced by Fishbein and Ajzen's theory a questionnaire was developed using 7-point Likert scale items. The questionnaire with the four types of introductions were randomly distributed without any opportunity for additional text elaboration. This "weakness" of intervention seeks to illustrate the situation when subject matter is poorly elaborated.

Some test items might illustrate:

* Dependent variable (learning intention): "During this school-year I will really work hard to learn about the greenhouse effect so I can understand this topic properly."

* Social norm: "In fact I don't care about these experts that focus so much on the man-made green house effect with these alleged harmful effects."

* Attitude: "If the earth's living conditions are seen all together one must conclude that increased greenhouse effect can result in catastrophic consequences during this century."

Findings: The overall conclusion is that the differences between the groups often were not significant. The results indicate that the treatments probably were too weak, and demonstrate the well-known experience that passing on information without students' active/enduring participation in learning yields meagre changes.

What are the consequences of generally stimulating critical thinking? E.g. action intentions concerning the man-made green house effect was illustrated by some differences between group 1 and 2: Test item 6: "It is absolutely necessary to implement drastic measures to reduce the use of fossil fuel" (M1=6.6, SD1=0.8; M2=5.6, SD2=1.6) ($P=.02$). Test item 16: "It is not so important to work to reduce greenhouse gas emissions" (M1=6.8, SD1=0.5; M2=5.7, SD2=1.8 ($P=.02$). On both statements "the critical or autonomy group"(group 2) scored significantly lower than the "traditional academic group" (group 1). If further analysed, by removing 2 cases (contradicting answers in group 2) the analysis show even stronger results: Item 6 " (M1=6.6, SD1=0.8; M2=5.5, SD2=1.6) ($P=.01$); Item 16 (M1=6.8, SD1=0.5; M2=6.2, SD2=1.1 ($P=.04$). Splitting the cases shows gender differences: Among the females no significant differences were found when comparing group 1 and 2 regarding test items 6 and 16. However, among the males the differences are significant: Item 6 " (M1=6.5, SD1=0.8; M2=4.6, SD2=1.9) ($P=.05$); Item 16 (M1=6.8, SD1=0.4; M2=5.5, SD2=1.3 ($P=.03$). These results exemplify that stimulating general critical or autonomous thinking might function counterproductive as to increase the strength of the behavioural intentions we wish to promote. However, when the groups are divided into males/females this tendency is only significant among the males. Further analysis shows that gender has a significant impact on the behavioural intention test score in group 2 ($R^2=.26$, $F=6.2$, P

By constructing subscales we analysed the combined effects of attitudes, social norms and control factors on learning and action intentions in the four groups. This analysis revealed significant results only in group 1 and 2, and only for the social norm related to learning intention ($R^2=.55$, $F=21.5$, P

In summary, the results indicate that the social factor is the most influential factor on learning intention when students are confronted with a single academic text, or with an academic text in combination with stimulation of critical thinking. However, there are gender differences. The social factor shows a significant difference between the male and female students. The study does not reveal any significant effects of attitudes and control factors.

Theoretical and educational significance:

The study gives an example of the counterproductive effect that might occur when stimulating general/abstract critical thinking without making links to the subject matter. It seems as the male students are negatively influenced by this. The study also exemplifies that the social norm is of particular importance for learning intentions. One of the practical implications is about asking: Who are the experts in the area of interest? Who deserves to be listened to? How should critical thinking be integrated with subject matter learning?

This pilot study has some weaknesses regarding sample size, internal consistencies and distributions skewness. The design does not include subject matter elaboration. However, some results seem strong enough to encourage further research related to the proposed hypotheses. In addition to this, the study encourages further research on the background factors of the social norm (not only as an independent variable as in this study).

Multiple operationalism: VaKE with heterogeneous learning groups

Alfred Weinberger, Padagogische Hochschule der Diözese Linz, Austria; Jean-Luc Patry, Universität Salzburg, Austria

Do high and low achieving students profit equally from an adapted version of the teaching method VaKE (Values and Knowledge Education) which combines constructivist values education (e.g. Kohlberg, 1981) and knowledge construction?

The adapted version of VaKE (VaKEplus) implements repeated viability checks which are hypothesized to structure learning in order to support low achieving students but not to hinder high achievers in their knowledge construction. Two teaching methods are investigated: VaKE and VaKEplus. The sample consists of two classes (N=54) of a secondary school which are experimental and control groups in a quasi experimental cross over design.

Multiple operationalism (Campbell & Fiske 1959) in an extended version (Patry, 1990) is used. The study investigates the convergent and discriminant validities of the treatment (VaKE vs. VaKEplus), the dependent variable (trait: knowledge construction) and the design (influence of treatment). The instruments are teacher made tests, content analysis of student's essays, the WALK (Patry, 1999) and the Lesson-Interruption-Method (Patry, 1997).

Results corroborate partly the hypothesis and show a high validity of the study.

Literature

Campbell und Fiske (1959): "Convergent and Discriminant Validation by the Multitrait- Multimethod Matrix", in Psychological Bulletin, 56. Jg., Feb., S.64-73.

Kohlberg, L. (1981). Essays on Moral Development. Vol. 1: The Philosophy of Moral Development. Moral Stages and the Idea of Justice. San Francisco: Harper & Row.

Patry, J.-L. (1990). Feldforschung. In Kruse, L., Graumann, C.-F. & Lantermann, E.-D. (Hrsg.), Ökologische Psychologie. Ein Handbuch in Schlüsselbegriffen (S. 183-195). München: Psychologie Verlags Union.

Patry, J.-L. (1997). The Lesson Interruption Method in Assessing Situation-Specific Behavior in Classrooms. Psychological Reports, 81, 272-274.

Patry, J.-L. (1999). WALK. A Summative Assessment of Constructivist Teaching. Salzburger Beiträge zur Erziehungswissenschaft, 5, 2, 49-63.

The research project aims at investigating an adapted version of VaKE (Values and Knowledge Education) in secondary school (VaKEplus). VaKE (Patry & Weinberger, 2004) is a constructivist teaching method combining values and knowledge education. It is based on Kohlberg's theory of moral development (e.g. Kohlberg, 1981) and Glaserfeld's theory of knowledge construction (e.g. Glaserfeld, 1997). Starting with a moral dilemma the students discuss not only their arguments but also search for relevant information in order to arrive at a convincing moral decision. An important step within their learning process is testing whether the moral and content-related solutions they come up are viable (Glaserfeld, 1981), i.e., they perform what we call a viability check: The students exchange their constructions and check whether they are compatible with each other.

According to ATI-research low structured constructivist teaching methods tend to benefit high achieving students whereas low achievers perform better with well structured traditional teaching methods (e.g. Cronbach & Snow, 1977; Snow 1989). VaKE with heterogeneous learning groups (e.g. secondary school classes) aims at facilitating the learning outcome of high achievers as well as low achievers. VaKEplus implements repeated content-related viability checks as a constructivist method to structure the lesson in order to promote high achievers as well as low achievers.

This is done by asking the students to interrupt their information search several times to discuss their findings and to adapt their further learning steps.

In this study VaKEplus (treatment group) is compared with VaKE (alternative treatment control group). It is supposed that the implementation of repeated viability checks in VaKEplus will be more beneficial to the students than one single viability check in VaKE. The hypotheses are that with VaKEplus a) high achievers construct more (applicable) knowledge than low achievers and b) all students construct more (applicable) knowledge. The sample consists of two school classes (A and B; grade 7) with 27 students in each class. A quasi experimental cross over design is used. In phase 1 (topic: nuclear power plants) class A was the experimental group (teaching method: VaKEplus) and class B is the control group (teaching method: VaKE). In phase 2 (topic: drugs) which started eight weeks after phase 1 class A was the control group (teaching method: VaKE) and class B was the experimental group (VaKEplus). Phase 2 represents a conceptual replication of phase 1 with inverted roles of the two classes.

An extension of the multitrait-multimethod approach (Campbell & Fiske, 1959) will be used as research methodology: multiple operationalism of different constructs (Patry, 1989). While the multitrait-multimethod concept addresses only the dependent variable, the approach presented here includes multiple operationalism on the independent variable as well. It is based on the idea that many treatment operationalizations (operationalizations of the independent variable) and of the measures (dependent variables) that differ with regard to irrelevant features are needed to triangulate on a construct. The central claim is that the construct validity of the design validity (with respect to the hypothesis) rests on the convergent relationships between independent operationalizations of the respective constructs of the hypothesis. Three different classes of validity will be investigated: a) Validity of the treatment: There should be a difference between measures of different treatments whereas there should be no difference between independent measures of one treatment. b) Validity of the dependent variable: There should be high correlations between independent measures of the same trait and no correlations between measures of different traits (Campbell & Fiske, 1959). c) Validity of the design: The treatment should have an influence on the trait according to the hypotheses whereas the alternative treatment should have no influence on the trait.

Several instruments are used for the dependent variable: Content analyses of student's essays and the WALK ("W" assessment of latent knowledge), a new instrument for the summative evaluation of constructivist teaching (Patry, 1999) assess the applicable knowledge. Teacher made tests evaluate the factual knowledge. As to the independent variable, the LIM (Lesson Interruption Method) ascertains the implementation of viability checks in different VaKE-units (Patry 1997). An intelligence test gives information about high and low achieving students.

The results of the ANOVAs with repeated measurement for the two experimental phases show highly significant mean differences and high effect sizes between VaKEplus-units and VaKE-units for LIM. These findings support that the viability-check was indeed implemented in VaKEplus-units and that there was no viability-check in VaKE-units; this can be interpreted as discriminant validity of the independent variable. With respect to the assessment of the validity of the trait the mtmm-matrix reveals significant correlations between WALK and content analysis within VaKEplus-units and VaKE-units, respectively (convergent validity), and no correlations between WALK and content analysis between VaKEplus-units and VaKE-units across phases (discriminant validity). The results of an ANCOVA show that high achievers as well as low achievers partly benefit from VaKEplus and all students construct more (applicable) knowledge with VaKEplus. This means, among others, that the disadvantages of low achieving students in VaKE can at least partly be compensated by VaKEplus. It is proposed to further test the hypothesis that using viability checks in open teaching in general might help to overcome the problems low achievers have with this type of teaching-learning situations in other contexts as well.

Literature

- Campbell, D.T., & Fiske, D.W. (1959): Convergent and Discriminant Validation by the Multitrait- Multimethod Matrix. *Psychological Bulletin*, 56, 64-73.
- Cronbach, L. & Snow, R. (1977). *Aptitudes and Instructional Methods: A Handbook for Research on Interactions*. New York: Irvington.
- Glaserfeld, E. von (1981). The Concepts of Adaptation and Viability in a Radical Constructivist Theory of Knowledge. In I.E. Sigel, D.M. Brodzinsky, & R.M. Golinkoff (Eds.), *New Directions in Piagetian Theory and Their Applications in Education*. Hillsdale, NJ.: Lawrence Erlbaum, 89-95.
- Glaserfeld, E. von (1997). *Radikaler Konstruktivismus. Ideen, Ergebnisse, Probleme*. Frankfurt am Main: Suhrkamp.
- Kohlberg, L. (1981). *Essays on Moral Development. Vol. 1: The Philosophy of Moral Development. Moral Stages and the Idea of Justice*. San Francisco: Harper & Row.
- Patry, J.-L. (1990). Feldforschung. In Kruse, L., Graumann, C.-F. & Lantermann, E.-D. (Hrsg.), *Ökologische Psychologie. Ein Handbuch in Schlüsselbegriffen* (S. 183-195). München: Psychologie Verlags Union.

- Patry, J.-L. (1997). The Lesson Interruption Method in Assessing Situation-specific Behavior in Classrooms. *Psychological Reports*, 81, 272-274.
- Patry, J.-L. (1999). WALK. A Summative Assessment of Constructivist Teaching. *Salzburger Beiträge zur Erziehungswissenschaft*, 5, 2, 49-63.
- Patry, J.-L. (2001). Die Qualitätsdiskussion im konstruktivistischen Unterricht. In H. Schwetz, A. Reiter & M. Zeyringer (Hrsg.), *Konstruktives Lernen mit neuen Medien* Innsbruck: Studienverlag, 73-94.
- Patry, J.-L. & Weinberger, A. (2004). Kombination von konstruktivistischer Werterziehung und Wissenserwerb. *Salzburger Beiträge zur Erziehungswissenschaft*, 8, 2, 35-50.
- Snow, R. (1989). Aptitude-Treatment Interaction as a framework for research on individual differences in learning. In P. Ackerman, R.J. Sternberg, & R. Glaser (ed.), *Learning and Individual Differences*. New York: W.H. Freeman.

SYMPOSIUM

Teachers and Migrant Students' Home Cultures

Chairperson: Michele Grossen, University of Lausanne, Switzerland

Organiser: Ed Elbers, Utrecht University, Netherlands

Discussant: Charles Max, University of Luxembourg, Luxembourg

In this symposium we present research about the way teachers represent and construct relationships between the school and migrant students' home cultures. The studies encompass teachers, intercultural trainers and schools in Italy, Britain and the Netherlands. Surian's research (interviews, focus groups and Eurobarometer data for international comparison) is focused on intercultural education trainers who are themselves second generation migrants. Reflecting on their experiences as members of migrant families, the trainers have elaborated strategies for including families in school policies and in shaping and supporting young migrants' educational and career choices. Research by Abreu and colleagues (based on in depth interviews) is concerned with teachers' representations of immigrant students and their home cultures. They show that the teachers' understanding of the students' home background is a crucial dimension in the way they make sense of their students' transitions between home and school. These authors look, in particular, at the impact of teachers' views of themselves in their constructions of the students and their families. De Haan and colleagues (qualitative and quantitative analyses of actual conversations) observed teacher-parent conferences in the last grade of primary school. They found that the pedagogical views of teachers and parents influenced the way the child's school career is discussed. In their talks, teachers and migrant parents tended to emphasize differences, in terms of identity, knowledge of the educational system, language, pedagogical views and the responsibility of the teacher.

Migrant youth's experiences and educational narratives in Italian society

Alessio Surian, Università degli Studi di Padova, Italy

The type of transition across cultural (school-peers-family) contexts performed by "migrant" students is being given limited attention by educational institutions. The research addresses this issue; it is based upon data gathered in the Emilia Romagna region through focus groups involving, on the one hand, intercultural education trainers and secondary school students and, on the other hand, semi-structured interviews with "second generation" migrant trainers who run intercultural educational workshops in local secondary schools. Because the research was aimed at self-narratives and the assessment of educational choices, results provide both a rationale and concrete examples of "second generation" migrant trainers' educational approaches focusing on intercultural and citizenship education in both formal and non-formal educational settings. While secondary schools are facing significant discrimination attitudes, they are providing insufficient opportunities to young people of foreign origin to voice their transition strategies leaving a key role to youth groups and associations in elaborating transition strategies and in shaping and voicing young people needs and abilities for participation in social life. Based on their members' personal experiences these groups are now in a position to reflect upon ways to include families in educational policies as they have a key role in influencing school policies and in shaping and supporting young people's educational and career's choices. Results and educational implications are discussed within the framework provided by Frank Hutchinson (1996), linking young people's visions of the future (i.e. hopelessness, passive hope, active hope) and their social attitudes (i.e. low self-esteem, bland optimism, foresight and pro-social skills).

Aims

The research aims at understanding the key motivation, narratives and didactical approaches at the core of the educational practice implemented by a network of "second generation" migrant trainers in the Emilia Romagna (Italy)

region. The qualitative data are intended to explore both the self perception of the trainers' educational and social roles in dialogue with peers, schools, younger students, and their own families, as well as the key features of their intercultural narratives and educational projects. Methodology. The research is based upon data gathered in the Emilia Romagna region through, on the one hand, focus groups involving intercultural education trainers and secondary school students, and, on the other hand, semi-structured interviews with "second generation" migrant trainers who run intercultural educational workshops in local secondary schools. Seven semi-structured interviews were conducted with "second generation" intercultural trainers who play a pivotal role in local youth organisations that are part of an intercultural youth and education network in Emilia Romagna. Through direct reference to personal and professional experiences the interviews yield comparative data concerning the role of the family background and the social context in orienting the intercultural education and training choices made by the trainers and the organisations. The qualitative data are discussed within the wider context of quantitative data gathered through an on-line questionnaire addressing issues of lifestyles and discrimination among Italian youth, involving students from the same schools where the intercultural youth and education network runs its workshops. Selected items allow a comparison with European and Italian recent data provided by the Eurobarometer sources.

Findings

Particularly through self-narratives and the assessment of educational choices, focus group and semi-structured interview results provide both a rationale and concrete examples of "second generation" migrant trainers' educational approaches focusing on intercultural and citizenship education in both formal and non-formal educational settings. The citizenship dimension seems particularly relevant as a vehicle for intercultural issues -- as a right and a claim which is being perceived and communicated as legitimate by "second generation" migrant students who are not granted it by the Italian law. The qualitative results helps to identify a common position that rejects the "second generation" label: in terms of identity, young people of foreign origin who have raised their awareness through shared educational activities would rather opt for a reference to "article 3", the part of the Italian constitution granting equal rights to all citizens. While secondary schools are facing significant discrimination attitudes, they are providing insufficient opportunities to young people of foreign origin to voice their transition strategies leaving a key role to youth groups and associations in elaborating transition strategies and in shaping and voicing young people needs and abilities for participation in social life. Based on their members' personal experiences these groups are now in a position to reflect upon ways to include families in educational policies as they have a key role in influencing school policies and in shaping and supporting young people's educational and career's choices. Theoretical and educational relevance of the research "Migrant" secondary school students represent 4% of the total secondary students population. The type of transition across cultural (school-peers-family) contexts performed by "migrant" students is being given limited attention by educational institutions. Who are the institutions and educational roles that have an influence on such transition and what are the issues at stake in adapting to the demands of the various cultural contexts are key questions that are analysed within this research project according to Alberto Melucci's notion of challenging codes and Néêstor Garcia Canclini's multiculturalism mapping in terms of the different, disparate and disconnected categories. Results and educational implications are discussed within the framework provided by Frank Hutchinson (1996), linking young people's visions of the future (i.e. hopelessness, passive hope, active hope) and their social attitudes (i.e. low self-esteem, bland optimism, foresight and pro-social skills).

Teachers' representations of immigrant students and their home cultures: a dialogical self analysis

Guida de Abreu, Oxford Brookes University, United Kingdom; Sarah Crafter, University of Northampton, United Kingdom; Hannah Hale, University of Derby, United Kingdom; Ria O'Sullivan Lago, University of Limerick, Ireland

The understanding teachers have of their students' home backgrounds is a crucial dimension in the way teachers make sense of students' transitions between home and school. Research in this area has addressed issues about the cultural nature of school knowledge and how "everyday cognition" differs from "school cognition". As societies become increasingly diverse due to globalisation and migration, it is apparent that the mismatch between teachers' and students' cultural backgrounds is not only an issue of cognition but also an issue of identities. Research with teachers has mostly focused on the teachers' constructions of culturally diverse students, yet the ways in which teachers construct students are not independent of the way they construct themselves. In this paper, we question what new insights using concepts from Dialogical Self Theory can reveal about teachers' constructions of self and other in the school. Focusing on cultural contact zones where individuals must struggle to negotiate their lives and identities between cultures, Dialogical Self Theory holds that identities are constructed in dialogue, interdependent with the cultural context. This enables the study of the mutual relationships between self and other. We argue that modifying the traditional identity question "Who am I" to "Who am I in relation to the other" must also consider "Who

is the other in relation to who I am?" We illustrate this in our analysis of the impact teachers' constructions of themselves have upon their constructions of the students and their families.

Aims

This paper aims to examine how an analysis using concepts from the Dialogical Self can contribute to further understanding of the processes involved in teachers' constructions of their immigrant students, and their family backgrounds. Focusing on "Who is the other in relation to who I am?" We aim to empirically examine the impact of teachers' constructions of themselves in their constructions of their students and families.

Introduction

The understanding teachers have of their students' home backgrounds is a crucial dimension in the way teachers make sense of students' transitions between home and school. Research in this area has addressed issues about the cultural nature of school knowledge and how "everyday cognition" differs from "school cognition". As societies become increasingly diverse due to globalisation and migration, it is apparent that the mismatch between teachers' and students' cultural backgrounds is not only an issue of cognition but also an issue of identities. Research with teachers has mostly focused on the teachers' constructions of culturally diverse students, yet the ways in which teachers construct students are not independent of the way they construct themselves. In this paper, we question what new insights using concepts from Dialogical Self Theory can reveal about teachers' constructions of self and other in the school. Focusing on cultural contact zones where individuals must struggle to negotiate their lives and identities between cultures, Dialogical Self Theory holds that identities are constructed in dialogue, interdependent with the cultural context. This enables the study of the mutual relationships between self and other. We argue that modifying the traditional identity question "Who am I" to "Who am I in relation to the other" must also consider "Who is the other in relation to who I am?" We illustrate this in our analysis of the impact teachers' constructions of themselves have upon their constructions of the students and their families. Methodology: The empirical data examined consists of in-depth qualitative interviews from two studies that explored teachers' experiences and representations of their immigrant and minority students.

One study focused on teachers of Portuguese students in schools in England and Jersey (Abreu & Hale, 2003). The other study focused on teachers of ethnic minority children in England (Crafter, 2004). The rationale for drawing on interviews from more than one study follows on principles of cultural-psychological investigations. It involves an idiographic scientific methodological stance where the production of new knowledge is achieved from the analysis of single-cases to understand and explain the phenomena in other cases. Analytical framework and some illustrative findings: The interviews with teachers were coded firstly in terms of talk about the self in relation to the other, and secondly talk about other teachers. In the first, two constructions are paid particular attention: the self in relation to the construction of the student, and the self in relation to the construction of the students' families. In the second, particular attention was paid to talk about the other teachers in relation to the student and secondly in relation to the construction of the families. Below some findings from teachers' interviews that demonstrate attempts to make sense of the other (the student) using the self as the filter are presented. In the conference examples about constructions of families will be included.

1. TALK ABOUT THE SELF IN RELATION TO THE OTHER (the student) Positioning the self as the same a teacher with non-English background reflected on her own identity and trajectory as a mechanism to empathise with the students' experiences. Referring to her French cultural background she said "I've been through that myself". Positioning the self as different a native English teacher expressed aspects of her identity (language skills) which limited access to the immigrant students: "I don't feel very happy talking about her because um she's just so very quiet and I'm only just beginning to gain confidence enough for her to tell me what's going on. I don't speak Portuguese." Positioning the self as an "empathiser" one teacher drew on her professional identity to reflect on how she could empathise with her students' experiences: "I don't know where I have got it particularly from. Being an English teacher, I suppose you have got a natural empathy for other people."

2. TALK ABOUT OTHER TEACHERS IN RELATION TO THE SELF Extracts from the teachers' interviews also demonstrate attempts to make sense of other teachers' constructions of the student through comparisons with the self: Positioning the self as different (distancing from the "others"): Those teachers, who felt that they developed strategies that enabled them to empathise with aspects of the students' identities, also talked about differences between "other" teachers and self. As an example, one teacher reflected on attitudes in relation to school uniform: "I think with teachers you've got to be aware of this as well. You know, that it's one step to have them in full school uniform for instance. And then you don't want other staff members saying, 'Why haven't you got shoes on today?', 'Why are you wearing your trainers?'. Whereas I know perfectly well that there's a very good reason for that." Here the teacher was able to position herself as more aware of students' troubles than other teachers in the school.

Conclusion

A more detailed analysis will be presented at the conference. The illustrative findings suggest how the varying positioning of the self are involved in the construction of the other. They offer a theoretical contribution, demonstrating the development of an analytical framework to understand processes underlying teachers' understanding of their students. Moreover making these processes explicit has an enormous potential of contributing to teachers' professional development. This is particularly relevant, as the data illustrate how teachers can draw on both on their cultural and their professional identities to empathise with, or to distance themselves from, their students' experiences.

Parent-teacher conversations: The dialogical nature of culturally diverse pedagogies

Mariette De Haan, Utrecht University, Netherlands; Ed Elbers, Utrecht University, Netherlands; Inge Wissink, University of Amsterdam, Netherlands

We analyse parent-teacher conferences at the end of primary education in the Netherlands -- part of a formal procedure in which the child's future school career is decided upon. The conversations teachers have with migrant parents are contrasted with those teachers have with non-migrant, Dutch parents. Dialogues between parents and teachers are analyzed in order to see (1) how parents and teachers in their dialogues explain the child's school success (or the lack of it), (2) to what extent teachers, migrant parents and native Dutch parents differ in their explanations of the child's school success, and (3) how conversational partners, if they have different views, deal with these differences dialogically. We recorded and analysed 54 conversations using a combination of quantitative and qualitative (content and discourse) methods. In the conversations with migrant parents, the issue of effort was more prominent, while in the conversations with native Dutch parents attitudes and personality were brought forward for explaining the child's school career. In particular, this study shows how the process of creating 'common ground' needed for the coordination of actions in the conversation as well as for the creation of partnerships between parents and teachers, differs between non-migrant and migrant parents. We focus not so much on the differences between the referential frames, but rather on the process through which they are enacted. The study shows how expressions of difference are dialogical in nature: they are reactions to perceived oppositions and therefore can only be understood in their 'reactive' context.

Aims

In the Netherlands, like in many other Western countries, ethnic minority children (and especially minority children with a non-Western ethnic background) generally attain lower educational levels than ethnic majority children. The first moment that these differences become apparent more clearly is in the final year of primary education, when the child is about to make the transition to secondary education. According to the procedure regulating this transition in the Netherlands, the primary school teacher formulates an advice for the level of secondary education for each child. This advice is presented to and discussed with the child's parents in a series of formal talks. The advice is based on the child's score on a national test but it also depends on the teacher's impression of the child's abilities. In this presentation we will analyse the parent-teacher conversations at the end of primary education in which the child's future school career is decided upon. We take a comparative approach by contrasting the conversations between teacher and migrant parents with those between teachers and non-migrant, Dutch parents. We aim at gaining insight in (1) how parents and teachers in their dialogues explain school success (or the lack of it), (2) to what extent teachers, migrant parents and native Dutch parents differ in their explanations of the child's school success, and (3) how conversational partners, if they have different views, deal with these differences dialogically. We refer to theories of culture as dialogue (Clifford, Hannerz, Tedlock & Mannheim), from which we borrow the idea that cultural meanings and differences are not 'given', but constructed and managed in dialogical encounters. In addition, Communication Accommodation Theory (Jones et al, 2009) provides us with models of how partners with a diverse background try to bridge perceived differences in terms of discursive strategies.

Methodology

We audio recorded 54 formal talks about the child's transition to secondary school in four Dutch primary schools with a large percentage of migrant pupils. We transcribed the recordings which involve 15 native Dutch children, 22 Moroccan-Dutch children and 17 children of various migrant backgrounds. The talks lasted on average 16.46 minutes. Five teachers participated in the conferences, which were conducted in Dutch. All Dutch parents, but none of the migrant parents, had attended school in the Netherlands. In the majority of cases, one parent (father or mother) was present in the conference; in some conferences both parents participated; in a small number of cases another member of the family (sister, aunt) attended the conference. The study takes a mixed method approach as quantitative methodologies are combined with qualitative analysis. The quantitative analysis focused on the

attributions and accounts parents and teachers make to explain the school success or lack of success of the child. The qualitative analysis, which we did on a sample of 34 Dutch and Moroccan-Dutch parents, consisted of a content analysis and discourse analysis of the talks, concentrating on how teachers and parents constructed these accounts dialogically, how they dealt with differences conversationally, and to what extent they succeeded in creating a common view on the child's future.

Findings

Both the quantitative and qualitative analyses revealed that there were thematic differences between the two groups of parent-teacher conversations. In the conversations with migrant parents, the issue of effort was more prominent, while in the conversations with native Dutch parents attitudes and personality were brought forward for explaining the child's school career. The qualitative analysis showed that, since the attributions were made in an interactive context, they were always responsive to previous utterances of the other conversation partner and to perceived oppositions. Because of their institutional position teachers dominated the talks. The conversations with the native Dutch parents were mostly characterized by a partnership relationship, in which the teacher and parents often succeeded in co-constructing explanations and continued each other's ideas and suggestions. In contrast, many conversations with migrant parents were characterized by either opposition or by a passive position of the parents. In the conversations with the migrant parents differences were emphasized, both by the teacher and the parents, in terms of identity, knowledge of the educational system, language, pedagogical views and the responsibility of the teacher. Often these differences could not be overcome, despite attempts by the teacher and parents to bridge the distance. Scientific and educational significance. This study provides an analysis of parent-teacher conferences in schools with a large population of children from migrant families. This is not the first study that addresses this type of conferences. However, in contrast to other studies, it is not based on interviews or questionnaires, but on actual conversations which were recorded, transcribed and analysed with both quantitative and qualitative methods. The quantitative analysis provides a first insight into the accounts and attributions of the partners. We did not consider the accounts and attributions as separate or isolated contributions. Therefore, we applied a qualitative analysis (content and discourse analysis) to put the accounts and attributions into the context of the conversation. This study revealed that the distance between the teacher and the parents, as well as between the school and the home (as perceived or constructed in the talk), defined the possibilities for both co-constructing explanations for the child's school success or lack of it and the possibilities for constructing a view on the child's future. The implication is that schools should be pay explicit attention to how diversity operates in contacts with parents and in processes of decision making.

References

- Clifford, J. (1988). *The predicament of culture: Twentieth-century ethnography, literature and art*. Cambridge, Mass.: Harvard University Press.
- Hannerz, U. (1992). *Cultural complexity. Studies in the social organization of meaning*. New York: Columbia University Press.
- Tedlock, D., & Bruce, M. (Eds.) (1995). *The dialogic emergence of culture*. Urbana: University of Illinois Press.
- Jones, E., Gallois, C., Callan, V., & Barker, M. (2009). Strategies of accommodation: Development of a coding system for conversational interaction. *Journal of Language and Social Psychology*, 18(2), 123-152.

SYMPOSIUM

Current Trends in Metacognition Research

Chairperson: Stephanie Pieschl, University of Muenster, Germany

Organiser: Stephanie Pieschl, University of Muenster, Germany

Roger Azevedo, McGill University, Canada

Discussant: Zemira Mevarech, Bar-ilan University, Israel

The goal of this symposium is to present an overview of the (future) SIG coordinators' work as examples of current trends in metacognition research. In all three presentations, metacognitions are not investigated as stand-alone constructs. Rather, metacognitions such as planning, monitoring, and evaluation are embedded in complex models of self-regulated learning (SRL) that is assumed to unfold in multiple phases over time. These studies take this into account, for example, by using methodologies that can concurrently trace SRL processes (e.g., log files or think aloud protocols; Azevedo, Pieschl) or by specifically addressing different phases of SRL in different studies (Pieschl, Wirth). Further common themes of all presentations include the use of hypermedia or simulation technology, scientific learning content, and scaffolding metacognitive and SRL processes. However, these studies also reflect different focuses and avenues, especially with regard to scaffolding: Pieschl tested scaffolding on the level of epistemological

beliefs and in interaction with contextual conditions. Azevedo's work revolves around the design of adaptive (metacognitive) hypermedia systems such as MetaTutor and pedagogical agents that can deliver prompts and feedback. Wirth focused on scaffolding via very specific prompts in different phases and regarding different demands of SRL. Therefore, these presentations illustrate current trends in metacognition research, especially regarding new methodologies to capture and analyse data, new ways to scaffold metacognition and SRL, and use of new technologies for these purposes.

Adaptation to Complexity and Learners' Epistemological Beliefs as Important Aspects of SRL

Stephanie Pieschl, University of Muenster, Germany

Within a series of empirical studies we investigated learners' self-regulated learning (SRL) processes in hypermedia learning scenarios in detail. For this purpose, we focused on two important but rarely investigated issues: (1) Learners' adaptation of their SRL processes with regard to the contextual condition of task complexity. (2) And the impact of learners' epistemological beliefs on their SRL processes, especially on this kind of adaptation. Our empirical studies focus on different phases of SRL and utilize multiple methodologies to capture learners' SRL processes in detail, for example computer-generated log files and task-specific questionnaires. Consistently results show that learners systematically adapt their SRL to task complexity (1): They set more elaborate goals, (plan to) use more elaborate learning strategies, spend more time, and generate more elaborate products of learning (e.g., essays) for more complex tasks. Their SRL processes systematically co-vary with task complexity. Therefore we conclude that learners are well-calibrated in this regard. Results regarding epistemological beliefs are less consistent (2): Mostly, more sophisticated epistemological beliefs in complex and tentative knowledge are associated with better SRL processes and products, especially for complex tasks. Therefore, epistemological beliefs seem to be especially relevant for dealing with complex learning material. The theoretical and educational implications of these results will be discussed.

In this presentation I will argue that self-regulated learning (SRL) and associated metacognitive processes are highly dependent on external and internal conditions. Based on Winne and Hadwin's (1998) model of SRL and elaborations (Bromme, Pieschl, & Stahl, 2010a; Greene, Muis, & Pieschl, 2010; Pieschl, 2009). I will use the following exemplary hypotheses for illustrating these assumptions: (1) Good self-regulating learners systematically adapt their SRL to the external condition of task complexity. (2) And learners with more sophisticated epistemological beliefs (internal condition), namely in the complex and tentative nature of knowledge, demonstrate better SRL and better adaptation to task complexity. These hypotheses were investigated in a series of studies where learners used a hypermedia learning environment to learn about the topic of genetic fingerprinting (DNA analysis). Two studies will be reported in detail, one about the first goal setting and planning stages of SRL and one focusing on the later enactment stages.

In the first study (Bromme, Pieschl, & Stahl, 2010b) 52 biology students and 50 humanities students answered questions about their domain-specific and domain-general epistemological beliefs. In the main part of the study, they were given a list of six tasks of different complexity according to Bloom's revised taxonomy (Anderson et al., 2001). This constitutes the within-subject independent variable task complexity. For each of these tasks they filled-in a questionnaire about their goal setting and planning. While answering this questionnaire they had to envision solving the tasks with the help of a hypermedia learning environment about genetic fingerprinting. A factor analysis of the questionnaire items yielded three scales that were used as dependent variables: Deep processing, superficial processing, and use of multiple information sources. Results consistently indicate that learners systematically adapt their (planned) SRL to task complexity: A repeated-measure MANOVA showed significant effects of the within-subject factor task complexity for all dependent variables. And within-subject correlations between task complexity and the dependent variables were significant and of large effect size for all dependent variables. For example, the correlation of $G = .74$ (Goodman-Kruskal's Gamma) between task complexity and the scale use of multiple information sources indicates that learners planned to use few information sources for simple tasks but multiple information sources for complex tasks. To investigate the effects of epistemological beliefs, these scales (as well as the prior knowledge groups) were included in the MANCOVA. Results indicate predominantly main effects of learners' domain-specific epistemological beliefs in the variability of knowledge: Learners who believed in variable knowledge planned more use of deep processing strategies ($F(1,97) = 5.23, p = .024$) and more use of multiple information sources ($F(1,97) = 7.58, p = .007$) than those who believed in static knowledge.

In the second study (Pieschl, Bromme, & Stahl, in prep.) we used a similar paradigm to investigate these effects in the later enactment stages of SRL. This time, however, students' epistemological beliefs were experimentally manipulated: Students with an epistemological sensitisation that elicited more sophisticated epistemological beliefs were compared with students with a neutral treatment that did not change their beliefs. In the main part of the study, 14 biology students and 21 humanity students had to solve five tasks of different complexity according to Bloom's

revised taxonomy (Anderson et al., 2001) with a hypermedia environment about genetic fingerprinting. As dependent variables their SRL processes were captured via logfiles and concurrently verbalized thoughts were recorded and categorized. Results consistently indicate that learners systematically adapt their SRL to task complexity: Repeated-measure MANOVAs showed significant effects of the within-subject factor task complexity for all dependent variables. And within-subject correlations between task complexity and the dependent variables were significant and of large effect size for all dependent variables. For example, the correlation of $G = .94$ between task complexity and time-on-task indicates that learners spent little time on simple tasks but more time on complex tasks. To investigate the effects of epistemological beliefs, the groups of the experimental manipulation (as well as the prior knowledge groups) were included in the MANOVAs. Results indicate significant interactions between task complexity and these groups. For example, students with the epistemological sensitisation spent more time on the complex tasks but less time on the simple tasks than their counterparts with the neutral treatment ($F(4,96) = 3.41, p = .012$).

To summarize, our empirical results consistently show that learners systematically adapt their SRL to task complexity (1): They set more elaborate goals, (planned to) use more elaborate learning strategies, spent more time, and generated more elaborate products of learning for more complex tasks. Results regarding epistemological beliefs are less consistent (2): Mostly, more sophisticated epistemological beliefs in complex and tentative knowledge were associated with better SRL processes and products, especially for complex tasks.

These results have theoretical as well as practical implications: First, the results regarding adaptation indicate that the external context of SRL always has to be taken into account, for example the domain of learning and the concrete learning materials and tasks. Second, the results regarding epistemological beliefs imply that such beliefs might act as an apprehension structure for the content to be learnt.

References

- Bromme, R., Pieschl, S. & Stahl, E. (2010a). Epistemological beliefs are standards for adaptive learning: A functional theory about epistemological beliefs and metacognition. *Metacognition and Learning*, 5, (1), 7-26.
- Bromme, R., Pieschl, S. & Stahl, E. (2010b). Epistemological beliefs and students' adaptive perception of task complexity. Manuscript submitted for publication.
- Greene, J. A., Muis, K. R., & Pieschl, S. (2010). The role of epistemic beliefs in students' self-regulated learning with computer-based learning environments: Conceptual and methodological issues. *Educational Psychologist*, 45(4), 245-257.
- Pieschl, S. (2009). Metacognitive calibration - an extended conceptualization and potential applications. *Metacognition and Learning*, 4 (1), 3-31.
- Pieschl, S., Bromme, R., & Stahl, E. (in prep.). Does an epistemological sensitisation cause better adaptation to task complexity?
- Winne, P. H. & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277-304). Mahwah, NJ: Lawrence Erlbaum Associates.

Self-Regulated Learning with Multi-Agent Technology-Enhanced Learning Environments

Roger Azevedo, McGill University, Canada

This presentation will focus on current issues and future challenges regarding the role of self-regulation processes during learning with multi-agent technology-enhanced learning environments. More specifically, it will focus on issues related to the: (1) conceptualization and measurement of self-regulated learning (SRL); (2) measurement of SRL during learning with multi-agent AI-based intelligent systems; (3) detecting, tracking, and modelling these processes while learning about complex learning material (e.g., human body systems); and, (4) how these data are used to foster students' SRL during learning. These issues will be discussed based on the results of a recent lab experiment that was conducted to test the effectiveness of MetaTutor, an intelligent and adaptive multi-agent hypermedia system designed to prompt and scaffold the use of self-regulated learning (SRL) processes during learning about the human circulatory system. In this study, 77 non-science college students were randomly assigned to one of three conditions (prompt and feedback [PF], prompt-only [PO], and control [C] condition). All participants had two hours to learn using a 41-page hypermedia environment which included texts describing and static diagrams depicting various topics concerning the human circulatory system. We collected pretest and posttest data and log-file, eye-tracking, concurrent think-aloud protocols, and facial recognition data were collected during learning. Results showed significant difference those in the PF condition significantly outperformed those in the other two conditions.

Learning with MetaCognitive tools such as MetaTutor poses challenges for learners. This presentation will highlight the importance of using self-regulated learning (SRL) as a framework to understand the complex nature of learning with MetaCognitive tools. More specifically, I will focus on illustrating the benefits and challenges of using a theoretically-based approach to understand the nature of key processes of self-regulated learning, how they unfold in real-time, their roles during various phases of learning (for example, knowledge acquisition versus knowledge integration), and the qualitative and quantitative changes in self-regulated learning processes during the course of extended learning. This comparison will be supported by illustrative examples of product and process from a recent study. In the study, seventy-seven ($N = 77$) non-science college students were randomly assigned to one of three conditions (prompt and feedback [PF], prompt-only [PO], and control [C] condition). The PF condition received timely prompts from pedagogical agents to engage in planning processes, monitoring processes, and learning strategies and also received immediate directive feedback from the agents concerning the deployment of the processes. The PO condition received the same timely prompts, but did not receive any feedback following the deployment of the processes. Finally, the control condition learned without any assistance from the agents during the learning session. All participants had two hours to learn using a 41-page hypermedia environment which included texts describing and static diagrams depicting various topics concerning the human circulatory system. We collected pretest and posttest data and log files, eye-tracking data, concurrent think aloud protocols, and facial recognition data were collected during learning. Results showed significant difference those in the PF condition significantly outperformed those in the other two conditions. Those in the PF condition also spent significantly more time creating relevant sub-goals, spent more time on relevant text and diagrams, and deployed significantly more self-regulated learning processes associated with learning gains.

These results are discussed in the context of development of a fully adaptive hypermedia learning system intended to scaffold self-regulated learning. In addition, we provide a synthesis of our previous work by emphasizing the convergence of product and process data to trace the deployment of self-regulated learning processes and relate them to different learning outcomes (for example, declarative, procedural, and inferential knowledge, and mental models of biological systems). Classifying these processes at various levels of granularity is important for several reasons. For example, macro-level (for example, monitoring process) and micro-level classifications (for example, monitoring process such judgment of learning [JOL]) supplemented with valence (i.e., positive or negative [e.g., JOL+]) is key to understanding the multi-level nature of these processes (and inter-related feedback mechanisms) and serves to augment current conceptions and theoretical frameworks of SRL. Also, from a design perspective this multi-level classification is crucial for building adaptive systems with the ability to detect, model, trace, and foster SRL during learning. Lastly, we provide quantitative and qualitative data from learning outcomes, SRL processes, and log-file data with MetaTutor and discuss how this data can be used to design an adaptive version of MetaTutor to detect, trace, model, and foster students' self-regulated learning about complex and challenging science topics. The presentation will end with recommendations for future research that emphasize work on the conceptual, methodological, and analytical issues and approaches that allow researchers and educators to understand the role of these processes during self-regulated learning with MetaCognitive tools. For example, the use of sensors will be necessary to collect and analyze various physiological, cognitive, metacognitive, and affective states during learning. Also, new data analytical techniques and visualization tools are necessary to represent and analyze complex multi-channel data stemming from the use of computers as MetaCognitive tools.

Different Ways of Supporting Self-Regulated Learning

Joachim Wirth, Ruhr-University Bochum, Germany

Self-regulated learning can be modeled as a process with different phases (fore-thought, performance, and reflection) with each phase setting specific demands (goal setting, planning, observing, evaluating, and reacting) on learners. Since demands differ between phases, learners need different competencies to meet these demands. In several experimental studies we investigated how learners can be supported to meet a specific demand within a specific phase. In the first study, we investigated which goal type is most effective in fostering learning. It turned out that especially specific problem solving goals hinder learning whereas non-specific goals as well as learning goals were equally effective. In a second study, we used prompts in order to support planning and executing strategy use. We investigated whether the point of presentation time of strategy prompts has an effect on strategy use and learning outcome. It turned out that prompts delivered before learning were not effective. But prompts presented during the learning process were all equally effective independently from their point of presentation time. In a third study, we investigated feedback on strategy use as a support measure for evaluating strategy use. It turned out that feedback can enhance the effect of strategy prompts on strategy use. In sum, the studies show that there are multiple ways of supporting self-regulated learning. But what is still missing is a comprehensive set of measures focusing on the

competencies needed to meet the different demands. This could be an even more effective way of supporting self-regulated learning than focusing on demands only.

Theoretical models on self-regulated learning can be categorized in either component models or process models. Component models (e.g., Boekaerts, 1999) focus on pre-requisites and competencies of learners whereas process models (e.g. Winne & Hadwin, 1998; Zimmerman, 2000) describe the learning process in terms of different phases and different demands on learners. Schýtte, Wirth, and Leutner (in press) suggest integrating both kinds of models taking into account that learners encounter different demands in different phases of the learning process and therefore also need different competencies in different phases (Figure 1). Schýtte et al. identify three phases, a forethought phase which entails two main demands, i.e. goal setting and planning, a performance phase including the demand of observing oneself, and a reflection phase that comprises the demands of evaluating and reacting. They also specify nine different competencies learners need in order to meet the different demands (Figure 1). This integrated model can be used, on the one hand, as a framework for the assessment of the different competencies self-regulated learners need. On the other hand, it is also useful in order to create support measures for the learners that help them to meet the demands. In this paper, we focus on the support measures. Concerning goal setting, Wirth, Kýnsting, and Leutner (2009) conducted an experimental study with students learning in a computer-simulated science lab. Between groups, students received different kinds of goals according a 2-by-2 design with the two factors goal type (learning goal vs. problem solving goal) and goal specificity (specific vs. non-specific).

Results revealed that specific problem solving goals hinder learning what is partly due to the use of inappropriate learning strategies whereas the other three conditions did not differ concerning learning outcome. Thus, self-regulated learning can be supported either by setting non-specific goals or, even better, by setting specific learning goals. Concerning planning and using learning strategies, Thillmann, Kýnsting, Wirth, & Leutner (2009) investigated whether prompting can be an effective support measure, and whether the timing of the different prompts fosters strategy use and learning outcome. Again, students learned in the computer-simulated science lab. All students received identical prompts concerning the use of different learning strategies. Groups differed concerning the point of presentation time of the prompts. While the control group received all prompts before learning, experimental group 1 received prompts while learning and according to an optimal course of strategies. Experimental group 2 was also prompted while learning but received prompts opposite to the optimal course of strategies. It turned out that both experimental groups outperformed the control group concerning strategy use and learning outcome. However, experimental groups did not differ. One reason could be that prompts initiated general monitoring processes independent from the specific strategy prompted, and that these monitoring processes led to good strategy use and learning outcome. Nevertheless, prompting while learning turned out to be an effect support measure for planning and using learning strategies. In a recent study, we combined prompting with feedback information in order to support evaluating and reacting. Learners learned with the computer-simulated science lab, and their strategy use was assessed continuously by the computer. Students were assigned to one of four groups. In three groups students received prompts at several points of time while learning.

Group A received prompts concerning the use of different learning strategies according to a generally optimal course of strategies. Group B received respective prompts adapted to their current strategy use. Learners of group C received feedback about their strategy use always followed by an adapted prompt. Group D, the control group, received neither prompts nor feedback. It turned out that students of group C outperformed students in the other groups concerning strategy use and also motivation. Adapted prompts only (group B) had no significant effect compared to non-adaptive prompts or no prompts. Thus, it seems that evaluation of current strategy use, as it was triggered by feedback, can lead to an understanding why a certain strategy is prompted. As a consequence, learners accept and use the prompt information in order to improve their strategy use. To sum up, all studies presented are examples for successful ways of supporting self-regulated learning. They differ concerning the particular phase of self-regulation and the respective demands. But all of them have in common that they do not explicitly address the different competencies needed to meet the demand. It is an open question whether support measures also addressing each single competency could be even more effective than measures focusing only on demands and phases.

References

- Boekaerts, M. (1999). Self-regulated learning: Where are we today. *International Journal of Educational Research*, 31, 445-457.
- Winne, P.H. & Hadwin, A.F. (1998). Studying as self-regulated learning. In D.J. Hacker, J. Dunlosky & A.C. Graesser (Eds.), *Metacognition in education theory and practice* (pp. 277-304).
- Mahwah, NJ: Erlbaum. Schýtte, M., Wirth, J., & Leutner, D. (in press). Selbstregulationskompetenz beim Lernen aus Sachtexten. Entwicklung und Evaluation eines Kompetenzstrukturmodells [Self-regulation competence when learning with expository texts. Development and evaluation of a structure model of competence].

Zeitschrift für Pädagogik. Thillmann, H., Kynsting, J., Wirth, J. & Leutner, D. (2009). Is it merely a question of 'what' to prompt or also 'when' to prompt? - The role of presentation time of prompts in self-regulated learning. *Zeitschrift für Pädagogische Psychologie*, 23, 105-115. Wirth, J., Kynsting, J. & Leutner, D. (2009). The impact of goal specificity and goal quality on learning outcome and cognitive load. *Computers in Human Behaviour*, 25, 299-305. Zimmerman, B.J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic Press.

SYMPOSIUM

Metacognition in children with special educational needs

Chairperson: Gerhard Buettner, University of Frankfurt, Germany

Adina Shamir, School of Education, Bar-Ilan University, Israel

Organiser: Gerhard Buettner, University of Frankfurt, Germany

Adina Shamir, School of Education, Bar-Ilan University, Israel

Discussant: Ruth Kershner, University of Cambridge, United Kingdom

Metacognition is perceived in the literature as a powerful predictor of learning and accountable in great part for individual differences in children's development as learners. Yet, despite the wealth of theory and research the findings regarding the role of metacognition in promoting Special Educational Needs (SEN) students needs further investigation. The symposium will include presentations of researchers from Belgium, Israel and Germany. Desoete's and De Weerd's presentation will focus on metacognition and arithmetic in children with an isolated and comorbid learning disability. The authors will present a study aimed at validating a parent and teacher questionnaire for assessment of metacognitive skills as well as examining the relationship between metacognition and arithmetic. In joining the effort to introduce some clarity into the discussion about the effectiveness of electronic books (e-books) for promoting preschoolers at risk for learning emergent literacy Shamir and Lifshitz will present a study aimed at examining the effect of an activity with an educational e-book (with and without metacognitive guidance) on the vocabulary and rhyming ability of kindergartners at risk for learning disability. Deficits in metacognition are assumed to be a significant condition of the development and maintenance of cognitive problems of children with low intelligence. The third presentation (Buettner) refers to a study aimed at investigating both declarative knowledge and procedural metamemorial skills in two groups of children with mild and borderline intellectual disabilities and in control groups with both the same mental and chronological age. Ruth Kershner from Cambridge University, Great Britain, will discuss the presentations.

Are children with dyscalculia and dyslexia more impaired in metacognition than children with isolate Learning disabilities

Annemie Desoete, Ghent University, Belgium; Frauke DeWerd, University Gent, Belgium

In this paper it is investigated if a triangulation of parent and teacher questionnaire can be used to get a good picture of metacognitive skills in elementary school children. In addition the relationship between metacognition and arithmetic is investigated in children with an isolated and comorbid learning disability. For this purpose the parents and teachers of 48 children with dyslexia, 26 children with dyscalculia, 52 children with dyslexia and dyscalculia and 93 control children without learning disabilities completed the BRIEF (Goia et al., 2000). All children were at least average intelligent. Our dataset suggests convergent validity for teacher and parent ratings, as well as a significant relationship between the metacognition and procedural calculation and fact retrieval. Consequences for the assessment of metacognitive skills and for the concept of comorbidity will be discussed.

Although some researchers question the trustworthiness of teacher questionnaire data, reviews indicate that teachers' judgments can serve as worthy assessments of students' achievement-related behaviors triangulated with data gathered by other protocols. In this paper it is investigated if a triangulation of parent and teacher questionnaire can be used to get a good picture of behaviour regulation and metacognitive skills in elementary school children. In addition it is studied if children with a combined learning disability differ on behaviour regulation ('hot' executive functions) and metacognition ('cold' executive functions) from children with isolated dyslexia or dyscalculia on metacognition. For this purpose the parents and teachers of 48 children with dyslexia (27 boys and 21 girls), 26 children with dyscalculia (10 boys, 16 girls), 52 children with dyslexia and dyscalculia (23 boys, 29 girls) and 93 control children without learning disabilities (43 boys, 50 girls) completed the BRIEF (Goia et al., 2000). The BRIEF measures 'hot executive functioning' or behaviour regulation (inhibition, cognitive flexibility and emotion regulation) as well as 'cold executive functioning' or metacognition (taking initiatives, working memory, planning, precision and behaviour

evaluation). The MANOVA with as dependent variable the parent ratings as dependent variable and the group (DL, DC, DC+,Co) was significant for the behaviour regulation index as well as for the metacognition index. This was also the case for the MANOVA on the parent ratings as dependent variable. For M and SD and post hoc indexes we refer to Table 1.

There was a significant correlation between the behaviour regulation rating of parents and teachers ($r=.39$, $p \leq .0005$) and between the metacognition rating of both respondents ($r=.56$; $p \leq .0005$). There was also a significant correlation between the metacognitive ratings of parents and procedural calculation ($r=-.30$, $p \leq .0005$) and fact retrieval ($r=-.39$; $p \leq .0005$). and between the metacognitive ratings of teachers and procedural calculation ($r=-.39$, $p \leq .0005$) and fact retrieval ($r=-.34$; $p \leq .0005$). One of the education implications of this study is that parent and teacher questionnaires can be used to assess metacognitive skills in elementary school children. In addition it might be good practice to try to enhance and train less developed skills or adapt our instruction to ensure that children with learning disabilities are not placed at a substantial disadvantage compared to non-disabled students. From theoretical perspective children with DC+ might have a problem with hot and cold executive functioning, whereas in children with isolated DC or DL only the cold component (metacognition) seems impaired. In addition children with DC+ seem to show few initiatives and were found to have problems with tasks depending on working memory and planning. Planning and working memory was also impaired according to the teachers in DC, whereas DL was only a problem of working memory according to them. The implication for the concept of comorbidity will be discussed

E-books and Metacognitive Guidance for Promoting Emergent Literacy among Children at Risk for Learning At-risk students

Adina Shamir, School of Education, Bar-Ilan University, Israel

The aim of the research was to examine the effect of an activity with an educational electronic book (e-book) (with and without metacognitive guidance) on the vocabulary and rhyming ability of kindergartners at risk for learning disability. Seventy seven kindergartners aged 4.5-7.0 years ($M=5.88$, $SD=.67$) participated in the research. The subjects were randomly divided into three groups: the first experienced 5 intervention sessions with an educational e-book that contains metacognitive guidance ($n=26$), the second experienced 5 sessions with an identical book without metacognitive guidance ($n=25$), and the third group (control) participated in the regular kindergarten program ($n=26$). The children's cognitive level (verbal and nonverbal), rhyming level and vocabulary were examined pre-intervention. The children's vocabulary and rhyming level were again evaluated post-intervention. The research findings indicate a significant improvement in vocabulary and rhyming among the two groups of subjects who worked with the e-book compared to the control group. The greatest improvement in rhyming was found in the group that received metacognitive guidance. However, the group that received metacognitive guidance did not exhibit greater improvement in Vocabulary than the other experimental group. The findings will be discussed during the symposium.

Many children with learning disabilities have a history of difficulties in acquisition of the spoken language and mastery of its components (Catts, Fey, Zhang and Tomblin, 2001; Carroll and Snowling, 2004). These difficulties may later affect the ability to acquire reading and reading comprehension (Carroll and Snowling, 2004; Torgesen, 2002) and place them at risk for learning disability (NJCLD, 2006). It is therefore important to investigate unique methods for improving the emergent literacy of these children, taking into account their special needs, before they develop an adverse attitude towards this field. In this spirit, the aim of the current study was to examine the effect of an activity with an educational electronic book (e-book) on the vocabulary and rhyming ability of kindergartners at risk for learning disability. We also examined the effect of an activity with an e-book that combines self-regulation (planning before and evaluating after the task) metacognitive guidance, based on researches that indicated a deficit in the metacognitive skills of students with learning disabilities (Desoete and Roeyers, 2002). The e-book was developed for the purposes of the current research based on knowledge which has accumulated from the development of earlier e-books (Shamir and Korat, 2007) found to promote emergent literacy among young children.

The present book was adapted to the population of children at risk for learning disability both in terms of content and in terms of activities intended to contribute to the development of emergent literacy and metacognitive awareness. Few studies have been performed to date on the effect of an activity with an educational e-book on emergent literacy among children at risk for learning disability. In a recent study performed in order to compare the effect of an activity with an e-book to an activity with a written book on the emergent literacy of kindergartners at risk for learning disability, a significantly greater improvement in vocabulary and phonological awareness was found among the e-book group compared to the printed book group (Shamir, Fellah and Korat, 2010).

To the best of our knowledge, the effect of an activity with an e-book on the rhyming ability of young children and the effect of an activity with an e-book that combines metacognitive guidance have not been investigated so far. Seventy seven kindergartners (72.7% boys and 27.3% girls) participated in this study. Most of the subjects (except five) attended special education kindergartens for children with developmental delays. All subjects spoke Hebrew as their mother tongue, came from an average socioeconomic background and had a mental potential within the normal range but a low linguistic ability for their chronological age. They had no additional complex problems. The subjects' age was 4.5-7.0 years ($M=5.88$, $SD=.67$). All subjects were diagnosed by the educational psychological services as having specific developmental delays or learning difficulties which place them at risk for learning disability. The subjects were randomly divided into three groups: two experimental groups that experienced intervention with an e-book, one with a book that contains metacognitive guidance ($n=26$) and another with an identical book without metacognitive guidance ($n=25$), and a third group (control) that participated in the regular kindergarten program ($n=26$). The study included three stages: pre-intervention, intervention and post-intervention. The pre-intervention testing stage included an evaluation of the children's cognitive level (verbal and nonverbal), an evaluation of the level of their phonological awareness (rhyming) and an assessment of their vocabulary. The intervention stage included a total of 5 sessions. In the first session the story was presented to small groups of subjects (3-4 subjects per group), who were given an explanation on how to work with the software. The children then worked with the book individually in 4 additional sessions. The children's vocabulary and rhyming level were again evaluated post-intervention. Regarding recognition of rhyming words the analyses performed in order to examine the differences between the research groups yielded a significant difference between the group that received metacognitive guidance and the group that did not receive metacognitive guidance, $F(1,47)=8.30$, $Ph2=.15$, and between the group that received metacognitive guidance and the control group, $F(1,48)=4.56$, $Ph2=.09$. No significant difference was found between the group that did not receive metacognitive guidance and the control group, $F(1,47)=1.47$, $P>.05$.

These findings support the research hypothesis according to which the greatest improvement in the recognition of rhyming words would be found among subjects in the group that received metacognitive guidance, but do not support the hypothesis that the achievements of the group that did not receive metacognitive guidance would be greater than the achievements of the subjects in the control group. The analyses performed in order to compare the pre and post-intervention Vocabulary measurement in each of the research groups separately yielded a significant difference between the two measurements among the intervention group that received metacognitive intervention, $F(1,25)=26.76$, $Ph2=.52$, and the intervention group that did not receive metacognitive guidance, $F(1,24)=35.19$, $Ph2=.59$. However, no significant difference was found among the control group, $F(1,25)=1.58$, $P>.05$. In accordance with the research hypothesis, a difference was indeed found between the achievements of the subjects in the two intervention groups compared to the control group. However, the group that received metacognitive guidance did not exhibit greater improvement than the group that did not receive metacognitive guidance. In sum, the research findings indicate a significant improvement in vocabulary and rhyming among the two groups of subjects who worked with the e-book compared to the control group. One of the educational implications of the current research is that activity with an educational e-book comprises a good opportunity for cultivating the emergent literacy of children at risk for learning disability, in the event that it has a structure that supports literacy and is not software that only affords amusement. Activity with an educational e-book (with and without metacognitive guidance) promotes vocabulary and phonological awareness at the rhyming level among children at risk for learning disability. From the theoretical aspect, the findings of the present research present new findings on the unique effect of metacognitive guidance as part of an activity with an e-book in general, and indicate its effectiveness in advancing phonological awareness at the level of rhyming among children at risk for learning disability in particular. Nonetheless, the unique effect of self-regulation metacognitive guidance integrated within an activity with an educational e-book on the promotion of emergent literacy among children at risk for learning disability should be investigated in future studies. The findings of the research and their educational implications will be discussed at the conference.

Metacognitive competencies in children with low intelligence

Gerhard Buettner, University of Frankfurt, Germany

According to many theoretical approaches in cognitive psychology, metamemory is an important determinant of cognitive performance. Children with low intelligence (IQ below 85) are characterized by poor cognitive performance. From the perspective of cognitive psychology, deficits in metamemory are assumed to be a significant condition of the development and maintenance of cognitive problems of children with low intelligence. The study aimed at investigating declarative knowledge on memory as well as procedural metamemorial skills in two groups of children with low intelligence (both mild and borderline intellectual disabilities) and in age matched control groups. After answering some questions on their knowledge about memory the children had to learn lists with easy and difficult paired associated pictures until each pair could be remembered. Subsequent to finishing the learning process they had to

predict the retrievability of the second picture of a pair two minutes after finishing the learning procedure, when prompted with the first picture (judgment of learning). Although all groups overestimated their memory performance, they were able to assess the retrievability of items above chance. The fourth graders with normal intelligence better predicted their learning outcome than the other groups which were very similar in their results. The average study time for easy and for difficult paired pictures was comparable in both the experimental and the control groups. The findings suggest that children with intellectual disabilities have some basic metacognitive competencies and are in their metacognitive development rather delayed than structurally different from children with normal intelligence.

Theoretical Background According to many theoretical approaches in cognitive psychology, metacognition is an important determinant of cognitive performance. One component of metacognition is metamemory. In line with theoretical core assumptions of the information processing approach empirical evidence shows a significant relationship between metamemory and memory performance (Schneider & Pressley, 1997). Based on the work of John H. Flavell (1971) and Ann L. Brown (1978) declarative and procedural components of metamemory are distinguished. Declarative metamemory refers to knowledge about structural aspects of memory, conditional knowledge about strategies, and knowledge about task difficulties. Procedural metamemory includes knowledge about both monitoring and control processes (e.g., planning, evaluating) necessary to manage memory efficiently. Based on this general perspective two metacognitive processes are distinguished in the influential procedural metamemory model developed by Nelson and Narens (1994): (1) monitoring of one's own learning processes (self-monitoring), and (2) allocation of study time. According to this procedural metamemory model, monitoring one's own learning process allows the learner to assess the current state of mastery of a given item and to predict future memory performance. Depending on the judgment of learning (JOL), either more study time is allocated to the item, or the learning process is finished. Children with low intelligence (IQ below 85) are characterized by poor cognitive performance. From the perspective of cognitive psychology, memory is a core condition of the efficiency of cognitive processes.

Consequently, deficits in several aspects of memory (memory capacity, strategy use, knowledge base, metamemory) are assumed to be significant conditions of the development and maintenance of cognitive problems of children with low intelligence (e.g., Ferretti & Cavalier, 1991). From an educational perspective, metamemory is especially interesting as a condition of memory performance since it is assumed to be changeable more easily than memory capacity or knowledge base. **Aims** The study aimed at investigating declarative knowledge on memory as well as procedural metamemorial skills in two groups of children with low intelligence (mild intellectual disabilities with IQ between 50 and 69, and borderline intellectual disabilities with IQ between 70 and 84). Using a design with two control groups (both same mental and same chronological age) it was investigated to what extent children with low intelligence are delayed in their development of declarative and procedural metamemory. **Method** The study included 20 fourth graders with mild intellectual disabilities, 25 fourth graders with borderline intellectual disabilities, 25 fourth graders with normal intelligence (same chronological age), and 45 first graders with normal intelligence (same mental age). After presenting two booklets with easy (e.g., sun – moon) and difficult (e.g., traffic light – parcel) paired associated pictures respectively, the children were asked to assess how difficult it would be to learn the pairs in the two booklets, and to justify their choice. In addition, the children were asked three questions on strategy use (e.g., What can you do to facilitate learning of difficult paired pictures?).

Subsequently, the children had to learn lists with easy and difficult paired associated pictures until each pair could be remembered. The pictures were presented on a computer screen. The allocation of learning time was measured. Following learning the total list of pairs the children were given the opportunity to learn the list a second or even a third time if they had the feeling that they could not retrieve all items. After finishing the learning process they had to predict the retrievability of the second picture of a pair two minutes after finishing the learning procedure, when prompted with the first picture (judgment of learning). The accuracy of the prediction of the retrievability of the items was assessed by Gamma correlations. The data were analysed with analyses of variance and post-hoc-tests for independent samples.

Results

Generally, the two groups of children with intellectual disabilities showed similar results. About two-thirds of the disabled children precisely assessed the difficulty of the two booklets. However, only few could justify their judgment. In addition, only a small percentage was able to correctly answer the questions on strategy use. Similar results were found in children with the same mental age. In contrast, the fourth graders with normal intelligence showed better results. They outperformed the other groups in all aspects of the declarative metamemorial knowledge. Although all groups overestimated their memory performance, they were able to assess the retrievability of items above chance. The fourth graders with normal intelligence better predicted their learning outcome than the other groups which were very similar in their results. With regard to allocation of study time more children with normal intelligence than

intellectually disabled children used the opportunity to learn the items a second time. However, surprisingly, the average study time for easy and for difficult paired pictures was similar in both the experimental and the control groups.

Discussion

The results show that the two groups of children with intellectual disabilities were very similar in their metacognitive competencies. This finding is somewhat challenging for the differentiation between borderline and mild intellectual disabilities. Further studies are necessary to clarify if the two groups are different in other cognitive competencies (e.g. working memory). Although all groups showed similar patterns in allocating study time to easy and difficult items the disabled children less often used the second opportunity to learn the list of items. This pattern of behaviour may reflect a mild metacognitive deficit. Generally, the children with intellectual disabilities and the matched same mental age children showed comparable competencies in both declarative and procedural metamemory. This finding suggests that the intellectually disabled children have some basic metacognitive competencies and are in their metacognitive development rather delayed than structurally different from children with normal intelligence.

SYMPOSIUM

Processing and storing approximate numerical magnitudes during mathematical operations

Chairperson: Ernest Van Lieshout, VU University Amsterdam, Netherlands

Organiser: Ernest Van Lieshout, VU University Amsterdam, Netherlands

Discussant: Denes Szucs, University of Cambridge, United Kingdom

Research in the last decades has shown that mathematical knowledge is not only acquired in school or during experiences with numbers outside school. Besides the ability to build exact mental representations of Arabic number symbols and number words, there is also an innate ability to deal with quantities in an approximate way. These quantities are mentally represented in an analogue code. There is growing evidence that analogue magnitude representations play a role in exact symbolic mathematics. One of the very important questions is how the different mental representations of numbers are linked to each other. Sophie Batchelor and Camilla Gilmore will present a study that addressed this question by contrasting predictions derived from Dehaene's Triple Code Model with predictions derived from Campbell and Clark's Encoding Complex Model. Children can differ either in the ability to process analogue information or in their capability to transform symbolic numerical information, which they encounter in school, into this analogue code. Bert De Smedt will cover this intriguing issue by contrasting Butterworth's Defective Number Module Hypothesis with Rousselle and Noël's Access Deficit Hypothesis. There is also the interesting question of which working memory resources are necessary to store and update an approximate representation of a number of objects after this number is changed. Iro Xenidou-Dervou, Ernest van Lieshout, and Menno van der Schoot will report on a dual task experiment that tried to isolate the relevant working memory components in terms of Baddeley's Tripartite Working Memory Model.

Semantic processing of Arabic numerals, written number words and nonsymbolic numerosities

Sophie Batchelor, University of Nottingham, United Kingdom; Camilla Gilmore, University of Nottingham, United Kingdom

When adults and children perform arithmetic they make use of multiple representations of numerical information. As well as number words and Arabic numerals that provide symbolic representations of exact number, nonsymbolic representations provide information about approximate numerical magnitudes. The ability to flexibly map across these representations supports the learning and performance of formal arithmetic (Gilmore et al., 2010; van Loosbroek et al., 2009). However the role of these different representations of number in numerical magnitude processing is unclear. Previous research has investigated whether we represent and process numerical information independent of notation. To date, the evidence is mixed and it has centred on the adult population, who have years of experience in using multiple representations of number. By testing 7-9 year old children's ability to compare numbers in different formats, the present study provided a stringent test of this question. Results showed that all children were able to make cross-notation comparisons, indicating that the ability to use multiple representations interchangeably develops early on in formal schooling. There were no differences in performance amongst different types of cross-notation comparison, suggesting that the act of crossing the boundary between representations, rather than the type of representations involved, is of central importance.

There is a growing body of evidence suggesting that humans possess two systems for representing number; an approximate nonsymbolic system which enables us to represent and manipulate quantities nonverbally, and a precise

symbolic system which facilitates exact number comparison and manipulation (Dehaene, 1997). When we learn to use symbolic representations such as Arabic numerals and verbal number words, the approximate number system is not overridden; rather the two systems become mapped onto one another (Temple & Posner, 1998; Dehaene et al., 1990). Recent research suggests that being able to flexibly map across multiple representations of number is an important factor in the learning and performance of formal arithmetic. Both the ability to transcode between number words and Arabic numerals, and the ability to map between symbolic and nonsymbolic representations are predictors of arithmetic performance in children (Mundy & Gilmore, 2009; Gilmore et al. 2010; van Loosbroek et al., 2009). Children who struggle to learn arithmetic appear less able to convert between verbal and Arabic symbolic representations or to draw on nonsymbolic representations from symbolic representations (Geary et al., 2000; De Smedt & Gilmore, in press; Hanich et al., 2001).

Whilst it is understood that learning to map across numerical representations is an important developmental process, less is known about the exact nature of this mapping and the role of multiple representations of number in numerical magnitude processing. Two models of number processing provide contrasting accounts: Dehaene & Cohen's (1995) Triple Code Model, proposes that numerical information is processed in a notation-independent fashion engaging an analog magnitude code; Campbell & Clark's (1988) Encoding Complex Model proposes that numerical processing is notation-specific, with numerical magnitude information being accessed more efficiently in the notation an individual is more familiar with. Experiments designed to test these models have provided mixed evidence and they have involved adults with years of experience with symbolic representations. Research with children is necessary to provide a more rigorous test of the hypothesis that numbers are processed in abstract fashion. Thus, in the present study we tested children's ability to compare numbers across different numerical notations.

Twenty-one children (aged 7;8 – 9;5, $M=8;3$) and 29 adults (aged 18 – 49, $M=27$) completed a computer based comparison task, in which they had to indicate which of two stimuli was numerically larger. In total there were 120 experimental trials with numerosities ranging between 4-9. The numerical distance between the numerosities being compared was varied; half of the pairs had a small numerical distance (a distance of 1 or 2) and half of the pairs had a large numerical distance (a distance of 3, 4, or 5). The notational format of the number pairs was also varied. Each of the number pairs was presented in 6 different formats; 3 within-notation formats (Arabic numeral vs. Arabic numeral, verbal number word vs. verbal number word, dot array vs. dot array) and 3 cross-notation formats (Arabic numeral vs. verbal number word, Arabic numeral vs. dot array, verbal number word vs. dot array). All 6 notational formats were randomly intermixed and the order of the trials was randomised. Prior to the comparison task, children were given 2 number reading assessments to ensure that they had sufficient symbolic number knowledge to complete the task.

Accuracy and reaction time data was submitted to a series of repeated measures ANOVAs. First, 2 by 2 ANOVAs were conducted with repeated measures factors of numerical distance (small/large) and numerical notation (within/cross). For children, there was a significant main effect of notation; children were faster ($F(1,20)=18.14$, $p=0.001$) at making within-notation comparisons compared to cross-notation comparisons. Adults also showed a performance advantage for within-notation comparisons but only for trials with a small numerical distance. This interaction between distance and notation was significant for both accuracy ($F(1,27)=5.26$, $p=0.03$) and reaction time ($F(1,27)=4.19$, $p=0.05$) data. These findings show that there is a cost of working with numbers across different notations but that once individuals have more experience using multiple numerical representations, this cost lessens. This contradicts the Triple Code Model, according to which, numbers are converted into an analog magnitude representation before comparison and thus, there should be no effects of notation on performance.

A further ANOVA was carried out to compare the different cross-notation formats. Both adults and children showed no main effect of notation; there were no differences in accuracy amongst the different types of cross-notation comparisons. These results suggest that the act of crossing the boundary between representations, rather than the type of representations involved, is of central importance. This is difficult to reconcile with the Encoding Complex Model, according to which magnitude information can be accessed more efficiently in the notation an individual is more familiar with.

To summarise, neither of the two models of number processing are able to account for our pattern of results. We found that all children were able to compare numbers across different notations as well as numbers in the same notation. Thus, all representations are mapped in children aged 7 and above. The ability to use multiple numerical representations interchangeably develops early on in formal schooling. Given that both adults and children showed a performance cost for cross-notation comparisons but no difference in performance amongst the different types of cross-notation comparison, we can conclude that the act of crossing the boundary between representations is a fundamental challenge for learners. Further work with younger children will help to elucidate the exact nature of the mapping between representations. A deeper understanding of such processes may provide us with new ways of supporting symbolic arithmetic learning which is typically lengthy and arduous for many children.

Numerical magnitude processing in first graders with mathematical difficulties

Bert De Smedt, University of Leuven, Belgium

This study investigated numerical magnitude processing in first graders with severe and mild forms of mathematical difficulties, i.e. children with mathematics learning disabilities (MLD) and children with low achievement (LA) in mathematics, respectively. Participants were 20 children with MLD, 21 children with LA and 41 regular achievers. All children completed a numerical magnitude comparison task and an approximate addition task, which were presented in a symbolic and a non-symbolic (dot arrays) format. Children with MLD and LA were impaired on the symbolic tasks, which involved the access of numerical magnitude information from symbolic representations, with the LA children showing a less severe performance pattern than children with MLD. They showed no deficits on the nonsymbolic tasks. Our findings indicate that this performance pattern occurs in children from first grade on and generalizes beyond numerical magnitude comparison tasks. These findings shed light on the types of interventions that may help children who struggle with learning mathematics.

Aims

Mathematics learning represents a stumbling block for many children in primary school. In order to devise appropriate interventions, we need to have good understanding of the cognitive deficits underlying children's poor achievement in mathematics. One source of these deficits may be in the types of numerical representations that underlie mathematics learning (Dehaene, 1997). Indeed, studies have demonstrated that children with mathematical difficulties have particular impairments in understanding and processing numerical magnitudes (Rousselle & Noël, 2007). Two accounts for these impairments have been put forward. The defective number module hypothesis (Butterworth, 2005) proposes that a highly specific deficit of an innate capacity to understand and represent quantities leads to difficulties in learning number and arithmetic. The access deficit hypothesis (Rousselle & Noël, 2007) states that mathematical difficulties originate from impairments in accessing numerical meaning, i.e. their quantity, from symbols rather than from difficulties in processing numerosity per se. To disentangle between both hypotheses, performance should be compared on numerical tasks with and without a symbolic processing requirement. If children with mathematical difficulties perform more poorly on both types of tasks, this favours the defective number module hypothesis; if they perform more poorly on symbolic tasks but not on non-symbolic tasks, this supports the access deficit hypothesis. Specifying the locus of this impairment provides a crucial building block for developing appropriate interventions, which should then either focus on the representation of quantity or on the mapping between symbols and the quantities they represent. Therefore, the aim of the present study was to contrast both hypotheses in children with mathematical difficulties in the middle of first grade.

Methodology/Research design

Participants were 82 first graders (34 boys, 48 girls) with a mean age of 6 years and 8 months ($SD = 4$ months), which were recruited from a larger sample of 290 children from 11 regular primary schools. All children completed the curriculum-based standardized general mathematics achievement test Math up to Ten (Dudal, 1999) as a screening measure. From this sample, we selected children with mathematical difficulties, i.e. those children whose performance was below the 25th percentile on this screening measure. We divided our sample of children with mathematical difficulties into children with low achievement (LA) in mathematics ($n = 21$), if they had math achievement scores between the 16th and 25th percentile, and children with mathematics learning disabilities (MLD, $n = 20$), if they had math achievement scores below the 16th percentile. For each child with mathematical difficulties, we selected from the total sample a child from the same school that performed above the 35th percentile on the screening measure. This yielded a sample of 41 typically achieving (TA) children who were matched in terms of educational environment to the children with mathematical difficulties.

All children completed a numerical magnitude comparison task and an approximate addition task, which were presented in a symbolic and a non-symbolic (dot arrays) format. In the numerical magnitude comparison task (number domain 1-9), children indicated the numerically larger of two simultaneously presented Arabic digits (symbolic condition) or dot patterns (non-symbolic condition). In the approximate task addition task (number domain 5-58), children had to solve problems such as "Daniel has some marbles and puts them in a box" and an array of blue dots fell down behind a grey occluder. Next, a second array of blue dots fell down behind the same grey occluder and the experimenter stated "and he puts some more into his box. Now, all Daniel's marbles are in his box". Finally, an array of red dots appeared and the experimenter stated "Look. Polluto has also some marbles" and asked "Can you tell me who has more?". Again this task was administered in a symbolic (Arabic numerals) and non-symbolic (dot arrays) version.

Findings

The overall accuracy on the numerical magnitude comparison tasks was high and there was no significant main effect of group ($F(2,79) = 2.36, p = .10$). With regard to speed, there was a significant group \times task interaction ($F(2,79) = 5.12, p t(59) = 3.33, p t(60) = 1.22, p = .45$) or from the children with MLD ($t(39) = -1.87, p = .16$); there were no group differences on the non-symbolic task (t

On the approximate addition task, there was also a significant group \times task interaction ($F(2,60) = 5.05, p t(47) = 4.11, p t(43) = 3.50, p t t(43) = 1.72, p = .20$; TA vs. LA: $t t$

Theoretical and educational significance

Children with mathematical difficulties, who are at the earliest stages of learning mathematics, have particular impairments in the ability to access numerical magnitude information from symbolic representations, with the LA children showing a less severe performance pattern than children with MLD. The children with mathematical difficulties did not show any deficits in underlying nonsymbolic magnitude representations. There is no doubt that difficulties in accessing the numerical meaning from Arabic numerals will have a tremendous impact on the acquisition of other mathematical concepts and procedures. Without knowing that numbers represent quantities, mathematics learning runs the risk of becoming a meaningless endeavour (Griffin, 2002). The current findings have important implications for teaching and intervention. These should provide plenty of opportunities where children learn to connect symbols and the quantities they represent in rich and meaningful ways.

Nonsymbolic approximate arithmetic and working memory: A dual-task study

Iro Xenidou-Dervou, VU University Amsterdam, Netherlands; Ernest Van Lieshout, VU University Amsterdam, Netherlands; Menno van der Schoot, VU University Amsterdam, Netherlands

Preschool children have been proven to possess nonsymbolic approximate skills before learning how to manipulate exact nonsymbolic or symbolic math and thus before the acquisition of any formal math learning instructions. Nonsymbolic approximate math tasks necessitate the allocation of working memory (WM) resources. Research has consistently shown WM to be a predictor of prime importance for children's math development and achievement. Until now, however, the relationship between approximate math and WM had not been investigated. The present study focused on answering the following research question: Which of the three WM components – phonological loop, visuo-spatial sketchpad, central executive – influence preschool children's nonsymbolic approximate addition processing? For this purpose, a dual-task study was conducted with phonological, visual, spatial and central executive interference during the implementation of an addition nonsymbolic approximate dot-task. As expected, results showed a breakdown in children's performance on the central executive interference condition. Surprisingly, the phonological loop was also proven to play a role in nonsymbolic approximate math processing. Our findings provide insight in the cognitive process of storing and updating nonsymbolic approximate representations of magnitudes during arithmetic. These results can foster the early prediction of children's math development and consequently the opportunity of enhancing early personalized interventions for the advancement of children's math skills.

Introduction

Recently, research has flourished around the question of how children's early ability to learn mathematics develops (e.g. Mundy & Gilmore, 2009). It has been found that preschool children, who have not yet had any formal mathematic instructions, possess an ability to estimate and manipulate approximate numerical magnitudes (Gilmore & Spelke, 2008). Barth and colleagues (2006) assessed children's nonsymbolic approximate (NA) addition skill utilizing a computerized dot-task. In this, a blue dot array appeared on the screen followed by a rectangle covering the dots and an additional array of blue dots hiding within the rectangle; lastly a set of red dots appeared. Children had to remember the summed hidden blue set and decide whether there were more blue or red dots. It has been postulated (Mundy & Gilmore, 2009) that exact symbolic verbal mathematic skills – i.e., as taught in school – develop on top of and are fostered by these NA arithmetic skills. Thus, it is important to understand and uncover the cognitive processes underlying these skills.

Working memory (WM) is an important cognitive predictor of children's mathematic development and achievement (e.g., Raghubar, Barnes & Hecht, 2009). It reflects a cognitive architectural system responsible for storing and manipulating limited amounts of elements. According to Baddeley (2001), WM is comprised of three main subsystems: a) the visual-spatial sketchpad (VSSP) which is responsible for retaining and manipulating visual-spatial information, b) the phonological loop (PL), which is responsible for maintaining verbal information and c) the central executive (CE), which is characterized by a limited-capacity supervising master system that integrates and allocates memory resources to the previous two subsystems and to the long-term memory.

Despite the strong relationship between WM and math, however, no previous study examined the WM resources allocated for NA arithmetic processing. This was the focus of our study. Rasmussen and Bisanz (2005) explored the differential effects of the different WM components on symbolic and nonsymbolic problems but not approximate. They found that preschoolers while solving nonsymbolic problems utilize a mental model for arithmetic that requires VSSP WM. Thus, we hypothesized that NA arithmetic processing would depend on VSSP components and not on the PL WM component. Furthermore, given the nature of the task which necessitates memory updating on the elements presented, we also hypothesized CE involvement (Morris & Jones, 1990).

Method

Participants were 53 first graders (31 girls, 22 boys; mean age: 5.95 years) from 5 regular Dutch primary schools. In order to examine the differential contribution of the WM components, a dual-task interference design was used. The primary task was a NA addition task (dot-task; array numerocities ranging from 6-70) with trials where the numerocities of the sum (two blue dot sets) and the comparison array (red dots) differed by ratios 4:7, 4:6, 4:5. Testing trials were designed in order to control for the usage of non-addition strategies with ratio-based distances. Continuous quantity cues such as summed dot surface area and circumference, total array area and density were controlled for. Children solved the dot-task in a standalone manner (i.e. no interference) and in four WM interference conditions. In these conditions, the dot-task was executed alongside another task that was developed to interfere with each WM component respectively: 1. PL - adapted Letter Span task (LS), 2. Visual- adapted Abstract Patterns task (AP), 3. Spatial - adapted Corsi Blocks (CB) and 4. CE - Continuous Choice Reaction Time Task-Random (CRT-R task). These secondary tasks were also conducted in standalone control conditions with a 15 sec delay replacing the primary task. All tasks were computerized. Children responded on the dot-task by pressing on either a blue or a red response button. Secondary task responses were vocal and were registered by the experimenter. First, all children performed the dot-task, then participants were counterbalanced based on intelligence level (assessed with the Raven's) between two task-order presentation conditions: AP, LS, CB, CRT-R, dual-AP, dual-LS, dual-CB, dual-CRT-R or the opposite order.

Results

Children succeeded on the primary task (63.44%, chance = 50%, $t(52) = 11.71$, $p F(2,104) = 28.66$, $p F(4,208) = 15.39$, $p F(4,208) = 7.84$, $p F(4,208) = 13.51$, $p p t(51) = 7.34$; p the PL ($t(52) = 3.14$; p

Discussion

Our results showed that preschoolers allocate primarily CE but also, surprisingly, PL WM resources to process NA arithmetic problems. We found that the process of updating WM, which characterizes the CE, is the most important for NA math processing. The involvement of the PL indicates children's attempt to phonologically code the numerical magnitudes they saw in order to process them (Krajewski & Schneider, 2009).

"Non-symbolic, approximate representations are central to human knowledge of mathematics" (Gilmore & Spelke, 2008; pp.943). Our findings are relevant to the enhancement of later math development prediction and early intervention. Does a math-specific skill like approximate math play a role in later math performance or are non-specific WM components that mediate approximate math performance more important?

SYMPOSIUM

Learning math with multiple representations: In search for dimensions of representational flexibility

Chairperson: Shaaron Ainsworth, University of Nottingham, United Kingdom

Organiser: Wim Van Dooren, K.U. Leuven, Belgium

Discussant: Shaaron Ainsworth, University of Nottingham, United Kingdom

In school mathematics, the use of external representations has increasingly attracted attention. Students are often exposed to multiple representations of the same idea, with the hope that such exposure will positively impact their learning and problem solving performance.

Despite the potential that multiple external representations in supporting students' learning and problem solving, several studies have shown that they can also negatively affect them. One of the reasons is that students are sometimes lacking representational fluency, being unable to use a given representation to solve a problem. Another reason why students do not always benefit from solving problems using multiple external representations is that they lack representational flexibility which prohibits them from optimally using the variety of representations that is available to solve a given problem.

The notion of representational flexibility in mathematical learning and problem solving will be the core of this symposium. In the literature, many conceptualisations of representational flexibility are used, each stressing particular aspects of flexible problem solving behaviour and/or the way in which this flexibility can be learned. The three contributions will introduce their conceptualisation of representational flexibility, and substantiate these with empirical results. The different studies introduce various dimensions of representational flexibility, such as task, student, and context characteristics, and discuss the educational implications.

Facilitating Representational Fluency and Flexibility through Sequencing Multiple Representations

Martina Rau, Carnegie Mellon University, United States; Vincent Aleven, Carnegie Mellon University, United States; Nikol Rummel, Institute of Education, Ruhr-Universität Bochum, Germany; Zelha Tunc-Pekkan, Carnegie Mellon University, United States; Laura Pacilio, Carnegie Mellon University, United States

We investigate how to balance two aspects of learning with multiple graphical representations that are provided in addition to symbolic representations: Representational fluency and representational flexibility. Being fluent with a graphical representation requires learners to relate it to the more abstract symbolic representation. On the other hand, we view the ability to make comparisons across graphical representations as an aspect of representational flexibility: It requires recognizing similarities and differences between graphical representations, which is prerequisite for knowledge about strengths and weaknesses of each graphical representation. We conducted an in vivo experiment using an online tutoring system for fractions to investigate a key aspect of this issue: The temporal sequencing of graphical representations presented one-at-a-time. Specifically, we investigated the effects of blocking vs. interleaving multiple graphical representations. Results show an advantage for interleaving representations and an increasingly interleaved sequence, demonstrating the importance to provide opportunities for students to acquire representational flexibility.

Theoretical background

Understanding fractions is foundational for more advanced mathematics (NMAP, 2008), yet fractions pose a significant challenge for students. Multiple graphical representations of fractions are widely used in paper curricula because each of them provides a slightly different conceptual interpretation of fractions. In an earlier study we found that students working with multiple graphical representations of fractions learn better than students working with a single graphical representation, when prompted to explain how the graphical representations (e.g., a circle) relate to the symbolic representation (e.g., $1/2$) (Rau, Aleven, & Rummel, 2009). This finding is in line with a number of studies that demonstrate benefits of learning with multiple representations (Ainsworth, Bibby, & Wood, 1998). However, providing students with multiple representations is not always beneficial (see Ainsworth, 2006), which has been attributed to the fact that they require learners to acquire several cognitive competencies: Learners need to understand the particular representations and to use them appropriately; in other words, they need to acquire representational fluency with each representation (Ainsworth, 2006). In addition, students need to develop representational flexibility (Spiro & Jehng, 1990): students need to understand the differences and similarities between them, which will enable them to make adaptive representational choices as they use representations for problem solving (Acevedo-Nistal et al., 2009). We argue that representational flexibility requires students to make comparisons across representations. In our project, we strive to help students integrate the different conceptual interpretations that are being emphasized by different graphical representations into one coherent mental model

Problem Statement

At this point, it is an open question how to balance the support of representational fluency and representational flexibility in order to help students integrate them into one single, complex mental model of the to-be-learned content. In the present study, we consider the temporal sequencing of multiple graphical representations presented one-at-a-time. This question is often being disregarded when designing learning material with multiple representations, even though literature on sequencing tasks with different properties (Van Merriënboer & de Croock, 1992) suggests that the temporal sequences of different representations may also have an influence on students' learning. However, we know of no study that has systematically investigated the sequence of different graphical representations. Specifically, we contrast blocking representations (e.g., AAABBBCCC, where A may be a circle, B a rectangle, and C a number-line representation), versus interleaving them (e.g., ABCABCABC). When practice with representations is blocked, students have the opportunity to develop fluency with one representation before the next one is introduced. On the other hand, when practice with different representations is interleaved, students may have greater opportunity to (spontaneously) make comparisons between representations and develop representational flexibility along with fluency. If the development of representational flexibility relies on students' fluency with the individual representations, students should learn best when practice with the representations is blocked. If, on the other hand, representational flexibility can develop along with or even contribute to students' acquisition of representational fluency, students should learn best when practice with the representations is interleaved. We think

that making comparisons between representations without having acquired fluency with each of them will come at a certain cost (e.g., students may then tend to make surface-level comparisons). We therefore hypothesize that students' benefit from the opportunity for comparison making builds on fluency, and thus predict an advantage for a condition where students first learn with each representation in a blocked fashion and then gradually shift into a mode where they encounter the different representations in an interleaved fashion (i.e. the frequency of switching is increased).

Methods

We conducted an experimental study with 690 4th- and 5th-graders who worked on different versions of an intelligent tutor for fractions during their regular class time. Students were randomly assigned to either of four conditions that varied regarding the degree to which practice with the representations was blocked versus interleaved: blocked, moderate, interleaved, or increased. Students in all conditions worked on the same numerical problems. Students in the blocked condition encountered the representations in three blocks: They worked on the first third of all problems with one graphic, on the second third of all problems with a second representation, and finally on the last third of all problems with a third representation. In the moderate condition, the blocks were much smaller: Students switched representations after every twelve problems. Students in the interleaved condition switched representations after every single problem. And finally, in the increased condition, the length of the blocks was gradually reduced from eighteen problems at the beginning to a single problem at the end. Students' knowledge of fractions was assessed three times: Before, immediately after, and one week after working on the fractions tutor.

Results and discussion

Results show an aptitude-treatment-interaction demonstrating that low prior knowledge students benefit significantly more from an interleaved sequence of graphical representations and an increasingly interleaved sequence than from a highly blocked sequence and a moderately blocked sequence. This finding demonstrates that interleaving graphical representations results in the best integration of multiple conceptual interpretations of fractions into a single mental model. The advantage of the increasingly interleaved sequence further demonstrates that students may require a certain amount of practice with each graphical representation by itself before benefiting from more frequent opportunities to make cross-representational comparisons. A thorough analysis of students' interactions with the tutoring system is underway to compare learner profiles between the interleaved and the increasingly interleaved conditions. A follow-up think-aloud study on the interleaved condition demonstrates that students tend to not make explicit comparisons between the graphical representations and thus supports the interpretation that the benefit from interleaving graphical representations stems from repeatedly eliciting different conceptual interpretations rather than from supporting students' active processing of correspondences and differences between the different graphical representations. Future research is planned to investigate explicit support for conceptual connection-making between multiple graphical representations.

Two approaches to evaluating students' representational flexibility

Ana Acevedo Nistal, K.U.Leuven, Belgium; Wim Van Dooren, K.U. Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

This study evaluated students' representational flexibility while they solved linear function problems. Eighty-six secondary-school students solved problems under one choice (C) condition, where they could choose a table, a formula, or both to solve each problem, and two no-choice (NC) conditions, a NC-table and a NC-formula condition, where one representation was forced upon them. Two approaches to the evaluation of representational flexibility were used: a groupwise approach, where students were considered to make a flexible choice if they selected the representation that yielded the best NC condition performance for the problem at hand for their grade, and an individualised approach, where a student's choice in a particular problem was considered flexible if he selected the representation that, according to his own performance in the NC conditions, was the most likely to help him reach the solution to that problem. A strong positive correlation between groupwise flexibility and C condition performance was found, but an even stronger positive correlation between individualised flexibility and C condition performance was also found, especially in the highest grade. In this grade, where students' representational fluency profiles were very diverse, individualised flexibility scores that took into account each student's fluency with each representation were better at predicting C condition performance than groupwise flexibility scores that ignored individual differences in representational fluency.

Aims

We live in a world where representational material is omnipresent. Not surprisingly, teaching students to extract information from representations and encouraging them to adopt a critical approach towards such information is an important goal of today's mathematics education (Greer, 2009). It has been claimed that, for students to benefit from using external representations in mathematical tasks, they need to possess two main skills:

1. Representational fluency, defined as "the ability to work within and translate among representations" (Bieda & Nathan, 2009, p. 637).
2. Representational flexibility, which involves making appropriate representational choices. As we have explained elsewhere (Acevedo Nistal, Van Dooren, Clarebout, Elen, & Verschaffel, 2009) not all authors conceptualise representational flexibility in the same way. For some authors (e.g. Schnotz & Bannert, 2003) a choice is flexible if it matches the demands of the task at hand. We refer to this as task-based flexibility. However, other authors (e.g. Acevedo Nistal, Van Dooren, Clarebout, Elen, & Verschaffel, 2010) consider a choice as flexible if it takes into account task demands and the characteristics of the subject making the choice, for example his representational fluency. We call this task ' student-based flexibility. In this paper we compare two task ' student-based approaches to the evaluation of representational flexibility – a groupwise approach and an individualised approach. The purpose of this comparison is to determine which approach better predicts performance in problems about linear functions where a representational choice is required. Methodology

Eighty-six ninth, tenth, and eleventh graders participated in the study. All had prior knowledge about solving linear-function problems using tables and formulae.

All students solved paper-and-pencil tests concerning the refilling of two fuel tanks in a gas station. Half of the problems asked how much fuel a tank contained at a specific moment (value problems). The other half asked when both tanks contained the same amount of fuel (intersection problems).

The choice/no-choice (C/NC) method (Siegler & Lemaire, 1997) was used. In the C condition, students could choose a table or a formula to solve each problem. In the NC-table and NC-formula conditions, students could only use the representation provided. There were 8 problems per condition. The problems in the 3 conditions were parallel. The C condition was administered first. Half of the students received the NC-table condition next, the other half the NC-formula condition. Students were instructed to show their work and not to use a calculator.

Findings

Two (task ' student-based) approaches to the evaluation of flexibility were used: a groupwise approach, and an individualised approach.

Groupwise Approach

A student's choice was considered flexible (and given a flexibility score of 1) if he selected the representation that, according to the NC data from his grade, yielded the highest accuracy for the problem at hand. A score of –1 was given if the student failed to choose that representation. Average flexibility scores obtained using this approach were correlated with C condition performance to determine if flexible students performed better than less flexible students. As Table 1 shows, this was indeed the case.

Individualised Approach

A choice was considered flexible (and given a flexibility score of 1) if a student chose a representation with which he successfully solved a parallel problem in the corresponding NC condition. A score of –1 was given if he chose a representation with which he was unable to solve a parallel problem in the corresponding NC condition. Correlations between individualised flexibility scores and performance in the C condition were calculated. As Table 2 shows, a link between individualised flexibility scores and C condition performance was also found.

Individualised flexibility scores were more strongly correlated with C condition performance than the scores obtained using the groupwise approach, especially in eleventh grade. In this grade, where students' representational fluency profiles were very diverse, individualised flexibility scores that took into account each student's fluency with each representation were better at predicting C condition performance than groupwise flexibility scores that ignored individual differences in representational fluency.

Implications for instruction

Judging by the close link observed between representational flexibility and choice condition performance, teaching students to make flexible representational choices might be a skill worth developing in the mathematics classroom. A dilemma that remains, however, is: Which instructional approach should we adopt – a groupwise approach, where all students within a grade are taught to make the same representational choices for the same types of problems based

on their average fluency with the different representations, or an individualised approach, where each student is encouraged to use the representation that fits not only the task at hand but also his own fluency with the different representations. When teaching representational flexibility, one is unavoidably faced with a trade-off between adopting a groupwise, normative approach that is relatively easy to implement but that ignores individual differences, and an approach that is sensitive to individual differences but that is challenging for instruction.

How successful learners deal with changing task demands in learning from multiple representations

Rolf Schwonke, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany

Limitations of working memory suggest that mental model construction in learning from multiple external representations (MER) is most successful when the most essential aspects of the learning material are visually inspected in close temporal succession. Furthermore, such visual integration activities should be most beneficial when they occur early during the inspection of a set of related external representations. Learning from MER can further be expected to be most successful when such patterns as well as the amount of visual attention are flexibly adapted to changing task demands. In a correlative lab study 31 psychology students studied the product rule of combinatorics from correct and incorrect worked examples. Each example provided a problem description, a tree diagram, and equation. In incorrect examples one of these external representations provided incongruent information regarding the product rule. During learning gaze data were registered. Learners who showed successive gaze shifts between the three most relevant elements of correct examples early during inspection acquired highest amounts of conceptual understanding. The amount and pattern of visual attention differed markedly during the inspection of correct and incorrect examples. Importantly, those learners who showed the largest differences in the amount and pattern of visual attention (e.g., total number of fixations and gaze shifts) were those who acquired highest amounts of conceptual understanding. Thus, successful learning from MER seems to be positively related to an early (visual) integration of semantically related pieces of information as well as to the ability to flexibly adapt visual attention to changing task demands.

In order to benefit from external representations in learning and problem solving contexts, students are supposed to have two related subskills. First, learners need to be able to interpret (and construct) external representations (i.e., representational fluency; Acevedo Nistal, Van Dooren, Clarebout, Elen, & Verschaffel, 2010). Second, learners need to be able to make appropriate choices between external representations given a certain learning situation (or problem-solving situation) and given certain personal characteristics (e.g., the acquaintance with certain representational formats). This skill has been referred to as representational adaptivity or flexibility (Acevedo Nistal et al.).

In the present study we compared the self-regulation of visual attention during the inspection of correct and incorrect worked examples in the domain of probability. During the inspection of correct examples (consisting of a problem description, a tree diagram, and an equation), we expected successful mental model construction (Schnotz & Bannert, 2003) to be reflected in attempts to visually integrate the most relevant aspects as soon as possible. During the inspection of incorrect examples, we expected successful learners to inspect the examples more holistically (i.e., to compare each external representation more extensively) in order to detect the error. As task demands between correct and incorrect examples differed, we expected to find respective differences in the allocation of visual attention (e.g., more gaze shifts in the error detection task). Moreover, successful learners were expected to be better able to adapt their allocation of visual attention to task demands.

Method

After reading a written introduction into the product rule of combinatorics, first year psychology students ($N = 31$; age: $M = 23.35$, $SD = 6.41$) studied sixteen worked examples of combinatorics problems. Each example consisted of a problem description, a tree diagram, and an equation. The first line of each problem description referred to the number of drawings (which was always two), the second line to the number of possibilities at the first drawing, the third line to the question (stem), and the fourth line to the instantiated mathematical rule (with/without replacement).

In order to understand a worked example, at least the fourth line of the problem description and both layers of the diagram (representing the two successive drawings) had to be integrated. As an indicator of attempts of visual integration of these central pieces of information, we analysed successive gaze shifts between these semantic units. The first occurrence (in terms of the number of fixations) of such an 'integrative' gaze shift was taken as an indicator of visual integration.

After four correct worked examples the participants were asked to study four incorrect worked examples (followed by another four correct and four incorrect examples). In incorrect examples, two of the three external representations

(e.g., problem description and equation) suggested one rule (e.g., 'with replacement'), whereas the remaining external representation (e.g., the tree diagram) suggested another rule (e.g., 'without replacement'). In order to detect the incongruent representation, learners had to process each individual external representation to a sufficient degree as well as to relate all external representations to one another. We examined the total time spent on each type of representation and the frequency of gaze shifts between them.

Directly before and after the learning phase all participants worked on identical pre- and post tests (procedural and conceptual knowledge). In procedural tasks (6 items) learners were asked to solve combinatorics problems. In conceptual tasks (8 items) learners had, for example, to explain the product rule or had to decide whether a problem was solvable.

Results

Conceptual understanding (post-test) was, as expected, positively related to an early occurrence of an integrative gaze shift (i.e., a successive gaze shift between that line of the problem description from which the mathematical rule could be inferred and both layers of the tree diagram) during the inspection of correct examples, $r_p = -.47$, p

Both the amount and the pattern of visual attention devoted to the worked examples differed between correct and incorrect examples (i.e., as a result of the change in task demands). When studying incorrect worked examples, learners spent more time inspecting each individual representation compared to the inspection of correct examples – with largest increases in inspection times of equations (Table 1). Similarly, the frequency of gaze shifts between representations increased during the inspection of incorrect examples – with largest increases in the frequency of gaze shifts between diagrams and equations (Table 1).

Importantly, those learners with the largest differences (here, increases) in the amount of visual attention devoted to incorrect examples (as indicated, for example, by the total inspection time of the examples) were those who acquired the highest amounts of conceptual understanding in the post-test, $r_p = .41$, p $r_p = -.50$, p

Summary and Discussion

The aim of the reported analyses was to get a better understanding of how learners regulate their visual attention during learning from multiple external representations and how learners adapt their allocation of visual attention to changing task demands.

Results show that in learning from multiple representations representational fluency is reflected in early attempts to visually integrate central related aspects of the learning content. As expected, both the amount and pattern of visual attention differed between the inspections of correct versus incorrect examples. Importantly, those learners who showed the largest differences in the amounts and patterns of visual attention were those who developed the deepest understanding of the subject matter. These results suggest that in learning from multiple external representations representational adaptivity is reflected in changes of both the amount and the pattern of visual attention as a reaction to changing task demands. Overall, the results suggest that representational fluency and flexibility have behavioural correlates at the level of the self-regulation of visual attention.

SYMPOSIUM

Identifying key learning activities in strategy instruction in various ill defined do-mains. Part I

Chairperson: Tanja Janssen, Universiteit van Amsterdam, Netherlands

Organiser: Gert Rijlaarsdam, University of Amsterdam, Netherlands

Discussant: Patricia A. Alexander, University of Maryland, United States

The symposium aims at the identification of effective instructional strategies in various domains of learning, in ill structured tasks. General idea is to bring together and to analyze intervention studies that focus on strategy development. The symposium will address the question 'What works in strategy instruction and why?' with variations in content (the strategy learned), the learning activity and the content domain.

Therefore, we selected studies that were set up as componential analysis of instructional components (e.g. Fidalgo et al. in this symposium), studies that analyzed data from complex interventions with multi-components to isolate the contributions of each component to the total effect (for instance Glaser et al. in this symposium), and experiments that aimed at studying the effect of a single learning activity (Groenendijk et al., focusing on observation as learning activity). In three sessions, the symposium will deal with various domains (visual arts: divergent thinking; history: historical thinking and language arts: writing and reading literary texts). The domains have in common that they aim at thinking skills, and are seen as ill-structured.

Analysis of Instructional Components in the Strategy Instruction in Writing

Raquel Fidalgo, University of Leon, Spain, Spain; Mark Torrance, Nottingham Trent University, United Kingdom; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Patricia Robledo, University of Leon, Spain; Huub Van den Bergh, Utrecht University, Netherlands

This research explores the effectiveness of four subcomponents of a strategy-focused writing program for 6th Grade students. This program taught process and product strategies in four stages: (1) student observation of teacher modeling, (2) declarative teaching, supported by mnemonics, (3) emulation with teacher and peer feedback on strategy use, and (4) individual emulation with teacher feedback. Stages 3 and 4 both involved students thinking aloud while writing. Our sample comprised 62 Spanish students with a full range of abilities, in three classroom groups. Components were evaluated with a lagged and cross-panel design across two ten-week phases. In Phase 1, Group A and Group B received the intervention, with Group B lagging one component behind Group A. Group C acted as a normal curriculum control with matched writing practice. In Phase 2, Group C received the intervention, but with instruction focusing on a different text genre. Groups A and B returned to the normal curriculum. All groups received writing tests at baseline and at the end of each intervention component (or matched times in the control). Findings confirm the benefit of strategy focused writing instruction with relatively large effect sizes. We found, however, that nearly all gains resulted from the two-session modeling and observation component with only small further increases in text quality resulting from subsequent declarative instruction and student practice.

There is considerable evidence that strategy-focused instruction is successful in developing the writing skills of both typically developing and struggling writers (Graham & Perin, 2007a; Graham & Perin, 2007b; Fidalgo, Torrance, & García, 2008; Torrance, Fidalgo, & García, 2007). Strategy-focused writing interventions aim to develop self-regulation in both writing process – the use of effective planning and revision strategies – and written products. They typically involve several different instructional strategies. In the intervention employed in the present study (Cognitive Self-Regulation Instruction – CSRI – previously evaluated in Fidalgo, Torrance, & García, 2008; Torrance, Fidalgo, & García, 2007) these instructional strategies included (1) student observation of teacher modeling, (2) explicit (declarative instruction), (3) emulation with peers, and (4) emulation alone. During the first instructional component, students observe their teacher composing text in front of the class whilst "thinking aloud". The think aloud is part-scripted so as to illustrate specific writing strategies, and therefore provides a "mastery" model. Students then reflect on what they have observed, noting the important features of the teachers writing (both text and process). The second component involves explicit teaching of process and product strategies, supported by the teaching of mnemonics. During the third component students emulate the model that they have observed, but with procedural facilitation by both peers and teacher. Students work in pairs. One thinks aloud while composing text which the other observes and comments on the extent to which they are successfully emulating the model. They then swap roles. The teacher also provides some feedback on the students' emulation. The fourth component is similar to the third. Students emulate the model while thinking aloud, but working alone and relying on just teacher feedback. Our previous research has demonstrated that when these components are combined the resulting intervention has large, positive benefits for the quality of students' texts. What is not clear is whether all components are necessary. The present study therefore aimed to explore their relative efficacy. Our sample comprised Spanish sixth-grade students (11-12 years) in three extant full-range class groups taken from the same cohort at the same school: Group A (N = 21), Group B (N = 20), and Group C (N = 21). Evaluation was completed in two phases. Both phases involved delivery of all four instructional components, in the order indicated above, and with each delivered over two sessions of between 60 and 90 minutes by the same instructor (the students regular literacy teacher). In Phase 1 both Group A and Group B received the full intervention, with Group B lagging one component (two sessions) behind Group A. Group C were taught under the school's normal writing curriculum in the same number of sessions and completing the same number of writing tasks. Instruction in Phase 1 focused on the composition of compare-contrast texts. In Phase 2, which focused on texts that expressed an opinion, Group C received the intervention and Groups A and B formed a normal curriculum control. Students' writing performance was evaluated in all three groups at the start of Phase 1 and then at two-session intervals throughout both phases (i.e. at the end of each instructional component for intervention groups and at equivalent times for controls). This design allowed (a) assessment of the cumulative effects of the components, (b) replication of this finding (in the lagged group B in Phase 1), (c) replication of this finding in a different text genre (Group C in Phase 2), and (d) multiple transfer and maintenance measures (in Groups A and B during Phase 2). We evaluated writing performance through both holistic and text-analytic measures of writing quality, and with measures of writing process derived from notes taken during planning and analysis of revisions made to the final text. Results confirmed the efficacy of CSRI, with substantial and sustained gains in the quality of students' texts. Given the similarity of CSRI to other strategy-focused approaches, notably Self-Regulation Strategy Development (Harris & Graham, 1996) this provides further evidence of the general efficacy of strategy-focused writing instruction. However, gains in performance appeared to be associated almost entirely with the initial, observation component. This finding was consistent across all three groups (A and B in Phase 1, C in phase 2). This suggests that in writers with fairly well developed language skills, but who have previously been exposed only to traditional instructional approaches (focused

on feedback on finished products), then just observing good use of strategies may be sufficient to improve text quality. Our findings do not however rule out the possibility that other components are necessary if these benefits are to be maintained beyond the end of the intervention.

References

- Fidalgo, R., Torrance, M., & García, J. N. (2008). The long term effects of strategy-focused writing instruction for grade six students. *Contemporary Educational Psychology*, 33, 672-693.
- Graham, S., & Perin, D. (2007a). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology*, 99, 445-476. doi:10.1037/0022-0663.99.3.445.
- Graham, S., & Perin, D. (2007b). What we know, what we still need to know: Teaching adolescents to write. *Scientific studies to reading*, 11, 313-335.
- Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composing and self regulation*. Cambridge, MA. Brookline.
- Torrance, M., Fidalgo, R., & García, J. N. (2007). The teachability and effectiveness of cognitive self-regulation in sixth grade writers. *Learning and Instruction*, 17, 265-285.

The Effect of Observational Learning on Artistic Production

Talita Groenendijk, University of Amsterdam, Netherlands; Tanja Janssen, Universiteit van Amsterdam, Netherlands; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Huub Van den Bergh, Utrecht University, Netherlands

Previous research has shown that observation can be effective for learning in various domains, e.g. argumentative writing and mathematics. It provides strategic knowledge to the learner and also changes students' conception of what the modelled skill involves. The question in this presentation is whether observational learning can also be beneficial when learning to perform creative tasks in visual art. We designed an intervention that enables students to learn from observation of video models. The models in the video carried out creative tasks (the making of a collage) while thinking aloud. In a pretest-posttest experimental design we assigned 131 Dutch students (tenth grade, 16 years old) randomly to one of three conditions; two observational learning conditions and a control condition (learning by practicing). The observational learning conditions varied in instructional focus when students had to evaluate the thinking processes of two peers on video: focusing on the weakest or the more competent student. We measured posttest performance on a collage task. As a process indicator, amount of 'revision' (or production that did not end up in the final work) was registered. A questionnaire was used to measure motivation. We found that both observation conditions were more effective than the regular practicing activities with regard to creative products, creative processes, and motivation.

In contemporary curricula, creativity is mentioned as a skill that should be developed in schools. However, we know little about how to develop creative skills of students in secondary education. In art education, teachers aim to improve students' creative processes, but little is known about the effectiveness of strategies they use to teach creativity. In the present study we test the effectiveness of observational learning, a process oriented learning arrangement. Before the phase formal schooling, apprenticeship was the most common means of learning (Collins, Brown, & Newman, 1986). In cognitive apprenticeship, an expert model externalizes usually internal processes. Collins et al. (1986) describe how observation, as an element of cognitive apprenticeship, may provide strategic knowledge to the learner, and also may change students' entire conception of what the modelled skill involves. In writing, for example, students may be unaware that good writing involves organizing one's ideas about a topic, elaborating goals to be achieved, thinking about what the audience is likely to know about the topic, etcetera. Observation may enhance this awareness. Couzijn (1999) and Braaksma et al. (2004) found that observational learning is indeed an effective learning tool for students when learning to write informative texts. Students who observed (weak and strong) peer models performing a writing task, afterwards wrote better texts than students who performed the writing task themselves. Observation affected students' writing processes; students who had learned to write by observing more often engaged in metacognitive activities during writing, such as planning, analyzing and goal-orientation. Braaksma et al. (2002) also found that similarity in competence between the model and the observer influenced the learning effect positively (the 'model similarity effect'). Observational learning proved to be an effective learning activity in various domains, such as mathematics (e.g. Schunk & Hanson, 1985), argumentative writing (e.g. Braaksma, 2002; Couzijn, 1999), learning to collaborate (Rummel & Spada, 2005), and learning argumentation skills (Schworm & Renkl, 2007). There is still no research on observational learning and creative tasks. In this study we focus on the effect of observation on students' performance on a creative task: the making of a collage. Research question & hypotheses: observational learning more effective than learning by practicing? Our hypotheses were that observational learning would have a positive effect on visual art making: (1) higher quality collages in the observational learning conditions than in the control condition; (2) more revision in the observational learning condition as a result of more creative exploration, and (3) higher motivation in the observational learning conditions.

We expected weak students to learn more from focusing on the process of a weak model as contrast to the process of the stronger model, and stronger students to learn more from focusing on the process of a strong model, contrasted with the process of a weaker student.

Method

An experiment with a pre- posttest control group design and three conditions (two experimental conditions and a control condition) was carried out to measure its effectiveness. During the intervention students either observed other students at work (observational learning) or carried out the tasks themselves (control group). The models in the videos thought aloud, while doing the task, so observers could understand demonstrated creative processes. Participants were asked to watch videos carefully, make notes, evaluate the models' behaviour, and elaborate on the observed behaviour. The students in the observational learning conditions watched four videos of pairs of students (weak and strong). The observational learning conditions varied with respect to instructional focus (elaboration on the weakest or the more competent model of a pair). 131 students, about 16-year old, in 10th grade of pre-university education, participated and were randomly assigned to conditions. As a pre- and posttest, all students made a collage. No differences between conditions on the pretest were observed. We measured differences between the conditions on the posttest; differences in product quality, in the process and in motivation. The quality of students' collages was determined making use of Amabile's consensual assessment technique, a procedure that provided reliable and valid creativity scores in previous research (Amabile, 1982). We reached a reliability of .77 on the pretest and .72 on the posttest.

Results

The hypotheses on main effects were largely confirmed; students in the observational learning conditions (1) made better collages than students in the control condition, (2) these students revised more and (3) showed higher rates on motivation than students in the control condition. We had to reject the hypothesis on model similarity; no effect of similarity in competence between model and observer was found. The study contributes to the acquisition of knowledge on creativity and modeling. It provides insight in the possibilities for enhancing creativity in the classroom through observation, providing new possibilities to connect productive, receptive and reflective activities in art education.

References

- Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology*, 43, 997-1013.
- Braaksma, M.A.H., Rijlaarsdam, G., & Van den Bergh, H. (2002). Observational learning and the effects of model-observer similarity. *Journal of Educational Psychology*, 94, 405-415.
- Braaksma, M.A.H., Rijlaarsdam, G., Van den Bergh, H., & Van Hout-Wolters, B.H.A.M. (2004). Observational learning and its effects on the orchestration of writing processes. *Cognition and Instruction*, 22(1), 1-36.
- Collins, A., Brown, J.S., & Newman, S.E. [1986] 1989. Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics. In L.B. Resnick (ed), *Knowing, Learning and Instruction: Essays in honour of Robert Glaser* (pp. 453-494).
- Hillsdale, N.J. Erlbaum. Couzijn, M. (1999). Learning to write by observation of writing and reading processes: effects on learning and transfer. *Learning and Instruction*, 9(2), 109-142.
- Rummel, N & Spada, H. (2005). Learning to collaborate: an instructional approach to promoting collaborative problem solving in computer-mediated settings. *The journal of the learning sciences*, 14(2), 201-241.
- Schunk, D.H., & Hanson, A.R. (1985). Peer models: Influence on Children's Self-efficacy and Achievement. *American Psychological Association*, 77(3), 313-322.
- Schworm, S. & Renkl, A. (2007). Learning argumentation skills through the use of prompts for self-explaining examples. *Journal of Educational Psychology*, 99(2), 285-296.

Improving children's writing through parental intervention

Patricia Robledo, University of Leon, Spain; Jesus-Nicasio Garcia-Sanchez, University of Leon, Spain

The empowerment of linguistic communication from schools frequently focuses on oral language and reading, relegating writing to the background (Torrance, Fidalgo, & García, 2007). Thus, the family could prove to be an effective alternative for its teaching (Robledo, García, & Díez, 2009). The objective of this study is to verify whether it is possible to improve students' writing competence through the mothers' implication in their teaching.

The sample consists of 50 students, enrolled in the 5th and 6th grade (10-12 years old). 26 of them formed the experimental group (mothers received a program to assisting children with writing homework, providing them with

models of writing composition processes) and 25 formed the control group (mothers only received information to help children with writing homework).

We tested the effectiveness of parental collaboration on students' writing compositions through the evaluation of text quality (text based and reader based measures) in a comparison-contrast texts (pre-posttest), and the activation of writing processes. We also evaluated the maintenance (three months later) and generalization to other textual typologies (argumentative).

Results shows that students from the experimental group improved their writing compositions more than the control group did, and they maintained these improvements over time and generalized them to other texts. We conclude that mothers can contribute to students' successful acquisition of writing competence if they receive specific training.

In Spain, the achievement levels of learning goals and requirements has significantly increased as a result of the Organic Education Law (2006) which was adapted to meet the proposals made by the European Union. As a result, the impact of any extrinsic factor or agent, such as the family, on their process of teaching-learning is particularly important to the student.

With the implementation of European educational guidelines, young people must have acquired eight competences on completion of their compulsory education. The importance of the linguistic communication competence, which refers to the use of language as a tool for oral and written communication is emphasized. The school must prepare competent communicators who can successfully navigate in different communicative contexts and conditions.

In Spain, the empowerment of linguistic communication in school usually focuses on oral language and reading. At school, writing is in the background, which is a bit strange when we know that writing is cognitively demanding and requires explicit instruction. Therefore, we focus in this study on the contribution of the family on writing development. The family could be an effective alternative for the lack of school teaching, because we know from Spanish research that the habit of writing is more common in students whose families provide models and positive attitudes toward writing tasks (Reyes, Alexandra, & Azuara, 2007; Romero, Arias, & Chavarría, 2007). Also, depending on the different parental variables (education level and degree of involvement in education) the family can contribute to better quality of texts (Robledo, García, & Díez, 2009). Therefore, the objective of this study is to verify whether it is possible to improve students' writing competence through the mothers' implication in the teaching of writing. We based the family intervention on research experiments in schools on the teaching of writing strategies that showed to be effective on text quality and writing process measures. (Fidalgo, Torrance & García, 2008; Torrance, Fidalgo & García, 2007)

Method

The sample consisted of 50 students, enrolled in the 5th and 6th grade (10-12 years old). 26 of them formed the experimental group and 25 formed the control group. These were distributed over four different classes within two similar schools.

In the experimental group the students' mothers (all the familiar participants were women and mothers) participated in a specific program to support children with writing homework by providing them with models of writing composition processes. The mothers' program, implemented by an expert researcher, consists of seven sessions, carried out twice a month, to coincide with the teachers' suggested writing homework. The objective of this program was that mothers (1) learn different strategies for planning, editing and revision of writing using different methods (exposure of content by the instructor accompanied by pictures or graphic organizers, mnemonic devices, role-playing, working in pairs of mothers), and (2) learn techniques (cognitive modeling, thinking aloud, working collaboratively with children, providing feedback and procedural support) to teach the writing strategies to their children with them.

In the control group, the mothers, interested in the study but without possibility of assisting the training program, received information to help children with writing homework.

All children received the same number of homework tasks.

At the same intervals, pre-post and follow-up, the two groups of students were assessed. We used individual writing practice of the genre that was taught (compare-contrast) and an argumentative essay as generalization measure.

Measures of the written product, including text based measures (productivity, coherence, etc.), and reader based measures (structure, coherence, overall quality) were employed. The writing process measures included time delivered in planning, drafting and revision processes, through on-line records (Writing Log).

Results

The preliminary results suggest that students from the experimental group improved their writing compositions more than control group, and maintained these improvements over time. The effect can be generalized to other texts. The study demonstrate that the mothers, if they receive specific training, can contribute to the students' successful acquisition of the writing competence, as has been demonstrated in reading (Persampieri, Gortmaker, Daly, Sheridan, & McCurdy, 2006).

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References

- Fidalgo, R., Torrance, M., & García, J. N. (2008). The long term effects of strategy-focussed writing instruction for grade six students. *Contemporary Educational Psychology*, 33, 672-693.
- Persampieri, M., Gortmaker, V., Daly, E. J., Sheridan, S. M., & McCurdy, M. (2006). Promoting parent use of empirically supported reading interventions: Two experimental investigations of child outcomes. *Behavioral Interventions*, 21, 31-57.
- Reyes, I., Alexandra, D., & Azuara, P. (2007). Las prácticas de lectoescritura en los hogares de inmigrantes mexicanos. *Cultura y Educación*, 19 (4), 395-407.
- Robledo, P., García, J.N., & Díez, C (2009). The role of parents implication in teaching writing in relation to writing products in students with and without learning disabilities. 31st International Conference on Learning Disabilities, October 2nd & 3rd, Dallas, TX: Council for Learning Disabilities (CLD).
- Romero, S., Arias, M., & Chavarría, M.M. (2007). Identificación de prácticas relacionadas con el lenguaje, la lectura y la escritura en familias costarricenses. *Actualidades Investigativas en Educación*, 7 (3), 1-15.
- Torrance, M., Fidalgo, R., & García, J. N. (2007). The teachability and effectiveness of strategies for cognitive self-regulation in sixth grade writers. *Learning and Instruction*. 17(3), 265-285.

SYMPOSIUM

The relationship between learning conceptions and approaches to learning

Chairperson: Carol Evans, University of Exeter, United Kingdom

Organiser: Carol Evans, University of Exeter, United Kingdom

Jan Vermunt, Utrecht University, Netherlands

Discussant: Sari Lindblom-Ylänne, University of Helsinki, Finland

The aim of this symposium is to enhance knowledge and understanding of the role of students' and teachers' conceptions of learning and teaching in affecting their approaches to learning and teaching within higher education environments. Discussion of the implications for enhancing student and teacher learning will be a focus of the symposium. Interventions aimed at promoting deeper approaches to learning frequently report unintended effects with learners adopting more surface approaches to learning (Balasooriya et al., 2009; Papinczak, 2008). As articulated by Gijbels et al. (2009, 50) "investigating complex learning in new learning environments in higher education remains a challenge for future research." Advances in styles research are highly relevant to this context. Developments within the styles research field stress the need for coherent theory building; methodological development and enhanced links with pedagogy (Rayner & Cools, 2010; Evans et al., 2010; Kozhevnikov, 2010). This symposium represents a response to this call by aiming to consolidate and enhance understanding of the nature of the interaction between conceptions of learning and approaches to learning through a focus on cross-sectional and longitudinal studies to explore the nature of such relationships including notions of stability and change. In addition, links to other individual differences will be identified in an attempt to cohere understandings of how these concepts are applicable to differing

contexts. Consolidation of existing knowledge and development of new concepts to inform learning are discussed so as to inform practice along with identifying future collaborative directions for research within this area.

Stability and variation in concepts describing learning for understanding in higher education

Noel Entwistle, The University of Edinburgh, United Kingdom; Velda McCune, University of Glasgow, United Kingdom

This paper uses conceptual analyses of related empirical studies that have a common focus on learning for understanding, although using contrasting concepts. This methodology is best described as a focused, integrative literature review of carefully chosen related studies, leading to a conceptual analysis of the findings. The intention would be to pool related analyses in order to develop clearer perspectives on the relationship between broader, more stable student characteristics and concepts describing narrower and more variable aspects of learning, such that the nature of the underlying capabilities becomes clearer. In this way, the analyses would make an important contribution to theory in the field of learning for understanding in higher education. Conclusions from this review could be used to guide future research in this area in which theoretical developments are tied in closely to pedagogical innovations. Considering the interplay between stability and change in student learning will help to draw out pedagogical implications for promoting students' development as learners, and that will be the main focus of the presentation for the symposium.

Aims

The paper explores the value in carrying out conceptual analyses of a set of related empirical studies that have a common focus on describing high quality learning at university level, although using contrasting concepts. The main aim is to investigate the relationships between broad, relatively stable and narrow, more context dependent concepts describing aspects of student learning, as a way of exploring the theoretical and pedagogical implications of these contrasting conceptualisations.

Methodology

The first analysis focuses on a group of cross sectional studies selected to provide a breadth of perspectives on concepts describing learning for understanding in higher education. The review would include studies by Perry (1970), Säljö (1979), Vermunt et al., (2001, 2007), Perkins & Tishman (2001), Fyrenious et al. (2007), Entwistle & McCune (2009), Richardson (2010, in press) and Vermunt & Vermetten (2004). These studies were all based on samples of university students, using interviews and/or inventories and broad and/or narrow concepts showing elements of stability and variation, to investigate related ways of describing aspects of student learning and studying. The analysis looks at the pattern of relationships obtained across these studies, and also at evidence from student interviews about the nature of the concepts describing high level academic functioning.

Differences in academic functioning within these studies are described, firstly, in terms of the relatively stable concepts of dispositions to understand and conceptions of knowledge and learning. The more variable concepts include approaches to learning and studying and learning patterns. The second analysis looks more closely at the issue of stability and change in students' learning. This analysis draws on longitudinal studies relating to learning for understanding in higher education, such as those conducted by Baxter Magolda (2009), Hofer and Pintrich (2007), McCune (2000), Neiminen et al. (2004) and Vermetten et al. (1999). In order to shed greater light on the interplay between stability and change in students' learning in higher education, the second analysis also considers how learners' trajectories (Wenger, 1998) can shape their perspectives on learning for understanding in higher education. Learners' trajectories are important aspects of their identities as learners, which describe their perspectives on where they have been and the direction in which they are moving, in relation to particular communities of practice. A trajectory that takes a student into closer engagement with a community of practice can support a stronger commitment to learning for understanding in the long term (McCune, 2009).

Findings

Based on previously empirical investigations, dispositions are seen in terms of ability, intentions to understand, and awareness of context. The more sophisticated conceptions of learning, as well as learning patterns, show a similar pattern of awareness of the purpose and possibilities involved in studying, with empirical relationships linking them to approaches to learning and cognitive processes that focus on meaning and understanding. The disposition to understand for oneself, which is a newly introduced concept, brings together existing learning strategies that facilitate understanding, the strong intention to understand, and the awareness of opportunities both to develop understanding further and to use existing understanding productively in meeting new situations or problems. Such an interwoven combination of abilities, motivation, and awareness represents a set of necessary conditions for high quality learning outcomes.

The attributes reviewed in this paper are affected, to differing extents, by students' experiences of the teaching-learning environments, but there was also evidence of individual differences in the extent of that contextual influence. Where an individual is already 'reading the academic game' confidently and effectively, as shown through their responses in inventories and interviews, there is, as expected, less likelihood of change as a result of subsequent teaching seeking to encourage that way of thinking. The implications of this conclusion are considered in relation to aspects of the relationships between, stable and, variable conceptualizations of learning for understanding.

Theoretical and educational significance

Currently, there is a recurring debate about the extent of stability in learning for understanding, where learning is also understood as a situated endeavour. A clearer understanding of the implications of relative stability and variability for student learning and university teaching is needed. Carrying out focused conceptual analyses of empirical findings into similar concepts describing high quality student learning helps to clarify the nature of those concepts. This approach allows a pooling of related analyses that clarifies the nature of the contributory concepts, while having a clearer idea of the relationship between broader, more stable student characteristics and the narrower and more variable ones helps to make pedagogical implications clearer. This approach can then be used to guide future research in this area in which theoretical developments are tied in closely to pedagogical innovations.

Indicative references

- Entwistle, N. J., & McCune, V. (2009). The disposition to understand for oneself at university and beyond: learning processes, the will to learn and sensitivity to context. In L-F. Zang & R. J. Sternberg (Eds.), *Perspectives on the nature of intellectual styles* (pp. 29-62). New York: Springer.
- Fyrenius, A., Wirell, S., & Siléên, C. (2007). Student approaches to achieving understanding – approaches to learning revisited. *Studies in Higher Education*, 32, 149-165.
- McCune, V. (2009). Final year biosciences students' willingness to engage: Teaching-learning environments, authentic learning experiences and identities. *Studies in Higher Education*, 34, 3, 347-361.
- Perkins, D. N., & Tishman, S. (2001). Dispositional aspects of intelligence. In J. M. Collis & S. Messick (Eds.), *Intelligence and personality* (pp. 233-258). Mahwah, NJ: Lawrence Erlbaum.
- Vermetten, Y.J., Lodewijks, H.G., & Vermunt, J. (1999). Consistency and variability of learning strategies in different university courses. *Higher Education*, 37, 1–21.
- Vermunt, J., & Vermetten, Y.J. (2004) Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review*, 16, 359-384.

Student teachers' learning orientations in school-based teacher education programmes

Maaiké Endedijk, Utrecht University, Netherlands; Vincent Donche, University of Antwerp, Belgium

One of the key tasks of pre-service teacher education nowadays is to support student teachers to develop a learning orientation necessary for lifelong learning. In order to design teacher education programmes in a way to stimulate this development in student teachers, scientific knowledge is needed about the influencing personal and contextual factors, as well as how these learning orientations develop over time. The main research question central to this study is: How are student teachers' learning orientations related to various personal and contextual variables and how do these orientations develop over time? Across six different studies, student teachers' learning orientations have been measured with the Inventory Learning to Teach Process (ILTP) (Oosterheert, 2001). In these ILTP-studies measurements of several personal, contextual and time-related variables took place. Drawing on the results of these studies as well as presenting cross-validated research results, we aim to present in this paper an emerging framework on student teachers' learning orientations. In particular, the study will present a state of the art regarding the present ILTP-studies investigating student teachers' learning orientations and how they are related to contextual, personal and time related variables in a work-based learning environment. This model can be used as a basis for new studies, as well as for teacher education programmes to design their curriculum in way to stimulate the development of beginning teachers in view of lifelong learning.

Aims

One of the key tasks of pre-service teacher education nowadays is to support student teachers to develop a learning orientation necessary for lifelong learning (Hagger et al., 2008). In order to design teacher education programmes in a way to stimulate this development in student teachers, scientific knowledge is needed about the influencing personal and contextual factors, as well as how these learning orientations develop over time. A vast body of research into learning styles, learning approaches, and learning orientations has been carried out in the context of higher education contexts in which students learn in an academic setting. Studies have now shown that these characteristics are

influenced by several personal and contextual factors (Vermunt & Vermetten, 2004) and are variable across time (Donche, Coertjens, & Van Petegem, 2010). Just as in the case of research into learning approaches in student learning, Oosterheert (2001), using qualitative and quantitative research, established a number of consistent relationships between different learning approach components within a work-related context of learning-to-teach during internships. Consistency in relationships is here regarded as different 'orientations' of learning to teach by way of analogy with the concepts of 'learning styles' or 'learning approaches'. Moving beyond the academic setting, this specific research on individual differences in learning to teach, makes a distinction between open meaning-oriented; closed meaning-oriented; closed reproduction-oriented; and survival-oriented learners (Oosterheert, 2001).

In the last five years, multiple cross-sectional and longitudinal studies have been carried out using the Inventory Learning to Teach (ILTP) as a valid way to assess these differences in learning during internship. In these ILTP-studies measurements of several personal, contextual and time-related variables took place. Drawing on the results of these studies as well as presenting cross-validated research results, we aim to present in this paper an emerging framework on student teachers' learning orientations. In particular, the study will present a state of the art regarding the present ILTP-studies investigating student teachers' learning orientations and how they are related to personal, contextual and time-related variables in a work-based learning environment.

The main research question central in this study is: How are student teachers' learning orientations related to various personal and contextual variables and how do these orientations develop over time?

Methodology

Across six different studies, student teachers' learning orientations have been measured with the ILTP (Oosterheert, 2001). The ILTP questionnaire consists of 10 scales, including learning conceptions, learning and regulation activities and emotion regulation. Besides assessing learning orientations, data is collected throughout these studies about on the one hand, personal variables such as age, teaching experience, gender, teaching efficacy, self-determination and on the other hand, contextual variables such as type of teacher education programme, perception of school learning environment and university learning environment, and time investment. For these variables, scales were developed or adapted versions of existing scales were used.

Different cross-sectional and longitudinal datasets are included in this study, such as a longitudinal dataset with three measurements occasions on 81 student teachers in a one-year university based teacher education programme, a dataset with a two-wave design including 253 third-year student teachers from a pre-service teacher education institute, and several cross-sectional datasets from different teacher education programmes. To cross-validate results from separate studies, new data analyses on several data sets will be carried out. Longitudinal multilevel analysis will be carried out for discovering changes over time, multivariate analyses to find relations between groups of students and structural equation modelling to find relationships between multiple background variables and scale scores.

Findings

Across all available data sets the postulated four learning orientations within the model of Oosterheert were not always found. In particular the open meaning oriented way of learning could not always be identified as a distinct orientation. Several personal variables turned out to be related to the learning orientations. Older student teachers were more often found to have a meaning-oriented learning orientations which was also related to their level of experience as a teacher. Different learning orientations were related to differences in motivation. For instance, survival oriented student teachers were found to be the most a-motivated and least autonomously motivated learners. Results based upon structural equation modelling show that 25% of the variance of teaching efficacy can be explained by specific components of learning orientations, in particular emotion regulation. The contextual variables showed that student teachers who are following a teacher education programme with more responsibility for teaching and more teaching practice have more often a meaning-oriented way of learning. However, their learning orientations are more stable than their peers who are having less teaching tasks.

Looking at changes over time, in both longitudinal data sets, it appears that, overall, student teachers' orientations to learning to teach change during time in the direction of more meaning-oriented learning. Changes within learning orientations were also present across different measurement times. In addition also one third of the student teachers in one data set changed in the direction of independent meaning-oriented learning. It appeared that changes with respect to student teacher learning are found predominantly among survival-oriented students and to a lesser extent among students who exhibit closed reproduction-oriented and closed meaning-oriented orientations of learning to teach.

Theoretical and educational significance

Orientations to learning to teach are found to be subject to a relative degree of change. Especially survival oriented student teachers appear to have undergone a greater degree of change after the long teaching practice placement. Also, student teachers with more teaching experience seem to more often have a meaning oriented way of learning. Regarding curriculum development, the results suggest that introducing longer teaching practice placements and related activities during teacher education degree courses, may be a lever for motioning survival oriented learners to change their orientation to learning to teach. The emerging framework that will be presented from these analyses, will provide an intricate view on how learning orientations, time-related factors and personal and contextual variables are interrelated. It will also provide more insights for practice and future research into the factors that can stimulate the development of student teachers' learning orientations.

Approaches to studying in deaf and hard-of-hearing students

John Richardson, The Open University, United Kingdom

This contribution to the symposium reviews recent research on the influences on approaches to studying in deaf and hard-of-hearing (DHH) students in institutions of higher education. DHH students who use sign language are more likely to exhibit a reproducing orientation in their studies, apparently because they are more likely to hold a reproductive conception of learning. Teachers on separate programmes for DHH students are more likely than teachers on mainstream programmes to adopt a student-focused approach to teaching that is aimed at bringing about conceptual change in their students. Sign-language interpreters often hold a reproductive conception of interpreting and tend to adopt a literal approach to interpreting. This in turn promotes a reproductive conception of learning among deaf students who use sign language. However, interpreters who hold a reconstructive conception of interpreting are likely to adopt a free approach to interpreting that promotes a reconstructive conception of learning among deaf students who use sign language.

The role of the learner

Hearing students in higher education adopt different approaches to their studies: some adopt an approach oriented towards the meaning of their course materials; others adopt an approach oriented towards being able to reproduce the course materials for the purposes of assessment (Laurillard, 1979; Marton, 1976). These are influenced by the students' perceptions of their academic environment, such that students who have more positive perceptions of the quality of their courses are more likely to adopt desirable approaches to studying (Richardson, 2005). However, they are also influenced by their underlying conceptions of learning: students who hold a reconstructive conception of learning are more likely to adopt a meaning orientation, but those who hold a reproductive conception of learning are likely to adopt a reproducing orientation (Van Rossum & Schenk, 1984).

Some deaf and hard-of-hearing (DHH) students attend separate programmes or institutions that are specifically intended for deaf students, but most DHH students attend mainstream institutions along with their hearing peers. Very few studies have concerned the approaches, conceptions, and perceptions of deaf and hard-of-hearing (DHH) students. Nevertheless, questionnaire surveys in both the United States and the United Kingdom have found that DHH students in mainstream institutions exhibit a meaning orientation and a reproducing orientation to their studies, but that in comparison with hearing students they are more likely to exhibit a reproducing orientation (Richardson et al., 2000, 2004). The difference is more pronounced in DHH students who use sign language. This is not because they perceive their courses as lower in academic quality. On the contrary, they may rate their courses more highly because of the additional forms of learning support that they receive in their studies. When variations in the students' perceptions of their academic context are statistically controlled, DHH students still tend to be more likely than are hearing students to adopt a reproducing orientation (Richardson, 2008). This suggests that DHH students who use sign language are more likely to hold a reproductive conception of learning and are less likely to hold a reconstructive conception of learning than are hearing students.

The role of the teacher

Hearing teachers in higher education adopt different approaches to teaching: some adopt a teacher-focused approach aimed at the transmission of information, but others adopt a student-focused approach aimed at bringing about conceptual change in their students (Trigwell & Prosser, 1993). These approaches to teaching are influenced by the teachers' perceptions of their teaching context, such that teachers who feel that their departments value teaching, that their class sizes are not too large, and that they have control over their teaching are more likely to adopt a student-focused approach and are less likely to adopt a teacher-focused approach (Prosser & Trigwell, 1997). Nevertheless, teachers' approaches to teaching are also influenced by their underlying conceptions of teaching. Teachers who hold a reproductive conception of teaching are likely to adopt a teacher-focused approach to teaching that promotes a reproductive conception of learning in their students. Teachers who hold a reconstructive conception

of teaching are likely to adopt a student-focused approach to teaching that promotes a reconstructive conception of learning in their students (Trigwell & Prosser, 1996).

Most of the research that has been carried out to date on approaches to teaching has involved hearing teachers teaching hearing students in mainstream educational institutions. Marschark et al. (in press) used a questionnaire survey to compare approaches to teaching among teachers on either mainstream or separate programmes within the same institution in the United States. They found that teachers on separate programmes were more likely than teachers on mainstream programmes to report seeking to promote conceptual change in their students and adopting more student-focused approaches to teaching. Marschark et al. inferred that the teachers experienced in teaching separate programmes were better able to recognise the strengths and needs of DHH students.

The role of the sign-language interpreter

Teachers on separate programmes are usually able to communicate with students using both sign language and spoken language. In mainstream programmes, however, the relationship between teachers and deaf students who use sign language is mediated by sign-language interpreters (Richardson et al., 2010). The latter adopt different approaches to interpreting: some use a literal approach, but others use a free approach. Observational studies have shown that these approaches are influenced by the interpreting context: in particular, some interpreters adapt their approach to the properties of the material being interpreted (Napier, 2002). Nevertheless, interpreters' approaches to interpreting also seem to be influenced by their underlying conceptions of interpreting: some hold a reproductive conception based on the idea that the interpreter is a passive, neutral communication link or conduit, whereas others hold a reconstructive conception based on the idea that the interpreter is an active, engaged participant (Roy, 1993). The training and assessment of sign-language interpreters have traditionally promoted a reproductive conception, but it has been argued that the demands of real-life interpreting (including educational interpreting) are accommodated better by a reconstructive conception (Turner & Harrington, 2001). An interpreter who holds a reproductive conception of interpreting is likely to adopt a literal approach to interpreting that in turn promotes a reproducing orientation among deaf students who use sign language. This may undermine the efforts of teachers who adopt a student-focused approach to teaching aimed at bringing about conceptual change in their students. If these students are repeatedly exposed to a literal approach to interpreting, it is also likely that they will persist in holding a reproductive conception of learning. An interpreter who holds a reconstructive conception of interpreting is likely to adopt a free approach to interpreting, to be an active participant in the classroom, and to take into account the students' needs and expectations. This may promote a meaning orientation among deaf students who prefer to communicate using sign language and encourage them to acquire a reconstructive conception of learning (Richardson, 2008).

SYMPOSIUM

Social and individual aspects of regulation in collaborative group learning activities

Chairperson: Simone Volet, Murdoch University, Australia

Organiser: Simone Volet, Murdoch University, Australia

Deborah Pino-Pasternak, , Australia

Discussant: Valeska Grau, Pontificia Universidad Catolica deChile, Chile

Research concerning the nature and significance of social and individual aspects of regulation in collaborative group learning activities is growing. This development is consistent with an increasing focus on pedagogical practices based on social constructivist models of learning present in all sectors of education. Reaching a better understanding of the role played by individual and social regulatory processes on the quality collaborative learning is therefore critical. The purpose of this symposium is to bring together researchers who are grappling conceptually, methodologically and empirically with these issues, and more specifically with distinctions between socially-based metacognitive regulation, productive coconstruction of knowledge, and the quality of interactional exchanges. The role of different task variables such as difficulty level, mode of interaction, and task goals are also explored. Pino-Pasternak and Whitebread investigate the nature of individual and social regulation in young children's problem-solving, and the extent to which it relates to the quality of dialogue and task understanding. Iiskala et al. explore the extent to which metacognition appears as socially-shared within school age dyads and groups. Finally, Khosa and Volet examine the effectiveness of an intervention aimed at enhancing university students' engagement in productive metacognitive coregulation, coconstruction of complex knowledge and collaborative learning. The discussant, Valeska Grau, expert in the analysis

of group regulation, will comment on common conceptual and methodological threads and will highlight future directions in the area.

Metacognitive regulation as socially shared in collaborative processes

Tuiki Hannele Iiskala, University of Turku, Finland; Marja Vauras, University of Turku, Finland; Erno Lehtinen, University of Turku, Finland; Riitta Kinnunen, University of Turku, Finland

This paper aims to discuss social aspects of metacognitive regulation. The concept of 'socially-shared metacognition' (Iiskala et al., 2004, 2010) is used to refer to the consensual monitoring and regulation of joint cognitive processes in demanding collaborative problem-solving. The research question is as follows: Does metacognition appear as socially shared within dyads' face-to-face and small groups' virtual collaboration? STUDY 1 involves four high-achieving dyads (4th grade, 10 year olds). The dyads worked face-to-face solving 251 problems of three difficulty levels. Lessons were videotaped, and verbal/nonverbal behaviours were transcribed as turns. STUDY 2 involves 6 small groups (6th grade, 12 year olds, $n = 25$). The small groups worked in an asynchronous CSCL environment during 22 lessons, participating in research-like processes of inquiry (Hakkarainen, 2002). In both studies, an episode (set of turns/notes), was used as a unit of analysis. According to results, socially-shared metacognition within both groupings was found. Examples of typical episodes and quantitative outcomes are presented. In STUDY 1, episodes were found in 75% problems. The tests indicated that episodes appeared significantly most often in the most difficult problems. In STUDY 2, preliminary results show that emergence of episodes varies according the phase of the process. Comparison of socially-shared metacognition between two different contexts is discussed.

Introduction and aim

Although the social nature of learning is emphasized to gain a more profound understanding of learning (e.g., Lehtinen, 2003; Resnick et al., 1991; Salomon & Perkins, 1997), social aspects of metacognitive, regulatory processes are yet rarely looked from social, interpersonal perspective (Vauras et al., 2008; Volet et al., 2009b). We have argued that both the self and social forms of regulation are needed in order to understand regulation of actual collaborative learning processes, and that inter-individual metacognition is not equivalent to individual metacognition, and cannot be reduced to the group members' individual characteristics or processes, and, thus, should be conceptualized differently (Iiskala et al., in press; Volet et al., 2009b). Only scarce empirical evidence exists (cf., Iiskala et al., 2004, Iiskala et al., in press; Volet et al., 2009a) on how the social forms of regulation play out in real-life collaborative group learning activities, and how the individual and social regulation interact. This also means that the study of metacognitive regulation in collaborative learning is characterized by only emerging operationalization and methods for data analysis. This paper aims to discuss the role of social aspects of metacognitive regulation on the basis of evidence from two studies, one on dyads' face-to-face and the other on small groups' virtual collaboration between young, primary school pupils'. The concept of 'socially-shared metacognition' (Iiskala et al., 2004; Iiskala et al., in press; cf., Molenaar et al., 2010; Whitebread et al., 2007) is used to refer to the consensual monitoring and regulation of joint cognitive processes in demanding collaborative problem-solving situations (Iiskala et al., 2004; Iiskala et al., in press; Vauras et al., 2003). We argue that in a genuine collaborative learning process the participants' regulatory activities are shared and reciprocal, depending on each other; in this case, collaboration referring to a certain degree to symmetry, shared goal and low division of labor in the interaction (see, Dillenbourg, 1999). The questions raised in this paper are as follows: Does metacognition appear as socially shared within dyads' and small groups' collaboration, and does it appear similarly in face-to-face and virtual collaboration?

Method

STUDY 1 involves four high-achieving dyads, altogether eight (4th grade, 10-year-old) pupils, ranking in the top 11% of their schoolmates ($n = 393$) in mathematical word-problem solving and reading comprehension. The dyads worked face-to-face in the computer-supported, game-format learning environment, and solved altogether 251 problems of three difficulty levels during 56 (45 min) lessons. Working sessions were videotaped, and verbal and nonverbal behaviors were transcribed as turns ($N = 14\,675$). STUDY 2 involves 6 small groups consisting of four to five (6th grade, 12-year-old) pupils ($n = 25$). The small groups worked in an asynchronous CSCL environment during 22 (45 min) lessons, participating in research-like processes of inquiry (see, Hakkarainen, 2003; Scardamalia & Bereiter, 1996), and solving complex open-ended problems concerning the universe. Working was partly scripted and divided into overlapping phases as follows: creating the context and setting up research questions, making hypotheses, planning study methods, studying deepening knowledge, and publishing findings. Data revealed pupils' written productions, i.e. notes ($N = 4771$). In both studies, an episode, i.e. a set of turns/notes, was used as a unit of analysis. Hence, metacognition was not coded via individuals' single actions but a dyad or a small group was treated as a system, in which individuals' regulatory actions were inseparably interrelated, i.e. socially shared.

In STUDY 1, the inter-coder agreement was measured in 30% ($n = 76$) of the problems, where the second coder was asked to trace the episodes of socially-shared metacognition. The coders reached 86% ($k = .63$) agreement. In STUDY 2, the inter-coder agreement has not been measured yet. In all respects, ethical code for scientific research has been followed, and ethical aspects of original research plan were accepted according to the guidelines of the ethical committee of the University of Turku. Results and conclusions In this paper, we first present qualitative results from both studies by giving examples of typical socially-shared metacognition episodes. The qualitative analysis is based on the application of an interaction flowchart analysis (Sfard & Kieran, 2001), specifically, preoccupational analysis, which deals with how interacting participants move between different channels of communication (individual, interpersonal) and different levels (cognitive, metacognitive). Second, quantitative outcomes are presented.

In STUDY 1, 385 socially-shared metacognition episodes in 187 (75%) problems out of all the 251 problems were found. The number of episodes per problem at three difficulty levels was compared. The Kruskal-Wallis test indicated a significant effect of difficulty level, $\chi^2(2, N = 251) = 47.37, p < .001$. To conclude, the results suggest that it is possible to find socially-shared metacognition within the dyads' face-to-face and small groups' virtual collaborative learning processes. Episode analyses showed that metacognitive regulation fluctuated between individual cognitive and metacognitive processes and shared metacognitive regulation. However, the emergence of episodes seems to vary according the level of difficulty (e.g., apparent most likely in difficult problems) and the phase of process. Further, more in-depth comparison of socially-shared metacognition between the two different contexts is discussed. The significance of the studies is discussed in terms of impact on current theories and methods in metacognition research are highlighted. Particularly, we discuss how empirical evidence from these studies helps us to conceptualize and relate individual and social regulation in different real-life collaborative group learning activities in the case of young learners.

Fostering metacognitive coregulation and co-construction of knowledge in collaborative learning

Deep Khosa, Murdoch University, Australia; Simone Volet, Murdoch University, Australia

Interest in understanding the significance of social regulatory processes taking place in real-time, student-led collaborative learning activities has gained substantial momentum in recent years. There is growing evidence that engagement in genuinely shared metacognitive regulatory processes is associated with effective collaborative learning processes. Empirical studies with different age groups have revealed that although such productive processes can be found across a range of collaborative learning activities, most students do not spontaneously engage in high-level coregulation of their content learning, and therefore miss out on unique opportunities for learning from each other. Gaining further insight into this phenomenon while trying to address the educational challenge, naturally calls for design experiments. This paper presents the design and findings of a field-based intervention aimed at fostering high-achieving, highly motivated university students' engagement in metacognitive coregulation adapted to their learning content and activity, with a view to enhance their co-construction of complex knowledge and valuable learning from each other. Data involves video-footage of twelve groups' interactional processes while working on a clinical case in two meetings, one informal, the second involving a cognitive scaffold, with follow-up interviews. Data analyses also explore the added value of a cognitively scaffolded activity in fostering high-level metacognitive coregulation, and the nature and relationship of metacognitive coregulation to co-construction of knowledge.

Introduction

Educational psychologists' interest in understanding the significance of the social regulatory processes taking place in real-time, student-led collaborative learning activity has gained substantial momentum in recent years (Iiskala, Vauras, Lehtinen & Salonen, in press; Järvelä & Järvenoja, in press; Rogat & Linnenbrick, 2010; Volet, Vauras & Salonen, 2009). This development parallels the growing importance, given to pedagogical practices grounded in social constructivist models of learning, such as group projects, collaborative learning tasks, and case-based or problem-based learning. Yet, empirical studies using microgenetic designs show that even high achieving students may not spontaneously engage in high-level shared regulation of learning (Salonen, Vauras & Efklides, 2005; Summers & Volet, 2010) unless instructed to do so (Khosa & Volet, 2010).

To date, there is a paucity of intervention research investigating how to promote genuinely shared metacognition and high-level co-construction of knowledge embedded in regular instruction. Gaining further insight into this phenomenon while trying to address the educational challenge, naturally calls for design experiments. This paper presents a field-based intervention aimed at enhancing high-achieving, highly motivated university students' engagement in productive metacognitive coregulation, co-construction of complex knowledge and collaborative learning from each other.

Aims

The aims of the study were to determine: a) the effectiveness of a metacognitive intervention on groups' engagement in high-level shared regulation of learning and co-construction of complex knowledge b) the additional impact of co-constructing a cognitive representation of content knowledge; c) how effective co-construction of knowledge is supported by productive metacognitive coregulation and specific individual and group processes.

Participants were 12 groups of 5-6 high achieving veterinary science students (n= 69), required as an integral part of their regular study in physiology, to learn from an authentic clinical case (in own time, over seven weeks, different case per group). Each group was required to generate their own learning objectives, undertake background research on selected parts of the case, and present their collective findings in class at the end. Observational data from a prior cohort (control group in this study) had displayed limited spontaneous engagement in the target behaviours, students spending most of their time managing the task (Summers & Volet, 2010).

Intervention and embedded data collection process

The intervention comprised three consecutive components, administered by a veterinarian-researcher not teaching in the unit: 1. Metacognitive instruction; 2. Stimulated metacognitive reflection; 3. Customised concept map as cognitive representational scaffold. Multiple data sources were collected. Only data reported in the presentation is described.

1. Metacognitive instruction aimed at fostering high-level metacognitive coregulation and co-construction of knowledge of the clinical case. A set of selected interactional strategies and stem-questions (inspired by King, 1998 customised to the veterinary task) were introduced, commented and supported by two short films: one featuring student-actors enacting the strategies and questions (to show what effective collaborative learning can "look like"), and one featuring professional collaborative learning in a real veterinary clinical setting (to stress relevance). Short- and long-term benefits of effective peer learning were emphasised.

Data: (a) Video-footage of each group's first informal meeting (ten days into the project); (b) audio-recorded group interview (a few days after the meeting).

2. Stimulated metacognitive reflection aimed at providing customised, consolidation of the metacognitive instruction. It was elicited during (b) on the basis of a 2-minute segment of the group's best content-related interactions, that is, featured metacognitive coregulation and co-construction of knowledge.

3. Customised concept map or cognitive representational scaffold aimed at providing a visual support for enhancing metacognitive regulation and co-construction of shared knowledge of the case. Support material comprised pre-prepared cards of key concepts, a large board, markers for connections, a set of instructions and a sample concept map.

Data: (c) Video-footage of each group's construction of the cognitive representation of their clinical case (customised concept map); (d) audio-recorded group interview (immediately after) eliciting metacognitive reflections on the concept map learning experience.

Data analysis

The group is the main unit of analysis and video footages provide the primary data sources. Selected individual level complement group level analyses. To address the first research question, the analytical framework of Volet, Summers & Thurman (2009) is used. The ratio of content- to management-related group interactions, and proportion of time spent on high-level co-regulation (as conceptualised by Volet et al) are compared across intervention and control groups. To address the second research aim, data analyses involve within-groups' comparisons of high-level co-regulation episodes across activities (spontaneous shared understanding in informal meeting; co-construction of customised concept map). The third research aim involves within groups and across activities' analyses of content-related interactional processes and overall style, with a view to establishing the extent to which cognitive representational scaffolding might create stronger opportunities for metacognitive coregulation - with possible variations in the take-up of opportunities across groups (Gresalfi, 2004). Episodes of metacognitive coregulation and co-construction of knowledge also need to be disentangled in order to determine how effective co-construction of understanding is supported by productive metacognitive coregulation, separately for each activity. Individual level analyses of patterns of participation across activities within groups are examined in relation to group analyses, and combined with metacognitive reflections from interviews. Preliminary findings suggest a higher proportion of in-depth content discussion in the customised concept map activities compared to the informal meetings relying on spontaneous shared understanding. A different style of interactions also emerges. While episodes of metacognitive coregulation in informal meetings display formal, turn-taking approaches where students respectfully allow each other to present their research findings, the customised concept map construction activities exhibit rapid interjections

of questions and answers, elaborative fact clarification and supportive or dismissive discussions of physiological principles related to the case. Co-constructing a customised concept map appears to enhance metacognitive coregulation, increase members' participation and generally improve the collective effort to share understanding, which was consistent with students' metacognitive reflections. This research provides insight into how university students' learning and understanding of complex knowledge can be enhanced in collaborative learning groups.

Young children's regulation during group-work: Links with dialogue and understanding

Deborah Pino-Pasternak, , Australia; David Whitebread, University of Cambridge, United Kingdom

Though the value of transactional and mutually regulated processes during groupwork has been widely acknowledged (Iiskala et al., 2004, 2010; Volet et al., 2009) fine distinctions on what constitutes co-regulatory processes versus collaborative processes of co-construction of understanding are yet to be clearly established. Moreover, the majority of empirical work concerning this issue has been carried out with older students. The aims of this paper are therefore to explore the extent to which young children engage in individual and social forms of regulation when working in groups and the extent to which these regulatory processes relate to the groups' quality of dialogue and understanding. The dynamics of 4 groups engaged in 4 problem-solving activities is analysed looking at individual and social forms of regulation as well as aspects of the activity targeted by regulatory actions. These regulatory episodes are explored in relation to productive (exploratory) and less productive (disputational & cumulative) forms of dialogue (Mercer, 2000). Based on prior research, it is hypothesised that these groups will engage in different forms of regulation (individual & social) and that regulation will be directed towards different task-related aspects (understanding, task procedures, and social interaction). We also hypothesise that higher incidences of social forms of regulation, particularly those targeting task understanding, will be positively associated with higher incidences of exploratory talk within the groups. Evidence supporting these hypotheses is presented.

Research concerning the quality of students' group-work has identified successful collaborative processes as those characterised by the presence of mutual regulatory exchanges between members that attempt to achieve a shared understanding of the goals and contents of the task at hand (King, 1998; Goos et al., 2002; Volet et al., 2009). The value of these transactional and mutually regulated processes has been highlighted by researchers within the Self-Regulation literature (Iiskala et al., 2004; Vauras et al., 2003; Volet et al., 2009) as well as by those investigating forms of group dialogue and collaboration that lead to positive academic outcomes (Howe et al., 2007; Mercer & Littleton, 2007; Tolmie et al., 2010). However, fine distinctions between what constitutes co-regulatory processes versus collaborative processes of co-construction of understanding are yet to be clearly established. From a developmental perspective, the majority of this empirical work has been carried out with late primary, secondary school, or university students. We still lack an understanding of how these processes emerge earlier in development, and more importantly, what are the key characteristics of contexts that facilitate the emergence of these forms of interaction. The aims of this paper are therefore to explore the extent to which young children (5-6 year olds) are able to engage in individual and social forms of regulation when working in groups and the extent to which these regulatory processes relate to the quality of dialogue and understanding evidenced in the groups' exchanges. The study reported here examined the following research questions: (1) To what extent do young children engage in individual and social forms of regulation when working in small groups?, (2) Which aspects of the task do groups seem to regulate?, and (3) Which forms and aspects of regulation relate more closely to productive forms of dialogue between group members? The results presented in this paper are part of a larger study assessing the effectiveness of an intervention designed to enhance young children's regulation of learning, conceptual understanding, and productive forms of classroom dialogue. As part of this larger study, 6 Year 1 classes in the UK participated in 8 activities which encouraged children to collaboratively work in small groups (normally 3 participants) to jointly solve problems in the curriculum areas of Science and Arts/Music. Video recorded data for each one of these activities was collected for 2 target groups in each class (12 groups, n= 36, 96 group-work sessions). This paper will focus on the analysis of 4 of these groups (n=12, 6 boys & 6 girls) belonging to 2 of the intervention classes. These classes were selected as they constituted the richest examples in terms of the appropriation of the forms of dialogue and general principles fostered by the intervention. The selection of optimal classroom contexts was deemed as the most productive strategy to target the research questions and a particularly suitable one when exploring the early development of individual and social forms of regulation in young students.

Four intervention sessions were selected for the purposes of the analysis presented in this paper (Sessions 1, 4, 5 and 8). The underlying rationale for this selection was: (a) to address the chronological dimension of the intervention, and (b) to provide a representative selection of the different curriculum areas and types of activities. In addition to the video data, the dialogue of the 4 target groups was transcribed for each one of the selected sessions, leading to 16 transcribed episodes of group-work.

In order to capture individual as well as social aspects of regulation a multi-layered analytic strategy has been developed. In agreement with prior research (Molenaar et al., 2010), the first analytic layer codes individual turns in terms of their regulatory function (prior knowledge, planning, monitoring, control, & evaluation) or absence of it, leading to an exhaustive coding of all utterances and associated non-verbal actions present in the dialogue. Subsequently, these regulatory turns are categorised on the basis of the task-related aspects being targeted (i.e.: task-understanding, task-procedure, & social interaction). The presence of consecutive regulatory codes within the interaction is then explored, leading to the identification of social regulation episodes which, in turn, are categorised as other-regulation or shared-regulation on the basis of the direction and reciprocity of the regulatory utterances or actions (Iiskala et al., 2010). Episodes of other-regulation are characterised by uni-directionality (from one student to the others) and lower reciprocity, while episodes of shared-regulation are characterised by multi-directionality and high reciprocity. In order to explore relationships with the quality of dialogue Mercer's (2000) framework is used, identifying episodes of productive (exploratory) versus less productive (disputational & cumulative) forms of dialogue. Relationships between regulatory episodes and dialogue quality are explored quantitatively and qualitatively.

On the basis of prior research (Iiskala et al., 2010, Whitebread & Grau, in press), we hypothesise that these groups will engage in different forms of regulation (individual & social) and that regulation will be directed towards different task-related aspects (understanding, procedures, and social). We also hypothesise that higher incidences of social forms of regulation, and particularly those targeting task understanding, will be positively associated with higher incidences of exploratory forms of dialogue within the groups. Evidence supporting these hypotheses is presented. From a theoretical perspective, this paper attempts to shed further light on distinctions between social forms of regulation, dialogue, and the joint construction of task understanding during group work. In addition, it provides an indication as to how these processes might emerge in young children's development.

SYMPOSIUM

Students' reasoning about the past: from understanding towards improving

Chairperson: Carla Van Boxtel, University of Amsterdam, Netherlands

Organiser: Jannet van Drie, University of Amsterdam, Netherlands

Carla Van Boxtel, University of Amsterdam, Netherlands

Discussant: Carla Van Boxtel, University of Amsterdam, Netherlands

The aim of the symposium is to deepen our understanding of how students reason about history and how we can use this understanding to improve students' historical reasoning. Since the 1990s there has been an increased interest from researchers in the subject of historical thinking and reasoning. The majority of empirical studies analyses students' ways of reasoning about the past and the conceptions that underlie this reasoning. There is a growing interest in how students' ethnic, cultural and national identities affect their reasoning. There is also a growing amount of research focusing on teaching methods to enhance historical reasoning. This symposium brings together these different lines of research. The papers focus on students aged 16 to 19. In the first presentation we will look at students' thinking when confronted with conflicting interpretations of the past. What are students' ideas about why historical disagreement arises? The second presentation is about how students' ethnic identities influence their ascription of historical significance. What criteria do students employ when selecting significant events? The third presentation looks at the potential of a task that explicitly asks students to give their own opinion about and discuss the significance of historical persons and events. To what extent does such a task provoke and enhance historical reasoning? All papers will discuss implications for history education. The discussant will reflect on the contribution of the three different lines of research. How can we proceed from understanding towards improving students' historical reasoning?

A case study exploration of students' explanations for variation in historical interpretation

Arthur Chapman, Edge Hill University, United Kingdom

There is widespread agreement that history education should aim to help students engage with plural interpretations and accounts of the past, however, research suggests that understanding plural interpretations can present challenges for students and that educators need to consider students' preconceptions about historical knowing if they are to facilitate progression in understanding. Drawing on case study research this paper poses the question 'How do 16-19 year old English students explain variation in historical accounts and what conceptions of historical knowing underlie the explanations that students offer?' and proposes a typology of modes of explaining variation in historical accounts.

Twenty-four 16-19 year old students completed three written tasks over the course of one academic year and twelve students were also interviewed. Data are analysed qualitatively, through a process of inductive coding, and a model of five 'ideal typical' explanations for historical disagreement is posited. The assumptions about historical knowledge construction implied by each mode of explanation are explored. Whilst this paper's findings are consistent with, lend support to and further develop existing work they also demonstrate the importance of a focus on developing students' understandings of conceptual and hermeneutic aspects of historical interpretation.

There is widespread agreement that history education should aim to help students engage with plural interpretations and accounts of the past (von Borries, 2009). However, as an important body of research has shown (Ashby, Gordon & Lee, 2005; Lee & Shemilt, 2004; Maggioni & VanSledright, 2009), understanding plural interpretations can present challenges for students and educators need to consider students' preconceptions about historical knowing if they are to facilitate progression in understanding. Drawing on case study research (Chapman, 2001 and 2009) that set out to build on and extend existing English work modelling 7-14 students' understandings of historical accounts (Lee, 1997 and 2001) this paper poses the question 'How do 16-19 year old English students explain variation in historical accounts and what conceptions of historical knowing underlie the explanations that students offer?' and proposes a typology of modes of explaining variation in historical accounts. Although, as is inevitable in case study research, the findings of this paper cannot be generalised to a wider population, it is argued that the analytical tools it develops are suggestive and will have analytical value in helping educators model student thinking.

A written research instrument was developed, drawing on existing work (Lee, 1997 and 2001), piloted with seventy students in three institutions (Chapman 2001) and refined, extended and deployed in a case study of students in one institution (Chapman, 2009). Twenty-four 16-19 year old students, twelve in the first and twelve in the second year of their advanced level history studies, completed three written tasks over the course of one academic year. Each task presented a different historical controversy, in the form of paired texts in which two historians made differing claims about an historical topic. Students were asked the same questions in each task, designed to elicit data about the students' understandings of historical interpretations. Three tasks were used to explore the extent to which students' ideas could be considered stable or variable across a series of controversies raising conflicts of interpretation of different kinds. Twelve of the twenty-four students, six from each year, were also interviewed at the end of the academic year, using questions that mirrored the written task questions but that were general in nature, in order to explore students' thinking in greater depth.

Data analysis focused on the students' ideas about explaining why historical disagreements arise and students' underlying understandings of how historical accounts are constructed. Data was analysed qualitatively, through a process of inductive coding, and a model of five 'ideal typical' explanations for historical disagreement was posited on the basis of this analysis: explanation for variation in terms of (1) author background and beliefs, (2) archives consulted, (3) author bias and manipulation, (4) author interpretation and meaning construction and (5) author questioning and research focus. All task responses could be characterised as making reference to one or more of these explanatory moves and nineteen out of the twenty four students made reference to the same move or moves in two or more tasks. Patterns of opposition emerged also in the types of move that many students made: for example, whereas four students made reference to move (3) but not to move (4) in two or more tasks, three students made reference to move (4) but not to move (3) in two or more tasks.

The assumptions about historical knowledge construction implied by each mode of explanation were explored, through detailed discussion of individual students' responses to task questions, and ideas that may inhibit or facilitate progression in understanding were considered and explored. Key themes developed in the discussion include student ideas about evidence and, for example, the extent to which explanations for account variation in terms of author bias and manipulation depended upon testimonial conceptions of historical evidence. It was apparent also that although students who explained account variation in terms of author interpretation were often aware of the importance of processes of meaning construction in historical interpretation these students did not have a conceptual apparatus available to enable a coherent account of such processes. Whilst it will be argued that this paper's findings are consistent with, lend support to and further develop existing work on student understandings of historical accounts (Lee and Shemilt, 2004; Maggioni and VanSledright, 2009), it will also be argued that the data presented demonstrates the importance of a focus on developing students' understandings of conceptual and hermeneutic aspects of historical interpretation.

References

Ashby, R., Gordon, P. & Lee, P.J. (Eds.) *Understanding History: Recent Research in History Education*, International Review of History Education, Volume 4. London and New York: Routledge Falmer.

Chapman, A. (2001). *Accounting for Interpretations / Interpreting Accounts*. Unpublished EdD Institution Focused Study. University of London, Institute of Education.

Chapman, A. (2009). *Towards an Interpretations Heuristic: A Case Study Exploration of 16-19 year old students' ideas about explaining variations in historical accounts*. Unpublished EdD thesis. University of London, Institute of Education.

Lee, P.J. (1997). "None of us was there": Children's ideas about why historical accounts differ. In S. Ahonen & A. Pauli, et al (Eds.) *Historiedidaktik I Nordern 6, Nordisk Konferens om Historiedidaktik*, Tampere 1996. Copenhagen: Danmarks Laererhøjskole.

Lee, P. J. (2001). 'History in an Information Culture'. *International Journal of Historical Learning, Teaching and Research*, 1(2). [Online]. Available at: <http://centres.exeter.ac.uk/historyresource/journal2/journalstart.htm>. Last accessed 21st August 2009.

Lee, P.J., & Shemilt, D. (2004). "I just wish we could go back in the past and find out what really happened": progression in understanding about historical accounts. *Teaching History*, 117, 25-31.

Maggioni, L., & VanSledright, B. (2009). Walking on the borders: A measure of epistemic cognition in History'. *The Journal of Experimental Education*, 77(3), 187–213.

von Borries, B. (2009). 'Competence in Historical Thinking, Mastering of a Historical Framework, or Knowledge of the Historical Canon' in L. Symcox & A. Wilschut (Eds.) *National History Standards: The Problem of the Canon and the Future of Teaching History*. Charlotte, North Carolina: Information Age Publishing Inc.

Students' ethnic identities and their narrative constructions of Canadian history

Carla Peck, University of Alberta, Canada

In this paper I explore findings from a study that investigated the relationship between students' ethnic identities and their ascriptions of historical significance to moments in Canada's past. Twenty-six grade 12 students living in an ethnically diverse urban centre in British Columbia participated. Students were asked to discuss and select, out of a possible thirty, the ten most significant events in Canadian history. Students were asked to describe their ethnic identity and then reflect about the ways in which their ethnic identity may have influenced the decisions they made during the timeline task. Findings show students employed three different narrative templates to construct the history of Canada and used specific types of historical significance depending on the narrative(s) they used. The student's ethnic identities played a central role in determining the shape of the narrative he/she created and the criteria he/she employed to select the events for his/her narrative. Many students articulated complicated notions of their identities, with some perceiving that particular "sides" of their identity were at play, or in use, during the research task. Implications for history and citizenship education are explored.

In this paper I present research that investigated the relationship between students' ethnic identities and their ascriptions of historical significance to moments in Canada's past. Previous research has demonstrated that socio-cultural factors, including ethnic identity, can influence students' understanding of various aspects of history and cause them to have different ideas about "what counts" as historically significant (Barton & McCully, 2004; Epstein, 2000; Lévesque, 2005; Levstik, 1999; Seixas, 1993). In this paper I argue that the history education community has not sufficiently theorized the nature of ethnicity and its relationship to students' historical understandings. In previous work, researchers have made evaluative statements about the relationship between ethnic identity and understandings of history (generally, or regarding specific aspects of historical understanding such as significance) but have not based these conclusions on a complex understanding of ethnic identity (Bhabha, 2001; Hall, 2003) or on students' reflections on the nature of such a relationship.

The research presented in this paper attempts to respond to this gap in the literature. Twenty-six grade 12 students living in an ethnically diverse urban centre in British Columbia, Canada participated in this study. In groups, students completed a "timeline task" during which they were asked to make decisions about the historical significance of particular events and themes in Canadian history and then to explain their timeline. Students were also asked to describe their ethnic identity and reflect about the ways in which it may have influenced the decisions they made during the timeline task. I found that the students employed three narrative templates to explain their timelines and used specific types of historical significance criteria (Cercadillo, 2001) depending on the narrative(s) they used. Many students articulated complicated notions of their ethnic identities, with some perceiving that particular "sides" of their identity were at play, or in use, during the research task. Students who collaborated on the timeline activity often used different narrative templates to explain their timeline. The students' ethnic identities played a central role in determining which narrative template(s) they employed and the historical significance criteria they selected to

construct these narratives. These findings suggest that students come to the study of history with pre-existing criteria for historical significance that closely match those discussed in the literature and that their ethnic identities influence how they use these criteria to story the nation.

In the remainder of the paper I argue that the three narrative templates that the students in my study used can be mapped onto Westheimer & Kahne's (2004) framework of citizenship. Westheimer and Kahne theorize three types of citizens: the "personally responsible citizen," the "participatory citizen" and the "social justice oriented" citizen. In the latter half of this paper I explore the ways in which the three narrative templates employed by the students in my study may be aligned with Westheimer and Kahne's three types of citizens and suggest implications for policy and practice in history and citizenship education.

References

- Barton, K. C., & McCully, A. W. (2004). History, identity, and the school curriculum in Northern Ireland: An empirical study of secondary students' ideas and perspectives. *Journal of Curriculum Studies*, 36(6), 1-32.
- Bhabha, H. (2001). *The location of culture*. London: Routledge.
- Cercadillo, L. (2001). Significance in history: Students' ideas in England and Spain. In A. Dickinson, P. Gordon & P. Lee (Eds.), *Raising standards in history education: International review of history education* (Vol. 3, pp. 116-145). London: Woburn Press.
- Epstein, T. (2000). Adolescents' perspectives on racial diversity in U.S. History: Case studies from an urban classroom. *American Educational Research Journal*, 37(1), 185-214.
- Hall, S. (2003). New ethnicities. In L. Martín Alcoff & E. Mendieta (Eds.), *Identities: Race, class, gender, and nationality* (pp. 90-95). London: Blackwell Publishing.
- Lévesque, S. (2005, June 1). "Pour moi c'est pas une fierté pour le Canada mais pour ma famille": The problems of Canadian identity and francophone and anglophone Ontario students' understanding of historical significance. Paper presented at the Annual Meeting of the Canadian Historical Association University of Western Ontario, London.
- ON.Levstik, L. S. (1999, April). The well at the bottom of the world: Positionality and New Zealand [Aotearoa] adolescents' conceptions of historical significance. Paper presented at the Annual meeting of the American Educational Research Association, Montreal, Quebec.
- Seixas, P. (1993). Historical understanding among adolescents in a multicultural setting. *Curriculum Inquiry*, 23(3), 301-325.
- Westheimer, J., & Kahne, J. (2004). What kind of citizen? The politics of educating for democracy. *American Educational Research Journal*, 41(2), 237-269.

Enhancing students' historical reasoning: the potential of discussing historical significance

Jannet van Drie, University of Amsterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Brenda Stram, University of Amsterdam, Netherlands

Developing students' abilities in historical reasoning is an important goal in history education, but also raises the question of how to enhance and stimulate students' historical reasoning in the classroom. In this paper we study whether discussing the historical significance of persons and events is such a suitable approach. A lesson unit on determining historical significance was developed in which group work and whole-class discussions were systematically alternated. Two teachers and their students (in sum 43, pre-university education) participated in the study. Analyses included both learning outcomes, measured through a pre- and posttest and student-essays, and learning processes (whole-class discussions). The outcomes suggest that engaging students in issues of historical significance does enhance historical reasoning, however it also revealed that students have difficulties with different aspects of it, for example, contextualization and the use of meta-concepts.

Developing students' abilities in historical reasoning is an important goal in history education. This requires that students get ample opportunities to practice this. But what are powerful approaches that elicit and stimulate students' historical reasoning? Although this is an important question, for teachers as well as for researchers, who want to gain insight in the effects of instructional approaches on learning outcomes and processes, it has received relatively little attention in the history domain. Here, we present a study that investigated the question whether engaging students in questions of historical significance is a powerful approach to enhance historical reasoning. Determining the significance of people, events, and developments is a key activity of historians, however, students in secondary education are not often confronted with it. Instead, they are confronted with the outcomes of these debates through selections and ready-made stories. Hunt (2000) suggests that enabling students to make sophisticated decisions about what is important from the past and why, may be a fruitful and motivating approach. Discussing historical significance may include many components of historical reasoning as described by van Drie and van Boxtel (2008). In order to make judgments about the significance of a person or events one should not only consider facts related to this person/event and relate this to the context of the time people lived or events took place,

but also consider the changes that it brought about, the impact of these changes, and its' causes and consequences. The question of historical significance is an evaluative question which stimulates historical reasoning (Van Drie, Van Boxtel, & Van der Linden, 2006). At this point, there is hardly any empirical evidence that engaging students in thinking about historical significance elicits and stimulates historical reasoning, since most studies on historical significance focus on students' ideas about what is significant and why, and how this relates to socio-cultural factors (e.g. Epstein, 2000; Peck, this symposium).

A lesson unit of five lessons was developed on the question of which person or event was most important for the development of the Dutch democracy from 1800 till present. Starting from a socio-constructivist perspective on learning, group-work, whole-class discussions, and writing tasks were included (cf. Engle & Conant, 2002; Leinhardt, 1993; Mercer, Dawes, Wegerif, & Sams, 2004). Students studied in groups one of ten preselected persons and events, determined their significance based on various criteria and presented this to the rest of the class, which finally resulted in a class top ten.

Participants of the study were two experienced history teachers and their classes (of 29 and 14 students) from one school in the Netherlands (pre-university education, 16-17 years of age). The concept of historical significance was new to the students, since it is not an aspect of the official history curriculum. Data included transcripts of the final whole-class discussion, student essays (in which they made a case for their personal favorite), and a pre- and posttest, containing items measuring concept knowledge, and knowledge of important periods and dates by constructing a time-line and writing a short text. Whole-class discussions and essays were analyzed on their occurrence of components of historical reasoning (see Van Drie & Van Boxtel, 2008). All analyses were conducted by the first two authors separately and differences were discussed until agreement was reached.

The results showed that students were actively engaged in historical reasoning during the whole-class discussion, making many substantive contributions that included a lot of comparing and evaluating persons and events and less explaining. In their reasoning the students did make use of substantive concepts (almost 40% of the utterances), but to a lesser extent they used meta-concepts as change, cause, and consequence. In addition, the various criteria to determine historical significance were discussed. However, in the essays the students almost all used the criteria is important for its' own time and is important for present times, whereas the criteria is a symbol was only used in 30% of the cases. Although students did contextualize in time and used meta-concepts, this was not done by all students to the same extent. Comparisons between the pre- and post test showed significant differences on the concept knowledge task, and on the knowledge of dates as measured in the timeline-task, indicating that students improved on the level of concept knowledge and overview knowledge. Additional outcomes of student questionnaires and teacher interviews indicated that both teachers and students found it an interesting and motivating approach. Despite the limitations of this study in (only two teachers and their classes), these results suggest that discussing historical significance can be a promising approach for enhancing historical reasoning, for it elicits different components of historical reasoning. However, the quality of the reasoning displayed by the students can still be improved. More research is needed to generalize these outcomes, and additional qualitative analyses may shed more light on the learning processes elicited.

References

- Engle, R. A. & Conant, F. R. (2002). Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom. *Cognition and Instruction*, 20(4), 399-483.
- Epstein, T. (2000). Adolescents' perspectives on racial diversity in U.S. History: Case studies from an urban classroom. *American Educational Research Journal*, 37(1), 185-214.
- Hunt, M. (2000). Teaching historical significance. In J. Arthur & R. Phillips (Eds.) *Issues in history teaching* (pp 39-53). London: Routledge.
- Mercer, N., Dawes, L., Wegerif, R., & Sams, C. (2004). Reasoning as a scientist: ways of helping children to use language to learn science. *British Educational Research Journal*, 30(3), 359-377.
- Leinhardt, G. (1993). Weaving instructional explanations in history. *British Journal of Educational Psychology*, 63, 46-74.
- Van Drie, J., & Van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review*, 20(2), 87-110.
- Van Drie, J., Van Boxtel, C., & Van der Linden, J. L. (2006). Historical reasoning in a computer-supported collaborative learning environment. In A. M. O'Donnell, C. E. Hmelo, & G. Erkens (Eds.) *Collaborative learning, reasoning and technology* (pp. 265-296). Mahwah NJ: Erlbaum.

SYMPOSIUM

Symbiotic Relationship between Disciplinary Literacy & Understanding: Scientific Literacy Examples

Chairperson: Vaughan Prain, La Trobe University, Australia
Organiser: Larry Yore, University of Victoria, Canada
Discussant: Elizabeth Moje, University of Michigan, United States

This symposium addresses the foundation, current research, and future agenda of exploring the essential roles of texts in doing and learning science. Specific attention is given to positioning scientific literacy with the broader literature and research into disciplinary literacy across academic domains and school curricula. First, presenters will provide a contemporary developmental view of science literacy that incorporates fundamental literacy in science, derived understanding of science, and socioscientific applications as well as a discussion of how these integrated senses of literacy guide and help interpret professional learning for primary, middle, and secondary teachers of science. Second, the presenters will provide a framework and research results on the functionality of texts across learning and teaching phases. Finally, the presenters will report on their current and future research agenda involving multiple representations and the transformation between modes to enhance scientific understanding and multi-representation competence.

Moving Disciplinary Literacy beyond a Slogan: Vision III of Scientific Literacy

Elizabeth Moje, University of Michigan, United States; Larry Yore, University of Victoria, Canada; Christine Tippet, University of Victoria, Canada; Kenneth Tang, University of Michigan, United States

The awareness and acceptance that discipline-specific language results from and in disciplinary understanding is becoming more common in language, literacy, and science education communities. The developmental view of scientific literacy posits that literacy in science and scientific understanding of the big ideas in science interact to enhance proficiency within and with each other, leading to fuller participation in the public debate about science, technology, society, and environmental issues to produce informed decisions and sustainable actions. The developmental nature of disciplinary literacy in any domain evolves from basic to intermediate to discipline-specific forms. Differences in assumptions about knowledge, what counts as warrants, the nature of available representational forms, and the larger goals of the discipline shape how one sets a purpose and previews a given text. Taken together, these assumptions establish a framework for defining and developing pedagogical content knowledge for scientific literacy teaching by primary, middle, and secondary school teachers of science. This paper will report theoretical work on what makes literate practice unique in science, research on scientific literacy teaching across 20 urban schools, and the results of a 5-year case study of middle school teachers of science.

Science Literacy is a long-promoted, but ill-defined, general expectation (Hurd, 1958) with international cache (McEneaney, 2003). Earlier visions of science literacy focused on scientific knowledge (Vision I) or contextual application of scientific knowledge (Vision II), but neither vision addressed the literacy component of science literacy (Roberts, 2007). More recently, Vision III has addressed the literacy, knowledge, and applications components and how these senses interact to enhance meaningful learning and abilities (Norris & Phillips, 2003; Authors, 2007a, 2007b, 2008). Disciplinary literacy in science and other disciplines evolves from basic (aspects common to production and use of most texts) to intermediate (aspects common to some texts) and finally to disciplinary (aspects common only to discipline-specific texts) literacy (Shanahan & Shanahan, 2008). In addition, developing theorization of the continuum of generic to disciplinary literacy practices suggests that the differences among disciplinary literacy practices are less about stark differences in underlying literate practices and more about how epistemological assumptions of each discipline shape the way generic, or common, practices are enacted. Previewing and purpose setting, for example, are strategies readers of any text engage in before and as they read; what it looks like to preview and set a purpose for text reading in science, however, is unique from the previewing and purpose setting when reading a primary source in history. Differences in assumptions about knowledge, what counts as warrants, the nature of available representational forms, and the larger goals of the discipline shape how one sets a purpose and previews a given text. Taken together, these assumptions establish a framework for defining and developing pedagogical content knowledge for scientific literacy teaching by primary, middle, and secondary school teachers of science.

This paper will report theoretical work on what makes literate practice unique in science: research on scientific literacy teaching. One study explored the classroom practices of both teachers and students across 20 urban schools. Most notable was the finding that the teachers made literacy teaching distinct from science teaching, despite co-constructed professional development activities that sought to integrate literacy with science teaching. We also noted that, of all literacy teaching practices, vocabulary teaching seemed to be taken up with the most enthusiasm (Authors, 2010). In this paper we will draw from various theories of scientific literacy and of science learning to offer possible explanations for these practices.

Another study examines the stark contrasts between two sets of texts and literate practices that deal with more or less the same physics phenomena; one from high school physics and the other from everyday media that adolescents are familiar with (e.g., magazines, websites, sci-fi, videos). Findings indicate that although there are many thematic similarities between these texts (thus opportunities for meaningful science learning), there are also vast divergences in terms of their epistemological assumptions in framing the phenomena and what can be counted as knowledge about those phenomena. Through these divergences, we were able to better understand how the disciplinary literacy of high school physics presents major challenges for the students to master its thematic content, and consequently how literacy teaching practices needed to be modified to cater to such challenges.

The third study reports on a 5-year case study of middle school teachers of science. Generalist teachers (limited science content backgrounds) from three Grades 6–8 middle schools in a suburban Canadian school district were tracked as they set the research and development agenda of a community-based project, participated in professional learning activities identified by the participants and project staff, developed instructional resources related to a subset of strategies and literacy tasks for their schools' science program, and later disseminated these resources to colleagues in their schools. Results indicated that these teachers gravitated toward intermediate literacy strategies and tasks (general reading strategies, vocabulary development, concept mapping, using visual representations, designing informational posters and brochures), implemented these strategies and tasks into their science program and other disciplinary studies (social studies, mathematics), and were willing and effective professional development providers in their school. However, even teachers who participated in the study from the beginning were reluctant to conduct professional development workshops in the other district schools and elsewhere.

The combined results of these studies indicated that both teachers and students approach the idea of scientific literacy teaching as a matter of inserting literacy instruction into science teaching, rather than considering the teaching of scientific language and literacy practices as part and parcel of learning science. Possible explanations for this stance include the teachers' own past science learning experiences, a conflict between stances toward science learning as the construction of knowledge and literacy learning as discrete and didactic, and/or the possibility that students' skills and learning practices shape what teachers believe they can accomplish in regard to deep scientific literacy learning.

References

- Authors (2007a). Review of Research in Education.
- Authors (2007b). International Journal of Science and Mathematics Education.
- Authors (2008). Journal of Adolescent & Adult Literacy.
- Authors (2010).
- Hurd, P. D. (1958). Science literacy: Its meaning for American schools. *Educational Leadership*, 16, 13–16 & 52.
- McEneaney, E. H. (2003). The worldwide cachet of scientific literacy. *Comparative Education Review*, 47(2), 217–237.
- Norris, S. P., & Phillips, L. M. (1994). Interpreting pragmatic meaning when reading popular reports of science. *Journal of Research in Science Teaching*, 31(9), 947–967.
- Roberts, D. A. (2007). Scientific literacy/science literacy. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 729–780). Mahwah, NJ: Lawrence Erlbaum.
- Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review*, 78(1), 40–59.

Cognitive and Pedagogical Functionality of Literacy Tasks and Texts in Learning and Teaching Science

Jennifer Tilson, University of California, Berkeley, United States; P David Pearson, UC Berkeley, United States; Jacqueline Barber, University of California, Berkeley, United States; Megan Goss, UC Berkeley, United States

This paper examines a model of science-literacy integration that embeds literacy learning within inquiry science in a way that supports students' development of science knowledge, practices, and dispositions. Using the logic of design research, we present an analysis of literacy tasks and texts in the middle school curriculum (USA Grades 6–8) and its role in supporting students' acquisition of these phenomena, with special emphasis on understanding earth science concepts, argumentation (oral and written) skills, and collaborative knowledge building dispositions. Early field trials within the first round of design experiments revealed a great deal about the constraints and affordances of the ecology in which we embed literacy texts and tasks; namely, middle school organizational structures, the science curriculum (both content and process), the developmental characteristics of adolescent learners, and the cultural practices of middle school science teaching. These factors dramatically shape the ways in which text can be used to support the science learning goals. The overarching insight thus far is that there is an important role for text in the

acquisition of knowledge, skills, and dispositions in science, but it involves much more than simply applying the default practices of language arts classrooms (and narrative text) to science classrooms.

Literacy educators and science educators alike are gathering evidence that these two domains are inexorably linked. In science education, reports such as the National Research Council's *Taking Science to School* (2007) recognize the centrality of the language in science and call for a high level of student participation in scientific discourse and practices; in literacy education, recent documents such as the Carnegie Foundation's *Time To Act* (2010) acknowledge the critical role of discipline-specific knowledge and literacy strategies as a factor influencing student achievement. These calls raise essential questions about how to achieve the aims of enabling students to reach a high degree of facility with scientific ideas and practices (in particular, the ability to read science texts with deep understanding). How can science teachers be supported in helping students develop the sophisticated literacy skills associated with the domain?

In this paper, we describe our work on a curriculum development and research project (January 2010–December 2013), the aim of which is to provide teachers and students with materials specifically designed to support inquiry science and disciplinary literacy learning simultaneously. Over the past 6 years, the authors have designed a successful approach for the elementary level and have instantiated this approach in educative curriculum materials; currently, we are working to adapt and revise this approach for middle school. Though just beginning, we have already found some key ways in which the contextual differences between elementary and middle schools affect the curriculum design as well as the instructional supports offered to teachers and students. This paper describes our initial insights based on 3 months of design research; we expect others will emerge as well. Some areas in which we have found unique constraints and affordances are middle school organizational structures, the science curriculum (content and practices), the developmental characteristics of adolescent learners, and the cultural practices of middle school science teaching. These factors dramatically shape the ways in which text can be used to support the science learning goals of the project.

The organizational structures of American middle schools shape the curriculum and approaches that can be used. Middle schools are typically organized into periods of 40–50 minutes in length; thus, the typical student sees 5–7 teachers per day and the typical teacher teaches over 100 students per day. These constraints on time and the number of students per teacher have implications for the use of text in the science classroom as well as for the tasks in which students engage.

In addition, the science curriculum itself, with an emphasis both on content knowledge and processes such as gathering and interpreting scientific evidence and engaging in scientific argumentation, shapes the curriculum and the texts associated with it. The complexity of the content as well as the ways in which the content is connected has implications for the use of text in the science classroom. At least two influential dimensions have emerged so far—complexity (how many variables are involved in the domain) and abstractness (how easy is it to represent how things work in the domain).

In reviewing and revising our curricular model, we have hypothesized that special attention must be paid to the developmental characteristics of the adolescent learner. By middle school, students have developed perceptions of themselves as learners and as readers. We hope to share some insights from our research design about supporting the science learner as part of teaching students to be sophisticated readers of science texts and engage in scientific inquiry and discourse.

The cultural practices of middle school science teaching also affect the use of text in the science classroom. Many American elementary school teachers are facile with literacy teaching but lack preparation in teaching science; thus, an integrated curriculum at the elementary level provides a measure of familiar territory to K–5 teachers by combining literacy and science. However, most American middle school science teachers are trained as disciplinary experts but are not typically as familiar with literacy teaching methods, may not be as confident supporting students in reading science texts, and may, as we have found, view teaching reading skills and strategies as someone else's responsibility. We are investigating ways to support teachers in acquiring strategies for supporting students in their literacy development in science through educative curriculum materials as well as ways to carefully structure the texts themselves so that students are supported in their reading and interpretation of these texts.

Finally, our initial work indicates some differences in the design of texts as well as the ways in which texts are linked to firsthand science experiences. Our elementary model posited that text played five essential roles: providing context, supporting firsthand inquiry, providing data for students to interpret, modeling processes, and delivering content (Authors, 2009). In middle school, an additional role, providing critique, is emerging as key for supporting students in

engaging in argumentation around scientific ideas. We will report on these and other aspects of text design that impact the pairing of science inquiry and text to support student learning.

We are confident that what we learn over the next 8 months (November–June) will prompt us to revise these insights and to develop new ones that have not yet presented themselves. We remain committed to the overall goal, however, of creating a curriculum and a pedagogical approach that finds a key role for literacy and language in supporting the acquisition of knowledge and inquiry skill among middle school students.

References

Authors. (2009). Guilford Press.

Carnegie Corporation. (2010). Time to act: An agenda for advancing adolescent literacy for college and career success. New York: The Carnegie Corporation.

National Research Council. (2007). Taking science to school: Learning and teaching science in grades K-8. Committee on Science Learning, Kindergarten through Eighth Grade. R. A. Duschl, H. A. Schweingruber, & A. W. Shouse (Eds.). Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

The Cognitive Power of Transforming/Translating between Representations in Science Learning

Brian Hand, University of Iowa, United States; Vaughan Prain, La Trobe University, Australia

There has been a strong emerging interest on students' use of multimodal representations in which research has concentrated on students learning from interpreting and interacting with prepared representations. Our focus has been on students constructing their own representations and on examining how students engage with challenges of representing science claims, the relationship between elements of a concept expressed in a single modal form, as well as students' understanding of a concept across modal forms, and how students engage with an idea within and between modal forms. The movements between and within representation forms are critical in helping students build a meta-representational competency where they are able to use knowledgeably and regulate a representational focus to build new knowledge. We have focused on several approaches to explore how students engage in the use of multimodal representations to build science understanding. These approaches are centred on pedagogical actions needed as critical elements of instruction as well as writing activities to be completed at the end of a unit of work that require students to explain the modal forms used to represent a concept. The shift in emphasis—from something given to students (prepared representations of a concept) to something students construct and critique about the target concept—places different demands on students from interpreting others' texts. Results indicate that embedding multimodal representation-making within the context of learning has the potential to increase the cognitive demands, and hence learning outcomes, for students.

Various studies have investigated the value of student-generated representations to promote understanding in science (Greeno & Hall, 1997; Ritchie, Rigano, & Duane, 2008). Greeno and Hall (1997) pointed out that student engagement only with authorized representations may constrain opportunities for learning. They argued that student construction and interpretation of their own representations had various consequences:

- Forms of representations can be considered as important tools for constructing and communicating understanding;
- Constructed representations are adapted for the purposes at hand;
- Students need to be more actively engaged in constructing and interpreting representations by actively discussing the properties of representations, including their strengths and limitations.

Ford and Forman (2006) emphasized the construction and critique (interpretation of the persuasiveness) of a representation in developing students' understanding. They suggested that unless students learnt to construct and interpret representations of their observations, become active participators in the learning process, and recognise the role and function of their constructions then learning could be constrained and superficial. They acknowledged that such an approach required students to use skills often learnt in other disciplines as they constructed and interpreted their representations of emerging understanding.

Pursuing this pedagogical focus, various researchers have sought to identify cognitive and communicative conditions that supported knowledge-building in science and advocated that students construct a diverse range of representations to enable this learning (Authors, 2006; Gunstone, 1995). This approach asserts that students should use a more diversified range of representations, both formal and informal, to engage with the practices and intent of

scientific investigation. In advocating text diversification, these researchers accept that students need to demonstrate a capacity to use accurately the current vocabulary and multimodal representations of science discourse. However, they argue that there are motivational gains and enhanced learning opportunities when students engage in a cycle of planning and guided revision of different text types where there is a strong emphasis on clarification of claims in science and their justification for both self and others.

This paper reports on two different approaches to promoting student engagement in generating their own representations. Both studies involve students in the process of constructing explanations of phenomena that place cognitive demands on them to transform representations across different modal forms. These studies are centred on immersing students in the experience of construction and critique of their representational transformations.

The first case study with two teachers and their upper elementary classes examined the use of a series of representational challenges to develop students' understanding of the concept of evaporation. These sequences focused on students making multimodal representations to justify causal claims to other class members and the teacher about the topic. Data collection entailed researcher observational notes of lessons, analyses of key aspects of the teachers' role in the sequences, student and teacher interviews on the learning effects of this approach, extensive analyses of the representational choices and conceptual content of students' artefacts throughout the unit of study, and subsequent student testing for transfer to new contexts. We found that this explicit teacher focus on the form/function of representations, and on guided student judgment of the clarity, comprehensiveness, and adequacy of their own representations, and coherence across modes, resulted in (a) strong student motivation, (b) strong gains in students' reasoning about claims in science, and (c) improved learning performance on subsequent topic tests.

The second case involved 1,000 middle and secondary school students, divided equally into treatment and control groups. Their science teachers were provided with professional development related to incorporating multimodal writing exercises into their teaching units. The teachers were asked to conduct a lesson with the treatment in which students generated a set of criteria for examining multimodal representations within text, for example, textbooks, publications, and websites. Students were asked to use these criteria as a support for the production of their written piece. Control students were given the same writing assignment but were not exposed to the development of criteria. Examination of written products and test scores indicates that there is a strong correlation between coherence of text and test scores; that is, the students who were able to construct strong links between the modes they used to explain the concept and the text used to describe these modes were able to perform better on tests.

References

- Authors. (2006). Teaching Science.
- Ford, M. J., & Forman, E. A. (2006). Redefining disciplinary learning in classroom contexts. *Review of Research in Education*, 30(1), 1–32.
- Greeno, J. G., & Hall, R. P. (1997). Practicing representation: Learning with and about representational forms. *Phi Delta Kappan*, 78(5), 361–368.
- Gunstone, R. (1995). Constructivist learning and the teaching of science. In B. Hand & V. Prain, (Eds.), *Teaching and learning in science: The constructivist classroom*. Sydney, Australia: Harcourt Brace.
- Ritchie, S., Rigano, D., & Duane, A. (2008). Writing an ecological mystery in class: Merging genres and learning science. *International Journal of Science Education*, 30(2), 143–166.

SYMPOSIUM

Diversity as Intercultural Competence

Chairperson: Susanne Weber, Ludwig-Maximilians-Universitat-Munchen, Germany

Organiser: Hans Gruber, University of Regensburg, Germany

Susanne Weber, Ludwig-Maximilians-Universitat-Munchen, Germany

Discussant: Frank Achtenhagen, Institute for Business and Human Resource Education, Germany

Dynamics of globalization are accompanied by processes of migration. The increasing flow of people creates new challenges for governments, national economies, single enterprises, workplaces and individual. Migrants and their descendants make up a considerable share of the overall population in many EU countries. Although much has already been done in many countries about migrants' structural integration there is still an imbalance between migrants and local population with regard to their participation in society and especially, the labour market which is a crucial factor in the integration of migrants to the new society. Beside formal restrictive regulations (e.g., non-accreditation of foreign qualification certificates) studies show that there exist prejudice, uncertainty and anxiousness of employees in hiring people from abroad. These might be rooted back to a public recognition to others' distinctiveness on a

collective level as well as to individuals' cultural incompetent acting. The first paper maps out the first generation migrants' experiences, how the Finnish society has recognized their competence and provided chances to jobs; it is also shown how intervention strategies may foster commonly shared understanding. The second paper suggests a method for measuring intercultural competencies in business on an individual level by a cognitive achievement test and essays. The third paper measures the development of intercultural sensitivity of engineers in comparison to different treatments. The main theoretical and educational significance is getting insight into collective and individual processes of recognition to others' distinctiveness. This is a huge challenge and point of departure for learning and training measures.

Recognition and access: immigrants' workforce competence

Johanna Lasonen, University of South Florida, United States; Marianne Teras, University of Helsinki, Finland

Immigration and migration in a broader sense are pertinent phenomena of our globalizing world. The increasing flow of people creates new challenges for governments, national economies and workplaces. Employers look for specific skills and competencies, while migrants arrive with qualifications that are not described in terms that are used, recognized and understood in the receiving country. A critical social theory and developmental work research guide the conceptual framework of the paper that discusses some issues of the recognition of migrants' education and competence among the first and second generation immigrants and their integration to new environments. The answers for the following questions are searched: (1) To what extent migrants' prior learning is recognized and accepted? (2) How does this contribute to their career prospects and influence their access to jobs? (3) To what extent are pathways open for minority secondary education students to education and work? - The data have been collected by face-to-face interviews, a questionnaire and by an intervention method. The data have been analyzed using both qualitative and quantitative methods. The study has revealed that the immigrants in Finland are stratified into 'ethnic minority disadvantaged' groups which show a similar pattern of stratification, found in other Western countries (Heath and Cheung 2007). In addition, a pattern of immigrants' children's access to work and education is studied.

Aims

Immigrants and their descendants make up a considerable share of the overall population in many EU countries, and also in Finland. Because educational level and occupational placement have proved crucial factors in the integration of immigrants to the society of their new home country, their position in the labour market is a central topic in public and political debate. Although much has already been learnt in many countries about immigrants' structural integration, the amount of research knowledge is not yet sufficient. There is still need for comparative studies, and the mechanisms attributable to ethnic inequalities in the labour market call for further theoretical exploration, even though many analyses have already described the situation fairly well. Many earlier studies have shown that migrants coming from outside Europe and also their descendants are treated unequally with regard to employment. In this respect, discrimination exists in the societies of EU countries. The aim of this paper is (1) to map out the actual situation for ethnic minorities in Finland and to produce new knowledge that illuminates why and how immigrants are stratified into 'ethnic minority disadvantaged' groups and (2) to demonstrate possible collective learning and development by implementing a socio-cultural intervention. By the results social institutions and organisations are challenged to stop ethnic inequalities from transferring them from one generation to another.

Methodology

Identity, self-definition and recognition have been linked to struggles for dignity, respect and autonomy. Taylor and Honneth, who have conceptualized theories of multicultural politics of recognition, emphasize that individuals require membership in social groups with recognition to their distinctiveness rather than rights and resources. According to Taylor (1994), human life has a dialogical nature, and it is bound up with public recognition for the ethnic, religious and national groups. Identities are revised, affirmed and developed. Honneth (1992) indicates that recognition requires a measure of "social acceptance for a person's method of self-realization within the horizon of cultural traditions of a given society" (p. 191). Fraser goes further and says that social justice is at issue when a society's "dominant cultural patterns of interpretation and valuation" (1997, p. 39) establish unequally the social bases of self-respect for different social groups. Fraser emphasizes a basic discord between a "theory of cultural justice" that enhances the recognition of difference and a "theory of distributive justice" that advocates the just distribution of resources (p. 6). To produce new knowledge that illuminates why and how immigrants are stratified into 'ethnic minority disadvantaged' groups and whether this pattern of stratification, found in other Western countries (Heath & Cheung 2007), is true in Finland, face-to-face interviews and a questionnaire survey all over Finland have been run and discussed in the context of "The Integration of the European Second Generation" project (TIES, 2010), the EU Labour Force Survey (EULFS 2000) (Kalter & Kogan, 2002) as well as the studies of Heath & Cheung (2006). For demonstrating and initiating collective learning and development processes a second study was run also on the bases of the Vygotskian socio-cultural approach to learning which emphasizes social interaction and activity in the process of

knowledge and skills construction (Vygotsky, 1987). Psychological and material tools mediate the competence construction that occurs in historical and cultural settings. Personal and event histories are seen as combinations of social actions in specific contexts. These are not predefined environments but include the dimensions that are relevant to the participants in the activity. The participants themselves produce and create the contexts in their joint activity. Teräs (2007) analyzed the challenges of intercultural learning and development and included the voices of immigrant students in a multicultural dialogue in Finnish vocational schools. The intervention was based on the generic Change Laboratory method (Virkkunen, Engeström et al., 1997); embedded in a one-year-long Preparatory Immigrant Training program for students who, after the training, intended to study in regular vocational education and training. Teräs developed and implemented a new intervention called the Culture Laboratory, to meet challenges of everyday life inside the school. The Culture Laboratory is a participatory method for observing, comparing and creating new cultural activity. However, there is a need to understand how young minority students' competence and experiences are identified and faced in secondary schools.

Many studies concerning intercultural education and immigrant students' experiences in Finland have been done in comprehensive schools, in teacher training contexts and in working life, but secondary schools have not been in the focus. One central pathway to a new society and to working life goes through vocational education and training. The empirical research material consists of nine two-to-three-hour meetings of the Culture Laboratory, which were audio- and videotaped (altogether 20 hours). The participants included 17 students who were natives of eight different countries (Estonia, Russia, Somalia, Iraq, Chile, Italy, Afghanistan, and Japan), four teachers, a school assistant, a counsellor, the project coordinator, the chief interventionist, and a researcher.

Findings

In Helsinki, ten percent of young people and 8.2 percent of the whole population speak a language other than Finnish or Swedish as their mother tongue. The results of the first study show the first generation immigrants' experiences, how the Finnish society has recognized their competence and provided chances to jobs and experiences of the second generation, that is children and adolescents who develop their agencies in multiethnic and multicultural settings, and whose voices are not listened to, at least not in the public debate going on in Finland.

The results of the second study – the Culture Laboratory intervention - shows and explores the dynamic movements of intercultural encountering, and how this situation can enrich learning and development. Theoretical and Educational SignificanceThe research has focused on children of immigrants in transition phases of their educational paths. Schools do not only transfer the skills and knowledge needed in the community but also the prevailing practices and cultural values and symbols of dominant groups. The results give first hints for effective and efficient ways to develop migrants' workforce competence.

Instilling Global Competence in Baccalaureates Through International Experiences:

Jonathan Gordon, Georgia Institute of Technology, United States; Amy Henry, Georgia Institute of Technology, United States; Jack Lohmann, Georgia Institute of Technology, United States

This study presents the results of a longitudinal evaluation of the Georgia Tech International Plan, a curricular and co-curricular initiative designed to give students the opportunity to develop intercultural competence skills through a combination of language study, coursework, and long term international work and study opportunities. The evaluation measures gains in intercultural sensitivity through the use of the Intercultural Development Inventory (IDI), a reliable, psychometrically validated instrument designed to ascertain the degree of cognitive complexity people bring to their experiences with different cultures. A quasi-experimental cohort study employs the use of multiple control groups in addition to the population of interest.

Aim

Our research stems from the Georgia Tech International Plan (IP), an initiative to increase the number of undergraduate students who graduate with global competence in the practice of their majors. Through a combination of foreign language study, coursework in international relations, global economics, and cultural studies, and extensive work and/or study abroad experiences, the IP is designed to produce graduates who have an understanding of global relations, intercultural communication, and international disciplinary practice. Over the past five years, we have evaluated student achievement of learning goals associated with the IP utilizing multiple methods of assessment including pre/post surveys, externally normed and validated instruments, and quantitative methods such as focus groups. This paper shares the results from one instrument designed to measure the degree of cognitive complexity

that an individual brings to perceptions of cultural difference—the Intercultural Development Inventory (IDI). The IDI was developed by Bennett and Hammer to measure intercultural sensitivity and has been found to be a reliable and reasonably valid measurement tool (Paige, et al., 2003). The IDI is based on Bennett's (1986) Developmental Model of Intercultural Sensitivity (DMIS). The DMIS postulates six stages of increasing sensitivity to cultural difference. As one's experience of cultural difference becomes more sophisticated, one's competence in intercultural relations increases.

People truly bicultural or multicultural; do not define themselves in terms of any one culture (very rare) The DMIS posits three ethnocentric stages of development and three ethnorelative ones—each associated with more sophisticated cognitive ability to recognize and appreciate cultural differences.

Methodology

The study utilizes a quasi-experimental longitudinal model comparing three groups: students who participate in the IP, students who participate in some international experience (e.g., short-term study abroad programs), and students who engage in no international experiences. Students were asked to complete the IDI in their first year of undergraduate study, and again upon graduation. Using a matched-pairs design, we can measure the difference in developmental ability over the course of the undergraduate experience. To date, a total of 3,781 first-year students have completed the instrument; we have administered the post-test to 685 seniors. We will continue to collect data and expect to substantially complete data collection in 2011. Among the questions we will address in the paper:· Do intentional curricular and co-curricular interventions like the IP affect development of intercultural sensitivity?· Does second language fluency have an effect on intercultural sensitivity?

What is the role of gender and ethnicity as it pertains to intercultural sensitivity? Does it matter where a student travels as it pertains to intercultural sensitivity? Does the degree of "foreignness" affect IDI scores? Are there differences in intercultural sensitivity gains based on the type of international experiences? For example, do students who work abroad have higher gains than those who study at foreign universities?

Findings

We have sufficient data to draw some preliminary conclusions regarding the development of intercultural abilities as measured by the IDI. Analysis of Variance (ANOVA) demonstrates a significant difference ($p = .008$) between those who have enrolled in the IP and those who had other or no abroad experiences. Table 2 provides preliminary results on the change in Developmental Score on the IDI. Post-hoc tests show that the first two groups—those who enrolled in the IP and graduated with the designator and those who enrolled in the IP and completed some (but not all) of the requirements—manifested significantly higher gains in development compared with those who participated in less rigorous abroad experiences.

Measuring Intercultural Competence

Susanne Weber, Ludwig-Maximilians-Universität-München, Germany; Matthias Hofmuth, University of Munich, Germany; Michael Fretschner, University of Munich, Germany

Intercultural competence is nowadays indispensable for effectively coping with challenges at the workplace. Thus, it is no wonder that intercultural competence is claimed for as a 21st century skill (Binkley et al., 2010). Here we conceptualize intercultural competence according to Ting-Toomey (1999) as "Mindful Identity Negotiation" and operationalize it according to the pragmatic competence construct of Weinert (2001): intercultural competence as a professional action competence that integrates and coordinates cognitive, motivational and social abilities. Such multifaceted construct can be approached and measured by various measures (Kanning, 2009). In this paper we are going to discuss two of them: The measurement of intercultural knowledge about critical incidents by running a cognitive achievement test and of modes of intercultural negotiation skills by running an open test format using essays. Responses to both studies ($N=545$ for the cognitive achievement test and $N=61$ for the essay study) are calculated with methods of Item Response Theory (IRT). On the base of our empirical data we could confirm our theoretical models by acceptable fit values.

Aims

Intercultural competence is nowadays indispensable for effectively coping with challenges at the workplace. Thus, it is no wonder that intercultural competence is claimed for as a 21st century skill (Binkley et al., 2010). Here, we conceptualize intercultural competence according to Ting-Toomey (1999) as "Mindful Identity Negotiation" and operationalize it according to the pragmatic competence construct of Weinert (2001): intercultural competence as a professional action competence that integrates and coordinates cognitive, motivational and social abilities. It is assumed that these abilities can be learned and trained. The situations in which the competencies are realized and shown have to be complex and challenging. For visualizing and measuring social competencies – like intercultural

competencies – Kanning (2009) suggests four approaches: (1) capturing intercultural knowledge by running cognitive achievement tests, (2) observing intercultural behaviour in real clash situations, (3) summarizing and describing the behaviour running self-reports e.g., by modes of questionnaires or essays and (4) drawing inferences from distal indicators. In our project we, therefore, identified critical intercultural overlap and clash situations for the field of business, and operationalized intercultural competence according to the "Mindful Identity Negotiation" approach of Ting-Toomey (1999). We created construct maps for intercultural knowledge (ad 1) and intercultural negotiation skills (ad 2) and measured these facets of intercultural competencies on the individual level implementing methods of Item Response Theory (IRT) (Wilson, DeBoeck & Carstensen, 2008). Our research questions are: (1) Is it possible to visualize different ability levels of these facets of intercultural competence for individuals? (2) Is it possible to create items/tasks on different levels of these facets of intercultural competence?

Methodology

For measuring the first facet of intercultural knowledge competence we identified real-life case studies in the field of business. We constructed ranked-order multiple choice (MC) items (Wilson, 2005), sequenced from totally wrong, over partly and quite correct choice opportunities to a best answer option. The sequencing strategy followed the affected identity dimensions (Ting-Toomey, 1999) of the acting participants within the intercultural clash situations presented in the case studies. By means of an online questionnaire 650 complete responses were generated. After profound proofs of data quality we estimated the model with 545 data lines. For data analyses and proving our theoretical construct map we applied the Partial Credit Model (Masters, 1982), an IR-Model of the Rasch-family as our MC Items were rank ordered. The IRT measurement was run by using the software Conquest (Wu et al., 2007). For measuring the facet of intercultural negotiation skills we used critical incidents raised from intercultural training methods (e.g., Pedersen, 1996) and asked the testees for their intentional behaviour to solve an intercultural clash situation. The verbal data were analysed by a content analysis according to categories created in a second construct map (Weber, 2005; Wilson, 2005; Weber & Achtenhagen, 2010) dichotomously. Here a simple IR-Model was run by using Conquest (Wu et al., 2007).

Findings

The confirmatory check of our items and the model fits was very successful: (1) With regard to our first model of intercultural knowledge all MNSQ-values fitted significantly in the hypothesized theoretical model. We also found interesting results by analysing the different item functions (DIF) of meaningful sub-samples (vocational experience, foreign background, sex, cross-cultural experience). E.g.: One significant finding was that people with a foreign background scored in average 0.56 logits better than people without. (2) With regard to our second model of intercultural negotiation skills we also can confirm our hypothesized model (resp. construct map) by acceptable fit values (separation reliability = .970; $\chi^2 = 527,83$; $df=19$, p Theoretical and educational significance of the research Describing and visualizing facets of intercultural competencies is an essential step for fostering these important 21st century skills in a sustainable way. By IRT we can map out the item estimates separately from the individuals' ability estimates – and therefore, analysing individual competencies in relation to other facets of intercultural competencies as well as other variables of linked to intercultural competent acting. The detailed analyses allow made to measure training methods.

References

- Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M. & Rumble, M. (2010). Draft White Paper 1: Defining 21st century skills. Melbourne: ACTS.
- Kanning, U. P. (2009). Diagnostik sozialer Kompetenzen (2., aktualisierte Auflage). Göttingen [u.a.]: Hogrefe.
- Masters, G. N. (1982). A Rasch Model for Partial Credit Scoring. *Psychometrika*, 47, 149-174.
- Pedersen, A. B. (1999). Double-Loop Thinking: Seeing Two Perspectives. In H. N. Seelye (Ed.), *Experiential activities for intercultural learning*, Vol. 1. (pp. 105–111). Yarmouth, Me.: Intercultural Press.
- Ting-Toomey, S. (1999). *Communicating across cultures*. New York: Guilford Press.
- Weber, S. (2005). *Intercultural Learning as Identity Negotiation*. Frankfurt am Main: Lang.
- Weber, S. & Achtenhagen, F. (2010). Molare didaktische Ansätze zur Förderung forschungs- und evidenzbasierter Lehr-Lern-Prozesse. In J. Seifried, E. Wuttke, R. Nickolaus & P. F. E. Sloane (Hrsg.), *Lehr-Lern-Forschung in der kaufmännischen Berufsbildung - Ergebnisse und Gestaltungsaufgaben*. Zeitschrift für Berufs- und Wirtschaftspädagogik / Beihefte: Bd. 23. (S. 13–26). Stuttgart: Steiner.
- Weinert, E. (2001). Concept of Competence: A Conceptual Clarification. In D. S. Rychen & L. H. Salganik (Eds.), *Key competencies for a successful life and a well-functioning society* (pp. 45-65).
- Seattle et al.: Hogrefe & Huber.
- Wilson, M. (2005). Constructing measures. An item response modeling approach. Mahwah, N.J: Lawrence Erlbaum.
- Wilson, M., De Boeck, P. & Carstensen, C. H. (2008). Explanatory Item Response Models: A Brief Introduction. In J. Hartig, E. Klieme & D. Leutner (Hrsg.), *Assessment of Competencies in Educational Contexts*. (pp. 91–120).

Göttingen: Hogrefe. Wu, M. L., Adams, R. J., Wilson, M. & Haldane, S. A. (2007). ACER CONQUEST. Version 2.0. Camberwell: ACER Press.

SYMPOSIUM

Integrated tool support for learning through knowledge creation

Chairperson: Sten Ludvigsen, University of Oslo, Norway

Organiser: Crina Damsa, University of Oslo, Norway

Hanni Muukkonen, University of Helsinki, Finland

Discussant: Gijsbert Erkens, Utrecht University, Netherlands

In this symposium we discuss a pedagogical design involving technology that aims to support and foster learning through object-bound collaboration. The Knowledge Practice Environment (KPE) is a Web 2.0 application that provides participants with integrated tools and functionalities for learning through open-ended, collaborative inquiry. The designs employed have emerged from the knowledge creation approach (Paavola & Hakkarainen, 2005), which depicts learning as a collaborative activity aimed at creating shared knowledge objects. Technology-mediation has a prominent role in supporting collaboration processes, iterative development of products, and reflection of knowledge practices. The KPE environment (www.knowledgepractices.info/module-pages-display-pageid-42.html) is an integrated, modular open source software. It is designed to enable various visual views on the collaboration process and the related knowledge practices. The Content view provides a space for manipulating files, tasks, comments, and their relationships. The Process view can be used to view and edit tasks, timelines, and milestones. The Community view shows the members of the learning community, makes possible to create groups, and view responsibilities and products of members. Other integrated tools and functionalities support, for instance, conceptual modelling, tagging, collaborative authoring, and reflection of practices. We present three empirical studies that examine ways of supporting higher education learning and teaching activities, and pedagogical design for practices where the participants develop knowledge objects (e.g., manuals, designs, software applications, research reports). The three research studies attempt to explain how the different functionalities of the KPE can enhance collaboration and development of shared knowledge objects.

Iterative co-construction of knowledge objects by student teachers

Crina Damsa, University of Oslo, Norway; Sten Ludvigsen, University of Oslo, Norway; Patrick Sins, Leiden University, Netherlands

Abstract: In this contribution we investigate how student teachers collaborate to create and elaborate knowledge objects using web-based technological support. Creating settings that support students to solve problems with open-ended character is a challenge for the current educational practice. This contribution presents an empirical study of object-oriented collaboration, where groups of student teachers work on knowledge objects (e.g., didactic materials, guidelines or manuals for teachers) intended to address problems signaled in their internship places. We analyzed groups' collaboration processes and developing knowledge objects, with the aim of understanding the mechanism of both these processes. Also, we investigated how technology can support these specific activities. Findings show various degrees of idea sharing and co-elaboration of knowledge objects. Functionalities that support visualization of the object iterations, links to sources and commenting were most used. The findings assist us in formulating recommendations for future research and pedagogical design.

Introduction and theoretical considerations

In this contribution we investigate how teacher students work in collaboration to create and develop knowledge objects that will be employed at their internship places. We examine the processes revolving around collaborative and iterative knowledge object development and the way student groups employ features of technology designed to support this type of activities. We focus on variation in collaborative mechanisms across groups and we provide a more detailed insight into how knowledge objects are developed by a number of groups. Exposing students to knowledge practices they will perform as professionals seems to be a challenging task in higher education. In this study, the prevalent idea in the KP-lab project is that problems with an open-ended character entice students to engage with knowledge and make their own knowledge explicit. This involves theoretical and practical knowledge being materialized in objects (e.g., in educational material, evaluation instruments, research reports, etc.), where this knowledge becomes transparent for the participants involved.

Nevertheless, becoming actively involved and successful in such complex processes, and creating sophisticated knowledge objects, is a challenging task for students. The knowledge creation approach to learning (Paavola & Hakkarainen, 2005) can serve as a guide to develop new practices of learning and instruction, which places

collaborative creation of knowledge objects at its core. Knowledge creation processes not only shape the knowledge objects constructed but are also transformed by the actions that are performed on these objects (Stahl, 2006). Pedagogical designs should explicitly scaffold these practices through incorporating collaborative co-construction activities revolving around knowledge objects. This involves also providing various types of technological scaffolds. Whilst various studies showed how (online) technology features enhance dialogic interaction for learning (see for a review Ludvigsen & Mørch, 2010), technology that supports interaction through knowledge objects received less attention. Empirical setting, methods and data In the KPE, each group had its own shared workspace. Inside these spaces, students were expected to employ functionalities that supported organization and management of the collaborative process (i.e., task creation and planning functionalities) and iterative developing knowledge objects (i.e., item creation, versions, commenting, linking, sources display through web links, linking and chatting). We collected a rich set of data, consisting of: a) interaction data; b) knowledge objects, both produced in KPE or during fieldwork and c) reflection data. The analyses include frequencies of individual contributions to the collaborative work, coding of groups' interactions, and a detailed analysis of knowledge object development and iterations by one group.

Findings

Results indicate that groups employed different strategies to organize their work – division of labor was frequent. In terms of object development, there are a number of aspects that stand out. Co-construction moments occurred in some groups' work, such as discussing ideas and concepts, and then following up and materializing these ideas into iterations of the objects. Elaboration of object sections was often done individually, and the outcomes were placed in the group's shared space, where the other group members could read it and provide it with feedback. However, some groups had difficulties to collaboratively expand their knowledge on the matter and to build on it together, or to concretize this knowledge into the objects in-progress. Most recurrent situation in these groups was that ideas were discussed but not taken-up and not materialized. In these groups, mutual feedback and revisions on iterations of the objects were less common. Of the 20 participating groups 17 used the shared work spaces provided in KPE. Groups that employed co-construction strategies registered were also registered to be most active in using KPE, and received a positive final assessment of their final product by their tutor. Majority of groups used the shared spaces to store and organize their knowledge objects. Twelve of the groups used the Process view and task creation functionalities to plan and organize their collaboration, and reported on these functionalities as being good support for this purposes. The types of items mostly created were document files, web links (to online sources), and comments on document versions. Twelve groups used the system to visualize versioning of their knowledge objects, and indicated this functionality as supporting well the work on the knowledge object. To conclude, these results show that most students became engaged in co-constructing shared knowledge objects, but individual elaboration and strict division of labor without much feedback on object iterations occurred too. Theoretical and practical implicationsThe study indicates that the challenging task of managing and constructing knowledge objects and the use of complex web-based technological support suits students who are able to employ productive strategies, but that other students need more intensive support and scaffolds. Hence, these findings call for attention to students' understanding this pedagogical setting and of technology; also, to how these types of designs can provide a more clear scaffolds for students when entering the knowledge co-construction process. Furthermore, more focused studies are needed especially on how tools can support collaborative elaboration.

References

Ludvigsen, S. & Mørch (2010). Computer-Supported Collaborative Learning: Basic Concepts, Multiple Perspectives, and Emerging Trends. In E. Baker, P. Peterson & B. McGaw, *International Encyclopedia of Education*, 3rd Edition. Elsevier. Paavola, S., & Hakkarainen, K. (2005). The knowledge creation metaphor – An emergent epistemological approach to learning. *Science & Education*, 14, 535-557. Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press.

Modeling professional practices and object-bound collaboration - a higher education customer project

Hanni Muukkonen, University of Helsinki, Finland; Kari Kosonen, University of Helsinki, Finland; Minna Lakkala, University of Helsinki, Finland

The rapidly evolving knowledge practices of present professional settings generate novel demands for education. The knowledge creation approach to learning (Paavola et al., 2004; Hakkarainen et al., 2004) provides theoretical background to address learning and teaching organized around authentic problems and the development of shared knowledge objects. The investigation examined a higher education course involving students and teachers from 3 study programs and 4 customer companies. The students worked in 11 teams of 3-6 members to produce and iterate business ideas and plans, user stories, mock-ups, project reports, software applications and service concepts. The

teachers and customers were involved in weekly steering group meetings around the advancement of teams' business solutions and applications. The processes of two student teams were followed intensely. The Knowledge Practices Environment (KPE) was the main virtual collaboration environment in the course. As an outcome of the process, students generated several software applications and service concepts ready for further exploitation. The students faced difficulties related to focusing their business plans and coordinating the engagement and practices of students with multiple domain backgrounds. The customers and teachers facilitated especially turning attention to end-user needs and explaining the team's ideas to potential clients of their business solution. Similar collaboration and knowledge creation challenges have been reported in relation to global virtual teamwork in professional practices. Such a course appears, therefore, to provide a valuable experience resembling professional practices of teamwork.

Introduction

The rapidly evolving knowledge practices of present professional settings generate novel demands for education. The knowledge creation approach to learning (Paavola et al., 2004; Hakkarainen et al., 2004) provides a theoretical background to address learning and teaching organized around authentic problems and the development of shared knowledge objects, such as reports, products, and new practices. This approach highlights those aspects of social interaction and artefact-mediated activities, which focus on the development of shared objects in addition to the pursuit of personal learning and collaborative discourse interaction. The present study examines a higher education course which involved students, teachers, and customers in a complex tryout of knowledge creation. Multidisciplinary student teams from three degree programs, media engineering, industrial management, and communication, were asked to develop a business idea and make it happen for real. Teachers from these degree programs and customers from four companies were participating in the process for six months. Students were provided with various analytical, reflective and managerial documents (Omicini & Ossowski, 2004) that functioned as templates. The documents were intended to promote professional practices and object-bound knowledge creation (Eckert & Boujut, 2003; Ewenstein & Whyte, 2009; Paavola & Hakkarainen, 2005). We investigated how these documents and related guidance from teachers and customer representatives contributed to student teams' advancement in their projects. The advancement was expected to manifest itself in the produced business ideas and plans, user stories and mock-ups as well as in the management of workflow and project reporting, creation of functioning technical solutions, and communication with potential end-users. Three research questions were posed: 1. How the analytical, reflective and managerial documents were iterated (starting from templates); 2. How the various collaboration tools were used and what kind of mediation for joint activities they provided in the teams; 3. What kinds of questions and comments the teachers and customers provided in the weekly mentoring sessions and how this feedback was observed to influence the knowledge objects developed by the teams?

Research methods

A total of 50 students from 3 study programs of the Helsinki Metropolia University of Applied Sciences participated in the course. The Knowledge Practices Environment (KPE) software was used as the shared environment of the course, but student teams utilized several tools for their teamwork (e.g., GoogleDocs, Dropbox and project planning tools) in parallel. The course was one of the Finnish test sites in the EU-funded Knowledge Practices Laboratory project (KP-Lab; see <http://www.kp-lab.org>). An intensive follow-up of two multidisciplinary student teams was carried out. The following data were collected: video recordings of teacher and customer guidance during the weekly steering group meetings from the two intensively followed teams, as well as weekly self-reports on project advancement and KPE data on the versioning of central knowledge objects developed by all teams. Interviews with teachers, and the students and the customer representatives of the two teams were conducted at the end of the course, including questions about the use of the collaboration tools, team functioning, and the advancements of team productions.

Qualitative data analysis of the video recorded steering group sessions was carried out to examine what the mentoring focused on. A second qualitative content analysis focused on the progress reports and major editions found in the project documentation. The results of these two analysis were compared to gain an understanding of how the comments were observed to influence the iteration of knowledge objects. Further, a thematic examination of the interviews provided evaluations of the strengths and weaknesses of the course design, the tools used, and reflections on the process and its outcomes. Findings The templates provided a starting point for project documentation. Teams faced difficulties related to learning how to focus their business plans and to coordinate the engagement and practices of students with multiple domain backgrounds. The customers and teachers facilitated especially turning attention to end-user needs and explaining the team's ideas to potential clients of their business solution. Work on the intermediate documents and their versioning in conjunction with related guidance resulted in considerable changes in the successive versions of the business ideas and software applications in the two investigated teams. Three teams were actually able to accomplish all the steps involved in designing and implementing a software application and engaging clients for their business, which was in fact beyond the teachers' initial expectations. Most other teams accomplished either the application or acquiring the client, which was also major achievement. Several

teams used the KPE, which enabled the student teams to organize their sub-tasks visually as well as explicate the iteration of versions and interdependencies between diverse intermediate documents. Comparison of tool use is in progress. Theoretical and practical implications.

The findings suggest that the teams were faced with demands for efficient practices in analytical business procedures, work flow management, and coordination and communication with the customer representatives and potential clients. Similar collaboration and knowledge creation challenges have been reported in relation to global virtual teamwork in professional practices (compare Faraj & Sproull, 2000; Hyysalo, 2005). Such course with an assignment to produce business solutions for real customers appears, therefore, to provide students with a valuable experience resembling professional practices of teamwork. Based on the results, we encourage pedagogical design to include shared knowledge objects and modelling of professional knowledge practices in various forms.

References

- Eckert, C., & Boujut J.-F. (2003). The role of objects in design co-operation: Communication through physical or virtual objects. *Computer Supported Cooperative Work*, 12, 145–151.
- Ewenstein, B., & Whyte, J. (2009). Knowledge practices in design: The role of visual representations as 'epistemic objects'. *Organization Studies*, 30, 7-30.
- Faraj, S., & Sproull, L. (2000). Coordinating expertise in software development teams. *Management Science*, 46, 1554-1568.
- Hyysalo, S. (2005). Objects and motive in a product design process. *Mind, Culture, and Activity*, 12, 19-36.
- Omicini, A., Ossowski, S. (2004). Coordination and Collaboration Activities in Cooperative Information Systems. *International Journal of Cooperative Information Systems*, 1, 1-7.
- Paavola, S., & Hakkarainen, K. (2005). The knowledge creation metaphor – An emergent epistemological approach to Learning. *Science & Education*, 14, 535-557.

Making use of artefacts in processes of open-ended inquiry

Christoph Richter, Christian-Albrechts-Universität zu Kiel, Germany; Heidrun Allert, Christian-Albrechts-Universität zu Kiel, Germany

In this work we focus on the utilization of artefacts in processes of open-ended inquiry. We investigate the affordances different kinds of artefacts provide and how they are appropriated by project teams in higher education. Even though the importance of shared artefacts for learning and knowledge creation has been emphasized by various scholars, the affordances of different kinds of artefacts and their materiality in processes of open-ended inquiry has hardly been investigated yet. This contribution presents an empirical study on the creation and utilization of various kinds of artefacts by project teams working on a design task over the period of one semester, making use of the Knowledge Practices Environment. We analyzed both the artefacts created and used by the project teams, as well as the kind of activity they were used in. Findings show that the same kind of artefact can be used in quite different ways, depending on the purpose it is used for, but also the inherent affordances and properties of the artefact itself. The careful selection of the type of artefact to be used but also the tools to create and work with these artefacts hence appears to be crucial in fostering processes of open-ended inquiry. Implications for the design of future collaborative learning environments are discussed.

Introduction and Theoretical Considerations

This contribution focuses on creating and utilizing artefacts in processes of open-ended inquiry. We investigate how project teams create and make use of various kinds of artefacts in order to solve complex design tasks. We examine how different kinds of artefacts are used at different stages of the inquiry process and how their utilization is shaped by the properties of the artefacts chosen. Even though the importance of shared artefacts for learning and knowledge creation has been stressed by various scholars (e.g. Stahl, 2006; Bereiter, 2002) and is also at the core of the KP-Lab project, the affordances and materiality of different kinds of artefacts in processes of open-ended inquiry has hardly been investigated yet. While shared artefacts have been studied as means for grounding and coordination of collaborative efforts, their potential role as objects of joint exploration and inquiry is only poorly conceptualized and understood. Building on the work of Gedenryd (1998) and Knuutilla (2005) we conceptualize artefacts as dynamic entities, which can fill multiple roles depending on the type of activity they are used in, while yet being constrained by their material and sign-related properties. Rather than treating artefacts as mere representations or carriers of information and ideas, we are particularly interested in their material and sign-related qualities with regard to fostering and impeding their utilization for epistemic processes. From a pedagogical perspective artefacts are particularly interesting as they provide important means to scaffold and support but also to monitor learning processes. Therefore a better understanding of the properties of artefacts and their utilization for different activities can provide for better guidance in the complex endeavour of open-ended inquiry.

Empirical setting, methods and data This study was carried out in a project-based course at the University of Applied Sciences in the bachelor program "Communication and Knowledge Media". In a compulsory first-year bachelor course, project teams of 3-6 students were asked to develop an educational scenario drawing on existing web 2.0 technologies. The course was meant to promote an understanding of design as a process of open-ended inquiry. All in all 26 students in 8 teams took part in the study. To support the design process students were introduced to Knowledge Practices Environment as well as a variety of techniques and design artefacts to document their understanding of the design space at stake. Typical design artefacts included journey frameworks, conceptual models of the design space, various types of prototypes for probing as well as reports.

The set of data used for this study consists of: a) project-logs on students' activities filled in by each team, b) periodic interviews with the teacher on her intentions and experiences with the different interventions, c) retrospective group interviews with each team at the end of the course, d) log files from KPE and VME, e) artefacts and documents uploaded or linked to KPE. The analysis is focused on the contents of the various artefacts and the kind of activities they were created in and used for.

Results

Even though the design task and instructions have been the same for all groups, we found considerable differences in the overall flow of activities as well as in the utilization of the design artefacts. While most of the artefacts used can be directly traced back to the assignments given, we also found artefacts such as a dedicated project plan or a questionnaire for market analysis introduced by the teams themselves. The introduction of these artefacts is reportedly due to team-members prior practices and project experiences. Despite these variations in the types of artefacts used we also found differences in the way the same kind of artefact has been used by different groups. For example, some groups used the journey frameworks as a means to record and synthesize their ideas about user needs while other teams used the journey frameworks as a probe to depict envisaged usage scenarios and tried to enact these scenarios themselves. Similarly, prototypes were found to be used as means to describe and communicate ideas on the user interface level, to explore different design options but also to test for usability problems and probe experiences. The way the artefacts are used appears at least partly due to the particular kind of material chosen. Tool use turned out to be heavily dependent on the actual tasks at hand. While the KPE was primarily used to collect, document, and organize, links, notes, and documents, as well as to create visual models of the design space, most other artefacts were created by third party tools such as In design, MS Word and Excel but also pen, paper and scissors to create prototypes. It is obvious that students like to use flexible tools such as Word and paper-based notes, as they can easily edit, reuse, and share the artefacts created.

Theoretical and practical implications

The result of this study suggest, that processes of open-ended inquiry draw on a multiplicity of artefacts each of them providing unique affordances and constraints. Besides its content, the epistemic use of an artefact is also shaped by its material and sign-related properties. From a pedagogical perspective it appears important to be sensitive to the way these artefacts are appropriated by the students and the actual purpose(s) they are used for. From the perspective of tool development, these findings point to a major limitation of collaborative learning environments currently available. While existing collaborative learning environments usually provide a broad array of functionalities to share, comment, and trace resources as well as documents, they are often quite restricted in their capability to collaboratively create and work with artefacts beyond text, conceptual models and or simple sketches.

References

- Bereiter, C. (2002). *Education and Mind in the Knowledge Age*. Mahwah: Lawrence Erlbaum.
- Gedenryd, H. (1998). *How Designers Work: Making Sense of Authentic Cognitive Activities*. PhD-thesis. Lund University.
- Knuuttila, T. (2005). *Models as Epistemic Artefacts: Toward a Non-Representationalist Account of Scientific Representation*. PhD-Thesis. University of Helsinki, Helsinki, Finland.
- Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press.

SYMPOSIUM

The Performative Realisation of Competence in Asian and Western Mathematics Classrooms

Chairperson: Yoshinori Shimizu, University of Tsukuba, Japan

Organiser: David Clarke, University of Melbourne, Australia

Discussant: Minoru Ohtani, Kanazawa University, Japan

The three papers in this symposium employ different analytical approaches to the study of the performative realization of competence in Asian and Western mathematics classrooms. Comparison across such culturally-disparate sites poses powerful questions regarding the way in which competence is conceived, promoted and performed by both teachers and students. All three studies make use of the extensive data set generated by the Learner's Perspective Study (LPS). Data generation conformed to a common research design focused on sequences of at least ten lessons, documented using three video cameras, and supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews (Clarke, 2006).

Each paper exploits the capacity of international comparative analyses to generate insights into local assumptions regarding competent practice. The first paper uses teacher questioning in two classrooms in Germany and Japan to draw significant distinctions between the function of questioning in the two classrooms and the connection between competent practice and the encompassing culture. In the second paper, it is suggested that distinct discourses exist in any cultural setting in and about the mathematics classroom and that both discourses frame the nature of classroom participation for participants in different cultural settings. The final paper examines didactical situations in Sweden and the Philippines and exploits this particular activity to reveal differences and similarities in the practices of competent teachers in both cultural settings and to call into question the application of the same analytical construct at the level of both the whole class and the small group.

Competent teachers in different cultures: An analysis of teacher's questioning in the mathematics cl

Yoshinori Shimizu, University of Tsukuba, Japan; Yuka Koizumi, University of Tsukuba, Japan

Mathematics teaching is situated in a specific cultural setting and has evolved in ways that are valued in that culture (Stigler & Hiebert, 1999). Consequently, a "competent" teacher can be valued and conceptualised in different ways in different cultures. This paper reports an analysis that explored the characteristics of the mathematics classrooms taught by experienced teachers in Germany and Japan, who were identified for their locally-defined 'teaching competence'. The analysis focused on teacher's questioning at the phase of introducing mathematical concepts and found that there are great similarities in the teacher's questioning with respect to the same goal in each of the German and Japanese classrooms. In both classrooms, however, the significant difference between the German and Japanese lessons was found that the German teacher developed a procedure employing the elicitation-response sequence, while the Japanese teacher utilised a time period between posing a task and sharing and discussing the solution. Therefore, the teachers' questions were seemingly similar, but, in fact, the meanings to the questions for the student were different. The result of the analysis reveals that the enactment of competence for the same purpose can be different in each educational setting.

The study reported in this paper analyzed two mathematics lessons that were collected in Learner's Perspective Study (LPS, Clarke, Keitel & Shimizu, 2006), taught by experienced teachers who were identified for their locally-defined 'teaching competence'. One class was on simultaneous equations in a public junior high school in Tokyo (J3), and the other was on complex mathematical expressions in gymnasium in West Berlin (G2). These lessons were selected to minimize the differences in teaching method that arise because of differences in the content, and also because "algebra" is regarded as important learning content in each country. The particular lessons were selected because they involved introducing mathematical concepts and they were located at a critical point in the lesson sequence in each classroom.

The procedure for analyzing the teacher's questioning in G2 and J3 consisted of the following: (1) identifying the episode that starts with posing or formulating a task that is related to learning new things for the student and ends with some tasks for practice, (2) segmenting the transcript into the parts related to the mathematical topic taught in the lessons, and (3) comparing the teacher's questioning in those episode. The tasks treated in J3 and G2 have similarities in the way that students were asked to transform expressions to a previously-learned form.

The results of our analysis reveal that there were great similarities in the teachers' questioning between the Japanese and the German classrooms, while the things that the students were afforded by the teachers' questions were different. In both the German and Japanese lessons, the teacher asked the students for a suggestion about the solution, and then developed the solution of the problem based on the students' responses. However, a significant difference between the German and Japanese lessons was that the German teacher developed the procedure in an "elicitation-response" sequence, while the Japanese teacher used an extended time period between posing a task and sharing and discussing the solution.

The similarities in classrooms between Germany and Japan identified by the TIMSS 1995 videotape study were corroborated in that both the German and the Japanese teachers developed the lesson by incorporating students'

response into classroom process at the phase of learning new things. In particular, there were quite similar conversations in which the teachers asked students about strategies and concrete calculating processes. On the other hand, there were discrepancies in that the G2 teacher constituted the learning process through the teacher's and students' conversation after presenting the tasks, while the J3 teacher set individual activity after presenting the task and then conducted a discussion based on the things generated in the individual activity.

For that reason, the things that the teacher's questions required of the student were superficially similar, but the functions for the German students were to guide and cue students to think about the current task in the G2 lesson, while the teacher's questions functioned for Japanese students as reminders of the things that they generated in the individual activity in the J3 lesson.

Based on the comparison of the feature of the teacher's questioning, it emerged that the G2 teacher broke the task into small parts, focused on each step and aimed to develop a more general procedure, while the J3 teacher expected the students to find a strategy and solution through individual activity and questioning was intended to promote the students' individual activities and to look back on what processes they generated.

The mathematics teachers in each education system participating in LPS were identified for their locally-defined 'teaching competence' and for their situation in demographically diverse government schools in major urban settings (Clarke, 2006). Applying the same definition of teaching competence across countries would misrepresent local practice. Local criteria included such things as status within the profession, respect of peers or the school community, or contributing to teacher professional development programs. Comparative analyses, such as the one reported here, illustrate what is valued as quality mathematics teaching in each education system, as well as revealing the cultural values behind what can be counted as quality mathematics teaching in different contexts.

References

- Clarke, D. (2006). The LPS research design. In D. Clarke, C. Keitel & Y. Shimizu (eds.) *Mathematics Classrooms in Twelve Countries: The Insider's Perspective*. Rotterdam: Sense Publishers.
- Clarke, D., C. Keitel & Y. Shimizu (eds.) (2006) *Mathematics Classrooms in Twelve Countries: The Insider's Perspective*. Rotterdam: Sense Publishers.
- Stigler, J.W. & Hiebert, J. (1999) *The Teaching Gap*. New York: NY, Free Press.

The Cultural-Specificity of Accomplished Practice: Contingent Conceptions of Excellence

David Clarke, University of Melbourne, Australia

Of the contingencies relevant to any consideration of excellence in education, cultural norms and values are arguably among the most significant. Both classroom discourse and professional discourse about classrooms constitute forms of social performance undertaken within affordances and constraints that can be both cultural and linguistic. The nature of those discourses performed in mathematics classrooms provides a key indicator of pedagogical principles underlying classroom practice and the theories of learning on which these principles are implicitly founded. The discourses about mathematics classrooms give expression to these pedagogical principles sometimes explicitly and sometimes through embedding privileged forms of practice in the naming conventions by which the mathematics classroom is described. Research will be reported to suggest that each of these discourses is culturally and linguistically specific. As a consequence, conceptions of accomplished practice (or excellence) are contingent on the history of custom and insight embedded in the conventions of practice and the language with which that practice is described. In the same way that the differential promotion of fluency in spoken mathematics in different classrooms around the world enacts a different classroom mathematics, teachers, other educators, and researchers in different countries have at their disposal very different linguistic tools by which to conceptualise, theorise about, and research the mathematics classroom. International comparative research offers significant insights about how excellence in mathematics education might be performatively realised both in our classrooms and in our discourse about those classrooms.

In this paper, excellence in mathematics education is examined through consideration of conceptions of "accomplished practice." Research is reported that examines the accomplished practice of students and of teachers. In this research, the role of students' "spoken mathematics" is employed as a point of comparison between the performances valued and promoted in mathematics classrooms in different countries. Other research, also reported here, has examined the professional vocabulary available to mathematics teachers to describe their practice and the events of the classroom. One of the consequences of the international adoption of English as the lingua franca of educational research is that the international community of researchers, theoreticians and practitioners has only limited access to many sophisticated, technical, classroom-related terms in languages other than English, which might

otherwise have contributed to our understanding of classroom instruction and learning. An unnamed activity will be absent from any catalogue of desirable teacher actions and absent from the analyses of classroom researchers.

Our capacity to discuss and theorise classroom practice is critically dependent on the pedagogical vocabulary at our disposal. The extent and sophistication of this vocabulary varies greatly from language to language. If a teacher action can be named, then its occurrence can be identified and its contribution to classroom practice and learning examined. Actions considered as essential components of the teacher's repertoire in one country: for example, *kikan-shido* (Japan), *esclarece duvidas* (Portugal) or *jiang ping* (China), may be entirely absent from any catalogue of accomplished teaching practices in English.

The differences that we find in discourse about the mathematics classroom are also evident when we consider discourse in the mathematics classroom. Mathematics learning can be conceptualised in terms of participation in forms of social practice, where discourses form key components of that practice. Contemporary advocacy regarding desired forms of discursive practice in mathematics classrooms has become particularly strident. This advocacy derives from a valuing of mathematical classroom discourse as the means to effective learning, but also from a valuing of mathematical discourse as a major learning outcome in its own right. Both forms of advocacy, however, appear to be based entirely on research conducted by western researchers in western settings.

Comparative studies that include both Western and Asian classrooms have demonstrated that the instructional practices of teachers in classrooms in different cultures are predicated on pedagogies that privilege different forms of student action and these pedagogies appear, in turn, to be based on very different theories of learning. Our research into the practices of classrooms must draw on (and contribute to) theories that accommodate culture as one essential aspect of the situated nature of learning, rather than ignoring the pervasive role of culture in framing our attempts at theorizing. The need to safeguard against the unintended insularity of our theorizing suggests a key role for international research consortia that share a common research purpose but combine culturally diverse perspectives in the interpretation of research data and the consequent process of theory generation.

Judgements of what constitutes accomplished practice in mathematics classrooms can be considered in two broad categories. The simplest category presumes the existence of a consensus concerning the characteristics of good practice and the capacity to recognise performances aligned with this consensus. The second category is predicated on the warrant for the first: accomplished practice is identified with the achievement of valued outcomes. It is the contention of this paper that culture enters into the consideration of both categories: both through the culturally-situated nature of the valued outcomes by which accomplished practice is empirically identified; and, through the evolution of the practice itself, which must reflect cultural values regarding acceptable modes of classroom communication.

It is worth noting that the emphasis in this paper is on practice, not on the attributes of individuals. For example, much has been written on the knowledge needed to teach mathematics effectively. Ultimately, however, any such knowledge must be performatively realised through classroom practice. For the purposes of this paper, the entry point is discourse, and we have at least three levels of discourse to consider in classroom research: (i) the discourse of the classroom, as practiced in situ by the participants; (ii) the discourse about the classroom, as utilised by teachers and others to describe and reflect on the classroom; and (iii) the discourse of the researcher, in which particular constructs guide data generation, selection, configuring, interpretation, analysis and reporting. Each form of discourse represents the culmination of an evolving educational tradition and each form of discourse can constrain, frame, influence, and even determine the performative realisation of teaching competence in each mathematics classroom.

Adidactical situations in mathematics classrooms in Sweden and the Philippines

Jonas Emanuelsson, The University of Gothenburg, Sweden; Florenda Gallos Cronberg, University of Gothenburg, Sweden

In this study, analysing data materials from the LPS-project (Clarke, 2006), we provide analytical descriptions of competent teaching as enacted in Philippine and Swedish classrooms. The analysis draws upon Brousseau's idea of adidactical situations in mathematics classrooms (Brousseau, 1997).

In mathematics education research, many exemplary teaching practices in mathematics classrooms have been studied. However, it is often argued the perspectives of learners are not often scrutinized in the analyses and that

little has been learned from research about what teachers can do in order to support classroom discourses (Franke, Kazemi and Battey, 2007).

Results show that these competent teachers organized didactical situations in different ways, yet these ways of organizing are apparently suited to their respective class sizes and availability of resources. Also, learners' reasoning skills were evident in classrooms of both countries, although not in a huge number of cases. Some students showed skills in convincing their seatmates of the correctness of their mathematical statements using mathematical arguments and not relying on calculators or the authority of their respective teachers. Another result was that it was problematic to adopt the framework of didactical situations when considering the whole class as a unit of analysis during these situations.

The Learner's Perspective Study (LPS) is an in-depth study examining the patterns of participation in mathematics classrooms of locally nominated competent teachers in sixteen countries (Clarke, 2006). Didactical situations in mathematics occur when students are assumed to have agreed to work on the mathematical tasks on their own until they arrive at answers and where the teacher refrains from interfering (Brousseau, 1997). Competent teachers, as locally defined, from the Philippines and Sweden are expected to teach differently because of issues that might be related to language use, class size, availability of resources etc. What is meant by the phrase "competent teacher" may also differ in different local communities. Students working by themselves in mathematics classrooms without the teacher interfering is in Sweden an often occurring and much criticized way of organising teaching. This particular way to teach seems partly chosen by pedagogical reasons partly based on a rational based in time and hence cost effectiveness. In the Philippines, due to constraints related to the huge number of students in the classroom teacher exposition might sometimes be regarded as the most manageable way.

In the field of mathematics education research, many exemplary teaching practices in mathematics classrooms have been studied. However, it is often argued that in these studies the perspectives of the learners are not often scrutinized in the analyses and that little has been learned from research about what teachers can do in order to support classroom discourses, especially on learners mathematical argumentation (Franke, Kazemi and Battey, 2007). Researchers from the Philippines have already analyzed such data on private conversations among students (Gallos Cronberg, 2010; Gallos, 2006) and researchers from Sweden have made studies on mathematical conversations (Emanuelsson & Sahlstrom, 2008; Liljestrand & Runesson, 2006). These studies form one base for further analysis, this time looking into the ways students validate or provide mathematical arguments among themselves during didactical situations and into the ways the teachers handles such situations.

In this study, we aim to provide contrasting analytical descriptions of competent teaching as a situated practice that is enacted in different, but still competent ways, as defined in the respective local context. The situations chosen for comparison are didactical situations. The present study mainly uses a non-emergent qualitative research design and draws upon Brousseau's idea of didactical situations in mathematics classrooms.

Results show that these competent teachers organized didactical situations in different ways, yet these ways of organizing are apparently suited to their respective class sizes and availability of resources. Also, learners' reasoning skills were evident in classrooms of both countries, although not in a huge number of cases. Some students displayed mathematical skills in convincing their seatmates of the correctness of their mathematical statements using mathematical arguments and not only relying on calculators or the authority of their respective teachers. Another result was that it was problematic to adopt the framework of didactical situations (Brousseau, 1997) when considering the whole class as a unit of analysis during these situations. When analysing smaller groups of students working cooperatively the concept of didactical situations is more appropriate.

References

- Brousseau, G. (1997). *Theory of didactical situations in mathematics, 1970-1990*. Dordrecht: Kluwer.
- Clarke, D. (2006). The LPS research design. In D. J. Clarke, C. Keitel & Y. Shimizu (Eds.), *Mathematics classrooms in twelve countries. The insider's perspective* (LPS Book series Vol. 1, pp. 195-208). Rotterdam (Netherlands): Sense Publishers.
- Emanuelsson, J., & Sahlstrom, F. (2008). The price of participation- How interaction constrains and affords classroom learning of mathematics. *Scandinavian Journal of Educational Research*, 52(2), 205-223.
- Franke, M., Kazemi, E., & Battey, D. (2007). Mathematics teaching and classroom practice. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (Vol. 1, pp. 225-256). Reston, VA: National Council of Teachers of Mathematics.

Gallos Cronberg, F. (2010). Engaging students with mathematical tasks in a large class. In Y. Shimizu, B. Kaur, R. Huang & D. J. Clarke (Eds.), *Mathematical tasks in classrooms around the world* (LPS Book series Vol. 3, pp. 63-86). Rotterdam (Netherlands): Sense Publishers.

Gallos, F. (2006). Students' private discourses in Philippine classrooms: An alternative to teacher's classroom discourse? In D. J. Clarke, C. Keitel & Y. Shimizu (Eds.), *Mathematics classrooms in twelve countries. The insider's perspective* (LPS Book series Vol. 1, pp. 195-208). Rotterdam (Netherlands): Sense Publishers.

Liljestrand, J., & Runesson, U. (2006). Interaction, organisation, tasks and possibilities for learning about mathematical relationships: A Swedish classroom compared with a US classroom (Vol. 2). Rotterdam (Netherlands): Sense Publishers.

SYMPOSIUM

Motivation, Conceptual Change, and Complexity: How do Hot Factors Impact Learning of Complex Topics

Chairperson: Gale Sinatra, University of Nevada, Las Vegas, United States

Organiser: Suzanne H. Broughton, Utah State University, United States

Gale Sinatra, University of Nevada, Las Vegas, United States

Discussant: Barbara Hofer, Middlebury College, United States

Learning about science topics often involves a process of conceptual change, or the restructuring of one's existing knowledge to align with the scientific perspective (Vosniadou, 2002). Complex science topics such as biological evolution, emergent systems, and climate change, will likely require the learner to undergo conceptual change as they come to learn about these dynamic systems (Chi, 2008). Such complex topics may be challenging for the learner as they grapple with understanding the scientific explanation. These topics may elicit strong emotional reactions, such as anxiety and frustration that may, in turn, influence the conceptual change process. The recent warming trend (Sinatra, 2005) in conceptual change research provides an avenue for examining the influence of hot factors, including motivation and emotions, when learning about complex problems. An international panel of researchers exploring hot constructs (i.e., interest, goal orientation, and emotions) in relation to complex problems and conceptual change will present the findings of their empirical research.

Complex Problems and Interest: A Comparison of Problem-Based, Lecture-Based, and Self-study Formats

Sofie Loyens, Erasmus University Rotterdam, Netherlands; Jeroen Mikkers, Erasmus University Rotterdam, Netherlands

These studies investigated whether working on complex, ill-structured problems is more interesting for students compared to listening to a lecture or reading a text individually (i.e., self-study). Situational interest was measured three times (i.e., pre-test, post-test immediately after the instruction, and a follow-up after one week) across two topics: evolutionary theory (Study 1) and Newtonian laws (Study 2). Participants were randomly assigned to the problem-based learning, the lecture-based or the self-study condition. Results of both studies were similar: There was a significant decrease of situational interest over time in all three conditions and no significant interaction effects between time and instructional format. The nature of the topics is put forward as a possible explanation for these results.

One of the goals of student-centered instructional formats such as Problem-Based Learning (PBL) is to make students intrinsically motivated to learn (e.g., Hmelo-Silver, 2004). To foster this goal, students in PBL work on complex, ill-structured problems before they receive any other curriculum input. Ill-structured problems are problems that can be solved in multiple ways or, in case they cannot be solved, need to be understood in terms of their underlying mechanisms. These problems are therefore especially appropriate for eliciting discussion (Otting & Zwaal, 2006). They also better represent problems encountered in daily life and are, thus, more realistic. Working on problems is therefore believed to be engaging and interesting for students.

Empirical evidence for these claims is, however, scarce. The present studies investigate whether working on ill-structured problems is more interesting for students compared to listening to a lecture or reading a text individually (i.e., self-study). More specifically, students' situational interest is examined across three instructional formats: PBL, lecture, and self-study.

Situational interest is triggered by certain stimuli in the environment and implies short-term involvement (Hidi & Renniger, 2006; Mason, Gava, & Boldrin, 2008). It refers to the present state of interest in terms of focused attention and affect (Hidi & Renniger, 2006) and can be captured by text- (e.g., a text's vividness and coherence), task- (i.e., readers' approach of the text), and knowledge-based (i.e., prior knowledge) factors (Schraw & Lehman, 2001). These

factors underline that situational interest is context-dependent. Therefore, the present studies were carried out in two different domains: evolutionary theory (Study 1) and Newtonian laws (Study 2).

Previous research within a PBL environment has shown that situational interest increased after the presentation of a complex problem (Rotgans & Schmidt, in press). However, this study could not answer the question whether complex problems are better able to increase interest in students compared to other instructional formats. Given the robust finding that interested learners are more likely to master a topic (e.g., Krapp, Hidi, & Renninger, 1992; Renninger, Ewen, & Lasher, 2002; Schraw & Lehman, 2001), it is important to investigate interest in relation to instructional formats.

It is hypothesized that complex problems can increase students' situational interest because these problems have characteristics that are believed to promote interest. Because these problems describe a realistic, puzzling situation, often related to students' future professional practice, they can be considered vivid. Problems also consist of a coherent text, addressing one issue at a time. As mentioned, vividness and coherence are important factors within situational interest (Schraw & Lehman, 2001).

Method

Participants

71 psychology students participated in Study 1 and 77 different psychology students in Study 2. All participants were randomly assigned to one of the three instructional formats.

Materials

Situational interest was measured by 10 items that had to be rated on a 5-point Likert scale, varying from 1 (not at all true for me) to 5 (totally true for me). This test was designed by Rotgans and Schmidt (in press) and is based on the four-phase model of interest (Hidi & Renninger, 2006). This test was administered three times to each participant. For Study 1, Cronbach's alpha was .77 (pre-test), .83 (post-test), and .79 (follow-up). For Study 2, Cronbach's alpha was .75 (pre-test), .86 (post-test), and .73 (follow-up), reflecting good internal consistency.

Procedure

In all three conditions, participants started with filling in the pre-test and ended with the post-test. Time on task was equal (i.e. 60 minutes). In the PBL-group, a complex problem was then presented with a discussion about evolutionary theory (Study 1) or falling objects such as jumping from a swing (Study 2). In order to activate prior knowledge, students discussed possible explanations of the problem. Unresolved issues were formulated as learning issues. Subsequently, they received a study text about evolutionary theory (Study 1) or Newtonian laws (Study 2) in which answers on the issues could be found. After studying the text, students discussed the text and answered the learning issues. The meeting was guided by a tutor, who stimulated the discussion if necessary (Schmidt, Loyens, Van Gog, & Paas, 2007).

In the lecture-based condition, students entered an auditorium where the experimenter started a lecture about evolutionary theory (Study 1) or Newtonian laws (Study 2).

Participants in the self-study group were tested in a lab-room. Then, participants studied the text about evolutionary theory (Study 1) or Newtonian laws (Study 2).

In all three conditions, students came back 7 days later to take the follow-up-test.

Results and Discussion

Table 1 depicts mean interest scores across conditions in both studies.

Table 1: Mean and standard deviations in parentheses for situational interest

Repeated measures analyses showed a significant effect for time [$F(2,65) = 36.334$, $p < .001$]. Similar results were found in Study 2: A significant effect for time was found [$F(2, 67) = 47.205$, $p < .001$]. Students' situational interest decrease over time is not surprising given its temporary nature (Schraw & Lehman, 2001) and previous research (Rotgans & Schmidt, in press). The fact that complex, ill-structured problems are not better able to promote situational interest was unexpected. A possible explanation could lie in the nature of the complex problems used. They were designed for these studies and were not part of the psychology curriculum, which might have lowered their appeal. The lower scores for the problem on Newtonian laws compared to evolutionary psychology could be an indication for this explanation. Further research is needed in this respect.

Emotions and Misconceptions about Complex Topics in Science

Suzanne H. Broughton, Utah State University, United States; Reinhard Pekrun, University of Munich, Germany;
Gale Sinatra, University of Nevada, Las Vegas, United States

Learning in science classrooms is a complex and dynamic process that involves both cognitive and affective components (Pintrich, Marx, & Boyle, 1982). Over the past several decades, social psychologists have investigated the relationship between cognitive processing and emotions at a general level (Lazarus, 1982; Rosenberg, 1998). More recently, researchers have begun to explore emotions related specifically to academic contexts (Pekrun, Goetz, Titz, & Perry, 2002).

The aim of this exploratory study was twofold: First, to investigate which emotions may be present when learning about three specific controversial topics in science: climate change, genetically modified foods, and airport body scanners. Second, to identify which misconceptions may be commonly held by individuals in relationship to these three topics. Graduate students enrolled in a research methods course from a southwestern US university participated in the study. Participants completed individual interviews and related topic emotions surveys. Emotions reported as moderate to strong were: anxiety, curiosity, interest, frustration, and confusion. Curiosity and interest increased in intensity across each topic from pre- to post-interview. A variety of misconceptions were reported across each topic. For example, misconceptions for causes of climate change included weather changes and extreme seasons. This suggests that participants may not understand differences between changes in weather patterns and deep-time climate change. The present results confirm that controversial topics in science such as climate change and GMFs may spark strong emotional reactions from learners, especially when students hold misconceptions about such topics. Emotions such as curiosity, interest, and anxiety may influence conceptual change learning.

Learning in science classrooms is a complex and dynamic process that involves both cognitive and affective components (Pintrich, Marx, & Boyle, 1982). Over the past several decades, social psychologists have investigated the relationship between cognitive processing and emotions at a general level (Isen, 2008; Lazarus, 1982; Rosenberg, 1998). More recently, researchers have begun to explore emotions related specifically to academic contexts.

For example, Pekrun and colleagues (2002; 2006) have investigated emotions students may experience while attending class, studying for class, and taking exams, defining these emotions as academic emotions. Academic emotions include positive and negative emotions such as enjoyment, anxiety, frustration and boredom. Positive emotions may increase motivation and foster creative learning strategies, while negative emotions such as boredom may exert the opposite effect, dampening motivation and promoting superficial cognitive processing (Pekrun, 2006). However, some negative emotions, including anger and anxiety, may increase motivation to avoid failure and facilitate analytical, detail-oriented styles of processing information.

Previous research on academic emotions has focused on the influence of emotions at a general level across a range of disciplines including mathematics (Frenzel, Pekrun, & Goetz, 2007) and psychology (Pekrun, Daniels, Goetz, Stupinsky, & Perry, 2010). Few empirical studies have investigated the emotions experienced by students when learning about specific topics, including controversial topics in science.

Learning science topics often involves a process of conceptual change, which occurs when the student's prior knowledge conflicts with the scientific viewpoint (Chi, 2009). In these situations, the learner must revise their prior knowledge to align with the scientific explanation. Recent models of conceptual change include an affective component. For example, the Cognitive Reconstruction of Knowledge Model (Dole & Sinatra, 1998) suggests that change is less likely to occur when the learner has a strong emotional commitment to their prior beliefs. Although these models acknowledge emotions as a factor of conceptual change, it is yet to be understood which emotions may facilitate change and which emotions may impede that process.

The aim of this exploratory study was twofold: First, to investigate which emotions may be present when learning about three specific controversial topics in science: climate change, genetically modified foods (GMFs), and airport body scanners. Second, to identify which misconceptions may be commonly held by individuals in relationship to these three topics. We selected these topics based on pilot study data.

Method

Participants Graduate students (n=10) enrolled in a research methods course from a southwestern US university received extra credit for participating. Participants ages ranged from 23 to 58 years (M=31.07, SD=10.82) and were primarily female (70%), White (70%), and in their first year of their Master's program (60%).

Procedures and Materials

Participants completed individual interviews that lasted approximately 35 minutes each. During the interviews, participants completed a topic emotions survey followed by the topic-related interview. Next, participants completed the topic emotions post-survey. The purpose of the post-survey was to investigate whether topic emotions may have changed as a result of the interview and, if so, in what direction. Participants also completed a Demographics survey.

The Emotions about Climate Change survey consisted of 12 topic emotions based on Pekrun et al.'s (2002) taxonomy of academic emotions. These emotions are listed in Table 1. Participants rated the level of each emotion experienced on a scale of 1 (not at all) to 5 (very strong). The Emotions about Genetically Modified Foods survey and the Emotions about Airport Body Scanners survey each consisted of a similar format.

The Conceptions about Climate Change interview consisted of seven open-ended questions. A sample item is, "Do you think the earth's climate is changing? Why or why not." The purpose for these questions was to explore participants' understanding of climate change and to identify any existing misconceptions.

The Conceptions about Genetically Modified Foods interview also consisted of seven open-ended questions. An example item is, "What are genetically modified foods?" Our goal was to uncover participant's existing conceptions about GMFs, including misconceptions.

The third interview survey, Conceptions about Airport Body Scanners, consisted of nine open-ended questions intended to uncover participant's conceptions related to airport body scanners. A sample item is, "What does the Transportation Safety Administration official see when examining the graphic produced by body scanners?"

Results

Emotions

A range of emotions were reported in relation to the three science topics (Table 1). Emotions that were reported as moderate to strong, by topic, were: Climate change: anxiety, curiosity, interest, frustration; GMFs: anxiety, curiosity, interest, fear, confusion; and Airport body scanners: curiosity, interest. Climate change and GMFs had the greatest variety of topic emotions as well as the highest level of intensity of those emotions. Curiosity and interest increased in intensity across each topic from pre- to post-interview.

Interview data

Content analysis was conducted on participant interviews to identify which misconceptions were present for these science topics (Table 2). Examples of misconceptions for causes of climate change included weather changes, extreme seasons, and more natural disasters. This suggests that participants may not understand differences between changes in weather patterns and deep time climate change. Misconceptions about greenhouse gases included: greenhouse gases come from plants, consist of all the pollutants in the air, and come from carbon monoxide.

Misconceptions of GMFs included cloned animals, cloned fruits and vegetables, and processed foods. Participants also stated that GMFs were those that had been given hormones to increase growth, size, and production. These responses suggest that participants held the belief that scientists are primarily responsible for GMFs but participants did not acknowledge that GMFs can also occur through natural processes.

Participant misconceptions about the graphic image produced by airport body scanners included bone structure, tissue, and not seeing inside the body.

Conclusion

Science learning is a complex process involving both cognitive and affective factors. The present results confirm that controversial topics in science such as climate change and GMFs may spark strong emotional reactions from learners, especially when students hold misconceptions about such topics. Emotions such as curiosity, interest, confusion, and anxiety may influence conceptual change learning. Future research is needed to investigate the impact of emotions on conceptual change.

To Master Or Perform? Exploring Relations Between Achievement Goals and Conceptual Change Learning

Krista Muis, McGill University, Canada; John Ranelucci, McGill University, Canada; Melissa Duffy, McGill University, Canada; Xihui Wang, McGill University, Canada; Lavanya Sampasivam, McGill University, Canada; Gina Fraco, McGill University, Canada

We examined relations between achievement goals, use of deep versus shallow processing strategies, and conceptual change. Seventy-three undergraduate students were assessed on their prior knowledge and misconceptions about Newtonian Mechanics, and then reported their achievement goals and participated in think aloud protocols while reading Newtonian physics texts. Results revealed that a mastery-approach orientation negatively predicted shallow processing strategies, positively predicted deep processing strategies, but did not predict conceptual change or recall. In contrast, a performance-approach orientation did not predict processing strategies, but negatively predicted conceptual change, whereas a performance-avoidance goal orientation negatively predicted deep processing strategies. Moreover, deep and shallow processing strategies positively predicted conceptual change and recall. Results are discussed in relation to Dole and Sinatra's (1998) Cognitive Reconstruction of Knowledge Model.

Introduction

Given the negative effects misconceptions can have on subsequent learning, researchers have called for a conceptual change approach to addressing students' misconceptions (diSessa et al., 2004). Conceptual change involves the restructuring of existing knowledge structures and the integration of new information into memory (Sinatra, 2005). Recently, researchers have noted that "conceptual change in the affective domain, particularly involving interests and motivation has had limited attention" (Treagust et al., 2008, p. 300). In particular, Pintrich et al. (1993) called for more research that investigates "hot conceptual change" by including "personal, motivational, social and historical processes" (p. 170) in relation to conceptual change research. The present study aims to advance understanding of the role of achievement goals in conceptual change.

Theoretical Frameworks

Achievement goals explain the motives for behaviours in achievement activities (Ames, 1992). Under the trichotomous framework (Elliot & Church, 1997; Pintrich, 2000), individuals adopt performance-approach, performance-avoidance, or mastery goals. Learners who adopt a mastery orientation are motivated to develop competence and master the material. In contrast, learners who adopt a performance-approach orientation strive to demonstrate their ability to others. Finally, a performance-avoidance orientation is characterized by learners who fear failure or looking incapable.

The literature has generally found support for the positive outcomes associated with mastery-approach goals (e.g., use of deep processing strategies) and negative outcomes associated with adopting performance-avoidance goals (e.g., use of shallow-processing strategies) (Elliot & McGregor, 2001; Senko & Miles, 2008). Although consistent patterns have been found with these two goal orientations, results have been mixed for performance-approach goals. They have been found to relate to negative outcomes (Elliot & McGregor, 1999) and positive outcomes (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). Although a considerable number of outcomes have been examined in relation to achievement goal theory, there is a paucity of research on its relationship with conceptual change.

We adopted the Cognitive Reconstruction of Knowledge Model (CRKM; Dole & Sinatra, 1998) of conceptual change. Key to conceptual change under this model is depth of cognitive engagement (Dole & Sinatra, 1998). For change to occur, one's level of engagement must be high on the continuum, which involves "deep thinking and processing of the information and reflection on one's progression through the process" (Dole & Sinatra, 1998, p. 125). Dole and Sinatra note that researchers have largely ignored the role that engagement plays in conceptual change. Consequently, they advise that further studies explore the role of motivation and depth of processing on conceptual change to advance research in this area. Our study responds to this call.

Current Study

With the exception of Linnenbrink and Pintrich's (2002) study, little research has examined the relationship between conceptual change and achievement goal orientation. Linnenbrink and Pintrich conducted two studies to investigate conceptual change in students' comprehension of Newtonian physics. They found that mastery goals were related to conceptual change, whereas performance-approach goals were not related to conceptual change. They also investigated the mediating role of affect, self-reported depth of processing, and metacognitive strategy use to explore relations between these constructs. Results indicated that mastery-approach goals were positively related to increased depth of processing, and a decrease in negative affect, which predicted greater conceptual change. Despite these findings, theorists have identified issues with relying solely on self-report measures of learning (e.g., Winne, Jamieson-Noel, & Muis, 2002). To address this, Winne et al. (2002) suggested researchers use data about actual studying events recorded while learners study. Our study addresses this issue by exploring relations between achievement goals, depth of processing, and conceptual change learning in the context of learning about Newton's Laws of physics using refutational text and a think aloud protocol.

Method

Seventy-three undergraduate students (N = 57 females) participated in the study. The Patterns of Adaptive Learning Scale (PALS, Midgley et al., 2000) was used to measure students' goal orientations. A coding scheme was created to assess participants' think-aloud comments for evidence of deep and shallow processing. The Force Concept Inventory (Hestenes, Wells, & Swackhamer, 1992) was used to assess students' prior knowledge and misconceptions relating to Newtonian physics. Recall achievement was measured by asking participants to recall as much as they could from the text. Two science texts were used to increase amount of processing. The science texts consisted of refutational passages adapted from Kendeou and van den Broek (2007), which were initially based on a college-level physics textbook (Hewitt, 2002). Participants were tested individually in a laboratory setting.

Results

A path model was conducted. Our hypothesized model resulted in a poor fit, $\chi^2 = 112.40$, $df = 8$, $p < .001$. We removed non-significant paths, tested for mediation, and reran the model. No mediation was found. The subsequent model resulted in the best fit, $\chi^2 = 229.21$, $df = 8$, $p < .001$. Specifically, mastery goal positively predicted deep strategies (.23), shallow strategies (.15) and conceptual change (.16). In contrast, performance-approach goal did not predict the processing strategies, but negatively predicted conceptual change (-.20) and recall (-.19). Performance-avoidance goal negatively predicted deep strategies (-.11) and recall (-.28). Moreover, as predicted, deep processing strategies positively predicted conceptual change (.38) and recall (.39). Interestingly, shallow processing strategies also positively predicted conceptual change (.33) and recall (.27), but not to the same extent as deep processing strategies.

Discussion

Consistent with Dole and Sinatra's (1998) CRKM, the more that learners engaged in deep processing of the information, the more that conceptual change occurred. However, the moderately positive relationship between shallow processing and conceptual change was not predicted. Rather, the CRKM predicts that shallow processing will result in weak or no conceptual change. In contrast, the magnitude of the relationship between shallow processing and conceptual change indicated that an indiscriminate amount of conceptual change took place in relation to depth of processing. To explain this, we present one plausible reason. Specifically, it is possible that the refutational nature of the information presented in the text was very powerful, and thus reduced the importance of depth of processing. If participants were able to clearly identify the dissonance between their held conceptions and the new conceptions that were introduced, then level (shallow or deep) of processing may not have been a particularly important factor. We further elaborate our results and theoretical implications in the full paper.

SYMPOSIUM

Teaching Motivations in Different Countries: Comparisons using the FIT-Choice scale

Chairperson: Helen Watt, Monash University, Australia

Organiser: Helen Watt, Monash University, Australia

Discussant: Paul W. Richardson, Monash University, Australia

Researchers from different contexts, experiencing problems of teacher shortage, discuss findings concerning teachers' motivations and perceptions, using data yielded by the FIT-Choice scale (Factors Influencing Teaching Choice; Watt & Richardson, 2007; Figure 1). Grounded in expectancy-value theory, the scale provides an integrated, theoretically guided, psychometrically sound framework. It was developed and validated in the Australian context; this symposium offers the possibility to examine how and why teaching motivations are similar or different across settings.

Berger and D'Ascoli (Paper-1) examine VET teachers' motivations, in German and French speaking parts of Switzerland; they further derive motivational profiles to discover 5 distinct groups. Fokkens-Bruinsma and Canrinus (Paper-2) in the Netherlands, measure FIT-Choice factors among preservice teachers commencing training, and, subsequent relationships with planned effort, involvement, professional commitment and self-efficacy at completion of teacher education. Taimalu, Luik, Voltri and Kalk (Paper-3) from Estonia, explore preservice and first-year teachers' motivations and perceptions.

The scale appeared robust across samples and settings. Perhaps surprisingly, highest rated motivations were similar (perceived teaching ability, intrinsic value, social utility value); the same applied to least important motivators (fallback career, dissuasion, social influences). In contrast, perceptions about the profession were more variable, presumably due to actual differences across settings. Extensions within studies, such as motivational profiles in Paper-1, longitudinal correlates in Paper-2, shed further light on sources and consequences of teaching motivations. Paul

Richardson's expert commentary highlights commonalities and particularities in light of sociocultural variations, poses fruitful directions for further research, and implications for attracting and sustaining new teachers.

Motivational profiles of Swiss VET teachers and trainers using the FIT-Choice framework

Jean-Louis Berger, Swiss Federal Institute for Vocational Education and Training, Switzerland; Yannick D'Ascoli, Swiss Federal Institute for Vocational Education and Training, Switzerland

Teacher shortage is a problem many European countries are currently facing for multiple reasons. In Switzerland, there is a lack of attractiveness of the occupation of VET teachers or trainers and thus a problem of ageing (39% of the VET teachers are over 50 years old). Hence, an important question concerns the motivations of people who choose to become VET professionals after several years of practice in a specific occupation. The present study aims at analyzing the motivations to become VET professional using a person-centered analysis to uncover motivational profiles. The FIT-Choice framework and scales were translated and adapted to the study context. Using cluster analysis, five groups were identified based on the motivations of 605 VET teachers and trainers from both the German and French speaking parts of Switzerland. Groups were then described regarding their socio-demographic characteristics, their beliefs about the profession, and their job satisfaction. Results indicated significant differences between profiles in terms of socio-demographic characteristics, suggesting for example that part-time VET teachers tend to adopt a different motivational profile from full-time VET teachers. Additionally, adoption of a motivational profile has implication for beliefs about teaching and training in VET, as well as for job satisfaction. On the contrary, pedagogical beliefs did not differ among the profiles. The results suggest that VET teachers and trainers may adopt five specific motivational profiles and that these are associated with several variables important for their career. Implications of the results for the FIT-Choice framework and for education will be discussed.

Teacher shortage is a problem many European countries are currently facing (OECD, 2005). In Switzerland, the occupation of VET teacher or trainer (VET professionals) suffers from a lack of attractiveness and, consequently, a problem of ageing (39% of the VET teachers are over 50 years old; FSO, 2010). Hence, an important question concerns the motivations of people who choose to become VET professionals. These people decided to leave either partly or completely their former profession to become, in the same professional domain, teachers for apprentices. In fact, understanding what drives people toward teaching in VET is of utmost importance both for the quality and the management of the VET system. Little information is however available on this topic. In particular, the motivations and beliefs of these people, which have important implication for involvement and commitment to the profession (Watt & Richardson, 2007), are rarely investigated. The present study aims at analyzing the motivations to become VET professional using a person-centered analysis to uncover motivational profiles. Furthermore, between-profile differences in socio-demographic characteristics, satisfaction with the choice of a career in teaching, antecedent socialization constructs, and beliefs about the occupation are investigated.

Theoretical Framework

For our research purpose, the FIT-Choice model was adapted according to the specificities of the VET Swiss system. Items from the FIT-Choice scales were translated from the original English version to German and French and some scales were removed or added. For example, because of its inadequacy to the study context, the scale fallback career was replaced by a scale assessing how much the choice of the career was done simply because the opportunity was present (a quite frequent phenomenon in Swiss VET teachers). Moreover, two scales (from the Teaching and Learning International Survey; OECD, 2009) regarding pedagogical beliefs were included to evaluate to what extent participants held beliefs oriented toward a constructivist or a classical conception of teaching (called direct transmission).

Method

Participants were 605 in-service VET professionals (467 VET teachers and 138 VET trainers) from the German (n = 413) and French (n = 192) speaking parts of Switzerland, two linguistically but also culturally different regions. All the participants had first trained in a professional field as apprentices and practiced for several years before beginning a (second) career as VET teachers or trainers; they teach profession-specific knowledge. The sample consisted of all those who were undergoing training at the Swiss Federal Institute for Vocational Education and Training during Spring 2010 in order to get a diploma or certificate as VET professionals. The FIT-Choice scales were administered (as part of a larger survey) by research personnel during a class period. The survey was pretested on a sample of 144 VET professionals to check the relevance of the items and the quality of the translation.

Results and discussion

Confirmatory factor analyses were first conducted to assess the equivalence of the translated scales with the original ones. Scales mean scores were then computed. Considering the whole sample, intrinsic career value, perceived teaching ability, and social utility value were the dimensions rated as the most important in the choice of a career as

VET professional (akin to Watt & Richardson, 2007). Contrarily, personal utility value, dissuasion, and social influences were rated as the least significant dimensions. The sample may however be heterogeneous, and consist of several subgroups differing in their combinations of motivations. Therefore, a two-step clustering method was employed in order to determine if there were subgroups and their number. The scores on five of the motivation to teach scales (intrinsic career value, ability, social utility value, personal utility value, and opportunity) were introduced to construct motivational profiles as they are considered the fundamental expectancy and value components of the framework. A five-cluster solution was selected based on statistical arguments, interpretability of the solution, and adequate size of the clusters. Based on their mean scores, the clusters were named respectively:

C1: "Low intrinsic career value, aptitudes, & social utility" (n = 51); C2: "High intrinsic career value & low opportunity" (n = 111); C3: "Low intrinsic career value and aptitudes, high personal utility" (n = 99); C4: "Low personal utility and high opportunity" (n = 172); C5: "Multiple motivations" (n = 170).

The distribution of German vs. French speaking, and type of VET professionals differed among the clusters. The distribution by language suggests a tendency for the German speakers, overrepresented in C2, to be less opportunistic than the French speaking in their choice to become VET professionals. Furthermore, part-time teachers were underrepresented in C5, whereas full-time teachers were over-represented in this same cluster. VET trainers were over-represented in C4. Cluster membership was neither related to age, number of years working with apprentices, nor to diploma level.

The subgroups differed significantly in all beliefs about task demand and task return, but not in their pedagogical beliefs (constructivism and direct transmission). Post-hoc analyses revealed that the participants in C5 perceived teaching as both a more demanding and more rewarding activity than the participants in the other clusters. In contrast, teachers in C1 and C3 had a different perception of teaching: Less demanding but also less rewarding. Satisfaction with the choice of a career in teaching was the most varying variable between clusters with C1 as the least satisfied. Concerning the antecedent socialization constructs, differences were observed in prior teaching & learning experiences and social influences but not in dissuasion.

The cluster analysis revealed that there was not a single motivational profile in VET professionals but five groups with different motivational profiles. Our analysis revealed significant differences in the composition of clusters according to their socio-demographic characteristics and antecedent socialization constructs. Additionally, adoption of a motivational profile has implications for beliefs about teaching and training in VET, as well as for job satisfaction (hence undoubtedly for professional engagement). On the contrary, pedagogical beliefs did not differ among the profiles. Educational and theoretical implications of the results will be discussed.

Motivation to become a teacher in a Dutch university-based teacher training programme

Marjon Fokkens-Bruinsma, University of Groningen, Netherlands; Esther Canninus, University of Groningen, Netherlands

The Netherlands is facing a growing problem of teacher shortage. Dutch politics have acknowledged this as a serious problem, yet implemented actions have not succeeded in countering the shortage (Ministry of Education, Culture, and Science, 2007). According to Sinclair, Dowson, and McInerney (2006), more insight into teachers' motivation for teaching is essential to understand how prospective teachers can be attracted and retained. Sinclair et al. furthermore state it is important to attract students with the "right" motives; these students will be more engaged and committed to their training and profession.

Using the FIT-Choice theory, 187 Dutch university-based preservice teachers' motives to become a teacher were listed. It was investigated how these teachers' motivation for teaching relates to planned effort and involvement, professional commitment, and, additionally, to self-efficacy. Data were collected at the beginning and end of the training programme.

Our findings are comparable to the findings of the Watt and Richardson studies. Teaching abilities, intrinsic career values, and making a social contribution were the motives rated highest by our respondents. Multiple motives were positively related to the preservice teachers' self-efficacy and professional commitment. Fallback career was negatively related to both self-efficacy and factors of professional commitment. This study provides a Dutch perspective on the FIT-Choice factors and gives more information on how motivation to become a teacher influences preservice teachers' planned effort, professional commitment, and self-efficacy. As such it provides us with starting points on how to improve retention during training and in the profession.

The Netherlands is facing a shortage of teachers. Dutch politics have acknowledged this as a serious problem, yet implemented actions have not succeeded in countering the shortage (Ministry of Education, Culture, and Science, 2007). According to Sinclair, Dowson, and McNerney (2006), more insight into teachers' motivation for teaching is essential to understand how prospective teachers can be attracted and retained. Sinclair et al. furthermore state it is important to attract students with the "right" motives; these students will be more engaged and committed to their training and profession. In this study we investigate how Dutch preservice teachers' motivation for teaching is related to teachers' planned effort, professional commitment, and, additionally, to their self-efficacy.

Our conceptual framework starts from the perspective of the Factors Influencing Teaching Choice (FIT-Choice) model (Watt & Richardson, 2007). They developed a detailed theoretical model on the motivation to become a teacher and specified five sets of constructs that are important to the decision to become a teacher: socialization influences, perceptions of the task, perceptions of one's abilities, values, and teaching as a fallback career. Teachers' planned effort and involvement are included as outcome variables in the FIT Choice model.

The FIT-Choice framework is used to relate teachers' motivation for teaching to their professional commitment. Meyer, Allen, and Smith, (1993) distinguished three factors of professional commitment: 'affective commitment' (in terms of positive emotions towards the profession and a strong desire to remain in the profession), 'normative commitment' (in terms of the feeling of obligation to remain in this profession), and 'continuance commitment' (in terms of being aware of the costs of leaving the profession).

Furthermore, we relate the FIT-Choice factors to teachers' self-efficacy, which concerns beliefs concerning a person's capacity for bringing about the desired learning outcomes even when pupils are difficult or unmotivated (Tschannen-Moran & Woolfolk Hoy, 2001). Self-efficacy beliefs have been positively related to perceptions of relevance of teacher preparation, to enthusiasm for teaching, to commitment to teaching, to wellbeing, and, importantly, to retention in teaching (Aelterman, Engels, Van Petegem, & Verhaeghe, 2003; Rots, Aelterman, Vlerick, & Vermeulen 2007;).

Our study aims to answer the following research questions: What are Dutch university-based preservice teachers' main motives to become a teacher? How are these teachers' motives to become a teacher related to teachers' planned effort, involvement, professional commitment and self-efficacy?

Methodology

Data were collected as a part of a longitudinal project at the University of Groningen in the Netherlands. A sample of 187 university-based preservice teachers (58% female; mean age=25.2 years) completed a questionnaire in October 2009. Their motivation to become a teacher, beliefs about teaching and engagement was measured by a Dutch version of the FIT-choice questionnaire (Watt & Richardson, 2007). Preservice teachers' self-efficacy was measured by Friedman and Kass' (2002) questionnaire, and professional commitment was measured by an adaptation of Meyer et al.'s (1993) questionnaire.

Findings

Analyses indicated that the highest rated motives for the group were: teaching abilities, intrinsic career values, and making a social contribution. This result is in line with the findings of Watt & Richardson (2007; Richardson & Watt, 2006), who additionally found that the motives shaping the future of children and working with children were important. Our results also coincide with those of Bastick (2000) who also found the need to make a difference to students and society as an important theme. Other researchers have indicated these types of motives as relevant as well (Brookhart & Freeman, 1992). Choosing the teaching profession as a fallback career or based on social influences were two motives that were found to be least important for the preservice teachers. Again, this corresponds with Watt and Richardson's (2007) and Richardson and Watt's (2006) findings.

The motives work with children, make a social contribution, job transfer, intrinsic career value, enhancing social equity, and ability were positively related to teachers' self-efficacy. Fallback career was negatively related to teachers' self-efficacy. Both beliefs about teaching as an expert career and a career with a high social status and motives such as teaching abilities, intrinsic career values, and working with children were positively related to affective commitment. The more importance teachers ascribed to these motives and beliefs, the higher their desire to remain in the profession. Fallback career was negatively related to affective commitment. Whenever preservice teachers had chosen the teaching profession as a fallback career, their desire to remain in the profession was low. The relationships with continuance commitment were less clear. Social influences and fallback career were positively related to continuance commitment. In contrast to our expectations, fallback career was positively related to normative commitment as well. We found that both motivation to become a teacher, in terms of social influences, job security,

making a social contribution and beliefs about teaching in terms of salary were positively related to normative commitment.

Similar to the Watt and Richardson 2007 study, we found the motives intrinsic career values, shape future, work with children, teaching abilities and fallback career to be related to planned effort in the profession. We also found that the beliefs about teaching as an expert career were related to planned effort. In contrast to the Watt and Richardson study we found enhancing social equity and make social contribution, both social utility values, to be related to planned effort. The Watt & Richardson (2007) study also examined relationships with involvement in the profession. Similar to their study, we found positive relationships between intrinsic career value, shape future, job transfer, teaching ability, fallback career and involvement. The beliefs about teaching as an expert career and a career with a high social status were also positively related to involvement.

Theoretical and educational significance This study contributes to the theoretical development of the motivation to become a teacher. It provides a Dutch perspective on the FIT-Choice theory and gives more information on how motivation to become a teacher influences preservice teachers' planned effort, professional commitment and self-efficacy. As such it provides us with starting points on how to improve retention during teacher training and in the profession.

Teaching Motivations among Teacher Trainees and First-Year Teachers in Estonia

Merle Taimalu, Tartu University, Estonia; Piret Luik, University of Tartu, Estonia; Olivia Voltri, University of Tartu, Estonia; Karmen Kalk, University of Tartu, Estonia

In Estonia there has been, and still is, a quite critical situation in the popularity of teaching and the social status of the profession. At the same time we have shortage of young teachers. Among young people's occupational preferences teaching has been among the least preferred occupations (Krips, Taimalu, Luik, & Kukemelk, 2009). Many young graduated teachers do not remain in the teaching profession, but, choose some other job, or quit after only a few years of teaching. Therefore it is important to find how to increase the motivations to teach, among students and beginning teachers. Before that, it is necessary to investigate what motivates those people who have chosen to become a teacher. Our presentation gives an overview of teaching motivations among teacher trainees and first-year teachers. The sample consisted of 107 respondents from 2 Estonian universities. Items from the FIT-Choice Scale (Watt & Richardson, 2007) were selected (26 motivation items, 12 perceptions about the profession items), which comprised 7 motivation factors and 4 perception factors, similar to those developed by the scale authors. The highest motivations in the teacher career choice were found to be teaching ability, intrinsic career value, work with children/adolescents and shaping the future of them, enhance social equity, prior teaching and learning experiences, and job security. For the perceptions about the profession the highest means found for expertise and difficulties, and satisfaction with choice.

Teachers' motivations influence their students, and hence the processes, quality and outcomes of learning (Butler & Shibaz, 2008). Motivations for choosing to teach vary, including a desire to work with children and adolescents and the potential for the job to provide for intellectual fulfilment (OECD, 2005; Watt & Richardson, 2007), positive self-evaluation of their capabilities to be teachers (Richardson & Watt, 2006; Sinclair, 2008), salary, job security, and career status (Watt & Richardson, 2008).

Teaching is a challenging, and therefore, often stressful job. As in Australia we have the similar problem in Estonia, of negative representations of teachers' work in the mass media, political ideology, and shifts in public opinion, all impacting on the popularity and reputation of teaching as a career choice (Richardson & Watt, 2006). In Estonia, the situation has become critical over the last decade, where only few students enrol in teacher training programs, and only one-third of graduates enter into the profession (Ots et al., 2008). Many teachers are older than 55 years (Statistics, 2009). Among young people's occupational preferences, teaching has been among the least preferred (Krips, Taimalu, Luik, & Kukemelk, 2009). It is therefore important to find ways to increase the teaching motivations of students and beginning teachers. Before that, it is necessary to investigate what motivates those people who have already chosen to become a teacher.

Aims

We aim to give an overview of teaching motivations among teacher trainees, and teachers in their first year in Estonia, and contrast those results with previous findings using the FIT-Choice scale.

Sample

Our target populations were teacher trainees during the start of their teaching practice, and first-year teachers at the start of their first year, from preschool, elementary and secondary school teacher curricula. In Estonia, the first year of teaching is an "induction year", during which they need to develop a teaching portfolio, and participate in university meetings and seminars, while they are beginning teachers. The teacher trainees were sampled from Tartu University in the 2010/2011 academic year, and, the first-year teachers from Tallinn University. The total sample was 107 respondents from these 2 universities (mean age 26.7 years; 21 teacher trainees and 86 first-year teachers; 106 women and 1 man, reflecting the highly feminised profession in Estonia). The response rate was 100%.

Methodology

We used the FIT-Choice Scale (Watt & Richardson, 2007) with selected items (26 motivation items, 12 perceptions about the profession items) to investigate teachers' and teacher trainees' motivations and perceptions. We translated all items into Estonian, and discussed the comprehensibility of each within the research team. Some items were left out because of obscurity in the Estonian context. After translation a pilot study was carried out with 41 teacher trainees and first year teachers in Spring 2010. According to respondents' comments some items were reworded for better clarity, and some more items left out.

Analyses and findings concerning teaching motivations

We used exploratory factor analyses (PCA with varimax rotation) to find the structural pattern of teaching motivation according to our sample. We identified 7 motivation factors, similar to the scale authors (Watt & Richardson, 2007):

1. Ability and intrinsic career value combined ($\alpha=.80$; these were 2 separate factors in the FIT-Choice Scale);
2. Work with children/adolescents, shaping the future of children/adolescents, and enhance social equity combined ($\alpha=.82$; these were 3 separate factors contributing to a higher-order factor in the FIT-Choice Scale);
3. Time for family and income ($\alpha=.78$; these were 2 separate factors in the FIT-Choice Scale);
4. Prior teaching and learning experiences ($\alpha=.79$);
5. Social influences ($\alpha=.74$);
6. Job security (single item);
7. Fallback career (single item).

For the perceptions about the profession, we found 4 factors similar to the scale authors:

1. 1. Expertise and difficulty combined ($\alpha=.55$; these were 2 separate factors contributing to a higher-order factor in the FIT-Choice Scale);
2. 2. Social status and salary combined ($\alpha=.64$);
3. 3. Workload and high morale ($\alpha=.19$)
4. 4. Satisfaction with choice ($\alpha=.94$)

Scale means were computed for averaged composites. The highest motivations for choosing teaching as a career were teaching ability, intrinsic career value, work with children/adolescents and shaping the future of them, enhance social equity, and prior teaching and learning experiences; similar to previous studies elsewhere (Watt & Richardson, 2007). In contrast to prior studies, job security was also rated high. The lowest motivators were fallback career and social influences, similar to previous findings. The highest means for perceptions about the profession were for expertise and difficulties; lowest assessments were for the social status of the profession and salary. Yet, satisfaction with choice was high; a pattern also noted previously (Richardson & Watt, 2006).

The most important motivators seem to be universal across several different cultures. Social influences (e.g., family's and friends' opinion) did not substantially impact on young people's career choice; these beginning teachers made their decisions on the basis of other motivators. It seems somewhat surprising that although participants rated the demanding nature and difficulties of the teacher profession high, they remained satisfied with their career choice. The lowest values of social status and salary are expected results in the Estonian context, where teachers do not feel themselves valued by society, and where the teaching profession offers sustained, but quite low income.

Limitations

The study offers important first indications of Estonian beginning teachers' motivations and perceptions about the profession, using an established scale which allows opportunities to interpret findings in relation to other settings. Our continuing study will add cohorts to increase the sample size, follow cohorts longitudinally through their early years teaching, and, administer the full scale rather than selected items which do not allow the possibility to make exact comparisons with findings elsewhere.

SYMPOSIUM

Mathematics education in pre-school years

Chairperson: Franziska Vogt, Pädagogische Hochschule des Kantons St. Gallen, Switzerland

Organiser: Franziska Vogt, Pädagogische Hochschule des Kantons St. Gallen, Switzerland

Discussant: Elisabeth Moser Opitz, Institut of Educational Research, Switzerland

In early childhood education, children develop fundamental mathematical understanding. This development depends not only on characteristics of the individual child but also on the stimulation of the learning environment at home and in pre-school. The symposium aims at bringing together empirical papers researching mathematics education for children aged 3 to 7 years in order to determine how mathematics can best be fostered. The Finnish contribution examines motivational characteristics of the child and the impact of parents' engagement in teaching their child mathematics. Children with lower mathematical skills and with higher task avoidance are being taught more intensely by their parents, this, however, does not support their motivation. The German contribution is based on extended video-based observational data on children in open play settings. The selected research results show on the one hand which semiotic resources children use to express their mathematical ideas and on the other hand, how early childhood educators could foster mathematical understanding without using an instructional training program but in enhancing the play activities on offer. The Swiss contribution is based on an intervention study comparing the effects on mathematical skills for five years old children in kindergarten of a training program and a play-based approach. The results show a significant effect on the mathematical competency for the play-based approach but not for the training program. The three research papers conceptualize core elements of mathematics education in pre-school: interaction, play and motivation.

Children's mathematical skills, task-avoidant behaviour, and parents' involvement in kindergarten

Riikka Hirvonen, University of Jyväskylä, Finland; Kaisa Aunola, University of Jyväskylä, Finland; Jari-Erik Nurmi, University of Jyväskylä, Finland

Besides cognitive factors, children's learning at school can be influenced by more dynamic phenomena, such as motivation and achievement-related task-avoidant behaviour. The present study examined the developmental dynamics of task-avoidant behaviour and mathematical skills from kindergarten to Grade 2, and the role of parents' education and parents' teaching of mathematics in this relationship. A total of 217 children were tested for their mathematical skills in kindergarten, Grade 1, and Grade 2. Children's task-avoidant behaviour in learning situations was rated by their teachers. Parents' educational level and their teaching of mathematics were assessed in kindergarten and Grade 1. The results showed that children's task-avoidant behaviour predicted lower skills in mathematics, and on the other hand, low skills in mathematics predicted task-avoidant behaviour. Parents' educational level was positively related to their children's performance in mathematics, whereas parents' teaching of mathematics was related to children's lower skill level.

Background

The importance of motivation and related classroom behaviour in the development of academic skills is well recognized (Wigfield & Cambria, 2010). Students' achievement-related behaviours have been found to contribute to the development of their mathematical skills (e.g., Aunola, Nurmi, Lerkkanen, & Rasku-Puttonen, 2003; Kikas, Peets, Palu, & Afanasjev, 2009). Less research has been carried out on the extent to which previous math learning experiences contribute to subsequent achievement-related behaviours (e.g., Aunola et al., 2003). However, it is reasonable to assume that the relationship between academic skills and achievement-related behaviours is reciprocal. The key idea behind this assumption is that a positive self-concept and beliefs of self-efficacy, originating from previous learning experiences (Wigfield & Eccles, 2000), promote students' expectations of success concerning a particular learning task. These expectations further lead to better motivation, increased effort, and task-relevant behaviour in new learning situations. High effort and task-focused behaviour then provide a basis for successful learning. By contrast, negative self-concepts of ability and low efficacy beliefs, originating from repeated failures in previous learning situations, increase the likelihood of failure expectations. This then leads to low motivation, low effort, and task-avoidant or task-irrelevant behaviour in later learning situations.

Parents' teaching of mathematics to their children is assumed to have an impact on children's mathematical skills (Blevins-Knabe & Musun-Miller, 1996; LeFevre, Clarke, & Stringer, 2002). There is also research showing that behavioural interactions of parents and children while they are working together on tasks are related to children's achievement motivation and behaviours (Hokoda & Fincham, 1995; Salonen, Lepola, & Vauras, 2007). Supportive home environment and parents' involvement can benefit the children both in the form of improved skills, and in the form of improved motivation and achievement behaviours.

Aims

The aims of this study were to examine (1) how children's task-avoidant behaviour and mathematical skills develop reciprocally and simultaneously, and (2) to examine how parents' level of education and their teaching of mathematics to their children relate to the development of skills and task-avoidant behaviours of their children.

Methods

A total of 217 children (105 girls and 112 boys) were tested for their mathematical skills in kindergarten and Grades 1 and 2. Children's task-avoidant behaviour in learning situations was rated by their teachers. Parents' educational level was assessed in the middle of the kindergarten year. Parents also reported how frequently they had taught mathematics to their children during kindergarten and Grade 1. Structural equation modelling was used to examine the relationships between these variables. Separate models were constructed for mothers and fathers, and multi-sample procedures were used to examine differences between girls and boys.

Findings

The results showed, first, that there was a reciprocal relationship between mathematical skills and task-avoidant behaviour from kindergarten till Grade 2. On one hand, task-avoidant behaviour was related to lower skills in mathematics in the subsequent time point, and on the other hand, low skills were related to more task-avoidant behaviour in the subsequent time point. Secondly, mothers' high level of education was predictive of children's good performance in mathematics. Mothers' teaching of mathematics in kindergarten enhanced their children's skills in kindergarten, but in Grade 1 mothers' teaching no longer had benefits for the development of children's skills. Fathers' high level of education also predicted children's good performance in mathematics, whereas fathers' teaching of mathematics in kindergarten and Grade 1 was related to their children's lower skills. Both mothers and fathers adjusted their teaching according to the children's skill level: The lower the child's skills in kindergarten were, the more the parents taught their child during Grade 1. Fathers also reacted to the avoidant behaviour of their sons: The more task avoidance boys showed in kindergarten, the more their fathers taught them in Grade 1.

Theoretical and educational significance

The findings of this study support the assumption of a cumulative cycle in the development of mathematical skills and task-avoidant behaviour: Task-avoidant behaviour is a risk of difficulties in mathematics, which can further lead to more task avoidance. Attention should be paid to how children interpret their performance in learning situations, because negative learning experiences are likely to lead to low efficacy beliefs and failure expectations, which further results in more task-avoidant behaviour and low effort. Parents' role in promoting children's learning of mathematical skills and their achievement motivation seems somewhat controversial. Parents evidently try to help when their children are facing difficulties in learning, but this help does not directly show in the children's performance. Instead of direct teaching of mathematical skills, children might benefit more from their parents' support of interest and motivation in learning of mathematics. Parents' personal attitudes and interest can help the children in developing and maintaining their motivation towards mathematics despite the difficulties they may face.

References

- Aunola, K., Nurmi, J.-E., Lerkkanen, M.-K., & Rasku-Puttonen, H. (2003). The roles of achievement-related behaviours and parental beliefs in children's mathematical performance. *Educational Psychology, 23*, 403-421.
- Blevins-Knabe, B., & Musun-Miller, L. (1996). Number use at home by children and their parents and its relationship to early mathematical performance. *Early Development and Parenting, 5*, 35-45.
- Hokoda, A., & Fincham, F. D. (1995). Origins of children's helpless and mastery achievement patterns in the family. *Journal of Educational Psychology, 87*, 375-385.
- Kikas, E., Peets, K., Palu, A., & Afanasjev, J. (2009). The role of individual and contextual factors in the development of maths skills. *Educational Psychology, 29*, 541-560.
- LeFevre, J.-A., Clarke, T., & Stringer, A. P. (2002). Influences of language and parental involvement on the development of counting skills: Comparisons of French- and English-speaking Canadian children. *Early Child Development and Care, 172*, 283-300.
- Salonen, P., Lepola, J., & Vauras, M. (2007). Scaffolding interaction in parent-child dyads: Multimodal analysis of parental scaffolding with task and non-task oriented children. *European Journal of Psychology of Education, 22*, 77-96.
- Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review, 30*, 1-35.
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81.

Early mathematical cognitive development in situations of play and exploration

Rose Vogel, Goethe-University Frankfurt / Main, Germany; Birgit Brandt, Goethe Universität Frankfurt, Germany; Gotz Krummheuer, Institut für Didaktik der Mathematik und der Infor, Germany; Melanie Huth, Goethe-University Frankfurt/Main, Germany; Anna-Marietha Hummer, Goethe-Universität Frankfurt a.M., Germany; Ergi Acar, Goethe-University Frankfurt/Main, Germany

Introduction

In the first three years the long-term study erStMaL (early Steps in Mathematics Learning) focused its research interests on children between the ages 3;6 and their entry into primary school. The overarching goal is to develop a theory of mathematics education concerning children's development of mathematical thinking between the ages four and ten. Particular attention is paid to the developmental stepping-stones of children acquiring mathematical knowledge in German as their second language. With regard to the international discussion in mathematics education an interdisciplinary theoretical framework is chosen. This framework integrates psychological theories of cognitive development, social-constructivist, cultural-psychological, linguistic and semiotic theoretical approaches. From a mathematical perspective an isolated description of separated mathematical domains, such as arithmetic or spatial thinking, is insufficient. Hence for a more extensive description the following mathematical domains were chosen for the erStMaL study: Numbers and Operations, Geometry, Measurement, Pattern and Structure, Data Analysis and Combinatorics (Ginsburg et al. 2004).

Aims

Within the symposium the following aims are central:

What are the multimodal contexts (relationships between spoken language, gesture, actions with material and inscriptions), which appear in mathematical discourses with children?

In kindergarten which concepts of folk pedagogy (Olson & Bruner 1996) become apparent in mathematical situations of play designed by kindergarten teachers?

Methodology

The qualitative study is carried out in 12 day-care centres within urban areas and surrounding. Chosen with respect to socio-economic factors the participating day-care centres show a great variety concerning this matter. Until now 178 children have participated in the study; thereof 120 children are observed at every data collection points within the longitudinal design. 55% of the children learn German as their second language when they enter kindergarten or even earlier. Data collection takes place twice a year and is carried out in the familiar environment of the day-care centres. The settings' central points are the mathematical situations of play and exploration, which especially were developed for data collection in the erStMaL study. Specially trained members of the project's staff carry out these situations. Thriftily placed stimuli in spoken language and through gestures follow the aim to encourage the participating children to act and argue mathematically in the chosen mathematical domain.

Furthermore the kindergarten teachers of the participating day-care centres get the order to design a mathematical situation of play and exploration, which might be interesting for the children.

On the one hand the video data emerging from these situations is analysed with videographic methods (Vogel & Reimann appears 2011) and with interaction and participation analysis on the other hand (Krummheuer 2007).

Results

According to the view, that gesture and speech form a single integrated system (cf. Goldin-Meadow 2003) the previous results show a bridging function of gesture concerning the development of a mathematical terminology as well as concerning the accessibility to the ideas of one's conversational partners (Vogel & Huth 2010). In the same way differences in the modes of expression indicate a possible perspective expansion or rather initiating "conceptual changes" (Huth 2010).

Regarding the situations designed by the kindergarten teachers with their own play and learning material the analysis on the one hand shows the width of the concepts of folk pedagogy in these mathematical situations. On the other hand a professional focus on mathematical aspects within the situations shows the praxis of doing mathematics that is integrated into the praxis of teaching and learning mathematics (Brandt & Tiedemann appears 2011).

Theoretical and educational significance

The previous results form a good basis for the development of a multi-perspective theory of mathematics education concerning early mathematical thinking. The theory exceeds the restriction to one special mathematical domain (arithmetic) and takes the implications of linguistic and cultural diversity as well as multimodal ways of expression into consideration. At the same time the potential of the mathematical situations of play and exploration as an instrument to collect data becomes clear.

Empirically grounded the professional aspects of concepts of folk pedagogy in institutionalised adult-child-interactions (kindergarten and pre-school age) provide a basis for the development of a training and advanced training concept. Such a concept sensitises kindergarten teachers to the relationships between action with material in co-constructivist interaction processes and the associated possibility of professional learning processes.

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References

- Brandt, B. & Tiedemann, K. (2011). Alltagspädagogik in mathematischen Spielsituationen mit Vorschulkindern. In G. Krummheuer (Hrsg.). Frühe mathematische Denkprozesse. Ergebnisse aus dem erStMaL-Projekt. Múnster: Waxmann
- Goldin-Meadow, S. (2003). *Hearing Gesture. How our hands help us think*. Cambridge, Massachusetts, London: The Belknap Press of Harvard University Press.
- Ginsburg, H., N. Inoue, et al. (2004). Young children doing mathematics. Observations of everyday activities. In: J. V. Copley (Hrsg.). *Mathematics in the early years*. Reston, VA, The National Council of Teachers of Mathematics; 88 - 99.
- Huth, M. (2010). Gestik und Lautsprache in mathematischen Gesprächen - multimodale Ausdrucksweisen mathematischer Ideen von Kindern. Beiträge zum Mathematikunterricht. Berichtband von der 44. Tagung für Didaktik der Mathematik in Múnchen 2010.
- Krummheuer, G. (2007). Argumentation and participation in the primary mathematics classroom. Two episodes and related theoretical abductions. In *Journal of Mathematical Behavior*, 26, S.60–82.
- Olson, D. und J. Bruner (1996): Folk psychology and folk pedagogy. In: D. Olson und N. Torrance (Hrsg.): *The handbook of education and human development. New Models of Learning, Teaching, and Schooling*. Blackwell, 9-27.
- Vogel, R. & Reimann, M. (projected). Early mathematical thinking. Instruments to collect and analyze longitudinal data.
- Vogel, R. & Huth, M. (2010). „... und der Elefant in die Mitte“ – Rekonstruktion mathematischer Konzepte von Kindern in Gesprächssituationen. In B. Brandt, M. Fetzer & M. Schütte (Hrsg.): *Auf den Spuren Interpretativer Unterrichtsforschung*. Múnster: Waxmann, S. 177-207.

Games fostering mathematics in kindergarten

Bernhard Hauser, Pädagogische Hochschule SG, Switzerland; Karin Rechsteiner, Pädagogische Hochschule St. Gallen, Switzerland; Rita Stebler, University of Zurich, Switzerland; Franziska Vogt, Pädagogische Hochschule des Kantons St. Gallen, Switzerland

In this intervention study, two approaches to fostering early mathematics are implemented in 35 Swiss Kindergarten: a training program (Krajewski et al 2007) and a newly developed play-based approach are compared with the learning outcomes of a control group. The training program and the play-based early mathematics cover identical learning goals on counting, quantities and numbers and require 24 units of half an hour over 8 weeks. 12 teachers implemented the training program with their class, 11 teachers the play-based early mathematics. Pre- and Post-tests (Moser & Berweger 2009) measuring the numeracy skills of the six years old children show a significant learning gain for the play-based approach compared with the control group, but no significance in the learning outcome of the training program. 47 videographed sequences of children playing the specifically selected and developed games reveal the ways in which a play-based approach can foster mathematical learning. Interviews with the teachers explore the potential and challenges of fostering mathematics in kindergarten – in a context of a controversy over the role of instructional learning in early childhood education.

Introduction

Precursory skills in mathematics are of great importance for future competence (Moser & Bayer 2010). Within early childhood education, foundations for numeracy skills are laid with children exploring quantities, counting and numbers. In order to enhance opportunities for all children, early childhood education needs to foster the acquisition of such precursory skills. Currently, the competence gap at entry into state education of four or five years old children in relation to their home learning environment is not tackled by educators. More effort is needed to enhance mathematics education in early childhood to ensure basic numerical skills for acquiring a quantity-number concept and for grasping number relationships for all children.

For young children, learning through play is essential (Golinkoff 2010; Hauser, 2005). Traditionally, the pedagogy of kindergarten centered on play. However, more recently, several highly structured training programs relying on teacher-directed instruction of the whole group have been implemented in many Swiss kindergartens. The training

program Mengen zählen Zahlen [Quantities, counting and numbers] had significant effects in a study in German kindergartens (Krajewski et al. 2008). Play-based approaches however, have not been yet systematically developed.

Aims

This research project aims at developing a play-based approach to foster mathematics in kindergarten and to compare the effectiveness on mathematical learning outcomes of the play-based approach with a training programme and with a control group.

Methodology

For this project, a play-based approach to early mathematics has been developed. Krajewski's model of mathematical competency development provides the theoretical background of the play-based approach. The play-based approach therefore addresses the same learning goals on counting, quantities and numbers as the training program. Duration has also been controlled: as the training programme has been laid out for 24 units of half an hour over 8 weeks, the play-based approach was set for the same time-frame. After a piloting phase of two months in three kindergartens, a set of twelve games (existing and newly developed) were included in the play-based approach.

For each of the intervention group and for the control group, 12 kindergarten teachers were randomly recruited to take part. Pre-tests included a numeracy test (Moser & Berweger 2007), a cognitive ability test (Moser & Berweger 2004) and a parent's questionnaire on the home learning environment.

Following pre-tests, teachers of the two intervention groups received two days of in-service training. They implemented the training program and the play-based early mathematics in their class. During implementation, two half day teachers' meetings ensured high quality of implementation. Both intervention groups were visited and equally accompanied and a session in each class was video graphed.

After the intervention, teachers were interviewed by an independent researcher and gave their feedback in a questionnaire. Children were tested again using the same numeracy test.

Results

The analysis is based on 324 children in 35 classes. The three groups do not differ with regards to cognitive abilities (ANOVA: $F = 0.652$, $df = 2$, $p = 0.522$) nor with regards to their pre-test numeracy skills (ANOVA: $F = 1.988$, $df = 2$, $p = 0.139$). Learning outcomes of the three groups differ: The two factor analysis of variance with repeated measure indicates a significant interaction effect (time * group: $F = 4.04$, $df = 2$, $p = 0.019$, $\eta^2 = 0.025$ partial η^2). Results from the Scheffé-Test reveal a significant effect between the play-based group and the control group (Delta Mean = -3.33; SD = 1.18, $p = 0.01$) but no significant differences between training and control (Delta Mean = -1.03; SD = 1.11, $p = 0.326$) nor between play-based and training (Delta Mean = -2.03; SD = 1.21, $p = 0.084$). It can be concluded, that the play-based early mathematics is effective in fostering mathematical skills, whereas the training program did not show the expected results.

More detailed analysis on subtests as well as an analysis examining the effects of the interventions for children with high and with low levels of skills at pretest will be presented. Also, the analysis of the qualitative data (video study and interview) will provide an understanding of these effects.

Theoretical and educational significance

Based on the results of this research project, it can be concluded, that a play-based approach, carefully tuned to mathematical development, implemented in a limited choice setting is at least as successful in terms of learning outcome as a training program in whole-group teaching and more effective than the traditional fostering of precursory skills in kindergarten. The play-based approach might also be more compatible with the pedagogy of kindergarten and possibly meets the interests of children better than a teacher directed whole class program. The findings of this research contribute to the debate on the role of play for early childhood education. Teaching in the classroom can benefit from a deeper understanding of the potential of play for early mathematics. In addition, the results are also relevant for policy development.

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References

Golinkoff, R. (2010) The Power of Play. Preparing 21st Century Children for a Global World. Keynote at the Earli Sig 5 Conference in Lucerne, 23.08.2010 http://www.phz.ch/fileadmin/media/earli.phz.ch/Präsentation_Golinkoff_D-EHandout.pdf

- Hauser, B. (2005). Das Spiel als Lernmodus: Unter Druck von Verschulung – im Lichte neuerer Forschung. In: T. Guldemann, & B. Hauser, (Hrsg.). Bildung 4- bis 8-jähriger Kinder. Mönster: Waxmann. 143–168
- Krajewski, K., Nieding, G., Schneider, W. (2007) Mengen, zählen, Zahlen (MZZ). Die Welt der Mathematik verstehen. Koffer mit Fördermaterialien und Handreichungen Cornelsen Verlag.
- Krajewski, K., Renner, A., Nieding, G. & Schneider, W. (2008). Frühe Förderung von mathematischen Kompetenzen im Vorschulalter. Zeitschrift für Erziehungswissenschaft, 10, Sonderheft 11/2008, 91-103.
- Krajewski, K., Nieding, G. & Schneider, W. (2008). Kurz- und langfristige Effekte mathematischer Frühförderung im Kindergarten durch das Programm „Mengen,zählen, Zahlen“. Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 40, 135-146.
- Moser, U. & Bayer, N. (2010) Schlussbericht formative Evaluation Grundstufe/Basisstufe, Bern: Schulverlag.
- Moser, U. & Berweger, S. (2007). Wortgewandt & zahlenstark. Lern- und Entwicklungsstand bei 4- bis 6-jährigen. St. Gallen und Zürich: Lehrmittelverlag.
- Moser, U. & Berweger, S. (2004) LeST 4-7 Zürich: Institut für Bildungsevaluation.

SYMPOSIUM

Brain mechanisms of arithmetic strategies: Implications for education?

Chairperson: Roland H. Grabner, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland

Organiser: Roland H. Grabner, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland

Discussant: Kerry Lee, National Institute of Education, Singapore

Arithmetic strategies have been a major focus of research on mathematics education. There is a vast amount of evidence from behavioral studies that children and adults apply various strategies to solve arithmetic problems and that the successful acquisition of arithmetic skills is typically accompanied by cognitive changes towards more effective and efficient problem-solving strategies. Building upon these findings, cognitive neuroscience studies have recently begun to investigate the brain correlates of these strategies. In this symposium, three studies are presented which not only show how the use of different strategies is reflected in brain activity but which also illustrate ways of how the application of neuroimaging and neurophysiological methods can yield incremental insights to educational theory and practice. An electroencephalography (EEG) study on procedural and retrieval strategies in simple arithmetic provided first neurophysiological evidence for the validity of verbal strategy self-reports which have been controversially discussed in the educational literature. Using functional magnetic resonance imaging (fMRI), a relationship between brain activity and strategy choice in multi-digit arithmetic was found which may shed light on why students persist in using sub-optimal strategies despite being taught more efficient ones. Finally, fMRI data is presented showing that verbal and visual cognitive styles do not influence the engagement of brain areas specialized for number processing, which may explain previous findings of a low correlation between cognitive style and arithmetic performance. The discussion of the symposium will focus on the potential and limitations of applying cognitive neuroscientific methods in educational research on arithmetic strategies.

EEG correlates of arithmetic strategies: Comparing self-reports with the problem size approach

Roland H. Grabner, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland; Bert De Smedt, University of Leuven, Belgium

Research on mathematics education has shown that arithmetic problems (e.g., $6 + 2 =$) are solved with various strategies such as fact retrieval (retrieving the correct solution from memory) or procedural strategies which involve counting or transformation. The applied strategies can be either inferred from the size of the presented problems or from trial-by-trial verbal strategy self-reports. The validity of these self-reports, however, has been repeatedly questioned. The aim of the present electroencephalography (EEG) study was to gain further insights into the brain correlates of arithmetic strategies by applying both research approaches (problem size manipulation and trial-by-trial verbal strategy self-reports) and to evaluate whether the neurophysiological result patterns from both research approaches converge. Twenty adults solved small and large addition and subtraction problems and they indicated the applied strategy after solving each problem. Analysis of event-related (de-) synchronization (ERS/ERD) in theta and alpha frequencies revealed a high convergence of both the problem size approach and the strategy self-reports. Fact retrieval was accompanied by higher left-hemispheric theta ERS, whereas procedural strategies were reflected in stronger widespread ERD in the lower alpha band. These findings provide neurophysiological evidence for the validity of verbal strategy reports and pave the way for the development of neurophysiological indices of problem-solving strategies in arithmetic.

There has been a long tradition of research on mathematics education showing that children and adults use different strategies to solve arithmetic problems. Neuroimaging and neurophysiological studies have recently begun to investigate the brain correlates of these strategies by manipulating the size of the presented problems.

This research approach is based on the assumption that small problems are mainly solved by fact retrieval from memory, whereas in large problems calculation procedures such as transformation or counting are typically more frequently used. In contrast to the problem size manipulation, many behavioral studies rely on verbal strategy self-reports to infer the applied arithmetic strategies, that is, participants have to indicate on a trial-by-trial basis how they solved each problem. These studies have revealed that individuals use different strategies in problems of a given size and that the strategies may vary from trial to trial. Even though this introspective research approach appears to be a more direct way to assess individuals' strategy use, its validity has been repeatedly questioned. In addition, there exists no neuroimaging or neurophysiological study that has used this approach to infer the brain correlates of arithmetic strategies. The aim of the present electroencephalography (EEG) study is to gain further insights into the brain correlates of arithmetic strategies by applying both research approaches (trial-by-trial verbal strategy reports and problem size manipulation) and to evaluate whether the neurophysiological result patterns from both methods converge. Twenty adult students were presented with addition and subtraction problems that have a high probability of retrieval (small problems) or procedural (large problems) strategy use. Retrieval problems were small problems with sums or minuends ≤ 10 , which showed high frequencies of retrieval use in adults. Procedural problems had sums or minuends between 11 and 35 and required carrying/borrowing. After solving each problem, participants were required to indicate whether they solved the problem by using fact retrieval, the application of a procedure or any other strategy.

The data were analyzed following the problem size approach and strategy approach. Specifically, we compared the behavioral and EEG data of small vs. large problems and of problems solved with retrieval vs. procedural strategies. In the EEG analysis, we focused on event-related (de-)synchronization (ERS/ERD), as this measure not only reflects the dynamics of functional network formation during cognitive processing but has also turned out to be sensitive to arithmetic problem solving. The behavioural data showed a high percentage of retrieval strategy use in small problems (about 90 %) and of procedural strategy use in large problems (about 75 %). As expected, small and retrieval strategy problems were solved significantly faster and more accurately than large and procedural strategy problems. Analysis of ERS/ERD patterns in the theta (3-6 Hz) and two alpha frequency bands (lower alpha: 8-10 Hz; upper alpha: 10-13 Hz) revealed a high convergence of both research approaches. Irrespective of the method, fact retrieval was accompanied by higher left-hemispheric theta ERS, whereas the application of procedural strategies was reflected in higher widespread ERD in the lower alpha band. In the upper alpha band, however, only the distinction based on the verbal strategy reports yielded differential activation patterns. Reported procedural (compared to retrieval) strategies elicited a higher ERD in the parietooccipital cortex bilaterally.

The theoretical and educational significance of the present findings are twofold. First, this study has revealed that fact retrieval and procedural strategies in mental arithmetic are accompanied by distinct neurophysiological patterns in the theta and alpha frequency bands. This finding does not only provide further insights into the brain correlates of arithmetic strategies but may also represent a potential starting point for the development of EEG indices of different problem solving strategies. These indices could, in future, be used in developmental and learning studies. Second, the high convergence of the EEG result patterns from the verbal strategy report and problem size approach suggests that both methods are appropriate instruments to capture arithmetic strategies. In particular, the present study provides the first neurophysiological evidence for the validity of verbal strategy reports which have been controversially discussed in the behavioural literature.

The finding that only strategy report data but not problem size manipulation was reflected in upper alpha ERD even suggests that the introspective approach is more powerful in detecting differences between arithmetic strategies at the neural level. In sum, the present study illustrates how neuroscientific investigations of arithmetic strategies can add to a more detailed understanding of how mathematical thinking and learning takes place.

Imaging reordered calculation strategies

Miriam Rosenberg-Lee, Stanford University School of Medicine, United States; Marsha Lovett, Carnegie Mellon University, United States; John Anderson, Carnegie Mellon University, United States

Most imaging studies of strategy variation have contrasted strategies which would be expected to have different neural substrates, such as calculation and retrieval. However, strategies that involve reordering calculation steps (and hence the same brain regions) may be of particular interest to educators: more efficient strategy use can signal

conceptual understanding. Here, we examined cortical activation as a function of two different calculation strategies for mentally solving multi-digit multiplication problems. The School strategy, equivalent to long multiplication, involves working from right to left. The Expert strategy, used by "lightning" mental calculators, proceeds from left to right. The two strategies require essentially the same calculations, but differ in that the School strategy incurs greater demands on working memory. Participants were slower and less accurate when using the School strategy, and had significantly greater activity in areas involved in attentional aspects of number processing (dorsal superior parietal lobule, SPL) and mental representation (ventral SPL), but not in a numerical magnitude area (intraparietal sulcus) or a semantic memory retrieval area (inferior frontal gyrus). A computational model of the task successfully predicted BOLD responses in parietal and frontal areas. In a follow-up session (outside the scanner), participants were allowed to select between the strategies. Surprisingly, participants did not exclusively use the less taxing Expert strategy; instead they favoured the strategy that had produced the least activity in the SPL, suggesting that students may persist in using less "optimal" strategies because they require less mental effort.

Extensive behavioural research into mathematical cognition suggests that children and adult use a wide variety of strategies when solving arithmetic problems. A growing awareness of strategy variation has led to imaging studies that examine the neural activation difference between calculation and retrieval strategies. While these strategies likely engage different brain areas, another class of strategy variation – reordering calculation steps – would not be expected to activate different brain regions. This form of strategy variation may be of particular interest to educators because it can signal conceptual understanding. This presentation focuses on the neural underpinnings of these so-called reordered calculation strategies, featuring two experiments where participants mentally solved multi-digit multiplication problems, such as 53746×8 . Using functional magnetic resonance imaging (fMRI) we established that these strategies differentially activate the same brain areas, and found that neural activity predicted participants' strategy choices. We also used cognitive modelling to disentangle the effects of strategy in brain areas relevant to numerical and mathematical cognition. We studied two multiplication strategies that differed in the order in which individual multiplication steps were performed. The "School" strategy, equivalent to long multiplication without pen and paper, involved working from right-to-left. The "Expert" strategy, used by some "lightning" mental calculators, proceeds from left-to-right, so that the largest place digit(s) of the product is calculated first. The two strategies require essentially the same set of calculations but in different orders. Responses were output largest digit first (as if spoken or entered into a calculator). As a consequence in the School strategy all calculations had to be completed before outputting could begin, producing a rapid sequence of key presses at the end of the trial. In contrast, in the Expert strategy, digits could be output as they were calculated, producing intermittent key presses throughout the trial. Thus, each strategy has a "behavioural signature" that was used to deduce which strategy participants were using.

The two strategies involve performing equivalent cognitive processes (retrieving multiplication facts, transforming internal representations, outputting responses), thus engaging the same brain areas. However, another important consequence of the "largest digit first" output constraint is that the working memory demands differ between the strategies. In the Expert strategy, participants output their responses as they go, reducing the amount of information they have to keep in mind; in the School strategy, they must retain all the calculated digits until the end of the trial, increasing the working memory demand. Thus, the two strategies should differentially engage brain areas that are sensitive to working memory load. In the first study, 15 participants solved 3- and 5-digit by 1-digit multiplication problems, while brain activity was measured using fMRI. Behaviourally, the Expert strategy produced faster and more accurate performance, particularly for the 5-digit problems. Participants' compliance in using the instructed strategy was confirmed by their pattern of key presses. We investigated two parietal regions implicated in numerical cognition: a dorsal superior parietal lobule (SPL) region and the intraparietal sulcus (IPS). We also considered two regions implicated in complex problem solving: a ventral SPL region and the inferior frontal gyrus (IFG). While all these areas were robustly activated in the task, only the dorsal and ventral SPL regions had greater activity for the School strategy.

A computational model revealed that activity in the IFG was consistent with the retrieval demands of the task, whereas activity in the ventral SPL matched the maintenance and transformation demands of the task. Interestingly, activity in the IPS and the dorsal SPL was consistent with a combination of visual and transformation processing. Thus, reorder strategy variation helped elucidate the function of brain regions involved in mathematical cognition. The second study was a behavioural follow up session using the choice/no-choice paradigm to investigate the relationship between performance, neural activity and strategy choice. Thirteen participants from the first experiment returned to repeat the in-scanner task of solving problems using an instructed strategy and then were allowed to use either strategy to solve the problems. Participants' self-reports of strategy use were confirmed using the pattern of key presses, and their performance inside and outside the scanner did not differ. When participants were allowed to pick a strategy, we predicted that most subjects should prefer the Expert strategy, as it requires less information to be maintained in memory and was faster on larger problems. Consistent with this prediction, about half of the

participants chose the Expert strategy exclusively. For these participants, activity in the SPL (measured during the study above) was lower for the Expert strategy than for the School strategy, suggesting their choice minimized mental effort. For the participants who chose both the School and Expert strategy, there was greater SPL activity for the Expert strategy, even for those 5-digit problems that were solved more quickly by this method. Thus participants chose strategies that produced the least neural activity, even when these strategies were slower.

This result sheds light on why students sometimes persist in using well-learned, but mediocre strategies over more efficient ones. Students may choose strategies based on their mental effort rather than objective measures, suggesting a link between solvers' subjective experience of difficulty and choice behaviour that would not be apparent without neuroimaging.

Different cognitive styles - different brains? The impact of cognitive style on arithmetic

Anja Ischebeck, University of Graz, Austria

Some people report that they mentally imagine an arithmetic problem visually whereas others report to repeat problems or parts of it verbally in their mind. Especially in education, a considerable amount of research has been devoted to the possible impact of an individual's cognitive style on arithmetic. However, although individuals consistently report habitual differences in cognition such as verbal or visual cognitive style, clear evidence of an impact on performance was comparatively scarce. At present, functional imaging offers yet another window to shed light on the elusive relationship between performance and individual differences such as different cognitive styles. In two fMRI studies we investigated whether differences in cognitive style (verbalizer, visualizer) influenced brain activation during arithmetic problem solving. Simple multiplication and subtraction problems were presented to forty-two participants reporting very different degrees of verbalizing or visualizing during calculation. We observed that the verbal cognitive style modulated brain activation in brain areas related to language and auditory processing, such as the supramarginal gyrus, the rolandic operculum, and Heschl's gyrus. No modulation was observed, however, in brain areas involved specifically in number processing, such as the intraparietal sulcus, bilaterally, or the left angular gyrus. These results suggest that the brain areas subserving number processing work independently from stimulus modality. Furthermore, the limited impact of cognitive style to more general aspects of sensory processing might explain the low correlation between cognitive style and behavioral performance in arithmetic.

Cognitive styles have a long history of research in mathematics education, based on the assumption that a better understanding of cognitive preferences can help develop training programs that are optimal on an individual basis. Evidence relating different cognitive styles to clear performance differences in arithmetic, however, is comparatively scarce. In the present study we investigated whether different cognitive styles (verbalizer / visualizer) modulated activation in brain areas involved in number processing. The intraparietal sulcus (IPS) is assumed to host an amodal representation of quantity, which has been referred to as the 'mental number line'. Another brain area important for arithmetic problem solving is the left angular gyrus (AG), which is assumed to support arithmetic fact retrieval, such as the multiplications tables. To assess an individual's verbal or visual cognitive style in arithmetic problem solving, a short questionnaire, the cognitive style in arithmetic questionnaire (CSAQ), was developed and tested in a preliminary investigation with 100 participants. In two fMRI experiments with forty-two participants in total, the impact of cognitive style score on brain activation patterns was evaluated. The first fMRI session investigated a possible impact of cognitive style on different operations, that is, multiplication and subtraction. 15 simple subtraction problems (e.g. $21 - 7$) and 15 multiplication problems (e.g. 3×4) were presented four times each in an event-related design. The second fMRI session investigated a possible impact of cognitive style on different number formats, that is, Arabic digits and number words. The same 15 single-digit multiplication problems were used. In total, 30 multiplication problems ($15 + 15$, order of operands reversed) were presented as Arabic digits (e.g., 3×4) or with number words (e.g. three times four) in an event-related design. In both sessions, the participant's task within the scanner was to select the correct calculation result out of two alternatives.

To investigate a possible relation between cognitive style and intelligence, participants were also asked to complete nine subtests of the intelligence test I-S-T 2000 R to assess verbal, numerical and figural-spatial intelligence. There was also no correlation between cognitive style and verbal, numerical or figural-spatial intelligence. For the fMRI measurement, a 3 T Siemens Tim Trio scanner was used with a Siemens-issued 32-channel bird-cage headcoil. For both fMRI sessions, the impact of cognitive style on brain activation was assessed. The ROIs to investigate the impact of cognitive style on number processing were the left and right AG and the left and right IPS. The ROIs to investigate the impact of cognitive style on verbal and visual processing were the left fusiform gyrus, the supramarginal gyrus, Broca's area, Heschl's gyrus, the Rolandic operculum, and the inferior occipital gyrus. The results showed that verbalizers activate brain areas involved in language and auditory processing more strongly than visualizers. For visualizers, no brain area was observed to be more activated than for verbalizers.

These results suggest that differences in cognitive style reflect differences with regard to the demand on or employment of modularity specific processing resources. No modulation of brain activation was observed, however, for the brain areas involved in number processing, namely, the IPS and the AG. This result suggests that the brain areas involved in number processing operate on a modularity independent and abstract level. Overall, cognitive style was not observed to wield a great influence on brain activation during calculation, maybe with the exception of relatively low-level modality-specific stages of processing. Our results suggest that an individual's assessment of their cognitive style is based on actual differences of preference for a specific processing modality. However, different cognitive styles do not seem to have consequences for cognitive abilities that depend on a modality-independent or abstract representation, such as arithmetic. It can be concluded that there is no true need to adapt instruction in arithmetic to an individual's cognitive style.

SYMPOSIUM

Working memory and educational achievement in children with intellectual/developmental disabilities

Chairperson: Henrik Danielsson, The Swedish Institute for Disability Research, Sweden

Organiser: Lucy Henry, London South Bank University, United Kingdom

Discussant: Claudia Maehler, Institute of Psychology, Germany

The relationships between working memory and educational achievement have been extensively investigated in typical children. However, such research is only just beginning in children with intellectual disabilities (ID) and specific language impairment (SLI), despite their vulnerability in terms of academic underachievement. This symposium will address two important questions: (1) are the working memory weaknesses characteristic of children with ID and SLI directly related to their performance on measures educational achievement?; and (2) what types of interventions can we offer to improve educational achievement in these populations?

In the first two papers, relationships between the three main components of working memory (phonological short-term memory, visuospatial short-term memory, executive-loaded working memory) and educational achievement will be examined. In paper 1, evidence is reported in relation to children with ID, that phonological short-term memory is linked to spelling; whereas executive-loaded working memory is related to mathematics and reading. In paper 2, evidence is reported in relation to children/young people with SLI, that stronger phonological short-term memory is linked with better reading; yet stronger visuospatial skills seem to depress performance. In the final paper, the effectiveness of targeted mathematics training on both working memory and arithmetical skills is assessed for children with ID.

The findings from all of the studies underline the importance of distinguishing different types of working memory ability and examining their independent relationships with academic achievement. In this way, new interventions that really work for children with specific types of intellectual and developmental disabilities can be developed.

Working memory and school achievement in children with mild to borderline intellectual disabilities

Sebastian Poloczek, Psychology (Psychologie), Germany; Gerhard Buettner, University of Frankfurt, Germany;

Marcus Hasselhorn, DIPF, Germany

In typically developing children working memory is linked to school achievement. The aim of the study was to examine whether and how measures of working memory are related to spelling, reading and calculating in children with intellectual disabilities (ID) and if these relationships vary with the difficulty level or executive load of the reading and calculating tasks. A selection of school achievement subtests and a battery of working memory measures were administered to 49 9- to 11-year-old children with mild to borderline intellectual disabilities. A mental age matched sample of 49 6- to 8-year-old typically developing children was also assessed. The indicator for the phonological short-term memory (PSTM) accounted for the most variance in spelling in both groups, while the prediction pattern for reading and calculating differed between groups. For children with ID the visuospatial working memory measures were most predictive for reading comprehension and calculating skills for tasks with lower and higher executive load. In contrast, in the group of typically developing children PSTM was the only significant predictor for reading, while calculating was predicted by the phonological working memory measures, in each case irrespective of the task difficulty. The results will be discussed with reference to the few previous studies on the topic and possible explanations for the differences in the prediction pattern between groups will be addressed.

Aims

There is extensive evidence that working memory measures are linked to reading, writing and mathematics in typically developing children (e.g. Alloway, Gathercole, Adams, Willis, Eaglen & Lamont, 2005) and that working memory components are impaired in children with specific reading or arithmetic learning disabilities (e.g. Swanson, Zheng & Jerman, 2009; McLean & Hitch, 1999). Besides, there is also ample evidence that working memory of children with intellectual disabilities (ID) is impaired in comparison to typically developing peers and that their phonological short-term memory even might be impaired in comparison to younger children matched for mental age (e.g. Schuchhardt, Gebhardt & Mähler, 2010; Van der Molen, Van Luit, Jongmans & Van der Molen, 2009). However, there are only a few studies on the relationships between working memory components and school achievement in people with ID and results vary between studies. The aim of the current study was to examine whether and how measures of working memory are related to spelling, reading and calculating in children with ID and if these relationships vary with the difficulty level or executive load of the reading tasks (word comprehension vs. sentence comprehension) and the mathematical tasks (addition and subtraction up to 10 vs. calculations crossing the 10).

Methodology

Participants

The final sample consists of 49 children with mild to borderline intellectual disabilities (ID) (mean IQ=72,4; Range 58–84) of non-specific aetiology attending special schools in Hesse / Germany with an age between 9;7 and 11;9 years. For the mental age (MA) control group we recruited 49 children from first grades in mainstream elementary schools (age range 6;7–8;3), who were matched for intelligence test raw scores and who had to obtain an IQ of at least 85 (mean IQ=105,9; Range 88–123). To be included, children of both groups had to be able to at least read and write simple words and solve some addition tasks.

Procedure

The ability to read, spell and calculate was assessed with subtests of 3 German school achievement tests suitable for first graders. To demonstrate their reading abilities children were asked to mark words corresponding to pictures (word comprehension) and to mark words fitting into a sentence (sentence comprehension; Lenhard & Schneider, 2006). To assess spelling a simple story consisting of 29 words was dictated word for word (Stock & Schneider, 2008). In 4 arithmetic subtests the participants were asked to add or subtract either in the number range up to 10 or up to 20 (Grube, Weberstock, Stuff & Hasselhorn, 2010).

Most working memory tasks were presented with the computerized German Working Memory Test Battery for Children (Hasselhorn et al., 2011). Word span and digit span scores were averaged to derive an indicator for phonological short-term memory (PSTM). Also, phonological working memory tasks with central executive load (PWM) digit backwards span and a complex span (judging whether objects are edible and remembering their names) were administered. Corsi span served as indicator for the visuospatial short-term memory (VSSTM). In order to also test visuospatial working memory with central executive load (VSWM) we created computerized corsi backwards and odd one out task with the same adaptive testing protocol as in the other memory tasks.

Findings

Stepwise regressions were used to examine the relative contributions of the different working memory indicators to the spelling, reading and calculating skills in each group. In both groups the only significant predictor for spelling was the phonological STM indicator (ID: $b=.42$, $p=.003$; MA: $b=.46$, $p=.001$). In the ID group reading was predicted by the visuospatial WM indicator (word comprehension: $b=.44$, $p=.002$, sentence comprehension: $b=.42$, $p=.003$), while the other indicators could not for additional variance. In contrast in the MA control group of typically developing children only PSTM was predictive of reading skills (word comprehension: $b=.51$, $p=.30$ - $.40$, $p=.03$ - $.005$). In two subtests (addition crossing 10 and subtraction up to 10) the phonological STM accounted for additional variance (ID group ($b=.33$ & $.35$, $p=.02$ & $.01$).

Theoretical and educational significance of the research

In accordance with two out of three previous studies (Henry & Winfield, 2010; Numminem et al., 2000) phonological STM seems to be important in the development of spelling skills in children with ID. Our study adds evidence that working memory plays some role in reading development of children with ID. However, from the existing studies no clear picture emerges which working memory component is most important in learning to read.

No evidence was found to support the assumption that working memory tasks with central executive load are more important in explaining reading comprehension or calculation skills measured with higher executive load than in predicting these skills measured with analogue tasks with lower load.

As in the studies of Alloway and Temple (2007), Henry and Winfield (2010) and Numminem and colleagues (2000) central executive loaded working memory measures were related to number and calculation skills. By separating phonological and visuospatial WM the prediction pattern differed between typically developing children (PWM most important) and children with ID (VSWM most important). One explanation for this difference might be that in special schools illustrations and visualizations of math problems are more important in teaching to calculate. A related explanation is that children with ID might use different strategies than typically developing children to solve the calculations. However, these explanations are speculative and the differences in the prediction pattern have to be interpreted cautiously. On the one hand the phonological and visuospatial WM measures might work differently in the ID and the MA group. On the other hand, the difference was just observed in one sample of moderate size ($N = 2 \times 49$) even though this sample size is relatively large for a study involving children with ID.

Working memory and reading achievement in children/young people with specific language impairment

Lucy Henry, London South Bank University, United Kingdom; David Messer, The Open University, United Kingdom; Gilly Nash, London South Bank University, United Kingdom

The relationships between working memory and reading achievement were assessed in age-matched samples of 51 children/young people with and without specific language impairment (SLI). For those with SLI, reading skills were significantly related to phonological short-term memory (the ability to passively hold verbal information in mind for short periods of time). Word reading, as opposed to nonword reading, was also negatively related to visuospatial short-term memory, suggesting that those with better visuospatial storage skills may have been using visual strategies for reading real words that hampered their overall reading progress. In children with typical development, executive-loaded working memory (tasks requiring concurrent processing and storage) related to both word and nonword reading achievement. Educationally, these findings suggest that passive phonological storage is crucial for reading in children/young people with significant language difficulties; whereas typical children rely more on executive working memory skills.

Aims

Children and young people with specific language impairment (SLI) have significant difficulties with language in the absence of an obvious cause, yet generally have non-verbal abilities in the average range. Many individuals with SLI also have significant difficulties with literacy.

The purpose of the current research was to examine whether literacy problems in children with SLI were related to their difficulties with working memory. The working memory model (Baddeley, 2000), which incorporates passive phonological and visuospatial short-term memory components, as well as active 'executive-loaded' working memory, was used as a theoretical background for the work.

There is extensive evidence that those with SLI have marked difficulties with phonological short-term memory (see Estes et al., 2007, for a meta-analysis). Similarly, executive-loaded working memory abilities, whether for verbal or visuospatial materials, are weak in this population (Ellis-Weismer et al., 1999; Marton, 2008). By contrast, visuospatial short-term memory appears to be relatively unimpaired (Archibald & Gathercole, 2006).

We predicted that reading achievement would be related to phonological short-term memory and executive-loaded working memory in those with SLI, reflecting their working memory difficulties. By contrast, we predicted that the most important predictor of reading in typical children would be executive-loaded working memory, based on previous literature (Leather & Henry, 1994; St Clair-Thompson & Gathercole, 2006; Swanson, 2008). Using regression analyses, the extent to which different measures of working memory accounted for variance in reading achievement over and above the contributions made by non-verbal and verbal ability was assessed in each sample.

Methodology

51 children and young people with SLI were recruited via Speech and Language Therapists from primary and secondary schools in London. They were between 8 and 14 years of age (mean 11.5 years) with significant language difficulties as measured by a well-established battery of language functioning (Clinical Evaluation of Language Fundamentals, Version 4; CELF-IV, UK, Semel, Wiig, & Secord, 2006). Included participants had non-verbal abilities that were no more than one standard deviation below the mean (British Abilities Scale II Matrices subtest); and language scores that were one standard deviation or more below the mean on at least two out of four subtests from the CELF-4. Typical participants were of the same age with no weak language scores and similar non-verbal abilities. Working memory was assessed using subtests from the Working Memory Test Battery for Children (WMTB-C, Pickering & Gathercole, 2001) and odd one out span (Henry, 2001). The measure of phonological short-term memory represented averaged z-scores from Word List Recall and Nonword List Recall; the measure of visuospatial short-term

memory was Block Recall (z-scores); and the measure of executive-loaded working memory was the averaged z-scores from Listening Recall and odd one out span.

Reading was assessed using the Test Of Word Reading Efficiency (TOWRE, Torgesen, Wagner, & Rashotte, 1999), which provides standardised measures of word and nonword reading.

Findings

Hierarchical multiple regressions were used to assess whether the working memory variables were good predictors of word and nonword reading, after IQ had been controlled. In all regressions, IQ (verbal or non-verbal) was entered at step 1; and at step 2 the three working memory variables were entered in a block. Standardised scores for word and nonword reading, rather than raw scores, were used to control for the effects of age.

Initial exploratory regressions indicated that executive-loaded working memory was never a significant predictor of reading for children/young people with SLI. Therefore, final regression models included only phonological short-term memory and visuospatial short-term memory. Exploratory regressions for the typical group indicated that executive-loaded working memory was the only significant working memory predictor, therefore final regression models did not include the other working memory variables.

Regressions

Word reading. (1) SLI: Verbal IQ, phonological short-term memory and visuospatial short-term memory were significant predictors of word reading. The contribution of phonological short-term memory was positive; those who had higher scores were better readers. The contribution of visuospatial short-term memory was negative; those with better scores were weaker readers. (2) Typical development: The only significant predictor of word reading was executive-loaded working memory.

Nonword reading. (1) SLI: Phonological short-term memory and verbal IQ were significant predictors of nonword reading. (2) Typical development: Executive-loaded working memory and verbal IQ were significant predictors of nonword reading.

The working memory variables accounted for between 11 and 21% of the variance in reading in all regressions.

Theoretical and Educational Significance of the Research

Children and young people with SLI have known difficulties with phonological short-term memory (Estes et al., 2007) and the current findings suggest that these difficulties are related to reading achievement. Those with weaker phonological short-term memory made less progress with respect to reading words and nonwords.

Although children and young people with SLI also have difficulties in relation to executive-loaded working memory (Ellis-Weismer et al., 1999), this aspect of working memory was not related to their word and nonword reading achievement. By contrast, typical children showed the expected relationships between executive-loaded working memory. It would appear, therefore, that passive phonological storage (phonological short-term memory) is more important for reading in those with SLI than the ability to concurrently process and store information (executive-loaded working memory).

The negative impact of visuospatial short-term memory on real word reading performance was surprising. This indicated that children and young people with SLI who had better visuospatial storage abilities made less progress in reading real words. This may have been because these individuals were attempting to make the most of their visuospatial strengths by reading words using visual strategies, and this may hold back their progress in phonological decoding. These relationships were not significant for nonword reading, suggesting that children and young people with SLI are less likely to use such visual strategies when attempting to read unknown nonwords, probably because they realise these items are not in their sight vocabularies. These findings have implications for teaching methods, suggesting that over-reliance on visual decoding strategies may not be helpful for children and young people with SLI.

Arithmetic practice and its influence on arithmetic skills and working memory in children with ID

Mariet van der Molen, VU University Amsterdam, Netherlands; Brenda Jansen, University of Amsterdam, Netherlands; Eva de Lange, University of Amsterdam, Netherlands

The aim of the present study was to see whether a five-week basic arithmetic practice with the Math Garden (Straatemeier, Jansen, Klinkenberg, & Van der Maas, 2010; see www.rekentuin.nl) leads to better arithmetic abilities, short-term memory and working memory in pupils with mild to borderline intellectual disabilities (M-BID).

Furthermore, the relationship between working memory and short-term memory on the one hand and arithmetic abilities on the other hand was investigated.

In total, 60 children with M-BID within special education were tested with a battery of tasks measuring fluid intelligence, arithmetic, short-term memory and working memory. Thirty of these children were then randomly assigned to the experimental group and practiced basic arithmetic abilities (addition, subtraction, multiplication and division) during five weeks with the computerized program Math Garden. After this period, both the experimental group and waiting list control group were tested again with the same battery but without the task for fluid intelligence.

Results are explained in terms of effectiveness of the program on arithmetic abilities, short-term memory and working memory in pupils with M-BID. Furthermore, the relationship between arithmetic and both working memory and short-term memory in children with M-BID are discussed.

Aims

Pupils with mild to borderline intellectual disabilities (M-BID) within special education show more problems with arithmetic than their typically developing peers within regular education. This difference can easily be explained by the lower intelligence level of the M-BID group. However, it is suggested that this difference is also related to the total amount of arithmetic lessons (Van Lieshout, 2001), which is lower within special education. The first aim of the current study was to see whether children with M-BID perform better on arithmetic tasks after a five-week period of practicing with the Maths Garden, a web-based method in which the four main operations are practiced; addition, subtraction, multiplication and division (Straatemeier, Jansen, Klinkenberg, & Van der Maas, 2010; see www.rekentu.nl). Kroesbergen and Van Luit (2003) showed with their meta-analysis that the effect size of arithmetic interventions for children with M-BID is rather large (.80). Especially interventions focussing on the main operations were effective. Therefore, we expected the Maths Garden to be effective for children with M-BID.

Children with M-BID also show a weak working memory, often weaker than is expected on the basis of their mental age (e.g. Henry, 2001; Schuchardt, Gebhardt & Maehler, 2010; Van der Molen, Van Luit, Jongmans, & Van der Molen, 2009). Working memory, the ability to simultaneously store and manipulate information, is considered a central construct within cognitive psychology and plays an important role in scholastic abilities like arithmetic (e.g. Shah & Miyake, 1999). Several studies have shown that working memory and visuo-spatial short-term memory strongly correlate with arithmetic abilities in typically developing children (e.g. Bull, Espy, & Wiebe, 2008; Holmes & Adams, 2006). It is not known if this relationship also holds for children with M-BID. The second aim of the current study was to see if arithmetic abilities and visuo-spatial short-term memory and working memory are correlated constructs in children with M-BID. A recent study on working memory training in children with M-BID revealed that the training led to higher scores on an arithmetic task (Van der Molen, Van Luit, Van der Molen, Klugkist, & Jongmans, 2010), therefore it was expected that also within this population at least working memory and arithmetic are related.

Finally, we explored if practicing with the Maths Garden also leads to increased working memory capacity in the children with M-BID. A study with normal aged people revealed that practicing arithmetic problems lead to improvements in cognitive functioning, including working memory (Uchida & Kawashima, 2008).

Methodology

Sixty children (age 12-14 years) with M-BID attending special education participated in this study, 30 within the experimental group and 30 within the control group. All children were tested with several tasks measuring arithmetic, working memory, short-term memory and fluid intelligence.

The children who were randomly assigned to the Maths Garden then practiced in 4 sessions per week of 15 minutes each, during five weeks with this web-based program. The Maths Garden is computer adaptive; the difficulty of the sums offered is adaptive to the child's abilities, based on reaction time and accuracy of each sum. On average, the children have a probability of 75% to make the sum correct within the time limit. The control group children got the opportunity to practice with the Maths Garden after the study was finished (waiting list control group).

Findings

Results will be explained in terms of effectiveness of the Maths Garden for arithmetic, working memory and visuo-spatial working memory. This was done by use of repeated measures ANOVA's. Furthermore, multiple regression analysis was used to give insight in how the different constructs are related.

Theoretical and educational significance

First of all, this study gives insight in the usefulness of the computerized program Maths Garden in increasing basic arithmetic abilities of children with M-BID. When proven effective, it could easily be implemented in the school context.

Furthermore, this study adds to the current understanding of the relationship between working memory / short-term memory and arithmetic in children with M-BID. Also, an increase in working memory / short-term memory capacity after following the program would mean that there is a reciprocal relationship between both constructs. This leads to new ideas about the working memory delays observed in this population (e.g. Schuchardt et al., 2010): not only does a weak working memory lead to weak scholastic abilities, also little scholastic practicing might lead to a weak working memory.

SYMPOSIUM

Interactive Problem Solving and Test Context: Current Issues from PISA 2003 to 2012

Chairperson: Jens Fleischer, University of Duisburg-Essen, Germany

Organiser: Detlev Leutner, Duisburg-Essen University, Germany

Jens Fleischer, University of Duisburg-Essen, Germany

Discussant: Romain Martin, University of Luxembourg, Luxembourg

In PISA 2003, problem-solving competency was assessed using a paper-and-pencil test format. In PISA 2012, a technology-based assessment (TBA) format will be used. This TBA format allows new ways of measuring problem-solving competency, using problems within an everyday context and focusing on interactive and dynamic aspects of the problem-solving process, e.g., problem-solving strategies. In the first paper, a generic model for the assessment of problem-solving competencies in dynamic problem situations (MicroDyn) is introduced and evaluated with respect to its psychometric properties based on a German sample. In the second paper, this model is evaluated in a Hungarian sample with a specific focus on item difficulty and background variables like motivation and ICT attitudes and ICT experience. Using problem-solving items from PISA 2003, the third paper focuses on test context as a further background variable that affects problem-solving assessment. The results of the three papers demonstrate that there is a significant development in problem-solving research, the results of which can be used to improve the assessment of problem-solving competency from PISA 2003 to PISA 2012.

Interactive Problem Solving: Just Intelligence or More than That – Some Empirical Answers

Sascha Wustenberg, University of Heidelberg, Germany; Samuel Greiff, University of Heidelberg, Germany; Joachim Funke, Psychology Department, Germany

Interactive problem solving (the terms interactive and complex problem solving are interchangeable) is commonly seen as a key qualification for success in life and therefore receives interest from international large-scale assessments like PISA and PIAAC. This growing interest increases the need for efficient assessment procedures.

As a possible measurement device we present MicroDYN, a new approach bringing together a formalized item pool and Dörner's Theory of Operational Intelligence (1986). Three facets to measure interactive problem solving competency in dynamic systems are theoretically derived and empirically evaluated.

Additionally, first empirical data to check psychometric properties (i.e., internal structure) and construct validity (i.e., relation to IQ and school grade) of the theoretically derived indicators are presented. By this, MicroDYN allows, for the first time, a psychometrically sound evaluation of a measurement device of problem solving ability and shows the importance of the captured multi-dimensional construct in the assessment of school achievement. Implications and further steps on the road to competency levels are critically outlined.

Interactive problem solving within dynamic systems has been an area of major interest in experimental research over the last decades (Funke & Frensch, 2007). Little research, however, has been conducted about interactive problem solving in the context of individual differences. However, embedded in the recent appearance of large-scale assessments like PISA or PIAAC, cross-curricular competencies such as interactive problem solving have been discovered as valuable aspects of school achievement. Despite the awakening interest in individual differences, there is still a substantial lack of well-scrutinized testing devices and almost nothing is known about their validity.

We propose a new approach taking into account a formalized item pool: The MicroDYN-approach (Greiff & Funke, 2008, in press). It provides an infinite number of items based on a mathematical formalism. Each item represents a

"system" and asks participants to detect causal relations between two sets of variables (exogenous and endogenous) and to control the system. We suggest that many everyday situations can be modeled by MicroDYN systems since advanced skills in strategic planning, internal model building and system control are crucial in the specified situations as well as tested within the MicroDYN framework. Participants face several items on the computer, each lasting about 6 minutes. The items are minimally but sufficiently complex in terms of the number of variables and their interconnections. Each item is processed in three stages: Stage 1, exploration phase: Participants can freely explore the system for some minutes. They are asked to become acquainted with the system and to learn how it works. No restrictions or goals are presented at this time. Stage 2, drawing the mental model: Simultaneously (or subsequently) to their exploration, participants are asked to draw the connections between variables as they suppose. Stage 3, control phase: Participants are asked to reach given target values on the endogenous variables by entering adequate values for the exogenous variables. During this phase, the practical application of the acquired knowledge is assessed. MicroDYN is linked to Dörner's theory of Operational Intelligence (1986). In his theory, Dörner names five characteristics of "problems": intransparency, interconnectedness, dynamics, complexity, and polytely. These characteristics correspond to five requirements on side of the problem solver: information retrieval, model building, forecasting, reduction of information, and evaluation. In MicroDYN, information retrieval is captured in Stage 1, the exploration phase, by evaluating use of strategy. Furthermore, the mental model drawn in stage 2 indicates model building as the second requirement sensu Dörner, while forecasting, the third requirement, is measured during the control phase (Stage 3). The two remaining facets are currently under development.

This paper focuses on two empirical questions:

- (1) Do the three theoretically distinguished dimensions show up empirically?
- (2) How do the MicroDYN-facets relate to other constructs, i.e. intelligence (measured by the APM) and final school grade. More specifically, does MicroDYN predict school grade beyond intelligence?

To elaborate on these questions data of $n = 121$ university students was available.

Ad (1): Empirically, the assumed 3-dimensional model had a substantial better fit ($\chi^2 = 55.75$, $df = 36$, $p = .02$, RMSEA = .06; WLSMV-estimator for this and all subsequent models) than a 1-dimensional model ($\chi^2 = 64.19$, $df = 34$, p information retrieval and model building were almost identical (latent $r = .95$, p information retrieval/model building and the second dimension forecasting fitted the data well ($\chi^2 = 55.31$, $df = 36$, $p = .02$, RMSEA = .06) and not worse than the original 3-dimensional model (χ^2 -difference 1.99, $df = 2$, $p > .05$). Additionally, this model with two dimensions fitted the data significantly better than a 1-dimensional model (χ^2 -difference 11.63, $df = 1$, p communalities in the final model were generally high and almost universally above .40. Reliability estimates were satisfactory (information retrieval/model building Cronbachs' $\alpha = .88$, forecasting Cronbachs' $\alpha = .90$). The two dimensions correlated latently with .85 (p

In summary, the three dimensions derived theoretically did not show up clearly because students who retrieved information well could obviously transfer this information into an adequate model. This might be true for the available data consisting of highly selected university students and might not hold for more heterogeneous samples where this transfer is likely to be more erroneous.

Ad (2): Additionally, we checked construct validity by comparing the subjects' results on the two facets information retrieval/model building and forecasting with their final school grade and intelligence. When entering the two MicroDYN-dimensions and IQ as simultaneous predictors of school grade, only information retrieval/model building showed a statistically significant relation to school grade (path coefficient .42, $R^2 = .18$, p The overall model fit was good ($\chi^2 = 43.63$, $df = 37$, $p > .21$, RMSEA = .03). When entering IQ as the first predictor and the two MicroDYN-dimensions as the second block in a latent stepwise regression analysis, IQ predicted school grade significantly (path coefficient .29, $R^2 = .09$, p information retrieval/model building explained considerable variance beyond intelligence (path coefficient .30, $R^2 = .09$, p Forecasting showed no significant relations with the criterion. The overall model fit was good ($\chi^2 = 44.04$, $df = 37$, $p > .19$, RMSEA = .04).

In summary, model building predicted final school grade better than intelligence and explained variance above and beyond intelligence – thus emphasising the potential of interactive problem solving not only theoretically but for the first time also empirically. Appropriate criteria predicted by the procedural aspect of forecasting are yet to be found.

If – at least in the long run – interactive problem solving can be classified and established as a valid construct it might be relevant in virtually all areas involving prediction or explanation of cognitive performance. In the context of educational large-scale assessments, the diagnostics of a cross-curricular competence like interactive problem solving yields important additional information for ability assessment. Encouraging empirical results are presented in this paper.

Measuring adults' dynamic problem solving competency

Krisztina R. Toth, German Institute for International Educational Research, Germany; gyongyver Molnar, University of Szeged Institute of Education, Hungary; Sascha Wustenberg, University of Heidelberg, Germany; Samuel Greiff, University of Heidelberg, Germany; Beno Csapo, University of Szeged, Hungary

Compared to traditional paper-and-pencil testing, technology-based assessment (TBA) offers the possibility to measure new constructs e.g. by using rich stimulus materials during testing. One example for the innovative use of TBA is the MicroDYN approach that measures dynamic problem solving (DPS). It integrates several advantages of computerized testing: it accomplishes a testing system involving everyday situation tasks, in which variables influence one or more outcomes, and provides the opportunity to assess dynamics. The user thereby has to interact with a system. In this paper we present the results of a first pilot study that measures adults' DPS competences in Hungary. Our aims are to (1) describe the internal structure of adults' competency level in DPS; (2) to identify item characteristics affecting item difficulty and (3) to depict relationships between DPS and a background data set (consisting of motivation, ICT-related variables). The MicroDYN test was composed of 8 complex and dynamic items. Results indicate that the internal structure of adults' competency level could be best described with a two dimensional model (two facets: model building and forecasting). The examination of item level characteristics identified the quality of effects as a responsible factor for item difficulty. Based on background variables, adults' DPS competency did not show significant relationships with ICT related variables, self efficacy and some of the measured motivational aspects. However, higher DPS-scores were generally associated with success orientation and job qualification.

Conceptual background

Existing models of assessment are typically inappropriate to measure complex and technology-associated competencies. However, these are becoming increasingly important in the 21st century and some of them might be captured more adequately in technology-based assessment (TBA). Consequently, the use of TBA in educational settings is now considerably more widespread than it was only a few years ago (see Csapo, Latour, Bennett, Ainley, & Law, 2010). Advantages of TBA are versatile, e.g., online item generation (CAT), automatic scoring and data processing, direct feedback and increased assessment speed. It is also possible to link rich stimulus material to conventional test item formats. All this enhances the measurement of traditional constructs (e.g. static problem solving in rich technology environments, see Bennett, Persky, Weiss & Jenkins, 2007) and enables the measurement of new constructs such as dynamic problem solving (Greiff & Funke, 2009).

Aims of this paper

Administering technology-based tests where participants meet a dynamically changing environment in educational context poses several challenges. The purpose of this paper is to study adults' DPS competencies and its underlying internal structure in Hungary. In this paper we (1) describe the internal structure of adults' competency in DPS; (2) characterize which item characteristics have an impact on item difficulty and (3) examine the correlation between DPS and several background variables (e.g., motivation, ICT-literacy).

Methods

The sample was drawn from high-school teachers ($n=86$) and students ($n=27$) with a mean age of $M=42.57$ ($SD=8.88$) and $M=21.04$ ($SD=1.87$) respectively. The instrument was developed within the MicroDYN approach (Greiff & Funke, 2009) and consisted of 8 items that were delivered fully computer-based. The MicroDYN-approach is strongly connected to Dörner's Theory of Operational Intelligence (Dörner, 1986) and captures three different facets of DPS: information retrieval (i.e., use of strategy), model building (i.e., correctness of mental model) and forecasting (i.e., controlling a system). In each item, participants first freely explore a dynamic system (facet 1: information retrieval). The adequate use of strategy is assessed here. Subsequently they draw the connections between variables as they suppose (facet 2: model building). This assesses acquired declarative knowledge. Finally, participants have to reach given target system values by entering adequate values into the system (facet 3: forecasting). During this phase, the participant has to apply the knowledge gained, which is a procedural aspect of problem solving competency (facet 3: forecasting).

A detailed task analysis was performed to determine item characteristics which potentially predict item difficulty. Furthermore, we also considered background variables such as motivation and ICT-related variables as predictors of performance in MicroDYN. The data was collected with the TAO platform.

Educational and scientific importance

While most TBA applications use only static items and conventional item formats, dynamic items and assessing characteristics of the problem-solving process (e.g., use of strategy) enable one to use the full potential of TBA. By

applying the dynamic assessment approach we measure skills and competencies that fit the requirements of the dynamically changing world. The paper outlines the results of a first pilot study of dynamic testing in Hungary.

Results and Discussion

The general fit of the theoretically assumed 3-dimensional model ($\chi^2=80.34$, $df=39$, $p=44.09$, $df=32$, $p>.07$, CFI=.96, TLI=.96, RMSEA=.05). Thus, each examinee was assessed with two individual scores, one on each facet. The average item difficulty was .20 ($SD=.19$) for model building and .19 ($SD=.23$) for forecasting, disclosing both facets as equally difficult with more variance in the procedural aspect of forecasting. Furthermore, results indicated high individual differences between test takers, while teachers' and students' achievements did not differ significantly on a group level.

Results indicated higher probability of drawing the correct mental model if direct effects (i.e., direct connections between input and output variables) were present in the items while indirect effects (i.e., true dynamics, the system changes by itself) increased difficulty considerably. Other item characteristics (e.g., number of connections, system size) were not varied systematically making it impossible to estimate their influence on item difficulty at this point. Further research needs to shed light on this important research question.

How is DPS related to motivation and self-efficacy? The latter was, unexpectedly, not associated with DPS performance. Additionally, four motivational factors were measured. Out of these four (anxiety, challenge, interest, expected success), only expected success was related to model building ($r = .26$, $p = .05$). However, the level of teacher qualification was found to be significantly related to DPS-scores ($r = .33$, p

In sum, DPS was not as strongly related to background variables as expected. This might be due to limited variance in motivation and ICT-variables. Evident was the relation between DPS and level of qualification emphasizing the importance of DPS as a cognitive construct. Studies with MicroDYN have been largely conducted in Germany and in English-speaking countries where 2-dimensional solutions are generally supported by the data. This was shown for the first time in Hungary in this study suggesting a cross-European comparability of DPS-scores.

References

- Bennett, R. E., Persky, H., Weiss, A. R., & Jenkins, F. (2007). Problem solving in technology-rich environments: A report from the NAEP Technology-Based Assessment Project (NCES 2007- 466). Washington, DC: National Center for Education Statistics, US Department of Education. Available: <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007466>.
- Csapo, B., Latour, T., Bennett, R., Ainley, J., & Law, N. (2010). Technological issues of computer-based assessment of 21st century skills. Draft white paper 3. Cisco, Intel, Microsoft. Melbourne: The University of Melbourne.
- Dörner, D. (1986). Diagnostik der operativen Intelligenz [Assessment of operational intelligence]. *Diagnostica*, 32, 290-308.
- Greiff, S. & Funke, J. (2009, June). On the way to competence levels in dynamic microsystems: The MicroDYN approach. In J. Funke, J. Wirth & S. Greiff (Eds.), Symposium on problem solving. Assessment of problem solving competencies. Paper presented at the EARLI in Amsterdam, The Netherlands.

Effects of test context on students' achievements in mathematics and problem solving

Jens Fleischer, University of Duisburg-Essen, Germany; Joachim Wirth, Ruhr-University Bochum, Germany; Detlev Leutner, Duisburg-Essen University, Germany

Despite strong theoretical and empirical relations between mathematics and problem solving, results from the PISA study 2003 show considerable differences between students' mean performance in both competencies, in many countries in favour of problem solving. This difference can be seen as an indication that students have cognitive potentials which have not been used sufficiently in school. Based on data from 515 students, we examined effects of test context and moderator effects by motivational and emotional factors that might hinder students in using their cognitive potential when working on mathematical tasks. A mathematics test and a problem solving test were embedded both within a mathematical and a problem solving context. Results show that students' achievements under the mathematical context condition are lower than under the problem solving context condition both for the mathematics and the problem solving test. This effect is especially pronounced among students with low mathematical self-concept, high mathematics test anxiety and low mathematical self-efficacy (last mentioned only for the mathematics test). The difference found in PISA 2003 might partly be explained by these results.

SYMPOSIUM

Extension of number concept: developmental trajectories of number sense

Chairperson: Erno Lehtinen, University of Turku, Finland

Organiser: Erno Lehtinen, University of Turku, Finland

Minna M Hannula-Sormunen, University of Turku, Finland

Discussant: Minna M Hannula-Sormunen, University of Turku, Finland

Students' difficulties learning fractions and decimal numbers are widely reported by mathematics teachers and researchers on mathematics learning. Many innovative teaching methods, including different metaphors, models and representations have been developed to support students' learning. However, the fraction concept continues to be one of the most challenging mathematical topics for elementary and middle school children. The learning of rational numbers is a complex process and better understanding of this complexity requires that the extensions of number concept are analyzed in a broader context of the development of number sense.

The aim of the symposium is to explore if the conceptual change approach and research on learning trajectories from earlier conceptions of numbers to rational numbers provide us with __ better theoretical and methodological tools to analyze these difficulties and developmental processes that underlie students' learning of rational numbers.

The papers of this symposium connect the learning of rational numbers to basic research on the nature of the mental number line that underlies children's number sense and to the emerging proportional thinking among younger children. These approaches are then connected to the analysis of intermediate states of understanding during the learning trajectory from natural to rational numbers.

Mental Number Line, Number Line Estimation, and Mathematical Achievement: Their Interrelations in Gr

Jennifer Paetsch, Freie Universitat Berlin, Germany; Michael Schneider, ETH Zurich, Switzerland; Roland Grabner, ETH Zurich, Switzerland

As indicated by the distance effect and the SNARC (Spatial-Numerical Association of Response Codes) effect, natural numbers are mentally represented on a number line. Purportedly, this number line underlies children's number sense which supports the acquisition of more advanced mathematical competencies. In three studies with a total of 429 fifth- and sixth-graders we compared the influences of each child's distance effect, SNARC effect, conceptual knowledge about decimal fractions, and numerical intelligence on mathematical school achievement. Additionally, we tested using decimal fractions whether number line estimation competence mediates the influence of the internal number line. In all, the results, found with path models, revealed that domain-specific conceptual knowledge, numerical intelligence, and number line estimation each were good predictors of achievement, while distance and SNARC effects were virtually unrelated to all other variables. Individual differences in the use of the internal number line, as assessed by these two effects, seem to be of little importance when it comes to the acquisition of the content of fifth- and sixth-grade mathematics lessons. The results instead highlight the importance of conceptual understanding and estimation competence for the acquisition of more advanced mathematical competencies.

Theoretical background

Mathematical competence comprises a wide variety of different cognitive skills and processes. Some elementary mathematical skills such as the discrimination of numerosity or arithmetic computations with small sets of objects are already observed in infants (Wynn, 1992) which has been interpreted as evidence that the human brain is endowed with an innate number sense (Dehaene, 1997). In this context, number sense refers to the fundamental "ability to mentally represent and manipulate numerosities on a mental 'number line'" (Dehaene, 2001, p. 17). Numbers are regarded to be represented in an analogical format on this mental number line, allowing for an automatic and efficient processing of numerical quantities (cf. Newcombe, 2002).

Empirical evidence of a link between the mental number line and higher-order mathematical competence is sparse and inconclusive. How the fundamental ability to represent and manipulate numerical information on the mental number line is related to mathematical knowledge and intelligence, and whether this basic capacity can explain individual differences in mathematical competence beyond these two well-established variables has not yet been investigated. The aim of the present investigation is to provide first insights into the relationship between the mental number line, conceptual knowledge, intelligence, and mathematical achievement in school. While it has already been shown that the mental number line influences children's early abilities to understand and operate on whole numbers (Gilmore, McCarthy, & Spelke, 2007), we focused on its influence on competencies, which are just a step further advanced. We investigated fifth- and sixth-graders' knowledge about decimal fractions, since this topic is taught

shortly after whole-number arithmetic in many countries. Three empirical studies are reported in which the relations between the aforementioned variables were investigated using path analyses.

Study 1

In Study 1, a parsimonious design was administered to provide first data on the relation between the mental number line, conceptual knowledge, and mathematical school achievement. Individual differences in reliance on the mental number line are operationalized by means of the distance effect size. If the mental number line is related to mathematical achievement, a significant correlation between the size of the distance effect and the mathematics mark should emerge. In addition to these three variables, the performance in an external number line test was included as variable that potentially moderates the influence of knowledge and mental number line on the mathematics mark.

The sample comprised 115 fifth-graders. We measured distance effect, conceptual knowledge about decimal fractions, number line estimation accuracy (of decimal fractions), number line estimation speed, and mathematics marks in a session that lasted about 70 minutes per child.

Study 1 provided no evidence of a relation between mental number line and mathematical achievement. However, mental number line was only measured in terms of the distance effect.

Study 2

In Study 2, the SNARC effect was introduced as an alternative measure for the mental number line. We used the same procedure as in Study 1, with $N = 110$ volunteering fifth-graders. Neither the distance effect nor the SNARC effect is significantly correlated with mathematics mark. There is only a small correlation between distance effect and number line estimation accuracy. In addition, distance effect and SNARC effect are significantly, yet weakly correlated. Based on the inter-correlations and our theoretical expectations, we specified the model shown in Figure 1. This model has an excellent fit to the data ($\chi^2 = 2.246$, $df = 5$, $p = .814$, $CFI = 1.000$, $RMSEA = 0.000$).

Study 3

Studies 1 and 2 revealed that conceptual knowledge is strongly related to mathematical achievement at school, whereas distance effect and SNARC effect are not. The participants' numerical intelligence was introduced as additional predictor in Study 3. Since competence in using external numerical representations may also transfer to more complex representations such as coordinate systems, an additional graph test was administered.

Participants were $N = 204$ volunteers from the fifth and sixth grades. We assessed children's conceptual knowledge about decimal fractions and their accuracy on the number line estimation task at three measurement points. At time 3 we additionally measured the distance effect, the SNARC effect, a graph test, and intelligence using the same method as in Study 1 and Study 2.

Based on the inter-correlations and our theoretical expectations, we specified the model shown in Figure 2. Most indices show a good fit of the model to the data ($\chi^2 = 17.269$, $df = 11$, $p = .100$, $CFI = 0.980$, $RMSEA = 0.053$).

Discussion

During the last two decades, researchers have claimed that the mental number line is not only important for the representation of numerical quantities, but also for mathematical competencies in general (Case & Okamoto, 1996). Dehaene (2001, p. 16) postulated "that higher-level cultural developments in arithmetic emerge through the establishment of linkages between this core analogical representation (the 'number line') and other verbal and visual representations of number notations". While this seems to be the case for elementary arithmetic (Gilmore, McCarthy, & Spelke, 2007), our results show that the limits of this claim are reached when it comes to the content of fifth- and sixth-grade mathematics classes. Using tasks from the domain of decimal fractions, we showed that in this age group, the influence of the mental number line on school achievement is negligible when compared with the influences of conceptual knowledge and numerical intelligence.

References

- Case, R., & Okamoto, Y. (1996). The role of central conceptual structures in the development of children's thought. New York: Blackwell.
- Dehaene, S. (1997). *The Number Sense*. New York: Oxford University Press.
- Dehaene, S. (2001). *Precis of "The number sense"*. *Mind and Language*, 16, 16-32.
- Gilmore, C., McCarthy, S. E., & Spelke, E. (2007). Symbolic arithmetic without instruction. *Nature*, 447, 589-591.
- Newcombe, N. S. (2002). The Nativist-Empirist controversy in the context of recent research on spatial and quantitative development. *Psychological Science*, 13, 395-401.
- Wynn, K. (1992). Addition and subtraction by human infants. *Nature*, 358, 749-750.

Spontaneous Focusing on Relations in 5-8 year old Children

Jake McMullen, University of Turku, Finland; Minna M Hannula-Sormunen, University of Turku, Finland; Erno Lehtinen, University of Turku, Finland

A child's tendency to spontaneously focus on numerosity (SFON) is a domain-specific predictor of mathematical development. Proportional reasoning can be seen as the basis for the later understanding of rational numbers and fractions. A basic understanding of proportional relations has been found in children as young as the age of four. In the present study we examine children's spontaneous focus in two tasks that can be attended to in a number of ways, including proportional relations, numerosity, or non-mathematical aspects. Video-recordings were collected from 86 children, ages 5 to 8, solving these two tasks. Children were found to differ in their tendency to spontaneously focus on proportional relations (SFOR) in these tasks. SFOR is defined as a person's spontaneous (i.e. undirected) focusing of attention on quantitative relations and the use of these relations in reasoning. On both tasks Grade-one children were significantly more likely to SFOR than both day-care and kindergarten children. This suggests that SFOR tendencies begin to develop around age 7, indicating that proportional relations become more salient with age.

Background

A child's tendency to spontaneously focus on numerosity (SFON) is domain-specific predictor of mathematical development (Hannula & Lehtinen, 2005; Hannula, Lepola, & Lehtinen, 2010). These findings indicate that children who more often spontaneously attend to exact number in their environment acquire from a greater amount of practice with enumeration. However, this self-initiated practice in enumeration may be only one aspect of the role of spontaneous focusing in mathematical skills development. As more advanced mathematical concepts, such as mathematical relations, become more relevant, children may similarly benefit from a tendency to spontaneously focus on relational aspects of their environment.

Proportional reasoning can be seen as the basis for the later development of rational number and fraction skills (Resnick, 1992) and a basic understanding of proportional relations may be seen in children as young as the age of four (Mix, Levine, & Huttenlocher, 1999). However, numerosity appears to become more salient than proportionality to children's thinking around the age of 5 (Sophian, Harley, & Manos, 1995) and continues even till the age of 9 (Boyer, Levine & Huttenlocher, 2008). The possible influence of spontaneous focusing processes on these developmental patterns warrants investigation. We therefore ask: (1) What are the age related differences in the tendency to spontaneously focus on proportional relations (SFOR) in tasks that require children to choose the most relevant aspect of the tasks?

Method

Data Collection

86 Finnish-speaking children, ages from 5 to 8 years ($M = 6;8$; $SD = 1.0$), with no diagnosed learning impairments participated in a series of video-recorded tasks over two 30-minute sessions with a trained experimenter. Children were given sufficient breaks during the testing and the ethical guidelines were followed. The tasks included measures of children's tendency to spontaneously focus on numerosity and proportional relations. Children were split into three age-groups based on their placement in kindergarten ($N = 31$; $MAGE = 5;6$), pre-school ($N = 27$; $MAGE = 6;9$), or first grade ($N = 28$; $MAGE = 7;9$).

Tasks

Two tasks were created from SFON tasks (Hannula & Lehtinen, 2005) to examine children's spontaneous focus on proportional relations. In both tasks children 'feed' stuffed animals with either different proportional sliced pieces of bread (see Figure 1) or different proportional sized spoons of rice. The tasks were introduced to the participants without any mention of the quantitative nature of the tasks; no mention of amount, relations in size, or number aspects were made during the experiment.

Based on video-recordings participants were scored as spontaneously focusing on proportional relations if they were able to give the same amount (i.e. the same proportion) of bread or rice as the experimenter gave, or make any mention of proportional relations. Participants were scored as spontaneously focusing on numerosity if they gave the same number of pieces of bread or spoonfuls of rice as the experimenter, or offer any other evidence of enumeration (e.g. counting, number words). If the child gave no evidence of focusing on relational or numerical aspects, they were scored as focusing on non-mathematical aspects. Children were scored for each trial based on the most complex aspect on which they focused, with proportional relations being the most complex, then numerosity, and finally non-mathematical aspects.

Results

12 (14%) participants focused on proportional relations on the majority of the trials for the bread task and 9 (11%) did so for the rice task. 55 (64%) participants focused on numerosity on the majority of the trials for both tasks. One-way ANOVA analyses were used to test age related differences in participants' spontaneous focus. For the bread task (Figure 2) significant main effects were found for the frequency of SFOR, $F(2,83)=7.85, p=0.001$. For the rice task (Figure 3), significant main effects were found for SFOR, $F(2,83)=4.40, p<0.05$ and focus on non-mathematical aspects, $F(2,83)=9.86, p<0.001$. Tukey post-hoc comparisons revealed that on both the bread and rice tasks Grade-one children had significantly higher SFOR scores than day-care and kindergarten children (Bread: $ps<0.01$; Rice: $ps<0.05$). On the rice task kindergarten children were more likely to focus on non-mathematical aspects than day-care and Grade-one children ($ps<0.01$).

Conclusions

SFOR is defined as a person's spontaneous (i.e. undirected) focusing of attention on quantitative relations and the use of these relations in reasoning. Age related differences were found that suggest that SFOR tendencies begin to develop around age 7. While whole-number knowledge has been shown to be both a promoter and an inhibitor of rational number development (Boyer et al., 2008), more detailed knowledge is needed about the learning trajectories of the relation of whole and rational numbers. The confounding influence of whole-number reasoning on the development of proportional reasoning may be partially explained by attentional processes. The significant increase in the tendency to SFOR between the age of 6 and 7 indicates that proportional relations become more salient with age. Rational number learning is based on experience with informal proportional reasoning (Resnick, 1992). Those who begin to SFOR with greater frequency may gain more, and more varied, valuable practice with relational reasoning better equipping them for formal fraction learning. The precise role of SFOR in the development of mathematical skills must be further investigated in order to truly assess these claims.

References

- Boyer, T. W., Levine, S. C., & Huttenlocher, J. (2008). Development of proportional reasoning: Where young children go wrong. *Developmental Psychology*, 44(5), 1478-90.
- Hannula, M. M., & Lehtinen, E. (2005). Spontaneous focusing on numerosity and mathematical skills of young children. *Learning and Instruction*, 15, 237-256.
- Hannula, M. M., Lepola, J., Lehtinen, E. (2010). Spontaneous Focusing on Numerosity as a Domain-Specific Predictor of Arithmetical Skills. *Journal of Experimental Child Psychology* 107(4), 394-406.
- Mix, K. S., Levine, S. C., & Huttenlocher, J. (1999). Early fraction calculation ability. *Developmental Psychology*, 35, 164-174
- Resnick, L.B. (1992). From protoquantities to operators: Building mathematical competence on a foundation of everyday knowledge. In G. Leinhardt, R. Putnam, & R. A. Hattup (Eds.), *Analysis of arithmetic for mathematics teaching* (Vol. 19, pp. 275–323). Hillsdale: Erlbaum.
- Sophian, C., Harley, H., & Manos, C. S. (1995). Relational and representational aspects of early number development. *Cognition and Instruction*, 13, 253-268.

Greek and Flemish students' conceptual difficulties in the shift from (discrete) natural to (dense)

Xenia Vamvakoussi, , Greece; Lieve Nertebs, University of Leuven, Belgium; Konstantinos P. Christou, University of Crete, Greece; Wim Van Dooren, K.U. Leuven, Belgium

The framework theory approach to conceptual change hypothesizes that in the shift from natural to rational numbers, overcoming the idea that numbers are discrete is gradual, and that certain intermediate states of understanding will appear in students. Previous studies with Greek participants pointed to such intermediate states of understanding of the number of numbers in an interval, wherein the type of the interval end points (i.e., natural numbers, decimals, or fractions) affects students' judgments. One could argue, however, that these results are the product of instruction within a specific educational system. We report a cross-cultural comparison study with Greek and Flemish 9th graders who solved a test targeting the infinity of numbers in an interval. It should be noted that Greek students are consistently ranked below the average in mathematical tasks in PISA, whereas Flemish students are consistently ranked among the best performing students worldwide. Thus, one could expect that Flemish students would outperform their Greek peers in our research tasks. From the perspective of the framework theory approach to conceptual change, one would nevertheless expect that similar intermediate levels of understanding of density would be traced in Flemish students as well.

As expected, Flemish students outperformed their Greek peers. More importantly, a cluster analysis of students' responses showed intermediate levels of understanding that were very similar for Greek and Flemish students. These results point to specific conceptual difficulties involved in the shift from natural to rational numbers, and raise some questions regarding rational number instruction in both countries.

It is widely documented that the density property of rational numbers is difficult for students to grasp. Vamvakoussi and Vosniadou (2010) investigated secondary students' understanding of density from the perspective of the framework theory approach to conceptual change (Vosniadou, Vamvakoussi, & Skopeliti, 2008). Based on this theoretical framework, they hypothesized that, in addition to students who answer consistently that there are infinitely many numbers in any interval and those who invariably believe that there is a finite number of intermediates, there are students at intermediate levels of understanding. Indeed, they found a considerable number of students who answered that there are infinitely many intermediates in some, but not all cases. These students, however, did not just provide answers randomly. Specifically, their judgements were largely affected by the type of the interval endpoints, (i.e. natural numbers, decimals, or fractions). For example, a student would answer that there are infinitely many numbers between 0.2 and 0.3, but no numbers between $1/2$ and $1/3$.

Because Vamvakoussi and Vosniadou (2010) make a rather general claim about the processes of learning counter-intuitive concepts in science and mathematics, a cross-cultural comparison is theoretically interesting. In the event that different populations do not appear to face similar difficulties with respect to the dense ordering of rational numbers, or do not show comparable intermediate states, one could argue that the results of Vamvakoussi and Vosniadou are merely a product of instruction, in the context of a particular educational system. Similarly, if students from other populations were found to either succeed or fail across all number types, or make random mistakes, then not only the generality of Vamvakoussi and Vosniadou's findings but also the assumptions of the framework theory of conceptual change would become questionable.

Using the method and instrument reported in Vamvakoussi and Vosniadou (2010), we conducted a cross-cultural comparison study with a Greek and Flemish sample of 9th graders. Belgium and Greece participated in the Programme for International Student Assessment (PISA) for 9th graders in 2000, 2003, and 2006. Greek students were consistently ranked below the OECD average in mathematical tasks, whereas Flemish students were consistently ranked among the best performing students worldwide. Thus, one could expect that a representative sample of Flemish students would perform better than the Greek ones in the tasks used by Vamvakoussi and Vosniadou. From the perspective of the framework theory approach to conceptual change, one would nevertheless expect that Flemish students would be at similar intermediate levels of understanding of the infinity of numbers in an interval.

The participants of the study were 84 Greek and 111 Flemish 9th graders. According to the mathematics curricula in both countries, 9th graders have in principle all knowledge necessary to deal with the research tasks correctly.

The items we used came from the questionnaire developed by Vamvakoussi and Vosniadou (2010). There were 10 multiple-choice items that presented students with pairs of pseudo-successive numbers, such as .005 and .006, or $1/3$ and $2/3$, asking how many numbers there are in between. The type of the interval endpoints was varied across natural numbers, decimals, and fractions. The answering alternatives were as follows: a) There is no other number, b) there is a finite number of decimals, c) there is a finite number of fractions, d) there are infinitely many decimals, e) there are infinitely many fractions.

Flemish students outperformed, as expected, their Greek peers. However, there was a significant effect of the interval endpoints on students' judgments for both nationalities. Specifically, Flemish as well as Greek students performed better in the case of natural numbers; their performance decreased in the case of decimals and was lowest in the case of fractions. A cluster analysis yielded four distinct individual student profiles. More specifically, 36 students (17.0%) answered that there is a finite number of intermediates across all types of numbers. Fifty-six students (27.4%) answered that there are infinitely many numbers between natural numbers, but a finite number between decimals and also fractions. Fifty-eight students (27.4%) answered that there are infinitely many intermediates across all types of numbers, but were reluctant to accept that there can decimals between fractions and vice versa. Finally, 62 students (29.3%) answered that there are infinitely many numbers, of different symbolic representations, across all number types. Compared to their Greek peers, Flemish students were found more frequently in the last, more "sophisticated", category (21.4% and 34.4%, respectively); and less frequently in the first, more "naïve", category (21.4% and 14.1%, respectively).

However, a similar –and more importantly, considerable– percent of students from both countries was found in the two intermediate categories (52.8% Greek, 51.6% Flemish).

These results are in line with the findings of the Vamvakoussi & Vosniadou (2010) study. In a more general fashion, they are in line with the predictions of the framework theory approach to conceptual change and thus provide support for this theoretical position.

On the other hand, these results raise some interesting questions about rational number instruction in both countries. The Flemish students, ranked among the best performing students in mathematics worldwide, appeared to face the same conceptual difficulties with the rational number concept as the Greek students. We suggest that these difficulties are, to a large extent, the product of an “enrichment” view on learning, reflected in the mathematics curricula of both countries, which do not address the problems of conceptual change in the transition from natural to rational numbers.

References

Vamvakoussi, X., & Vosniadou, S. (2010). How many decimals are there between two fractions? Aspects of secondary school students' understanding of rational numbers and their notation. *Cognition and Instruction*, 28(2), 181-209.

Vosniadou, S., Vamvakoussi, X., & Skopeliti, I. (2008). The framework theory approach to conceptual change. In S. Vosniadou (Ed.), *International handbook of research on conceptual change* (pp. 3-34). Mahwah, NJ: Lawrence Erlbaum Associates.

SYMPOSIUM

Teacher thinking about Learning and Teaching

Chairperson: Natalia Schlichter, Georg-August-University of Gottingen, Germany, Germany

Organiser: Natalia Schlichter, Georg-August-University of Gottingen, Germany, Germany

Matthias Nuckles, University of Freiburg, Germany

Discussant: Lin Norton, Liverpool Hope University, United Kingdom

Teachers' thinking has become a topic of interest in educational research. This interest is rooted in the belief that the way teachers plan classroom activities depends on their conceptions about learning and teaching. Indeed, there is growing consensus that teachers' thinking influences their teaching practices and this in turn affects the learning outcomes of their students. However, although considerable scientific effort has been made since Pajares' state of the art review in 1992, teachers' beliefs about learning and teaching still remain – to put it in Pajares' words – a ‘messy construct’. Theoretically, empirical research on teacher beliefs has naturally been inspired by scientific conceptions of learning and teaching. Accordingly, the distinction between a knowledge transmission and knowledge construction view of learning is reminiscent of the shift from early cognitivism to the modern constructivist paradigm. Current empirical research further suggests that there are more than two opposing views (Pratt, 2002). Hence, analogous to the socio-cultural shift in educational research, “learning as participation” (Sfard, 1998) might also constitute an important dimension in research on teacher beliefs. Thus, in this symposium, current research projects on teacher beliefs from Germany, China and Spain will be presented and the similarities and differences between their underlying theoretical assumptions and their empirical results will be explored.

Teachers' Thinking at the University Stage

Marcos Iglesias, University of Alicante, Spain; Ines Lozano, University of Alicante, Spain; Vicente Corrasco, University of Alicante, Spain; Maria A. Martinez, Universidad de Alicante, Spain

In this study, situated in the framework of a wider research on the academic staff thinking, the authors examine the teaching conceptions, visions and inner culture of a cohort of teaching assistants, members of diverse faculties of Alicante's University. The cohort studied is inclusive of 60 participants, male and female in the same proportion, in the fields of: sciences, health sciences, social sciences, law studies, technology, education, arts and humanities. The data were obtained through open, semi-structured oral interviews that were translated in a written form and processed with the support of the Aquad software for qualitative studies. In the first place, the authors identified significance units, that posterior were classified in coda and metacoda. The results inform about multiple dimensions of assistants thinking. Singularly, the data indicate that these professionals assume that in the constitution of their professional identity their vocational inclination and their motivation force to teaching are key points and, also that they feel their teaching identity stronger than their research claim. Furthermore, they explicit a social compromise as their lighthouse academic. On the other hand, they manifest a considerable degree of anxiety about their possible professional career. Ulterior, they are conscious that their efforts to improve teaching will be not rewarded, due that promotion, here and now, is only dependent on the research capital obtained.

Aim of the study

In this study, situated in the framework of a wider research on the academic staff thinking, the authors examine the teaching conceptions, visions and inner culture of a cohort of teaching assistants, members of diverse faculties of Alicante's University. The cohort studied is inclusive of sixty participants, male and female in the same proportion, in

the fields of: sciences, health sciences, social sciences, law studies, technology, education, arts and humanities. In the Spanish universities, the assistants have a pre or post doctoral contract that entitles them with teaching responsibilities. In some way, they are the source of the future staff community.

Theoretical background

The theoretical framework is focus on the perspectives, tendencies and methodological problematic of the teachers' thinking theories considering, also, the new hypothesis about the social mind and brain (Dunbar & Schultz, 2007; Rizzolatti & Sinigaglia, 2006). This hypothesis can open a light in our knowledge of the emotional dimension in teaching and learning.

We precise answer, with a new teaching model, the new role of the universities in the deep and complex social transformations context, mainly given the current blur of equity and solidarity values (Sennett, 2006; Silverstone, 2007; Zizek, 2006). Promote the teacher thinking is indispensable for the professional identity constitution if we want overcome the fall of the intellectual compromise and the emotional disaffection between the teachers' community (Altbach, 2003; Burge, 2007).

Methodology

The data were obtained through open, semi-structured oral interviews that were translated in a written form and processed with the support of specific software for qualitative studies. The data analysis process was performed using the AQUAD software program (Huber & Gurter, 2003) in its 6.8.2.2 version. The main characteristic of this software is its capacity both to categorise the data and to bring them together by codes mutually relating and crossing categories. The metacode, according with the emergent thematic in the participants narratives, are concentrated, ones around their teaching functions as the reflections about curricula program, teaching practice, students assessment, the articulation of the CIT, the student-teacher relations, or the teachers coordination; and others around the academic staff problems, needs, and perspectives. In the theme of professional identity, the research has identified significance units that were classified in code and diverse subcode, depending on how participants see them self as: alumni, disciple of a mentor, a calling person, a novice researcher, a teacher, or a social driving person.

In our view, the information obtained comes from the natural 'scenery' in which the participants are working. Then, the narrative data collected in the questionnaires become essential referents for qualitative research because one cannot construct a professional identity outside the professional culture (Errante, 2000).

Results

The results inform about multiple dimensions of assistants' thinking. Singularly, the data indicate that these professionals assume that in the constitution of their professional identity the key points are their vocational inclination (33.33%) and their motivational force to teaching (34.62%) and, even some participants feel their teaching identity stronger than their research claim (8.97%). Furthermore, they explicit a social compromise as their lighthouse academic. On the other hand, more the 23.08% manifest a considerable degree of anxiety about their possible professional career. Lastly, they are conscious that their efforts to improve teaching will be not rewarded, due that promotion, here and now, is only dependent on the research capital obtained.

Educational significance

The conceptions of learning and teaching that underlie the classroom practices could come in confluence or in confrontation with the innovative proposals of change that the Higher Education reforms are demanded (Henkel & Vabo, 2006). In an educative model that is not prepared to meet the complexity, diversity and uncertainty of the XXI century context, we must start with a deep analysis of teacher's visions and believing (Welch, 2007). The results of this research give us a deeper understanding of the voices that in the future will conform the Higher Education community.

References

- Altbach, P. (2003). Globalization and University: Myths and Realities in an Unequal World. *Current Issues in Catholic Higher Education*, 23, 5 – 25.
- Burge, E. J. (2007). *Flexible Higher Education. Reflections from Expert Experience*. Nueva York: McGraw-Hill Education.
- Dunbar, R. & Schultz, S. (2007). Evolution in the social brain. *Science*, 317, 1344-1347.
- Errante, A. (2000). But sometimes you're not part of the story: Oral histories and ways of remembering and telling. *Education Researcher* (March), 16-27.
- Henkel, M. & Vabo, A. (2006). Academic identities. En M. Kogan, M. Bauer, I. Bleiklie y M. Henkel (Eds.), *Transforming Higher Education. A Comparative Study* (Second Edition). 13 (pp. 127 – 160). Dordrecht (The Netherlands): Springer.

Huber, G. L. & Gurter, L. (2003). AQUAD Seis. Manual del programa para analizar datos cualitativos. Tübingen: Ingeborg Huber Verlag

Rizzolati, G. & Sinigaglia, C. (2006). *Mirrors in the Brain: How Our Minds Share Actions and Emotions*. Oxford: Oxford University Press.

Sennett, R. (2006). *The culture of the New Capitalism*. Yale: Yale University Press.

Silverstone, R. (2007). *Media and morality. On the rise of the mediapolis*. Cambridge: Polity Press.

Welch, A. (Ed.). (2007). *The Professoriate. Profile of a Profession*. Dordrecht (The Netherlands): Springer.

Zizek, S. (2006). *The parallax view*. Cambridge, MA: The MIT Press.

Beliefs at Different Stages of Teacher Education and with Different Levels of Teaching Experience

Natalia Schlichter, Georg-August-University of Göttingen, Germany, Germany; Rainer Watermann, University of Göttingen, Germany; Matthias Nuckles, University of Freiburg, Germany

Teachers' beliefs about learning and teaching play a significant role in classroom activities. Recent research identifies several beliefs with a focus on transmission and construction, while others like participation and nurturing are still neglected. The present study investigated how many and which beliefs could be found in teachers and whether they are associated with different stages of teacher education and different levels of teaching experience. The 50 interviewees were student-teachers at the (a) beginning, (b) middle, and (c) end of their studies, as well as teachers, both (d) beginning, and (e) experienced. Content analysis identified four distinct beliefs of which transmission was the prevalent one compared with the other beliefs. Furthermore, different beliefs were prominent at different stages of studies and levels of teaching experience. For example, more sophisticated beliefs such as knowledge construction and participation seemed to be relatively prominent in the middle of studies, whereby with growing professional experience less sophisticated beliefs such as transmission became dominant. Evidently, teacher beliefs are associated with teacher education and teaching experience. Hence, they may act as the agency of belief change. Suggestions for teacher education and professional development will be made.

Teachers' beliefs are assumptions about the learner, the teacher, the learning and teaching process and classroom management. They influence teachers' practices and this in turn affects the learning of their students (Fang, 1996). Therefore the aim of our study was to investigate self-reflected beliefs about learning and teaching.

Recent research differentiates between several beliefs: teaching as the transmission of knowledge from the teacher to the learner, learning as the cognitive construction of knowledge influenced by the prior knowledge. Current research often focuses on transmission and construction. In contrast, learning as a process of becoming a member of a community according to participation (Lave & Wenger, 1991; Sfard, 1998) or fostering students' self-efficacy according to nurturing (Pratt, 2002) have rarely been studied. Therefore our first research question focused on how many and which beliefs could be found in the interviews. We expected to find more distinct beliefs than merely transmission and construction.

Our second research question focused on different stages of teacher education and different levels of teaching experience. We were interested whether beliefs would differentiate across different stages and levels. According to Pajares (1992), beliefs do not change easily or rapidly, because they are at the core of our world views. However, there are some studies which provide evidence for changing beliefs (Martínez, Saulea & Huber, 2001).

Methodology

The sample (N = 50) consisted of student-teachers (mean age = 23.73; SD = 4.34) (a) at the beginning, (b) in the middle, (c) at the end of their studies, (d) beginning (M = 28.4; SD = 3.37), and (e) experienced teachers (M = 48.8; SD = 8.40).

Interviewees were asked to draw and explain a picture describing their ideas of learning and teaching. On the basis of these explanations we asked some clarifying questions, such as the role of teacher in the learning process. The interviews were divided into single segments (i.e. statements or idea units), which were assigned by their contents to subcategories and then to more comprehensive categories.

Example for a segment:

... It was always helpful when a text was written on the black board for copy//

This coding process was performed by two raters, who were trained for this procedure. The inter-rater reliability as determined by Cohen's Kappa was good ($\kappa = 0.82$).

Results

In our content analysis, four beliefs were identified: transmission, construction, participation and nurturing. The dominant belief, determined as the belief which had a value one standard deviation above the personal mean, was calculated for each participant. 32 were found to hold one dominant belief. Accordingly, transmission was dominant in twelve, participation in eight, construction in six and nurturing in six participants.

The second research question concerned different stages of teacher education and levels of teaching experience. We used the percentages of the single segments as they represent the personal preference of interviewees.

As the Figure 1 shows, transmission was highest in student-teachers at the beginning of their studies; it decreased in the middle and end of their studies and increased once again in practicing teachers with growing experience. Construction and participation, however, were relatively low at the beginning of their studies, then became quite pronounced during their studies, but lost their prominence in practicing teachers, depending on the levels of experience. Nurturing was relatively prominent at the beginning, lower during the studies, and stronger with growing professional experience.

To examine the statistical significance of these trends, we computed contrast tests for each belief. The test of the observed trend for construction (-3 1 1.5 1 -0.5) proved to be significant, $F(1, 45) = 18.75$, $p < .05$. The test of the trend for participation (-1.5 1.5 0.5 0 -0.5) was significant, $F(1, 45) = 4.21$, $p < .05$, and the test of the trend for nurturing (2 -2 -2 1 1) reached statistical significance, $F(1, 45) = 9.00$, $p < .05$. The trend test for transmission was not significant. Evidently, there were different patterns of beliefs depending on stages of teacher education and levels of experience.

Discussion

Investigating teachers' beliefs regarding different stages of studies and levels of experience, we found four distinct beliefs. The most traditional of these – transmission – was prevalent in our sample compared with the other beliefs.

Our study supports the findings of previous research that found changes in teachers' beliefs (Martínez, Saulea & Huber, 2001). We also found that different beliefs were prominent at different stages of studies and levels of teaching experience. For example, more sophisticated beliefs such as knowledge construction and participation seemed to be of relative low importance for student-teachers at the beginning of their studies, but gained greater attention during the studies as a result of academic instruction. Nevertheless, with growing professional experience, this trend was completely reversed, and less sophisticated beliefs such as transmission once again became dominant. It can be assumed that academic teacher education (in typical German universities such as the University of Göttingen) has no sustainable effect on teachers' beliefs about teaching and learning. Therefore teacher professional development should provide opportunities for practicing teachers to connect to current research and to scrutinize their own beliefs about teaching and learning.

Student Teachers' Epistemological Beliefs and Conceptions of Learning and Teaching

May CHENG, University of Oxford, United Kingdom; Angel K. Y. Wong, Hong Kong Institute of Education, China

This paper reports on a study involving 197 preservice teachers in the final year of a 4-year BEd programme in Hong Kong. The aim of the study is to capture student-teachers' epistemological beliefs, conceptions of teaching and learning, and the perceived influence of teaching and learning experience. The Pearson correlations of all the factors extracted from the three questionnaires found that four out of five factors of the perceived influence of teaching and learning experience are significantly correlated with their espousal of constructivist conception of teaching and learning. Both the formal and the informal curriculum of the BEd programme, the field experience, and the overseas learning experience which forms part of the programme are all positively related to the student-teachers' support of a constructivist conception of teaching and learning. With regard to the epistemological belief that effort is needed to acquire knowledge, the formal learning experiences at both tertiary and pre-tertiary levels have a role to play. Implications for the design of teacher education programmes are identified drawing on the findings. Apart from ensuring the quality of the formal learning experiences in a teacher education programme, the informal experiences and pre-tertiary are significant. While there are attempts to influence the student-teachers' conception of learning and teaching, teacher educators need to be aware of the changes of their epistemological beliefs during the programme.

Data were collected from 197 year 4 students in a Bachelor of Education (BEd) programme at the Hong Kong Institute of Education. Respondent were asked to complete the Epistemological Beliefs Questionnaire (EBQ), Conceptions of Teaching and Learning Questionnaire (CTLQ) (both by Chan & Elliot, 2002) and the newly developed Perceived Influence of Teaching and Learning Experience on these beliefs and conceptions (PITL). Principal axis extraction and

oblimin rotation were used to extract factors. Using a minimum Eigenvalue of 1 as criterion, a four-factor and two-factor model are identified for EBQ and CTLQ respectively, which replicate earlier-results of Chan and Elliot (2002) and Wong et al. (2009). The four EB factors are innate ability (INA), learning effort (LEP), authority of knowledge (AUK) and certainty of knowledge (CEK). With respect to the CLT, a constructivist teaching and learning conception (CONS) and a traditional one (TRAD) were extracted.

The 18 components of the newly developed scale of ITLE can be factorized into six factors that account for 69.57% of the total variance. This percentage is commonly considered to be a satisfactory solution in the social sciences. All the item loadings are over or very close to .40, which are considered significant with the current sample size (See Table 1). The factors are labelled as follow: factor 1: "core components in the formal curriculum of the BEd programme (FORM)", factor 2: "field experience (FIELD)", factor 3: "non-local learning experience (N-LOC)", factor 4: "informal and hidden curriculum of the BEd programme (INFORM)", factor 5: "pre-tertiary learning experience (PRE-TER)", and factor 6: "other experience" (OTHER). The Cronbach alphas of these factors, except that of "other experience", range from acceptable (.54) to very good (.91) (See Table 2). The low alpha of factor 6 (.34) indicates low reliability and it wouldn't be further analyzed.

The Pearson correlations of all the factors are reported in Table 2. The grey area reports the correlations among the sub-scales of EB, CLT, and PITLE. It is found that four out of five factors of the perceived influence of teaching and learning experience are significantly correlated with their espousal of constructivist conception of teaching and learning. Both formal and the informal curriculum of the BEd programme, the field experience that students have gone through, and the experience that they have gained in their overseas learning are all positively related to their support of constructivist conception of teaching and learning. The prime role played by the teacher education programme in shaping this conception is also indirectly indicated by the insignificant correlation of the constructivist conception with their pre-tertiary educational experience. On the contrary, the way these pre-service teachers thought about traditional way of teaching and learning is related to neither the educational experience in the teacher education programme nor the earlier schooling. With regard to the belief that effort is needed to acquire knowledge, both tertiary and pre-tertiary experiences have a role to play. But it is the "regular" learning experience, be it the learning of knowledge in the formal curriculum or the teachers associated with such learning in the informal curriculum, that counted. Practical experience in learning to teach in schools and immersion or exchange experience are not associated with this belief. The belief in teachers as authority in knowledge shows a significant positive, though a bit weaker, relationship with the formal curriculum. It seems that students still regard their teachers as an authority figure in their learning of academic content.

Table 1 Pattern matrix reported by exploratory factor analysis for perceived influence of teaching and learning experience of BEd students (n=197)

References

- Chan, K.W., & Elliott, R.G. (2004). Relational analysis of personal epistemology and conceptions about teaching and learning. *Teaching and Teacher Education*, 20, 817–831.
- Wong A. K., Chan, K-W., & Lai, P-Y. (2009). Revisiting the relationships of epistemological beliefs and conceptions about teaching and learning of pre-service teachers in Hong Kong. *The Asia-Pacific Education Researcher*, 18(1), 1-19.

PANEL DISCUSSION

Research on discursive teaching and learning: What have we learned and where are we heading next?

Chairperson: Christa Asterhan, Hebrew University of Jerusalem, Israel

Organiser: Christa Asterhan, Hebrew University of Jerusalem, Israel

Discussant: Lauren B. Resnick, University of Pittsburgh, United States

For the last 25 years or so there has been rising interest among scholars from a variety of disciplines in the role of dialogue and discussion in learning. The different research strands that have developed over the years have traditionally focused on different social situations and are rooted in different research disciplines. Each of them is characterized by a particular set of theoretical assumptions and research paradigms and by a focus on different aspects of both learning and of dialogue. Even though the research and theory development within each of these strands has been very productive, the extent of communication and collaboration across the strands has been rather limited. The overall aim of this discussion panel is then to practice what we, as proponents of discursive techniques for learning and instruction, preach, namely to initiate a multi-disciplinary, productive dialogue among experts from the different research traditions. We will look back to evaluate what has been accomplished and identify what thus far has remained unexplored, both within as well as across the specific research strands. Based on these insights, we will

then outline future directions in research on discursive learning and teaching, discuss the potential benefits and pitfalls of a multi-disciplinary approach, and explore the promise of novel technologies in future research and applications.

Time, talk and learning

Karen Littleton, Open University, United Kingdom

In my contribution to this panel discussion I wish to argue that the relationship between time, talk and learning is intrinsically important to classroom education, and deserves more attention by those engaged in educational research and practice. The coherence of educational experience is dependent on talk amongst participants, and so analyses of the ways that their continuing shared experience is represented and the ways that talk itself develops and coheres over an extended period are required if we are to understand the dialogic process of teaching-and-learning. I will suggest that as educational researchers, we need to understand more about the temporal processes and outcomes of educational dialogues, because only then will we be able to help teachers to see how the precious resource of the time spent with their students can be used to best effect.

In my contribution to the panel discussion I wish to argue that the relationship between time, talk and learning is intrinsically important to classroom education, and deserves more attention by those engaged in educational research and practice. The coherence of educational experience is dependent on talk amongst participants, and so analyses of the ways that their continuing shared experience is represented and the ways that talk itself develops and coheres over an extended period are required if we are to understand the dialogic process of teaching-and-learning.

In broader terms, a sociocultural perspective provides an appropriate theoretical base for developing a more temporally-sensitive understanding of teaching and learning – with concepts such as reflexivity, intertextuality and the Intermental Development Zone highlighting the dialogic, dynamic, self-contextualizing nature of classroom talk (see Mercer and Littleton, 2007). But stronger conceptual links need to be built between the different levels of human activity identified by sociocultural theory - the cultural, the psychological and the social – so that we do not treat the cultural context of educational activity as static and given but explain how it is constituted, renewed and transformed in and through the creative activities of people in conversation and embodied in the products of joint intellectual endeavour. In other words we need to take account of what Lemke (2001, p. 25) has called the multiple timescales of human social activity, development and learning, so that we are ...'as willing to look at biography and history as at situations and moments, as methodologically and theoretically prepared to study institutions and communities as to study students and classrooms.'

Methodologically, there is no doubt that we need better ways of analysing classroom talk as a continuing, social mode of thinking, which represent the ways in which the joint construction of knowledge is negotiated, contested, resourced and achieved over time. Talk which mediates continuing joint intellectual activity poses a considerable methodological challenge for a discourse analyst because of its reflexivity. Every conversational interaction has a historical aspect and a dynamic aspect. Historically, the interaction is located within a particular institutional and cultural context, and speakers' relationships also have local and more specific histories. Speakers may invoke any knowledge from the past experience of all those interacting, whether gained separately or jointly. The dynamic aspect refers to the fact that talk is inherently reflexive: its contextual base is in a constant state of flux, as immediate shared experiences and corresponding conversational content provide the resources for building future conversational context. A key problem for researchers concerned with explaining how talk is used for the joint construction of knowledge (or, indeed, with understanding how conversational communication functions at all) is understanding how speakers build contextual foundations within and for their talk.

We can only do this in a partial, limited fashion, by sampling their discourse over time and by drawing in our analysis on any resources of common knowledge we share with the speakers. Understanding the creation of shared knowledge over extended periods of time will bring with it many other challenges for researchers. For example, as learners establish a shared history and develop common knowledge, the need to be verbally explicit about their work declines. For the participants in a collaboration, this is undoubtedly an asset. For researchers of productive interaction, however, this backgrounding is an analytic challenge. But however difficult it may be to find solutions, the problems cannot be avoided. We need to find ways of representing how the joint construction of knowledge is achieved by participants over time, because the process of teaching-and-learning depends on the development of a foundation of common knowledge.

Temporal analyses can help us see how students' ideas change through the extended process of interaction with a teacher and each other and how new concepts, ways of using language and ways of solving problems are

appropriated. Analytic methods which do not recognize or deal with the temporal development of talk, its reflexivity and cohesive nature over longer timescales than one episode or lesson will inevitably fail to capture the essence of the educational process. Methods for analysing discourse in which the analyst only attends to the relationship between contributions made by participants in one recorded conversation, without applying available information about previous related interactions and historically contextual knowledge shared by participants (as seems to have been advocated by some conversation analysts) would simply not work. Other researchers making functional analyses of language in institutional settings, including those outside education, have made this point. The use of coding schemes in which utterances with the same syntactic form and/or explicit content are taken to have the same pragmatic or semantic value, regardless of their location in the temporal sequence of communication, would also be inappropriate for addressing the kinds of questions with which I am concerned. Rather than trying, in the interests of objectivity, to distance ourselves as analysts from the perspectives of those inside in the long conversations of teaching and learning, I suggest that we should rather try to share those perspectives. As Roth (2001) says, in advocating the dual role of teacher-researcher, knowing a school culture from the inside allows researchers to appropriate participants' competence systems and so enables a richer interpretation of observed language and events.

Teachers use talk to sow seeds from which, in time, may grow the understanding of their students. Dialogues with teachers, and with their fellows, enable students to consolidate and develop their understanding over time, so that they can build new understanding upon the foundations of past experience. As educational researchers, we need to understand more about the temporal processes and outcomes of educational dialogues, because only then will we be able to help teachers to see how the precious resource of the time spent with their students can be used to best effect.

Towards Monitoring Classroom Interactions Through Speech Processing

Carolyn Rose, Carnegie Mellon University, United States

This presentation reports on an effort conducted over the past 5 years to formalize and computationally model a construct that has been called "transactivity" in discourse, beginning with analysis of synchronous and asynchronous on-line discussions and then extended to the case of discussion in classrooms. Transactive contributions are arguments constructed in such a way as to explicitly display the speaker's reasoning processes while referencing, sometimes described as "operating on", the previously expressed reasoning of self or others. A body of work in the collaborative learning community supports its value as a property of discussions for learning. Ideas related to effective patterns of discussion in classroom contexts have evolved within their own separate history from that of the community of researchers studying analysis of collaborative learning interactions. At the same time, a growing subcommunity of the classroom discourse community has focused on facilitation strategies for group discussions that have very similar motivations relating to encouraging children to articulate their reasoning and to listen to and respond to the reasoning of others transactively. One goal of our formalization has been to work towards automating analysis of transactivity in discussions in multiple contexts for supporting research in the role of discussion for learning, for stimulating enhanced learning experiences through support of productive discussions, and for supporting teacher reflection on their own teaching practices. In this presentation, I will discuss the process of developing this formalization, both from a conceptual and technical perspective as well as exploring the many caveats and considerations from a methodological perspective.

This presentation reports on an effort conducted over the past 5 years to formalize and computationally model a construct that has been called "transactivity" in discourse, beginning with analysis of synchronous and asynchronous on-line discussions and then extended to the case of discussion in classrooms. Transactive contributions are arguments constructed in such a way as to explicitly display the speaker's reasoning processes while referencing, sometimes described as "operating on", the previously expressed reasoning of self or others. A body of work in the collaborative learning community supports its value as a property of discussions for learning. Ideas related to effective patterns of discussion in classroom contexts have evolved within their own separate history from that of the community of researchers studying analysis of collaborative learning interactions. At the same time, a growing subcommunity of the classroom discourse community has focused on facilitation strategies for group discussions that have very similar motivations relating to encouraging children to articulate their reasoning and to listen to and respond to the reasoning of others transactively. One goal of our formalization has been to work towards automating analysis of transactivity in discussions in multiple contexts for supporting research in the role of discussion for learning, for stimulating enhanced learning experiences through support of productive discussions, and for supporting teacher reflection on their own teaching practices. Automatic analysis of discussion logs from studies of computer supported collaborative learning has become more prevalent as technology for machine learning and text mining have become more powerful and usable. We have extended this effort to analysis of

transcripts of whole group classroom discussions. Results from an evaluation of this technology applied to transcripts from 3 class periods of middle school math demonstrate promising results, specifically Cohen's Kappa of .69 in comparison with human annotators for identifying transactive contributions and .68 for identifying which prior utterance a transactive contribution relates to.

Much work has already been invested in fruitful applications of automatic analysis technology in the area of computer supported collaborative learning. The work presented in this presentation points towards a new line of research applying this technology in a classroom context. One potential application of this technology could be for use in teacher professional development, by supporting instructors in reflecting on how their classroom interactions with students have proceeded and how the students are progressing in terms of striving towards articulations of transactive expressions of their reasoning. In support of the students themselves, such technology could be used to track development of a student's argumentation and articulation skills over time. Finally, eventually it may be possible for such technology to provide real time feedback to instructors or students during group discussions in order to stimulate higher levels of transactivity within the discussions. In addition to these practical applications, one can imagine that such technology also holds the potential to speed up the science of investigating the role of patterns of conversational behaviour in stimulating valuable social and cognitive processes within classroom contexts. We are beginning to apply this technology to speech recordings. Being able to achieve reliable detection of these types of conversational events from speech recordings is necessary before this technology will be able to be used in a classroom setting in real time.

Our current work on speech processing focuses on recordings from small group discussions. Simple pitch related prosodic features that have been predictive of a variety of affect related variables in other speech processing work have not proven very predictive of transactivity. However, based on the connection between transactivity and social constructs such as solidarity, trust, and respect, we expect to see correlations between the occurrence of transactivity and features that indicate stylistic convergence between speakers. Thus, we are investigating how to operationalize the notion of style convergence from a technical perspective. In this presentation, I will discuss our progress towards developing a formalization of transactivity in classroom discussions, both from a conceptual and technical perspective as well as exploring the many caveats and considerations from a methodological perspective.

Promoting Collaborative Dialogue in the Classroom

Robyn Gillies, The University of Queensland, Australia

Although it is well acknowledged that students benefit from interacting with others, it is only in recent years that research has begun to examine the role that teachers play in promoting collaborative dialogue in the classroom. This is a concern because there is no doubt that teachers play a key role in inducting children into ways of thinking and learning by making explicit how to express ideas, seek help, contest opposing positions, and reason cogently. This paper reports on two studies undertaken by the author that illustrate the difference between teachers' and students' discourses during cooperative and small-group instruction (Study 1) and the additive benefits students derive when their teachers are trained to use specific linguistic tools to enhance students' thinking and learning during cooperative learning (Study 2). The findings from these two studies provide clear support for the importance of explicitly teaching students how to dialogue together if they, in turn, are to use these dialogic strategies to generate new understandings and learn during their cooperative, small group discussions.

Cooperative learning is widely accepted as a pedagogical practice that can be employed in classrooms to stimulate students' interest in learning through collaborative interaction with their peers. When children work cooperatively, they learn to listen to what others have to say, give and receive help, discuss different ideas, and, in so doing, they learn to develop mutual understandings of the topic at hand. In fact, talk is so important that it is now recognised as more than a means of sharing thoughts. It is also a social mode of thinking and a tool for the joint construction of knowledge and new learning (Mercer, 1996). Students who cooperate show increased participation in group discussions, engage in more useful help-giving behaviours, and demonstrate more sophisticated levels of discourse than students who do not work cooperatively with their peers (Gillies, 2003; 2004). The result is that children who work cooperatively tend to perform better academically (Johnson & Johnson, 2002), and are more motivated to achieve than children who have not had these experiences (Johnson & Johnson, 2008).

However, while cooperative learning provides opportunities for students to dialogue, concern has been expressed about the quality of the discourse that often emerges if students are left to engage in discussions without training in how to interact with others. Meloth and Deering (1999) found that task-related talk about facts, concepts, and strategies only appear with low frequency when left to emerge as a by-product of cooperative learning while Chinn et al. (2000) found that children only used high quality discourse when they were required to discuss reasons for their

answers. Similarly Rojas-Drummond and Mercer (2003) reported that although children do not initially use talk to explore and investigate issues when they work collaboratively together, they can be taught to do so and this has a positive effect on their thinking and reasoning. In short, Meloth and Deering, Chin et al., and Rojas-Drummond and Mercer believe that direct intervention by teachers to facilitate discussions is warranted if children are to learn to dialogue effectively with each other.

The teacher's role in promoting collaborative discourse

Although the benefits of children's discussion in cooperating groups is acknowledged (King, 2002; Gillies, 2003), little research has examined the role teachers play in promoting interaction among students. This is a concern because there is no doubt that teachers play a critical role in inducting children into ways of thinking and learning by making explicit how to express ideas, seek help, contest opposing positions, and reason cogently, and to do so in socially appropriate ways. Given the widespread benefits attributed to cooperative learning, neglecting to document the role of the teacher is unusual. This may have happened because teachers have been encouraged to act as facilitators encouraging children to use each other as a resource rather than rely on outside help (Hertz-Lazarowitz & Shachar, 1990) so the focus has been on the benefits that accrue to children from interacting with others (Webb & Farivar, 1999) rather than the role teachers play in the learning process.

In the first study, Gillies (2006) reports on the different discourses used by high school teachers who implemented cooperative learning in their classrooms in contrast to teachers who implement small-group work only. The results show that the teachers in the cooperative condition used more mediated-learning interactions such as paraphrasing to assist understanding, prompting to scaffold learning, and mediating learning between students to encourage engagement about a topic under discussion. Comments such as the following are typical of the mediated-learning interactions the teachers used: You seem to be saying...(paraphrases the student's comments to elicit clarity); Maybe if you consider this....(prompting); and, Perhaps you could consider trying to see if his (students) idea may work (mediating learning between students). Interestingly, the students in these teachers' classrooms appropriated many of these dialogic interactions and recorded nearly twice as many elaborations and task-related interactions, interactions that promote learning, as their peers in the group-work only groups.

In the second study, Gillies and Haynes (2010) built on the previous study by seeking to determine whether teachers who receive training in explicit questioning strategies demonstrate more dialogic interactions that mediate students' learning than teachers who have not received such training. The study also sought to determine whether students who participate in such training demonstrate more explanatory behaviour than their untrained peers. The results show that the teachers who receive training in explicit questioning used significantly more mediated-learning discourse than their peers in the cooperative condition. Furthermore, the children in these teachers' classes engaged in more elaboration and received significantly higher scores on the follow-up reasoning and problem-solving tasks. Implications for both these studies will be discussed

How to talk about talking classrooms

Anna Sfard, University of Haifa, Israel

These days, students' active engagement in conversations on topics of their study is believed to be highly beneficial to their learning. However, corroborating the principle of "conversational learning" with empirical evidence is not a straightforward matter. When taken together, the relevant classroom studies are bringing a mixed message about merits of the talking classrooms. In this talk I wish to claim that one of the reasons for our inability, so far, to combine the results of multiple studies into a clear, if complex, message about advantages and pitfalls of learning-through-conversation is the lack of a language in which to express and summarize the multifarious findings. The first thing we need in order to make our research on learning-through-conversation truly useful is to present the inner workings of our respective research discourses as clearly as possible. Above all, we need to be explicit about the way we use the basic terms such as learning and discourse. As it turns out, however, these words are rarely given the attention they deserve. In this talk, after presenting the spectrum of possibilities for the conceptualization of the relation between communication and learning, I will present my own research discourse in which thinking is considered as a special case of communicational activity and learning of school subjects, such as mathematics or physics, becomes the activity of individualizing (gaining agency over) specialized, historically established forms of discourses.

These days, students' active engagement in conversations on topics of their study is believed to be highly beneficial to their learning. The use of the verb believe rather than know in this last sentence is not accidental. Although learning-by-talking quickly becomes the leading classroom practice, the benefits of the discourse-intense classroom cannot be

taken for granted. True, the study of dialogical learning occupies the centre scene in the current educational research and has already produced a wealth of relevant findings. As it turns out, however, corroborating the principle of "conversational learning" with empirical evidence is not a straightforward matter. When taken together, the relevant classroom studies are bringing a mixed message about merits of the talking classrooms. Whereas many of them justify the enthusiasm with which the idea is promoted by its numerous advocates, other voices can be heard as well, claiming that it has been largely oversimplified and will require much additional refining to be turned into a truly helpful pedagogical principle. The findings collected so far are not just ambiguous – they often appear to be ridden with inner contradictions.

In this talk I wish to claim that one of the reasons for our inability, so far, to combine the results of multiple studies into a clear, if complex, message about advantages and pitfalls of learning-through-conversation is the lack of a language in which to express and summarize the multifarious findings. As stated by Christa Asterhan in her invitation to this panel, "the research involving discussion-based teaching and learning is being conducted by investigators from multiple theoretical perspectives, uses varied methodologies and analyzes different aspects of both learning and of dialogue." This multiplicity of perspectives is, of course, a healthy phenomenon and any attempt at conceptual or methodological unification would bring more damage than benefits. This said, conceptual and methodological freedom must not be confused with the exemption from an explicit theoretical commitment by the researcher. Indeed, if we are to benefit from the collective wisdom of research on learning-through-conversation, the person committed to making a useful contribution cannot just talk in her own language; to be properly understood by others, she has to be explicit about the way she uses words and about the foundational assumptions implied in these words' definitions. While always important, in our times of discursive pluralism this principle of conceptual accountability becomes *conditio sine qua non*. Indeed, a person who wished to build on research already done has to be able to become, if only temporarily, a participant of other researchers' discourses. Only when endowed with keys to these other researchers' unfamiliar uses of familiar words will she be able to engage in the task of compiling their multiple stories into a consistent narrative, which she then may try to take a few steps further.

In short, the first thing we need in order to make our research on learning-through-conversation truly useful is to present the inner workings of our respective research discourses as clearly as possible. Above all, we need to be explicit about the way we use basic terms such as learning and discourse. As it turns out, however, these words are rarely given the attention they deserve. Even more worrying is the fact that the central question of the relation between communicating and learning, and even more fundamentally, between communication and thinking, is rarely addressed by researchers in a direct manner. At a closer look, a variety of answers seem to be underlying diverse research efforts. These answers are spanning a wide range of possibilities, delineated by two extreme doctrines. On one end of the spectrum, there is the conviction that thought and communication, although interrelated and often concomitant, are distinct types of human activity, with discourse playing the secondary role of the "carrier" of one's thoughts. The other extreme is marked by Wittgenstein's denial of the primacy of thought over speech and by his rejection of the idea of "pure thought" that would preserve its identity through a variety of verbal and non-verbal expressions. This radical position is in concert with the work of Lev Vygotsky (1896 – 1934), who illustrated the inseparability of thought (or meaning) and speech by saying that conducting study of thought independently of the study of words is comparable to investigating properties of water by focusing separately on hydrogen and on oxygen. Some would even go so far as to claim that learning mathematics is tantamount to holding a dialogue on mathematical problems.

In my own research, I opt for this last, non-dualist research discourse, in which thinking is considered as a special case of communicational activity and learning of school subjects, such as mathematics or physics, becomes the activity of individualizing (gaining agency over) specialized, historically established forms of discourses. The analytic argument for the indispensability of active mathematical talk for one's learning of mathematics is right there, in the definitions themselves. As I also hope to be able to show in this brief presentation, the proposed non-dualist approach is quite effective in accounting for much of what is known today from empirical research on learning in the talking classrooms.

SYMPOSIUM

Invited SIG

Towards bilingual Europe: Studies in L1 and L2 writing

Chairperson: Gert Rijlaarsdam, University of Amsterdam, Netherlands

Organiser: Gert Rijlaarsdam, University of Amsterdam, Netherlands
Discussant: Eva Lindgren, Umea University, Sweden

In Europe, students must learn their national language of instruction and the European lingua franca, i.e. Global English, for the purposes of international communication and study. In a European context, a large network of researchers in writing try to set up collaborative work to study the relations between L1 and L2 writing processes and the relations with written products to produced knowledge for linking education in writing in L1to L2 v.v., supported by European funds. The aim is to identify the conditions for successful transfer between L1 and L2 writing strategies, and to test the effects of learning environments on the quality of writing. Cross-national studies will be set up to analyze the relationship between L1 and L2 writing processes, and their impact on the resulting text quality, by observing these processes online, using various research tools such as Inputlog (Van Waes, Leijten, & Neuwirth, 2006) and think-aloud protocols (Rijlaarsdam & Van den Bergh, 2006). Data will be collected from L1 students (French, Dutch, Flemish) writing in L1 and L2. This symposium will discuss three studies on L1-L2-writing processes, each with different angles. The aim of the symposium is to explore possibilities to set up crossnational studies, that inform instructional design.

European Research Network on Learning to Write Effectively (ERN-LWE). www.cost-lwe.eu

Rijlaarsdam, G., & Van den Bergh, H. (2006). Writing process theory: A functional dynamic approach. In C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research*. [41-53]. New York/London: The Guilford Press.

van Waes, L., Leijten, M. & Neuwirth, C.M. (Vol. Eds.)(2006). *Studies in Writing: Vol. 17. Writing and digital media*. Oxford: Elsevier.

Formulation in foreign language writing and the temporal dimension of writing processes

Rosa Manchon, Faculty of Arts, Spain

Julio Roca De Larios, Faculty of Education, Spain

This presentation will report on some of the outcomes of a programme of research into the regularities that govern cognitive activity in foreign language writing. We shall focus on the results concerning the temporal dimension of writing processes by providing (i) an overview of our general findings in this area, and (ii) a more detailed analysis of the way in which our participants' L2 proficiency level influenced the temporal dimension of formulation processes. A total of 21 Spanish EFL participants took part in the research programme. They varied in terms of educational level, L2 proficiency and previous writing experience and instruction. Two main data sources were used in the project: think-aloud protocols while writing argumentative tasks in their L1 and L2, and retrospective questionnaires. Results show (i) the various composing activities our participants engaged in did not stand an equal chance of being activated at any given time in the composing process; (ii) the dominance of formulation processes regardless of L2 proficiency level; and (iii) the proficiency-dependency of both the purported recursive nature of writing, and the amount of composition time devoted to formulation.

This presentation will report on some of the outcomes of a programme of research whose ultimate aim was theoretical in orientation: we planned our research as an inquiry into the regularities that govern cognitive activity while writing, attempting at the same time to shed light on how our writers' processes and strategies varied when they tackled writing tasks in the languages that constituted their linguistic repertoire. The development of our research project over the years led to a search for answers in two main areas: the temporal dimension of writing processes, on the one hand, and the problem-solving nature of composing activity, on the other. Regarding the former (our focus of concern in this presentation), we assumed that it was worth looking into the temporal dimension of text production in order to ascertain whether all processes are equal candidates to be activated during L2 writing, and hence equal candidates for interacting with any other. In addition, we also speculated that the time-based character of composing might be constrained by individual differences, such as level of writing ability or L2 proficiency, an issue clearly overlooked in previous L2 writing empirical research. Our research agenda, therefore, included an inquiry into the allocation of attentional resources (operationalized as the time spent on different composing activities) by focusing on the whole L2 composing activity (Roca de Larios et al., 2008), or just on one macro-writing process in L1 and L2 writing, be it formulation, i.e. text-generating activity (Roca de Larios et al. 2001, 2006) or planning (Manchôn & Roca de Larios, 2007). This presentation will provide (i) an overview of our general findings regarding the temporal distribution of writing processes, and (ii) a more detailed analysis of the way in which our participants' L2 proficiency level influenced the temporal dimension of formulation processes.

Methods

In our attempt to achieve the necessary fit between the cognitive orientation and general aims of the project and its design and implementation, two main methodological decisions were taken. First we opted for think-aloud protocols as our main data-elicitation procedure because we needed to get as close as possible to our participants' on-line processing. Second, we chose a within-writer design in the belief that this would allow us to compare across languages and within proficiency levels.

A total of 21 Spanish EFL participants took part in the research programme. They varied in terms of educational level, L2 proficiency and previous writing experience and instruction. Our writers were 7 secondary school pupils (Level 1) with a pre-intermediate level of English proficiency, 7 university students of Education (Level 2) at an intermediate proficiency level, and 7 recent graduates in English (Level 3) with an advanced command of English. All were native speakers of Spanish, with classroom exposure to English that ranged from 5 to 12 years. The three groups had received some writing guidance as part of their language courses, but no instruction specifically aimed at developing their writing skills. The more advanced participants had had both greater contact with English (as this was the medium of instruction in the last three years of their degree course) and substantially more L2 writing practice, particularly academic writing.

Two main data sources were used in the project: think-aloud protocols while writing argumentative tasks in their L1 and L2, and retrospective questionnaires. We followed standard procedures for the elicitation of protocol data with respect to the nature of the instructions and the trial run. The data analysis entailed the transcription of the participants' verbalizations, on the one hand, and the setting up of the coding schemes guiding the different studies, on the other. Regarding the latter, we followed basic principles for the analysis of protocol data suggested in the relevant literature and, in particular, the tenet that encoding must have a theoretical basis, in our case cognitive, problem-solving theories of writing. With respect to the analysis of the temporal dimension of writing processes, we decided to use the time spent on the different writing activities as percentages of total composition time in an effort to neutralize variability across informants regarding the number of processes verbalized and the time spent on the task. As for the analysis of the temporal distribution of writing activity throughout the composing process, the total amount of time spent on each writing task was divided into three equal periods.

Main results

- 1) As proficiency grows, a more balanced allocation of attentional resources to different processes can be observed.
- 2) The various composing activities our participants engaged in did not stand an equal chance of being activated at any given time in the composing process. Across languages and proficiency levels, planning episodes tended to concentrate in the first period, whereas formulation reached its peak in the second period. Revision, in contrast, gradually increased from the beginning to the end of the composition process.
- 3) This general tendency was mediated by proficiency, as seen in the statistically significant triple interaction found between proficiency, process, and period. This means that with greater competence, L2 writers appeared to be able to strategically decide what attentional resources to devote to which composing activities at any particular point in the writing process.
- 4) Regarding formulation, the lower the proficiency level, the more dominant formulation was in the writing process. Another fairly robust finding was that for all participants, regardless of their proficiency level, this process took up most of their composition time, occupying around 60% (Levels 1 and 2) to 80% (Level 1) of the total time.
- 5) We also observed that the internal structure of text-generating activity entailed the combination of episodes in which writing developed without having to tackle problems (fluent formulation), and episodes that clearly involved having to solve various kinds of problems (problem-solving formulation). Fluent formulation was more frequent than problem-solving formulation for all groups and tasks.

Explaining process differences between L1 and L2 writing:

Marion Tillema, Utrecht University, Netherlands; Huub Van den Bergh, Utrecht University, Netherlands; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Ted Sanders, Utrecht University, Netherlands

Writing in a second language (L2) is more difficult than writing in a first language (L1). This is reflected by the observation that L2 writing processes often differ from L1 writing processes. Writing ability is a construct which consists of several subskills. Hayes (1996) lists a number of subskills in the long-term memory component of his model. These can be characterised as metacognitive skills (task schemas, topic knowledge, audience knowledge, genre knowledge) and linguistic knowledge. Since they are embedded in the model part labelled 'the individual', these subskills may be interpreted as learner variables. Can process differences between L1 and L2 be explained by learner variable differences? Twenty students (age=14/15) wrote four argumentative essays in Dutch (their L1) and four argumentative essays in English (their L2). Their cognitive activities during writing were registered by means of concurrent thinking aloud and keystroke logging. In addition, a number of learner variables were measured. These

were: metacognitive knowledge about process strategies, metacognitive knowledge about texts (i.e. the quality of the students' task schemas), and L1 and L2 vocabulary knowledge. L1 and L2 processes differed in terms of distributions of cognitive activities across task execution. The most notable of the observed effects will be discussed, focusing on differences between the effects of learner variables in L1 and L2 contexts. We will employ a theoretical perspective (i.e. relative contributions of each subskill) as well as an educational perspective (i.e. should L2 writing education focus on different subskills than L1 writing education?).

Even for relatively accomplished learners of a second language (L2), writing in their L2 is often more difficult than writing in their first language (L1). This is reflected by the observation that the execution of L2 writing tasks differs from the execution of L1 writing tasks. Van Weijen, Van den Bergh, Rijlaarsdam and Sanders (2008), for example, investigated L1 and L2 writing processes of undergraduate university students and found that cognitive activities, such as planning, generating ideas and text production, were differently distributed across the process of task execution in the L2 than in the L1. In addition, writers varied their writing processes more between tasks in the L1 than in the L2. How can these process differences between L1 and L2 writing be explained? We know that writing ability is a construct which consists of a number of subskills. These subskills have sometimes been identified in theoretical models. Hayes (1996), for example, lists a number of subskills in the long-term memory component of his model. The elements in this model component can be characterised as metacognitive skills (task schemas, topic knowledge, audience knowledge, genre knowledge) and linguistic knowledge. In Hayes' (1996) model, long-term memory is embedded in the model part labelled 'the individual'. Therefore, these subskills may be interpreted as learner variables, which are brought to the writing task by the writer. It seems likely that process differences between L1 and L2 can be (partly) explained by learner variable differences.

Method

Participants (N = 20) were fourteen- and fifteen-year-old students of pre-university secondary education. All participants completed eight writing assignments: they wrote four argumentative essays in Dutch (their L1) and four argumentative essays in English (their L2). Their writing processes were registered by means of concurrent thinking aloud and keystroke logging. These data were subsequently transcribed, segmented and coded by three coders, according to a coding scheme consisting of fourteen categories of cognitive activities. Examples of cognitive activities are: process planning, text planning, text production and revising. In addition, a number of learner variables were measured. Metacognitive knowledge about the writers' own writing processes were measured by means of Kieft's Writing Style Questionnaire (Kieft, Rijlaarsdam & Van den Bergh, 2008). This questionnaire measures the degree to which respondents characterise themselves as engineers (writers who generate text plans before text production) and/or sculptors (writers who use text production as a means to arrive at a text plan). The second learner variable was participants' metacognitive knowledge about texts: knowledge which the writer has about what the intended text should look like. To measure this, participants were presented with a finished argumentative essay with errors on various levels, such as spelling mistakes, wordy sentences, offensive tone and coherence mistakes. They were instructed to make all the improvements they deemed necessary. The quality of the revised texts was rated by five raters. These quality scores are an indication of the quality of their task schema. Thirdly, vocabulary knowledge was measured, both for the L1 and the L2. This was done by means of cloze tests. The distributions of various cognitive activities across task execution was modelled by means of polynomial logistic regression analysis, both for the L1 and the L2. The effect of the measured learner variables on the distributions of cognitive activities during writing was also modelled for both languages. For L2, the quality of the L1 texts (i.e. the L1 writing proficiency) was also used as a predictor variable.

Results & Conclusion

In the present study, too, differences were found between L1 and L2 in terms of distributions of various cognitive activities across task execution. In addition, process differences could be explained by learner variable differences. The higher the quality of the task schema, for example, the higher the probability that text production activities occur at the start of task execution and the lower the probability that text production activities are applied at the end of task execution. We will discuss some of the most notable of the observed effects, focusing especially on the differences between L1 and L2 contexts in terms of the size and shape of the each effect. In doing so, we will employ a theoretical perspective as well as an educational perspective. The theoretical questions are: what is the relative contribution of each of the constituent subskills and how is this different in L1 and L2? The educational perspective pertains to the identification of conditional relations between the various learner variables (do some subskills need to be mastered for other subskills to be effective?) and to the question whether the education of L2 writing should focus on different subskills than the education of L1 writing.

- Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C.M. Levy & S.Ransdell (Eds.). *The science of writing. Theories, methods, individual differences, and applications* (pp. 1-27). Mahwah, N.J.: Lawrence Erlbaum Associates.
- Kieft, M., Rijlaarsdam, G. & Van den Bergh, H. (2008). An aptitude-treatment interaction approach to writing-to-learn. *Learning and Instruction* 18, 379-390.
- Van Weijen, D., Van den Bergh, B., Rijlaarsdam, G. & Sanders, T. (2008). Differences in process and process-product relations in L2 writing. *ITL Applied Linguistics* 156, 203-226.

L1 use during L2 writing: relations between writing skill, language proficiency and text quality

Daphne van Weijen, Utrecht University, Netherlands; Huub Van den Bergh, Utrecht University, Netherlands; Gert Rijlaarsdam, University of Amsterdam, Netherlands; Marion Tillema, Utrecht University, Netherlands

This study examined the way in which second language (L2) writers use their first language (L1) to carry out cognitive activities when writing in their L2. The focus was on when L1 use occurred, whether it varied between writers and tasks, and whether L1 use was related to L1 writing skill, L2 proficiency and text quality. To answer these questions, twenty students each wrote four short argumentative essays in L1 (Dutch) and four in L2 (English) under think-aloud conditions. The writers in the study all appeared to use their L1 while writing in L2, although some did so more frequently than others, and the extent to which they did so also varied between cognitive activities. Thus L1 use did not appear to be a writer-specific characteristic. Proficient L1 writers were less likely to use their L1, and more likely to use their L2 during L2 writing than less proficient L1 writers. For L2 proficiency, no relation with L1 use could be determined. For the specific cognitive activities which were examined only the occurrence of L1 Metacomments appeared to have a negative effect on L2 text quality. For the occurrence of other cognitive activities the opposite effect was found, as they appeared to have a positive effect on L2 text quality when they occurred in L2 during L2 writing. Possible explanations for these findings and implications for teaching will be discussed.

The number of multilingual pupils in language classrooms all over Europe is rapidly increasing. This change affects the way languages and writing skills are taught at all educational levels. How should teachers respond, for example, to pupils who use their L1 while writing in their L2? Should this be encouraged or discouraged? Earlier research has shown that writers use their L1 during L2 writing for a wide variety of purposes, such as planning, generating ideas, solving linguistic problems, and as a means to prevent cognitive overload. But the effect of L1 use on L2 writing and text quality remains somewhat unclear. It can be beneficial, but not in all cases and not for all writers. This appears to depend, for example, on L2 proficiency, the type of task and topic-knowledge. Earlier studies were often based on a single task per writer, making it hard to generalize results over tasks or across languages. In addition, such studies often attempted to relate L2-proficiency to L1 use (e.g. Beare & Bourdages, 2007; Wang & Wen, 2002), instead of examining the possible effect of L1 use on text quality directly, which seems far more informative especially for educational purposes. Therefore, this study hopes to provide further insight into the role L1 use plays during L2 writing, by analyzing multiple tasks per writer. This study aims to determine to what extent specific cognitive activities occur in L1 during L2 writing. The analysis focuses on conceptual activities, which are more likely to occur in L1 during L2 writing than linguistic activities (Wang & Wen, 2002). Setting participants multiple writing assignments, helps determine whether L1 use is relatively stable within writers or whether it varies between tasks. This can also indicate whether writers are more or less inclined to use L1 while writing in L2 due to personal preferences, learner characteristics such as L1 writing skill or L2 proficiency, or due to task effects such as the topic of the assignment (see Krapels, 1990). Second, this study aims to establish more directly what the effect of L1 use is on text quality and to what extent this is influenced by the learner characteristics: L1 writing skill and L2 proficiency. This will be done by analyzing which cognitive activities occur in L1 during L2 writing and whether their occurrence correlates with text quality. Therefore, the main questions in this study are:

1. Do writers use their L1 to carry out conceptual activities while writing in L2? And if so, when?
2. To what extent does L1 use during L2 writing vary for individual writers? and
3. Is L1 use while writing in L2 related to text quality?
4. Is this relation influenced by general writing proficiency and L2 proficiency?

Method

Subjects: Twenty first year students (\approx 18 years old), wrote four short documented essays each in their L1 (Dutch) and four in their L2 (English) under think-aloud conditions. The think-aloud protocols were transcribed and coded to distinguish between eleven different cognitive activities. The assignment consisted of two parts: information concerning the writing task, and a number of quotes on the topic of the task, of which they had to integrate at least two in the text. Subjects were given thirty minutes to complete each assignment. Each session was recorded with audio and video equipment. Data & Analysis The think-aloud protocols were segmented and coded by five different

coders in L1 and six different coders in L2. Five protocols in each language were also coded by two independent coders. The interrater reliability proved satisfactory in both languages.

The quality of the L1 and L2 texts was rated twice, by two groups of five raters, one for each language. For both methods the correlation between raters proved satisfactory. The correlation between the two methods proved high in both languages, so they were summed into two general scores indicating text quality for L1 and L2. Participants were divided into two groups with high and low L1 writing skill based on the average text quality rating for their four L1 essays. They were also divided into two groups with high and low L2 proficiency based on their scores on an L2 vocabulary test.

Results & Conclusions

The writers in the study all appeared to use their L1 while writing in L2, although the extent to which they did so varied between writers, tasks and cognitive activities. Thus L1 use did not appear to be a writer-specific characteristic. Proficient L1 writers were less likely to use their L1, and more likely to use their L2 during L2 writing than less proficient L1 writers. For L2 proficiency, no relation with L1 use could be determined. For the specific cognitive activities which were examined only the occurrence of L1 Metacomments appeared to have a negative effect on L2 text quality. For the occurrence of other cognitive activities the opposite effect was found, as they appeared to have a positive effect on L2 text quality when they occurred in L2 during L2 writing. Possible explanations for these findings and implications for teaching will be discussed. Finally, it seems likely that L1 use itself does not cause a decrease in L2 text quality, but is a sign that writers are trying to overcome or prevent cognitive overload while writing in L2. If this attempt is unsuccessful, then L2 text quality is likely to suffer.

Beare, S., & Bourdages, J. S. (2007). Skilled writers' generating strategies in L1 and L2: an exploratory study. In G. Rijlaarsdam (Series Ed.), M. Torrance, L. Van Waes & D. Galbraith (Vol Eds.), *Studies in Writing Vol. 20, Writing and Cognition: Research and Applications* (pp. 151 - 161). Amsterdam: Elsevier.

Krapels, A. R. (1990). An overview of second language writing process research. In B. Kroll (Ed.), *Second language writing; Research insights for the classroom* (37 - 56). Cambridge: Cambridge University Press.

Wang, W., & Wen, Q. (2002). L1 use in the L2 composing process: an exploratory study of 16 Chinese EFL writers. *Journal of Second Language Writing*, 11(3), 225-246.

SYMPOSIUM

Invited EARLI

The Question of Research Methodology: Where next for EARLI?

Chairperson: Debra Myhill, Exeter University, United Kingdom

Organiser: Rupert Wegerif, University of Exeter, United Kingdom

Discussant: Rupert Wegerif, University of Exeter, United Kingdom

The question of what constitutes quality research in the field of Learning and Instruction is highly controversial and yet this question is seldom raised in official EARLI conferences and journals. This invited symposium, and the online debate that accompanies it, addresses this lack. It is an opportunity for self-reflection within EARLI on what counts as quality in our research. The symposium contrasts three distinct positions presented by three leading experts. Manfred Prenzel, President of the 2013 EARLI Conference, defends the importance of rigorous quantitative research studies designed to inform educational decision makers about 'what works' in education. Gert Biesta, an educational theorist, raises a number of fundamental conceptual challenges to this approach. He argues that because educational practices are constituted by values, good educational research always needs to be conducted with reference to the values that constitute such practices. Martyn Hammersley, an expert on educational research methodology, argues that there can be many types of high quality educational research serving different aims in different contexts. However, quality in research requires an academic dimension which can be threatened when the practical desire to find out 'what works' dominates. In his discussion Rupert Wegerif will relate these three talks to the question of the future direction of EARLI. Everyone is invited to participate in this debate. Do our current set of criteria for judging quality in research need challenging? Does EARLI need to change in order to remain cutting edge in a rapidly changing world?

More evidence is needed: What works and what does not work in education.

Manfred Prenzel, TUM School of Education, Germany

The idea of "evidence-based education" is sometimes associated with expectations that seem to be unreasonably high. It would not be fair, however, to criticise the approach of evidence-based education, because excessive demands have not yet been reached. For a factual dispute, the claims, the peculiarities, as well as the possibilities and limits of evidence-based education have to be analysed clearly and precisely. Evidence-based approaches could and should

show “what works.” Until now, however, the majority of educational research findings shows with high consistency and reliability “what does not work” in education. Some examples will be presented in the paper. Although this evidence about “what does not work” may be perceived as negative, it is in fact highly relevant. As will be argued, however, we have to deal with the idea of “evidence” in the educational context more carefully. For a number of relevant educational problems, we do not yet have sufficient evidence for effective treatments. For some issues, we have only provisional and fragile evidence. Frequently, we are also confronted with contradictory findings. However, for professionals as well as for researchers in education, any kind of evidence—even fragile or contradictory evidence—is helpful. The justification of evidence-based education is ultimately based on a model of rational decision. This rational model does not exclude educational relationships that are characterised by emotions, beliefs, and value-orientations. Moreover, the effects of beliefs, empathy, attitudes, or styles of interaction have to be analysed using controlled and randomised designs.

The idea of “evidence-based education” is sometimes associated with expectations that seem to be unreasonably high and unrealistic. Quite a number of stakeholders in administration and policy hope that pending decisions will win quality and legitimacy if they are based on scientifically sound evidence. At the same time, they expect that evidence-based educational practices may quickly lead to educational progress in the whole breadth of an education system. In addition, many practitioners would be happy to base their decisions on evidence at hand concerning effective educational practices. The sometimes too far-reaching hopes regarding the benefits of empirical knowledge and evidence-based approaches can be understood as a reaction to the long-standing disappointment with traditional pedagogy that has contributed little to improve the education taking place in schools and other institutions in recent decades.

Unrealistic expectations of evidence-based education inevitably lead to disappointment. It would not be fair, however, to criticise the approach of evidence-based education, because excessive demands have not yet been reached. For a factual dispute, the claims, the peculiarities, as well as the possibilities and limits of evidence-based education have to be analysed clearly and precisely. As long as there is limited evidence on interrelations between causally relevant factors (at different levels), educational processes, and multi-dimensional educational outcomes, the mere proclamation of evidence-based practices is not helpful. Evidence-based education requires a body of evidence from consequent, cumulative, and rigorous research. The use of solid designs and sound methods in educational research is relatively young and, considering the number of researchers and the resources in this field, relatively small. In this contribution, it will be shown that the number of studies that systematically examine the relations between outcomes and process or structural factors is still quite limited in many areas of educational research.

Evidence-based approaches could and should show “what works.” This is a common belief. Until now, however, the majority of educational research findings shows with high consistency and reliability “what does not work” in education. These findings attest, for example, that many students in many classrooms do not attain important educational goals, leading to increased disparities between certain groups of students. More examples will be presented in the current paper. Such evidence is unpleasant in many ways, first because it identifies problems and challenges for those who feel responsible. Additional evidence with respect to short- and long-term consequences of these problems for individuals and for society emphasises the relevance and urgency of such discrepancies between outcomes and goals.

Although this evidence about “what does not work” may be perceived as negative, it is in fact highly relevant. Such evidence points to an existing knowledge deficit—in research as well as in practice. On the other hand, there are also findings indicating that some problems do not occur under certain circumstances, showing, for example, that better results or lower disparities in schools or school systems can be achieved. Depending on the design of such studies, the findings may not reveal the crucial factors for success. At least such findings provide evidence that ambitious goals can be attained in principle and stimulate efforts to find ways for improvement: Practitioners may critically consider their own practices, alone or in professional communities, in order to discuss, reflect, change, and evaluate their approaches in continuous cycles with subsequent evaluations and reflections. This is not yet evidence-based practice, but professional action stimulated by evidence. For researchers, of course, such discrepancies (particularly between practical and attainable achievements) are the starting points to analyse systematically what works.

Hence, a theory-driven search for evidence begins that will systematically contribute to the body of evidence. As will be argued, we have to deal with the idea of “evidence” in the educational context more carefully. For a number of relevant educational problems, we do not yet have sufficient evidence for effective treatments. For some issues, we have only provisional and fragile evidence. Frequently, we are also confronted with contradictory findings. However, for professionals in education, any kind of evidence—even fragile or contradictory evidence—is helpful if they know

how to act professionally under conditions of insufficient evidence. This challenge provides important reasons to base professional teacher training on scientific studies.

The justification of evidence-based education is ultimately based on a model of rational decision and action. Rational decisions, however, are not a guarantee of success. In case of failure, rational actors do not have to blame themselves, because they tried to make decisions based on the best available knowledge and evidence.

The rational model of evidence-based education, however, does not exclude educational relationships that are characterised by emotions, beliefs, and value-orientations. Moreover, the effects of beliefs, empathy, attitudes, or styles of interaction have to be analysed using controlled and randomised designs. We also need controlled intervention studies that analyse approaches to develop such characteristics with teachers. Though such studies are quite challenging to implement, they will contribute to evidence-based approaches that really matter.

Evidence-based or value-based? The need to redefine the relationship between research and practice

Gert Biesta, University of Stirling, United Kingdom

The idea that professional practices such as education should be based upon or at least be informed by evidence continues to capture the imagination of many politicians, policy makers, practitioners and researchers. There is growing evidence of the influence of this line of thought. At the same time there is a growing body of work that has raised fundamental questions about the feasibility of the idea of evidence-based or evidence-informed practice. In this paper I make a further contribution to this discussion through an analysis of a number of assumptions that inform the discussion. I focus on the epistemological, ontological and praxeological dimensions of the discussion and in each domain identify a deficit. In the epistemological domain there is a knowledge deficit, in the ontological domain an effectiveness or efficacy deficit and in the practice domain an application deficit. Taken together these deficits not only raise some important questions about the very idea of evidence-based practice but also highlight the role of normativity, power and values. Against this background I outline the case for the idea of value-based education as an alternative for evidence-based education. As I am generally concerned about the expectations policy makers hold about what evidence can and should achieve in professional practices such as education, my contribution is primarily meant to provide educators and other professionals with arguments that can help them to resist unwarranted expectations about the role of evidence in their practices and even more so of unwarranted interventions in their practices.

The idea that professional practices such as education should be based upon or at least be informed by evidence has become influential in many countries around the world. There is, of course, something intuitively appealing about the idea that evidence should play a role in professional work. This is even more so because professions, unlike other areas of work, lay claim to the possession of specialized knowledge and skill thought to be of value to human life. This not only raises general questions about the basis for the knowledge and skills professionals deploy. Given that professional work is orientated towards human well-being, there seems to be a *prima facie* case for basing professional action on the best knowledge available.

This does not mean, however, that evidence should be the only thing that matters. The important question, therefore, is not whether or not there should be a role for evidence in professional action, but what role it should play. This at the very same time requires reflection on the question what kind of role it can play, as there is no point in having expectations about evidence that are impossible to achieve. This is particularly important in relation to the uptake of the idea of evidence-based practice by policy makers, where there is a tendency to expect far too much from evidence. This becomes deeply problematic in those cases in which it is argued that professionals should only be allowed to do those things for which there is positive research evidence available.

The idea of evidence-based practice has generated a substantial amount of discussion. While some caution about what can be expected from scientific evidence, others continue to promote research that emulates “the medical model” as the solution to many if not all problems in education. In my own contributions to the discussion I have particularly highlighted the ‘democratic deficit’ of the discussion, emphasising how a particular use of evidence threatens to replace professional judgement and the wider democratic deliberation about the aims and ends and the conduct of education. In this presentation I will revisit some aspects of this earlier discussion and will add some further dimensions to the analysis. I will present my reflections in the form of a case for value-based education as an alternative for evidence-based education. Calling the idea of value-based education an alternative, is not meant to suggest that evidence plays no role at all in value-based education but to highlight that its role is subordinate to the values that constitute practices as educational practices.

In my analysis I will focus on three aspects: epistemology, ontology and practice. In the case of epistemology I will make a distinction between representational and transactional epistemologies; in the case of ontology I will make a distinction between closed and open systems; in the case of practice I will make a distinction between application and incorporation. In all three cases I will identify a deficit. In the epistemological domain there is a knowledge deficit, in the ontological domain an effectiveness or efficacy deficit and in the practice domain an application deficit. Taken together these deficits not only raise some important questions about the very idea of evidence-based practice but also highlight the role of normativity, power and values. In the final section I will discuss the implications of these deficits for the practice of education which will lead me to my case for value-based education. I argue that the idea of value-based education can help to redefine the relationship between educational research and educational practice in a way that is fitting for the kind of practice that education is.

Can Research Tell Us What Works? On the Methods and Products of Educational Enquiry

Martyn Hammersley, UK Open University, United Kingdom

This paper begins from the idea, promoted by the evidence-based practice movement, that the task of educational research is to discover 'What works?'. It will examine the effectiveness of the randomized controlled trial, often taken as the gold standard by this movement. The argument is that there is no perfect research method, we are faced with a range of strategies with differing advantages and disadvantages, and we must make methodological decisions that trade these off against one another in ways that are most beneficial given the purposes and circumstances of each particular study. The notion of mixing or combining methods will be examined, and some of the complex issues around triangulation explored. It will be argued that mixing methods is no panacea, and that it carries the danger of leaving the methodological ideas currently underpinning qualitative and quantitative methods intact, when these need to be interrogated. In the final part of the talk the question of whether 'what works' is an appropriate focus for educational research will be considered. The way in which this notion conflates factual and normative goals and conclusions will be highlighted. It will be argued that, even when reformulated as a question about the effects of some policy or practice, it is an inappropriate task for academic, as against, practical research. The important distinction between these two kinds of enquiry will be clarified, and current threats to academic research outlined.

The starting point for this paper will be a discussion of the moves to reform educational research that began in several countries in the late 1990s, and that are continuing to one degree or another today. These relate both to the focus of enquiry, with a shift towards addressing technical questions about the effectiveness of particular policies and practices, and to the issue of what are valid research methods. One of the major factors behind the pressure for reform was the rise of the evidence-based practice movement. Its slogan was 'What works?', and educational enquiry came to be challenged by influential and powerful figures for failing to provide sufficient and reliable evidence about this. The origins of that movement lay in evidence-based medicine, which emerged in the 1980s and demanded that the treatments offered to patients must be scientifically tested to show both that they work and that they do not have serious side effects. The format for scientific testing here was randomized controlled trials synthesized through systematic reviews, the key exemplar being trials of new drugs. By this means, some medical treatments were shown to be ineffective or even harmful. This methodological model has been applied in other fields, including education, with mixed reviews; but even those advocates of the model who accept that it cannot be applied in all cases nevertheless tend to treat randomized controlled trials and systematic reviews as the gold standard. The questions that will be addressed in this paper are: whether this methodological model can be extended to the field of education in an effective way; whether it should be; and, if not, what is the alternative? The starting point will be an examination of the strengths of, but also the weaknesses and limits to, randomized controlled trials, especially when applied beyond the realm of drug trials. It will be made clear that the limitations operating on this method are by no means distinctive to the field of education. The more general theme will be that there is no perfect research method, that we are faced with a range of strategies with differing strengths and weaknesses, and that we must make methodological decisions that trade these off against one another in ways that are most advantageous given the purposes and circumstances of each particular study. Following on from this, the notion of mixing or combining methods will be examined, and some of the complex issues around triangulation explored. It will be argued that mixing methods is no panacea, and that it carries the danger that it leaves the methodological ideas currently underpinning qualitative and quantitative methods intact, when these need to be subjected to interrogation. There will be discussion here of attempts to ground mixed methods strategies in epistemological positions like pragmatism and critical realism, suggesting that this must be followed through into a fundamental reconsideration of the qualitative-quantitative divide. This needs to take in both the heterogeneity of the research strategies under each of those headings and the fact that they are designed to tackle the same tasks and face similar problems. In the final part of the paper the question of whether 'what works' is an appropriate focus for educational research, or should be its main focus, will be considered. The way in which this notion conflates factual and normative goals and conclusions will be highlighted. It will be argued that, even when reformulated as a question about the effects of some policy or practice, it is an

inappropriate task for academic, as against, practical research. The important distinction between these two kinds of enquiry will be clarified, and current threats to academic research outlined.

SYMPOSIUM

Invited SIG

Cognitive and Affective Processes in Multimedia Learning: In Memory of Dr. Roxana Moreno - Part II

Chairperson: Detlev Leutner, Duisburg-Essen University, Germany

Organiser: Roland Bruenken, Saarland University, Germany

Jan L. Plass, New York University, United States

Discussant: Detlev Leutner, Duisburg-Essen University, Germany

This invited SIG 6 symposium on Instructional Design is dedicated to Dr. Roxana Moreno, who passed away in summer 2010. Our community lost one of our most prolific researchers, highly productive scholars, and a wonderful human being who will be missed by many. With this symposium we would like to inspire more research related to Dr. Moreno's Cognitive-Affective Theory of Learning with Media (CATLM; Moreno, 2006). Therefore, seven contributions are presented that focus on cognitive and/or on affective processes in multimedia learning (De Koning, Tabbers, & Paas; Imhof, Scheiter, Gerjets, & Edelmann; Kirschner, Phielix, & Prins; Magner, Schwonke, Renkl, Aleven, & Popescu; Park, Seufert, Moreno, & Brünken; Um & Plass; van den Boom, Kirschner, & van Merriënboer). Kirschner et al. discuss self- and group awareness of cognitive and social behaviour. Magner et al. concentrate on the effects of decorative illustrations and their distracting or motivating function. Imhof et al. present different visualizations, which facilitate mental animation. Park et al. show that combined effects of different cognitive load inducing factors are not necessarily additive and how to motivate learners to make full use of their cognitive resources during learning. Um and Plass describe how experienced positive emotions facilitate cognitive processing and improve cognitive and affective outcomes. Van den Boom et al. discuss prompting to stimulate self-regulated learning competence. Finally, De Koning et al. present their results on the function of gesturing as a means to foster understanding. Detlev Leutner will be discussant for the papers presented in the symposium.

Emotional Design in Multimedia Learning

Eunjoon Rachel Um, The New York Times, United States; Jan L. Plass, New York University, United States

Can positive emotions experienced during multimedia learning facilitate cognitive processing and improve cognitive and affective outcomes? 118 college students were randomly assigned to four experimental treatment conditions created by two design factors for the induction of positive v. neutral emotions, (1) by means of a self-referencing mood induction procedure, and (2) through the emotional design of the learning material. Results showed that the emotional design of the materials can induce positive emotions in learners, and that these positive emotions improved cognitive learning outcomes, motivation, satisfaction and perception toward the materials. The study suggests that emotional design should be considered an important factor in the design of educational materials.

Background

Can positive emotions facilitate cognitive processing and improve cognitive and affective outcomes in multimedia learning? Positive emotions are attributed long lasting effects on the personal growth of individuals and their social and emotional well-being (Fredrickson, 2001). When it comes to designing educational experiences, however, little is known about how the emotional impact of learning materials on the learner may affect learning outcomes. There are two competing hypotheses for the effect of positive emotions on cognition. The facilitation hypothesis suggests that positive moods facilitate performance on divergent, creative problem solving tasks (Isen & Baron, 1991; Erez & Isen, 2002; Konradt et al., 2003). In contrast, the suppression hypothesis suggests that moods can take extra-task processing or task-irrelevant processing and will have a negative effect on reasoning (Oaksford, Morris, Grainger, & Williams, 1996). We aim to investigate whether positive emotions in multimedia learning environments facilitate or suppress cognitive processes and, as a result, learning. Our approach to induce positive emotion in multimedia learning uses manipulations that (1) do not add significant amounts of new information to the material, and (2) use established effects that have been empirically validated in their impact on learners' positive emotions. These effects include the use of specific color combinations, anthropomorphism, and the baby face bias - we refer to the combined application of all three visual design effects as positive emotional design. We are interested in how the induction of positive emotions during learning, through the positive emotional design of learning materials would affect learning outcomes compared to an induction of positive emotions before a learning task, through a mood induction procedure.

Method and Design

Participants were 118 students at a private university in the US (79 female, $M=4.9$, $SD=6.4$ yrs.), randomly assigned to one of the four treatment conditions in this factorial design. Factors were the external induction of positive emotions by means of a self-referencing Mood Induction procedure (positive or neutral emotions) (Seibert & Ellis, 1991), and the internal induction of positive emotions by means of the Emotional Design of the learning materials (positive or neutral design). Multimedia learning material was a seven-minute computer-based lesson covering the topic "How immunization works". To manipulate affect, there were two design versions; the neutral emotional design was developed in monochromatic gray-scale, the positive emotional design was a revised version of the neutral design that applied established effects to induce positive emotions without changing the learning content of the materials by using the visual design; color combination, anthropomorphism, and baby-face bias (Figure 1): (see Appendix)Figure 1. Screen shots of multimedia learning materials: Neutral Design (left) and Positive Design (right)As a manipulation check of mood induction, the Positive Affect Scale (PAS) from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1998) was used. Participants first received an introduction and then completed a background questionnaire. Then, twenty-five statements of either the positive or the neutral mood induction were displayed, followed by the first PAS as manipulation check. Next, the multimedia instruction with either neutral or positive design of the material was presented to study for 15 minutes. Participants were given 25 minutes to complete the second PAS, comprehension and transfer tests, and other motivation and interest measures.

Results

Manipulations check revealed that the mood induction had the intended effect. A 2x2 ANOVA on comprehension test scores with Emotional Design and Mood Induction as between-subject factors revealed a significant main effect for Emotional Design, $F(3,114)=11.57$, $MSE=90.58$, pA 2x2 ANOVA on transfer test scores with Emotional Design and Mood Induction as between-subject factors revealed significant main effects for Mood Induction, $F(3,114)=12.25$, $MSE=314.80$, $pConclusionResults$ showed that learners who studied materials designed to induce positive emotions had better comprehension than learners who received the neutral design. In addition, both methods of inducing positive emotions externally, before learning, and internally, using materials designed to induce positive emotions, increased participants' transfer test performance. Results support the facilitation hypothesis that a positive emotional state serves as an effective retrieval cue for other positive materials and demonstrate that positive learning effects can be obtained by applying emotional design principles to the design of multimedia learning environments.

Erez, A., & Isen, A.M. (2002). The influence of positive affect on the components of expectancy motivation. *Journal of Applied Psychology*, 87(6), 1055-1067.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, 56, 218-226.

Konradt, U., Filip, E., & Hoffmann, A. (2003). Flow experience and positive affect during hypermedia learning. *British Journal of Educational Technology*, 34(3), 309-327

Isen, A.M., & Baron, R.A. (1991). Positive affect as a factor in organisational behaviour. *Research in Organisational Behaviour*, 13(1), 1-53.

Isen, A.M., Shalker, T.E., Clark, M., & Karp, L. (1978). Affect, accessibility of material in memory, and behavior: A cognitive loop? *Journal of Personality and Social Psychology*, 36(1), 1-12.

Oaksford, M., Morris, F., Grainger, B., & Williams, J. M. G. (1996). Mood, reasoning, and central executive process. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 477-493.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.

Learning about locomotion patterns with static-simultaneous visualizations and motion-indicators

Birgit Karoline Imhof, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany; Jorg Edelman, Knowledge Media Center, Germany

The ability to self-regulate one's own learning is considered beneficial for learning and a prerequisite for lifelong learning, especially in non-formal and informal settings. Reflection on one's own learning experiences, in turn, is important for developing this self-regulated learning competence (SRLC). Prompting learners so as to stimulate their reflection can be effective for eliciting the desired reflections. Evocative feedback is seen as a means to intensify reflective activities. Students working together on a task in an electronic discussion group were stimulated to reflect on their own learning, provide feedback on each others reflections, and co-reflect on relevant aspects of these reflections. The effects of "instruction on how to provide feedback (feedback instruction)" and "guidance and support by a tutor in the discussion group (tutor moderation)" on the reflective activities, resulting SRLC development, and learning outcomes were investigated. Preliminary results show that in conditions with feedback instruction and tutor moderation reflective activities were more intensive than without feedback instruction and tutor moderation. The

groups differed significantly in their development on certain aspects of SRLC - as measured by MSLQ - as well as on the learning outcomes. A main effect on the MSLQ External goal orientation scale was found for "instruction on how to provide feedback". An interaction effect was found for the MSLQ Peer learning scale. Concerning learning outcomes, conditions with feedback instruction outperformed conditions without feedback instruction. No learning effect was found for tutor moderation.

Background

Self-regulated learning (SRL) refers to those learning processes where the learner orchestrates his/her own learning. The ability to self-regulate one's own learning (i.e., SRL-competence; SRLC) is an important factor in making learning more effective, efficient, and satisfactory and is a prerequisite for lifelong learning, not only in the formal setting, but also in informal and non-formal settings. Reflective activities are essential to acquiring SRLC (Ertmer & Newby, 1996; Nýckles, Hýbner, & Renkl, 2009; Van Velzen, 2002). Reflective activities, however, often need to be evoked. Several authors have claimed that prompts embedded in instruction are well suited for evoking reflection (Berthold, Nýckles, & Renkl, 2007; Kauffman, Ge, Xie, & Chen, 2008; Sobrol, 2000; Stark & Krause, 2009). Although reflection prompts in the form of assignments elicit the desired reflections, Van den Boom, Paas, Van Merriënboer, and Van Gog (2004) found that reflection prompts alone did not evoke the intended depth of reflection. Their results showed that reflection was more effective for developing SRLC when additional feedback on the reflection was provided which is in line with findings that the impact of reflection can be affected by external feedback (Butler & Winne, 1995; Kluger & DeNisi, 1996). Van den Boom, Paas, and Van Merriënboer (2007) found that reflection in combination with external feedback provided by a tutor positively influenced the development of SRLC. Since tutor capacity is expensive, especially as student numbers increase, they also investigated whether this positive influence could be found when feedback was provided by peers. They found, unfortunately, that students were not likely to spontaneously act as feedback providers or co-reflectors.

Aim

To determine how peer feedback and co-reflection can be stimulated in order to intensify reflective activities of students working in an electronic learning environment.

Methodology

An experiment was conducted to determine whether - and if so how - (1) instruction on how to provide feedback (feedback instruction, INS) and providing tutor guidance and support in a discussion group (tutor moderation, MOD) can affect and improve students' reflective activities, and (2) resulting reflective activities affect both self-regulated competence development and learning outcomes. Students enrolled in a university level distance education course (N=45), working together for several months on learning tasks in an electronic discussion group, were stimulated to reflect on their own learning. In all conditions, students were prompted to reflect and to provide feedback on each other's reflections and co-reflect on relevant aspects of these reflections. For the experiment, 11 reflection prompts were presented to the students as assignments in the learning tasks.

The participants were randomly assigned to one of four conditions resulting in the following division of participants over the conditions: see Appendix A, Table 1. Effects of feedback instruction and tutor support on reflective activities, SRLC development, and learning outcomes were investigated. The development of SRLC was measured via difference scores on pretest and posttest with the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991). Learning outcomes were determined via the regular course exam.

Findings

Preliminary results show that the groups differed significantly in SRLC development and learning outcomes. In the INS+ and MOD+ conditions, reflective activities were more intensive than in the INS-MOD- condition. Chi square tests revealed that the four groups differed significantly on total number of messages in the discussions ($\chi^2(1, N = 1230) = 4.11$, p MANOVA on the MSLQ difference-scores showed a main effect of INS on Extrinsic goal orientation (EGO), $F(1, 41) = 10.82$, $MSE = 0.67$, p ANOVA revealed a main effect of INS on learning outcomes, $F(1, 41) = 5.07$, $MSE = 1.81$, p Theoretical and educational significance. This study showed that an intervention using feedback instruction and tutor support in an electronic discussion group differentially affected the intensity of reflective activities. The impact of the reflections on learning outcomes was considerable. Only a minor effect was found on SRLC development. Prompting learners to reflect still seems to be a promising way to stimulate SRLC development, especially if it is combined with instructions on how to provide feedback to reflections of peer students. With that, we recommend concentrating on one or a limited number of aspects of SRLC realize a focus of control. The role of tutor support and the interaction of the tutor support and feedback instruction need to be reconsidered. Concerning educational significance, we advise cautious experimental implementation of strictly

directed feedback instructions to stimulate collaborative reflective activities and co-reflection which proved beneficial for learning. References see Appendix B

Hands in the air: Gesturing as a means to foster understanding of an animation about lightning

Bjorn de Koning, Erasmus University Rotterdam, Netherlands; Huib Tabbers, Erasmus University Rotterdam, Netherlands; Fred Paas, Erasmus University Rotterdam, Netherlands

Recent research indicates that dynamic visualizations involving human motor actions (e.g., origami folding) are more effective for learning than equivalent static visualizations, suggesting that cognitive processing is facilitated if the learning task is related to human movement. Using theories of embodied cognition and cognitive load, the present study shows for the first time that calling upon human movement in dynamic visualizations showing other (non-motor) types of knowledge also enhances learning. In two experiments, participants observed an animation about lightning formation while expressing the depicted information in gesture (i.e., manually following the movements in the animation), by observing an on-screen hand expressing the information in gesture, or without any gesturing. Interestingly, observing on-screen gestures, but not actual gestures made by participants, lead to better learning than observing the animation without gestures. These results suggest that motor experiences during learning, which have been considered to play an important role in observational learning of procedural-motor tasks, can also significantly improve people's understanding of (dynamic) systems or processes teaching more conceptual and non-motor knowledge.

Dynamic visualizations, such as animation and video, visualize processes that are dynamic in nature by explicitly showing the changes in the depicted system or procedure. Therefore, they are assumed to avoid more effort demanding dynamic inferences about the subject matter that are required in static visualizations (Hegarty et al., 2003). However, there is little evidence that animations are superior to static graphics for learning about mechanical or technical systems (Tversky et al., 2002). According to several researchers, ineffective learning from these animations is due to high working memory load caused by transient information (Van Gog et al., 2009). Nevertheless, the effectiveness of animations over static graphics in procedural learning (i.e., human motor skills) was supported in several studies (Ayres et al., 2009; Wong et al., 2009). The results of these studies tend to support the claim that the high working memory demands created by transitory information in animations is less of a problem if the learning focus is related to human movement, because of the 'mirror-neuron system' (Van Gog et al., 2009). Mirror neurons are neurons in the human motor system, which are activated both when people act and by observing motor actions made by others (for a review see Rizzolatti & Craighero, 2004). That is, the same cortical circuits that are involved in executing an action oneself, also respond to observing someone else executing the action. Moreover, this seems to prime the execution of similar actions, which suggests that the mirror-neuron system mediates imitation by preparing the brain for execution of the same action (e.g., Iacoboni et al., 1999). Hence, asking learners to observe an animation to learn a motor skill may not place an excessive burden on working memory resources.

Based on the theoretical framework of embodied cognition, in the present study, it is proposed that it might be effective for learning to call upon human movement also in animations showing other (i.e., non-motor) types of knowledge. Embodied theories of cognition assume that all aspects of human cognition such as ideas, thoughts, and concepts are shaped by the human body, such as perceptual and motor systems. That is, mental representations are formed using sensorimotor systems ordinarily used to control motor behavior and to perceive the world around us and thereby are grounded in perception and action, rather than being reducible to abstract symbols (Barsalou, 1999). One specific type of sensorimotor experience that has been shown to be effective for learning non-motor knowledge (i.e., math) and reducing cognitive load is expressing information in gesture or observing someone else who expresses information in gesture (e.g., Goldin-Meadow et al., 2001; Singer & Goldin-Meadow, 2005). We conducted two experiments that examined how gestures influence learning from an animation in a non-motor domain. The animation studied was a redesign of the animation about lightning formation originally developed by Moreno and Mayer (1998). In Experiment 1, there were two versions of the animation: an arrow-version and a hand-version. In the arrow-version, a moving arrow was added to the display that followed the main movements in the animation. In the hand-version, the arrow was replaced by a picture of a forearm of the same size. A control group of 25 participants studied the arrow-version, a self-gesture group of 25 participants studied the arrow-version while following the arrow with their hand, and an on-screen agent group of 25 participants studied the hand-version. Results revealed that participants in the on-screen agent condition performed better than the other groups on retention and transfer tests. No differences were found between the self-gesture and the control conditions, although from the gesturing literature actually making gestures should lead to the strongest learning benefits. Some likely explanations for the latter result are that 1) by placing one's hand before the screen in order to follow the arrow may have reduced the visibility of the presentation, 2) instructing participants to manually follow the arrow may have distracted learners from the core learning task because they allocated (too) much attention to the arrow.

The aim of Experiment 2 was therefore to further investigate the influence of self-gesturing on learning using a more natural and less interfering way of manually following the movements in the animation. The same animation as in Experiment 1 was used but it was presented without arrows or on-screen hands. In one group, participants were instructed to move magnets on a board placed before them in congruence with the animation's movements. This group was compared to a group who just studied the animation without making any human movements during animation study. To exclude the possibility that the act of gesturing itself and not the type of gesture (i.e., congruent or incongruent) results in better learning, we also included a third group in which participants were instructed to make gestures in a way that is incongruent with the movements in the animation (i.e., continuously rotating the hands). Experiment 2 showed that there was no significant difference in the retention and transfer performance between the three groups. This suggests that despite a more intuitive gesturing approach, coordinating one's movements with the animation's movements and trying to understand a multimedia presentation may be a too complex task for learners.

In conclusion, our experiments indicate that human action, which has been considered to play an important role in observational learning of procedural-motor tasks (Van Gog et al., 2009), can also significantly improve people's understanding of (dynamic) processes that usually have no direct relation to people's actions or bodies. Especially, observed manual gestures integrated in the animation fostered learning, which is consistent with text comprehension research (Marley et al., 2010). From an embodied cognition perspective, designing animations depicting non-human movements in ways that align with how mental representations are formed (i.e., through perceptual and motor experience), may help people understand those movements more easily.

SYMPOSIUM

Unravelling cognitive obstacles in interpreting external representations of data

Chairperson: Wolfgang Schnotz, University of Landau, Germany

Organiser: Wim Van Dooren, K.U. Leuven, Belgium

Discussant: Wolfgang Schnotz, University of Landau, Germany

Graphical displays of statistical data play an important role in an information society as a tool of communication and inference. Education therefore needs to prepare students to deal with information offered in tables and graphs. Consequently, the ability to understand quantitative phenomena and data presented in a graphical way, or shortly graphicacy (Wainer, 1992), is a common requirement in the curricula of primary and secondary education. Although most of the corresponding attainment targets are found in the field of mathematics, graphicacy can be considered as a domain-exceeding skill. The importance attached to tables and graphs in education can also be inferred from the fact that international assessments such as Trends in International Mathematics and Science Study (Mullis et al., 2005) and the Programme for International Student Assessment (OECD, 2009) frequently include tables and graphs in their test questions.

Notwithstanding the curricular importance adhered to external data representations, systematic research about the way in which students interpret these representations – and the difficulties they encounter in doing so – is rather scarce and very often anecdotal.

This symposium brings together three studies that systematically aimed at unraveling the cognitive obstacles that students encounter when they interpret external representations of statistical data. Each paper offers a theoretical perspective on this topic, and discusses the educational implications of the research findings

Students' cognitive difficulties in interpreting tables and bar graphs

Eduardo Marti, University of Barcelona, Spain; Merce Garcia-Mila, University of Barcelona, Spain; Fernando Gabucio, University of Barcelona, Spain; Sandra Gilabert, University of Barcelona, Spain

Fostering documental literacy is an important challenge in compulsory education. Tables and graphs are frequently used formats for presenting data, but there is scarce research devoted to middle school student's learning to interpret these formats. Some research (most of which focusses on adult participants) has shown that the processing required to interpret a table or a graph can be performed at different levels (Postigo & Pozo, 2000; Friel, Curcio & Bright, 2001). In the present study we analyzed primary and secondary students' degree of understanding of a double entry table and a bar graph. Our results show only a rather low level of understanding, but more importantly, little progress across educational levels. We identified some specific cognitive difficulties that can explain the students' low performance in deeply understanding tables and graphs (cross organization of data, dissociation of variables, figurative obstacles, meaning of intervals and prior knowledge). Some educational implications are discussed.

An important goal in the compulsory curriculum is to foster documental literacy, understood as the ability to identify and use information presented in various formats such as tables and graphs (Murray, Kirch, & Jenkins, 1997). This is not only important in academic and scientific tasks (Latour, 1987; Lemke, 1998) but also to function in our everyday activities. This challenge contrasts with the scarce research devoted to middle school students' learning to interpret tables and graphs. Most studies analyze adults' performance (Barquero, Schnotz, & Reuter, 2000; Leinhardt, Zaslavsky, & Stein, 1990) and those studies that involve children and adolescents mainly focus on graph interpretation. Among those studies that investigate the interpretation of graphs, we take as a reference for the present research the levels of understanding proposed by Friel, Curcio, and Bright (2001) and Postigo and Pozo, (2000). These studies explore the degree of processing involved in interpreting graphs. Friel et al. (2001) proposed the following processing categories: "read the data", "read between the data", and "read beyond the data". We take these as a starting point to understand middle school students' difficulties when they are asked to interpret graphs and tables. The objectives of our study are to analyze primary and secondary students' expertise on table and bar-graph interpretation and changes in this level of expertise over educational levels. We also wanted to test whether different levels of interpretation are present in the students' answers and to identify the main cognitive difficulties in interpreting a table and a bar graph. Method Two hundred students from a public school participated in the study: 43 5th graders (mean age= 10;8), 69 6th graders (mean age= 11;9), 43 7th graders (mean age = 13;0) and 42 8th graders (14;1). Two multiple-choice questionnaires (12 items each) were designed to evaluate the level of understanding of a table (double entry table of frequencies, see Figure 1) and a graph (bar graph, see Figure 2)

All students were asked to individually answer both questionnaires in their classroom. The order (Table - Graph) was counterbalanced in each grade level.

Items were categorized according to different levels of complexity as follows. Three of them correspond to the categories proposed by Friel et al.(2001). We added a new one (basic questions) to attend conventional and basic aspect of representations.

Level 1. Basic questions

Basic conventions of the representations; i.e. to know what is represented in the graph axis or in the table cells.

Level 2. Reading data

Extracting pieces of information that are directly present.

Level 3. Reading between data

Inferring data that are not directly available.

Level 4. Reading beyond data

To be able to relate global trends of data with other knowledge; i.e. to understand why bars are higher in the middle of the graph than in the extremes.

To analyze the main difficulties students presented in understanding the table and the graph in more detail, we interviewed 8 students of the same school (2 students in each grade). In these interviews, we presented the same table and graph with the corresponding questionnaires. For each answer, the interviewer asked the student for an explanation of his/her choice.

Results

Globally, the students showed a rather low level of understanding: for the table, mean of correct responses = 6.95 (standard deviation = 2.09) and for the graph, mean = 6.69 (standard deviation = 2.21).

Looking more closely at the data for the different groups, there were significant differences between age groups: $\chi^2(3) = 20.4$, $p = .001$ for the Table and $\chi^2(3) = 9.438$; $p = .024$ for the Graph. When the four groups were compared, only 5th graders showed a significantly lower mean compared to the other groups in both questionnaires, which was only due to the items that refer to "reading data".

Items theoretically classified as "reading data" (level 2) were the easiest, followed by "reading between data" (level 3) and followed by items of "reading beyond data" (level 4). The only non-expected result was that two items of "basic questions" were more difficult than items of direct lecture.

The qualitative analysis of the interview data enabled us to identify some of the following cognitive challenges the students encountered in the task:

a) Cross organization of data. To understand that each frequency is related to a particular value of gender variable and weight variable.

- b) Dissociation of variables. To understand that each variable is represented differently.
- c) Overcome figurative obstacles. To be able to avoid quick judgments only based in salient aspects of the figure (for example, height of bars).
- d) Meaning of intervals. To understand that the variable weight include ordered intervals that can be integrated (for example for knowing how many students weight less than 35 kg it is necessary to add the frequencies corresponding to two intervals).
- e) Questioning prior knowledge. To be able to accept that data can contradict previous ideas

Discussion and Educational Implications

According our results, the degree of middle school students' understanding of straightforward and common formats of data representation (a table of frequencies and a bar graph with two variables) was not very high. More importantly, we found little progress from 5th to 8th graders. The only exception was the progress from 5th to 6th grade in the most elementary level of interpreting: the ability to directly read data. The other levels of understanding were lower and did not show any progress over the four educational levels.

Some specific cognitive difficulties seem to be the cause of this low level of expertise. Our results lead to a some educational considerations: a) The need to explicitly instruct the specific features of tables and graphs formats (their conventions, their uses, their diversity); b) The importance of working out the main cognitive obstacles through tasks that not only require the specific use tables and graph but also need a metacognitive approach (to be able to know the main conventions of each format and their specific function).

The misinterpretation of space and direction in external representations for data distributions

Stephanie Lem, K.U.Leuven, Belgium; Patrick Onghena, Katholieke Universiteit Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium; Wim Van Dooren, K.U. Leuven, Belgium

External representations are needed when learning or solving problems about distributions of statistical data. Well-known and widely used examples of these representations are histograms, box plots, and descriptive statistics. Besides some anecdotal evidence, not much is known about the way people interpret and use these representations. In this study we asked 125 university students to solve tasks that were specifically constructed to test for misinterpretations concerning the use of space and direction in graphs in which the distribution of one variable is represented (Tversky, 1997). Overall, performance was relatively low. We were able to detect four misinterpretations that can be accounted for by means of Tversky's design principles. This suggests that we can probably assign these interpretation difficulties at least also to the design of the representations and not only to a lack of knowledge or skill of the students. Implications for research and teaching are discussed.

Reasoning about data distributions is an important part of data description and thus of data analysis (Moore, 1990). In addition, understanding data distributions is believed to help understanding theoretical and sampling distributions (Meletiou & Lee, 2002). When interpreting the distributions of statistical data, external representations are necessary. Various representations are available and widely used in education, like histograms and box plots. There is some (mostly anecdotal) evidence concerning difficulties students have interpreting these representations, especially concerning histograms (e.g., delMas, Garfield, & Ooms, 2005; Meletiou & Lee, 2002) and box plots (Bakker, Biehler, & Konold, 2004). The present study aimed at studying these difficulties in a more systematic way by having 125 university students solve tasks specifically designed to detect possible systematic misinterpretations of these representations. The tasks were constructed based on a pilot study and the graph design principles of Tversky (1997).

Tversky's cognitive design principles

Tversky (1997) proposed two important design principles that are based on the way people interact with their environment. First, space in a graph should be used in a natural way. This means that proximity of elements in a graph should correspond to proximity of a property of the represented variable, like value, frequency, or time. The same holds for the area in a graph. Second, people tend to focus more on the vertical than on the horizontal dimension of a graph. In the vertical dimension, the top is naturally better than the bottom: We grow in a vertical direction, if you make a pile of objects the pile will get higher, and so on. This means that we tend to associate higher with "more" or "better".

Tversky's principles about the use of space and direction in graphs can be applied to external representations for data distributions to explain (and maybe even predict) how people interpret these representations. For example, when looking at a histogram or box plot, people will tend to focus at the height of the elements they see. This is relevant for the bars in a histogram, but the height of the box in a (horizontal) box plot is not at all relevant. This way we could, for

instance, predict that when interpreting a box plot, it is not unlikely that students will make mistakes by trying to take the vertical dimension into account.

Method

125 university students (first year Educational Sciences) participated in our study in return for course credit. Participants had all completed the same introductory statistics course covering descriptive statistics and graphical representations, among other topics, at the time of the study. In this paper, we will focus on five tasks from a larger paper and pencil test. These tasks were specifically constructed to systematically detect misinterpretations that were encountered in a pilot study with another group of students and that can be explained by Tversky's principles. Although most of these misinterpretations are specific for certain representations, we randomly varied the representation that accompanied a task between students: histograms, box plots, and descriptive statistics. By doing so, we would be able to see whether a specific misinterpretation was due to a certain representation or due to the task (and the involved statistical concept) itself.

Results

On average, students solved 2.03 out of five tasks correctly. Four systematically occurring misinterpretations were detected. First, when using a grouped histogram or a box plot, students did not take into account that these representations only provide a summary of the data, disguising the exact data: They believed they could see in the graph whether a specific observation was made (Figure 1A). Second, students took the height of the bars in histograms into account to compare the means of two histograms, by stating that the histogram with the highest (modal) bar also has the highest mean, while it is of course the position and overall shape of the distribution that determines the mean (Figure 1B). Third, students thought that Quartile 1, or the beginning of the box in a box plot, was the lowest observed value, thus ignoring the 50% data which is located in the whiskers (Figure 1C). Fourth, again concerning box plots, students mistakenly thought that the area of the box represents the number or proportion of observations that are located in that interval, while in fact each part of a box plot represents 25% of the data (Figure 1D). All these misinterpretations can be accounted for by Tversky's (1997) design principles, as is explained in Figure 1.

Discussion

Our results show that students have various difficulties interpreting representations for data distributions. The design principles of Tversky (1997) can help to explain why these students misinterpreted the representations. Students focused for instance on the height of the bars in histograms instead of taking also the horizontal spread into account or they tried to interpret the area of the box in a box plot. This suggests that the problem with the interpretation of these representations is not (exclusively) caused by a lack of knowledge or experience with these representations, but (also) by the general design of these representations.

For research, these results have various implications. First, when studying students' distributional reasoning, representation is a crucial factor to take into account, because any study would unavoidable rely on some representations. Second, also in other domains of statistical reasoning many representations are used, which makes it interesting to study the occurrence of misinterpretations of these representations too. Third, more effort must be put into studying where these misinterpretations come from and how they can be prevented and remediated.

For education it is also important to know how students interpret representations of data distributions as this gives teachers the opportunity to diagnose, prevent, and remediate possible problems. A fruitful approach might be to use multiple representations of the same data distributions, and to confront the conclusions that are suggested on the basis of one representation with those in another representation, in order to directly address the misinterpretations.

Difficulties in using different representations in laboratory data analysis

Comprehension of Text and Graphics, Mathematics Education, Science Education

Ida Kukliansky, Ruppin Academic Center, Israel

Haim Eshach, Ben Gurion University of the Negev, Israel

The interpretation of data and graphs is a central practice in science. Therefore an important skill needed in the university physics laboratory is the ability to process data obtained from experiments. This study aims to show students' difficulties while dealing with multiple representations of data received from physics laboratory experiments. On one hand there are a lot of benefits in using multiple representations, on the other hand it may pose a serious challenge for learners. 77 university students participated in this study. The findings show that students have significant difficulties in translating information from one representation to another (for example, visual and analytical), and in dealing simultaneously with three different visual representations.

Introduction Given that data obtained from experiments in the physics laboratory need to be processed, the interpretation of data and construction and interpretation of graphs are central practices in science (Bowen & Roth, 2005). According to Bowen & Roth (2005, p. 1064), "physical phenomena are translated through consecutive inscriptions that may include, in increasing order of complexity, such re-representations as maps, lists, tables, totals, means, graphs and equations". In addition, in the process of developing theories, scientists also manipulate data translating one representation into another. Many studies highlight the benefits learners may reap from using multiple representations. For example, Ainsworth (1999) argued that a known representation may help understanding an unknown representation and that representations may complement each other. On the other hand, working within a multi-representational learning environment may pose a challenge to learners, since it requires: 1) understanding the syntax of each of the representations, 2) understanding which part of the topic is being represented, 3) identifying partial correspondence between representations, and 4) translating between representations by finding the similarities and differences in the two systems of representation (van der Meij & de Jong, 2006). This study aims to show the student's difficulties while dealing with multiple representations of data received from physics laboratory experiments.

Method The participants were 77 students: 28 first-year engineering college students, 24 first-year physics university students and 25 university students, having a bachelor's degree, participants of physics teaching certificate program. All of them filled out the questionnaire at the end of their physics laboratory class. The "data analysis" questionnaire, which was developed for our previous study, was used (Eshach & Kukliansky, 2007). It included 20 multiple choice questions referring to different parts of an experiment on Newton's second law. The questionnaire was evaluated by five experts and showed Alpha Cronbach of 0.69.

Results The results showed that the participants had difficulties translating from one representation to another and dealing simultaneously with several representations as we will exemplarily show here. About one fifth of the participants wrongly chose a linear graph instead of a parabolic one describing a cart's movement with constant acceleration on a straight line. About one fourth of the participants experienced difficulties in questions requiring reading of kinematics graphs, where visually represented information needed to be translated to a numerical representation. For example, difficulties were incurred calculating the distance traveled by the cart during a time interval specified by two time points. Another example (Figure 1) where students had to deal simultaneously with three different visual representations was a graph containing 1) a scatter plot describing the results of the experiment's measurements, 2) the regression line calculated and drawn between the points, and 3) the calculated error bar, marked around each point. The participants were asked whether, when applying the regression line, the two relatively distant points A and B needed to be taken into account. Over 70% of the participants chose the wrong options. The correct answer is that the point within the error bar needs to be included, while the one outside the error bar must be re-measured. It seems that students had difficulty to deal simultaneously with three graphical representations and considered only two of them – the scatter plot and the regression line – disregarding the error bar.

Discussion A possible explanation for choosing the linear graphs instead of the parabolic one is that the participants were influenced by the movement which took place on a straight line, and consequently, chose a graph which included straight lines. This attests to students' difficulties in translating information from one representation to another. The difficulties revealed in the questions requiring reading of kinematics graphs where visually represented information needed to be translated to a numerical representation fit the results of other studies in the domain of kinematics graphs, for example Forster (2004). The interpretation of a graph as being a kind of a picture might be due to students' difficulty to „translate“ the distance-time graph to the real life, and instead making parallels between the cart's height and the graph's height. Also, the difficulty to extract the acceleration from a graph describing distance as a function of time stems, probably, from the difficulty to extract a numerical value from a visual representation. In addition, the difficulty to choose a graph, which best describes the distance of the cart traveled during the experiment as a function of time, probably stems from the difficulty of conducting a number of sequential translations which this task demands: translating the distance traveled by the cart as a function of time to an analytical representation – a formula – and then translating it again from the formula to the description of the correct graph as described in Figure 2. The cognitive challenge students face when processing laboratory data (e.g. manipulating raw data, simultaneously representing them in a variety of forms, moving from one representation to another) may explain the difficulties identified in this study which also concur with other studies conducted regarding the handling of several representations simultaneously (Arcavi, 2003). The cognitive barriers in handling with multiple representations have to be taken into consideration when teaching in university laboratories.

References Ainsworth, S. (1999). The functions of multiple representations. *Computers & Education*, 33, 131-152. Arcavi, A. (2003). The role of visual representations in the teaching and learning of mathematics. *Educational Studies in Mathematics*, 52, 215-241. Bowen, G. M., & Roth, W.-M. (2005). Data and graph interpretation practices among preservice science teachers. *Journal of Research in Science Teaching*, 42(10), 1063-1068. Eshach, H., & Kukliansky, I. (2007). Statistics in the physics laboratory. Paper presented at the EARLI 12th Biennial Conference for Research on Learning and Instruction, Budapest, Hungary. Forster, P. (2004). Graphing in physics: Processes and sites of error in Tertiary entrance examinations in Western Australia. *Research in Science Education*, 34, 239-265. van der Meij, J., & de Jong, T. (2006). Learning with multiple representations: Supporting students' learning with multiple representations in a dynamic simulation-based learning environment. *Learning & Instruction*, 16, 199-212.

SYMPOSIUM

Research on Current Reforms in Teacher Education: Finland, Norway, and Germany

Chairperson: Johannes Bauer, TU Munchen, Germany

Organiser: Johannes Bauer, TU Munchen, Germany

Discussant: Kurt Reusser, University of Zurich, Switzerland

The Bologna-Process of higher education reform has brought an era of tremendous change in higher education structures and processes, including teacher education. The resulting variability in study forms and structures can be interpreted as a natural experiment and comes with great chances for research. Specifically, there is an urgent need for more evidence about the implementation of new study structures, innovations, and about the effects of different approaches to teacher education on prospective teachers' professional development. The aim of this symposium is to bring together empirical studies that take a comparative research perspective on innovations and reforms in teacher education. For this purpose, the symposium focuses particularly on the Scandinavian and German-speaking countries. The Scandinavian countries are renowned for their teacher education. In the German-speaking countries, there is currently a growing interest in exploring new ways of teacher education and in expanding teacher education research. By bringing together the described perspectives, the symposium creates synergies for teacher education policy and practice, as well as for further comparative research on teacher education and higher education in general. These synergies include, firstly, the provision of in-depth knowledge about current forms of, and reforms in, teacher education. Secondly, the symposium contributes evidence about the potential effects of different forms of teacher education and provides a stage for advancing new research questions and study designs.

Practice Architectures of Teacher Induction in Finland

Paivi Tynjala, University of Jyväskylä, Finland; Hannu Heikkinen, University of Jyväskylä, Finland

This study leans on the Finnish reform of the induction phase of teacher education. The national initiative to develop mentoring includes all the teacher education departments of universities and vocational teacher education institutions in Finland. The aim is to implement and further develop an innovation in supporting newly qualified teachers: peer group mentoring. Internationally, this approach is unique. The peer group mentoring model reflects the Finnish approach to educational reform, with a high level of teacher autonomy. The opposite of many mentoring programmes internationally, no elements of assessment, standardisation, or control are involved. Instead, working in a peer-mentoring group offers opportunities to learn together in a supportive environment, promoting time for collaboration and reflection. The model is built on a culture of responsibility and trust that values teachers' professional autonomy. The main aim of this presentation is to study the Finnish reform of induction within the theoretical framework of "practice architectures" (Kemmis & Grootenboer, 2008; Schatzki, 2002). Based on a nation-wide empirical data, it was found that peer group mentoring strengthens the agency of young teachers and supports their professional identity as autonomous teachers.

Aims

The objective of the project Practice Architectures of Teacher Induction (PATI) is to examine the Finnish peer group mentoring model as an innovative form of supporting newly qualified teachers, in contrast to the practice architectures of teacher induction internationally. The main aim is—in line with the European initiatives—to promote a lifelong continuum of teachers' professional development. The common European and global aim is to create conditions that might reverse feelings that contribute to teachers leaving the profession, particularly the feeling of lack of professional autonomy.

The project is based on long-term research on teacher induction at the national and international levels. At the national level, this plan leans on research and development work that has been carried out since the beginning of the century, coordinated by the Finnish Institute for Educational Research (FIER). As a result of this work, a new approach to induction, peer group mentoring model (*vertaisryhmämentorointi*), has been developed and will be disseminated nationally throughout Finland. The project is historical in two ways. Firstly, it has achieved a nation-wide consortium, including all the teacher education departments of universities and vocational teacher education institutions in Finland. Secondly, it marks the first time support for newly qualified teachers is financed so strongly at a national level (www.osaavaverme.fi). Contrary to many of the mentoring programmes world-wide, no elements of assessment, standardisation, or control are involved. Why does Finland seem to end up with such different solutions in comparison to other countries? One of the main aims of this research project is to answer this question. The main research question of this project is the following: How are the practice architectures of teacher induction reform in Finland

constituted within the national and international practice architectures of education and within the global practice architecture of the Global Education Reform Movement (GERM)?

Methodology

Methodologically, the project utilises mixed method research designs, including quantitative data collection and qualitative inquiry. We utilise material that has been collected through a nationwide quantitative enquiry in Finland, the Osaava Verme project. At the international level, the project is rooted in long-standing comparative research within European countries and Australia. The international network NQT-COME has worked with comparative studies on teacher induction since 2005. The Australian contact, since 1995, is Professor Stephen Kemmis (Charles Sturt University). Recently, Stephen Kemmis has been working with the theory of practice architectures. The main aim of this research project is to study teacher induction within this theoretical framework of practice architectures. This research approach can be described as a 'philosophical-empirical enquiry', drawing on contemporary practice philosophy and theory on the one hand, and on the other, exploring the ways that practices develop and are held in place, both in terms of the agency and actions of individuals, and in terms of the cultural-discursive, material-economic, and social-political enabling preconditions that make these practices possible.

Findings

The data shows that peer group mentoring strengthens the agency of young teachers and supports their professional identity as autonomous teachers. The model reflects the Finnish approach to educational reform, with a high level of teacher autonomy. Working in a peer-mentoring group offers opportunities for both new and experienced teachers to learn together in a supportive environment that promotes time for collaboration and reflection. Thus, it is in line with the general pedagogical trends in Finland that emphasise the social construction of knowledge (Heikkinen, Jokinen & Tynjälä, 2010; 2011). At the macro level, we view the Finnish model in the context of a (post-) welfare state, drawing on a Nordic tradition of democracy, and being challenged by neo-liberalist trends. Generally speaking, the Finnish education system has remained quite unreceptive to what is often called the global education reform movement (GERM), which has been adopted as an official agenda or accepted as educational orthodoxy within many education reforms throughout the world, including the USA, the UK, and Germany (Sahlberg, 2010).

Theoretical and educational significance of the research

The scientific impact of this project is a new theoretical understanding of teacher education and induction, based on the theoretical and philosophical literature of practice architectures. The induction phase of a teaching career is understood in the light of the macro and micro level practice architectures locally, nationally and globally. In terms of societal impact, the project will develop better methods to support teachers early in their careers. The results are directly applicable and feasible to all the teacher education institutions, and the results will be disseminated through articles, books and conference presentations. Among the potential end-users, there will be teacher educators, educational administrators, teachers and personnel in schools and educational institutions at various levels of their careers.

Heikkinen, H.L.T., Jokinen, H., & Tynjälä, P. (2008). Reconceptualising mentoring as a dialogue. In G. Fransson & C. Gustafsson (Eds.), *Newly Qualified Teachers in Northern Europe. Comparative perspectives on promoting professional development*. (pp.107-124).

Heikkinen, H.L.T., Jokinen, H., & Tynjälä, P. (2010). *Verme. Vertaisryhmämentorointi työssä oppimisen tukena*. Helsinki: Tammi Publishers.

Heikkinen, H.L.T., Jokinen, H., & Tynjälä, P. (2011). *Supporting learning at work through Peer Group Mentoring*. Manuscript to Routledge.

Kemmis, S. & Grootenboer, P. (2008). Situating praxis in practice: Practice architectures and the cultural, social and material conditions for practice. In S. Kemmis & T. Smith (Eds.) *Enabling practice. Challenges for education*. Rotterdam: Sense.

Sahlberg, P. (2010). Educational change in Finland. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.) *Second International Handbook of Educational Change* (pp. 323-348). New York: Springer.

Schatzki, T. R. (2002). *The site of the social: A philosophical account of the constitution of social life and change*. University Park: Pennsylvania State University Press.

The Bologna Reforms in German Teacher Education: A Comparison of Current Study Structures

Johannes Bauer, TU Munchen, Germany; Uta Diercks, Leibniz Institute for Science and Mathematics Education, Germany; Manfred Prenzel, TUM School of Education, Germany

In the present study, we aimed to systematically compare the study structures that are offered by current study programmes in German teacher education. German teacher education is currently characterized by diverse reforms of

study programs as a result of the Bologna-Process of higher education reform. The present study is part of a large-scale longitudinal research project that compares preservice teachers' professional development between different teacher education programs in Germany. Specifically, we aimed to describe the heterogeneity in typical study conceptions in secondary school teacher education on the level of the organization of study components. Furthermore, we evaluated the validity of the denomination of study programs as being profession-oriented versus polyvalent (i.e., aiming at a broad qualification and requiring a late decision for becoming a teacher) in the Bachelor phase. For this purpose, we systematically collected portfolios of documents related to teacher education programs from thirteen German universities. Theory driven content analysis focused on the relative distribution of subject-related, educational, and practical study components over the timeline of a course of study. As expected, the findings revealed a great degree of heterogeneity in the study programs, even between universities within the same federal states. In concordance with current observations, we found that the denomination of study programs as profession-oriented versus polyvalent is often invalid. Most programs, even when espoused to be polyvalent, require an early decision to become a teacher.

Aims

The Bologna-Process of higher education reform poses significant challenges to the reform of study structures (Maassen & Olsen, 2007; Teichler, 2007), which also concern teacher education. In this context, German teacher education is currently characterized by a huge diversity of reform strategies. While some federal states and universities stick to traditional state-examination programs (many in a modularized form), others have introduced Bachelor-Master programs (BA-MA) on an experimental or permanent basis (Terhart et al., 2010). Within the BA-MA programs, there is additional diversity. Some study programs are denominated profession-oriented, that is, they start with courses both in the subjects and in education. Others espouse a so-called polyvalent approach, aiming at a broad qualification in the subjects during the Bachelor-phase. Polyvalent programs are supposed to allow access to a variety of Masters programs next to the teacher-specific Master of Education.

In contrast to the plethora of new study concepts and programs, there is a lack of evidence about their implementation and their differential impact on prospective teachers' professional development. The present study is part of a large-scale longitudinal research project (PaLea) that compares preservice teachers' professional development between different teacher education programs in Germany. For this purpose, firstly, we analyze and compare study structures on a systematic and theory-driven basis; secondly, we investigate a panel of students in order to assess the impact of specific study concepts on students' professional development. The analyses presented here focus on the first strand of inquiry. Specifically, we aim at answering two research questions: (1) How can we capture and estimate the heterogeneity of typical study concepts on the level of the organization of study components? (2) How valid is of the denomination of programs as profession-oriented versus polyvalent? For the sake of reducing complexity, we focus only on secondary teacher education for the academic track here (i.e., the German Gymnasium).

Methodology

The sample for the present study consists of 13 purposefully selected universities that represent all current types of study programs. The design involves a mixed-methods-approach, combining expert-survey and -interviews with a portfolio technique. The portfolios comprise relevant internal and public documents that are related to the investigated teacher education programs (e.g., study and examination regulations, module descriptions, and accreditation applications).

The gathered documents were content analysed with a focus on the relative distribution of subject-related, educational, and practical study components over the timeline of a course of study. To answer Research Question 1, we used a graphical category system to present the study programs in a comparable format. That is, we developed charts that visualize the timeline of study components in relevant parts of teacher education (i.e., studies in subjects, subject didactics, education, and practical studies). Figure 1 illustrates these charts. As for Research Question 2, we used the amount of obligatory educational courses and their location in time during the Bachelor-phase as indicators of polyvalence. Polyvalent programs should require few or no educational studies in the Bachelor-phase and, therefore, a late decision for becoming a teacher (Terhart et al., 2010). Hence, study programs are considered less polyvalent when students have to earn many credit points (CP) in educational courses during the early phases of their studies.

We validated our analyses both internally within the research group and externally through our partners at the universities.

Findings

As expected, our findings revealed a great degree of heterogeneity in the study programs, even between universities within the same federal states. This diversity can be illustrated by looking at two examples. (a) The quantity of obligatory educational studies over the whole course of study ranges from 18 to 56 CP ($M = 39$; $SD = 9$ CP). That is, the minimum and maximum demand of educational studies necessary for becoming a teacher for the academic school track differs approximately by factor 3. (b) The total days of school internships varies between 50 and 110 days ($M = 73.08$; $SD = 18.9$ days). For these practical studies, students receive between 8 and 38 CP ($M = 19.5$; $SD = 7.7$ CP; not all internships are credited).

As for Research Question 2, we found that the denomination of study programs as profession-oriented versus polyvalent is often invalid. Of the seven investigated programs that are espoused to be polyvalent, five require educational and practical studies between 10 and 25 CP ($M = 18.2$, $SD = 6.1$ CP) during the Bachelor-phase.

Theoretical and educational significance

While arriving with a great potential to introduce competence-oriented study programs (Darling-Hammond & Bransford, 2005), the Bologna reforms in teacher education have brought a confusing heterogeneity of reform-approaches, at least in Germany. While there is a fierce debate between sceptics and advocates of the reforms—particularly concerning a polyvalent versus profession-specific orientation—this debate is neither informed by theories on professional learning (Boshuizen, Bromme, & Gruber, 2004) nor by empirical evidence on the actual implementation and impact of the reforms. Our study provides descriptive knowledge that, firstly, may lend this debate a more objective basis. Secondly, our findings add to comparative research on teacher education programs (Zeichner & Conklin, 2005) and the implementation of the Bologna-Process (Maassen & Olsen, 2007). Finally, our study is of practical relevance for teacher educators and students. The indicated diversity is likely to impair the transparency of study demands, as well as student flexibility and mobility, which are major goals of the Bologna reforms. The findings on polyvalence indicate that neither students—who want to choose a course of study—nor comparative studies on teacher education programs should rely on this label.

Boshuizen, H.P.A., Bromme, R. & Gruber, H. (Eds.). (2004). Professional learning: Gaps and transitions on the way from novice to expert. Dordrecht: Springer.

Darling-Hammond, L. & Bransford, J. (Eds.). (2005). Preparing teachers for a changing world. San Francisco: Jossey-Bass.

Maassen, P. & Olsen, J.P. (Eds.). (2007). University dynamics and European integration. Berlin: Springer.

Teichler, U. (2007). Higher education systems. Rotterdam: Sense.

Terhart, E., Lohmann, V. & Seidel, V. (2010). Die bildungswissenschaftlichen Studien in der universitären Lehrerbildung [Educational studies in teacher education]. Mynster: Uni Mynster.

Zeichner, K.M. & Conklin, H.G. (2005). Teacher education programs. In M. Cochran-Smith & K.M. Zeichner (Eds.), Studying teacher education (pp. 645–735). Mahwah, NJ.

National Reforms and Local Challenges in Teacher Education

Elaine Munthe, Stavanger University College, Norway; Kari-Anne Svensen Malmo, University of Stavanger, Norway

The implementation of a teacher education reform in Norway started in August 2010. It involves the creation of two distinct programs, as opposed to one program (grades 1-7 and grades 5-10), an increased emphasis on pedagogy, and no other compulsory subjects for grades 5-10, whereas students who choose grades 1-7 study math (30 ECTS) and Norwegian (30 ECTS). It also entails an emphasis on coherence and research.

A national panel was appointed to follow the implementation and development of the reform over the next five years. This paper addresses the initial phase of the reform and will present analyses based on site visits to all 20 teacher education institutes for grades 1-7 and 5-10 in Norway, as well as analyses of student responses to a questionnaire survey conducted in December 2010. Recruitment to the two programs will be compared and discussed, as well as their integrity with reform intentions and local challenges that have surfaced.

Cochran-Smith, M. & Zeichner, K. (2005). Studying Teacher Education, Mahwah, NJ: Erlbaum.

Munthe, E. & Haug, P. (2009). Trends and gaps in research on teacher education in Norway. Invited paper for SIG11, EARLI conference, Amsterdam (The Netherlands).

Ministry of Education Norway, Report to the Storting, no. 11 (2008-2009), <http://www.regjeringen.no/nb/dep/kd/dok/regpubl/stmeld/stmeld/2008-2009/stmeld-nr-11-2008-2009-.html?id=544920>

SYMPOSIUM

Learning with metacognitive prompts in technological environments: When and how do students benefit?

Chairperson: Bracha Kramarski, Bar-Ilan University, Israel

Organiser: Bracha Kramarski, Bar-Ilan University, Israel
Discussant: Alexander Renkl, University of Freiburg, Germany

Although technology learning environments (TLE) are powerful cognitive tools for enhancing domain knowledge, using such environments is a complex process that demands self-regulated learning (SRL) support. One promising form of SRL instructional support is the use of metacognitive prompts that is an important factor in developing SRL (Zimmerman, 2000).

Our symposium addresses two questions: (a) What characteristics should metacognitive prompts have in order to promote SRL and sustain complex domains knowledge (i.e., mathematics and science) in TLE, and under what instructional conditions? (b) How can their effectiveness be evaluated properly?

The symposium starts with Kramarski and Friedeman's (Israel) study in secondary school that presents the role of solicited vs. unsolicited metacognitive prompts in constructing mathematical knowledge and metacognitive discourse with a multimedia environment. After that Jacobse and de Kock (Netherlands) present a study in Primary school. In their study they try to understand the effects of written and auditive metacognitive hints on mathematics problem solving and metacognitive accuracy in CBL. We close the symposium with a study conducted by Azevedo and his colleagues (Canada) who tested the effectiveness of an intelligent multi-agent hypermedia system (MetaTutor) designed to prompt and scaffold the use of SRL processes during college students' learning about the human circulatory system under one of three conditions: Prompt and feedback, prompt-only, and control. The studies use various measures such as log-file, eye-tracking, think-aloud protocols, facial recognition as well as pretest-posttest data. The presented studies will be discussed regarding their theoretical and educational significance (Renkl, Germany).

Solicited vs. unsolicited metacognitive prompts in mathematical multimedia environment

Bracha Kramarski, Bar-Ilan University, Israel; Sheli Brenner, Bar Ilan University, Israel

Our study examines how the learner's control over choosing metacognitive prompts in a mathematical multimedia environment affected their learning outcomes. We compared the effects of solicited vs. unsolicited metacognitive prompts (based on the IMPROVE-method self-questioning) in a multimedia environment on learners' mathematical problem solving, discourse, use of computer help resources and cognitive load. The participants in the study consisted of sixty eighth-grade students (boys and girls) who were divided into three groups:

1. Group A – The participants received unsolicited metacognitive prompts and explanations in a multimedia environment, which consistently and regularly appeared on the screen.
2. Group B - The participants received solicited metacognitive prompts and explanations in a multimedia environment, which were accessible by clicking on a button at the learner's discretion.
3. Group C - The participants received no metacognitive prompts and explanations in a multimedia environment.

Results: The unsolicited-prompts group had the highest scores in the word problems and transfer tasks of the three intervention groups. They also maintained metacognitive discourse (assessed by thinking aloud protocols) on a higher level, and used the help resources more than the other two groups. Additionally, in the complex topics, which demand high levels of abstract thought, the solicited-prompts group felt they were under heavier cognitive load than the other two groups. Both theoretical and practical applications will be discussed at the conference.

Introduction

Many studies have examined different types of metacognitive prompts in a multimedia learning environment. Prompts provided automatically in a computerized environment, prompts provided upon request and prompts adapted to the learner's needs were examined. Results show that the prompts improved the learner's achievements, encouraged self-regulation of constructive learning and enhanced comprehension of learned material (e.g., Azevedo, Cromley, & Seibert, 2004; Davis, 2003; Ge & Land, 2003; King, 1991; Kramarski & Dudai, 2009; Kramarski & Michalsky, 2009; 2010).

Our study compared the effects of solicited vs. unsolicited metacognitive prompts based on the IMPROVE-method questioning (comprehension, connection, strategy and reflection self-questions; Kramarski & Mevarech, 2003) in a multimedia environment on the learner's outcomes. We examined whether it is more beneficial to give the learner prompts throughout the task and demand they acknowledge every cue, or whether it is preferable to allow the learner to choose when to use the cue and receive support.

In order to examine this issue, the participants were divided into three groups:

1. Group A – The participants received unsolicited metacognitive prompts and explanations in a multimedia environment, which consistently and regularly appeared on the screen.

2. Group B - The participants received solicited metacognitive prompts and explanations in a multimedia environment, which were accessible by clicking on a button at the learner's discretion.
3. Group C - The participants received no metacognitive prompts or explanations in a multimedia environment.

We examined how metacognitive support via solicited and unsolicited prompts in a multimedia environment affects (1) solving word problems; (2) mathematical discourse while problem solving; (3) utilization of help resources (cue – e.g. "imagine the situation in your mind or illustrate it another way," explanation – detailed presentation of the stages or principles of the full solution); and (4) students' cognitive load. A one-tailed hypothesis was formulated only with regards to the two supported groups' achievements vs. the no-support group.

Methodology

The participants consisted of sixty students (boys and girls) randomly chosen from five eighth-grade classes in a junior-high school in the center of Israel. The intervention was executed on heterogeneous pairs in the multimedia environment. Three meetings were held with each pair separately, each meeting approximately 3-4 hours in length. At first the students were told about the multimedia and the metacognitive approach to problem solving through IMPROVE-method questioning and its goals. The students were told to work according to the following stages: 1. Both partners read the problem. 2. One of the partners raises an idea for a solution. 3. Either the other partner agrees with their partner and explains why, or they disagree and suggest an alternative solution. If the partners disagree, each must explain their opinion to the other. Only once they have reached an agreement, they click on the solution and check whether their answer is correct. This method ensured mathematical discourse between the students even when they both agreed on the solution.

The three groups learned about graphs in a multimedia environment which was designed for the study by the second researcher. Each group received identical problems divided into different levels of complexity (e.g., basic graphs, general phenomenon and complex usage of graphs).

Six measures were used: (1) Pre/post-test of problem solving based on the graph unit (PISA, 2003); (2) Novel tasks for transfer ability of problem-solving skills (PISA, 2003); (3) Log-files for using computer help resources; (4) Thinking-aloud protocol during mathematical discourse from cognitive, metacognitive and motivational aspects (Kramerski, in press); (5) Cognitive load (Paas et al., 2003); (6) Personal interview about their feelings regarding the intervention.

Findings

In order to examine the hypotheses regarding the interventions' effects, analysis of variance was computed to compare the groups' problem-solving skills before and after the interventions. In these cases, a two-way ANOVA (groups(3) X time (2)) with time as a repeated measure was computed. When variables were measured only after the intervention, one-way ANOVAs were computed between groups on the mathematical discourse variable. Qualitative analysis of the mathematical discourse was also performed using an analysis schema designed for the study, which examined the cognitive, metacognitive and motivation aspects of the learner when they have difficulty understanding how to solve the word problems.

The results show that:

- (1) The unsolicited-prompts group had the highest scores in the word problems and transfer tasks of the three intervention groups ($F = 4.67$; $\eta^2 = 0.26$).
- (2) The unsolicited-prompts group maintained metacognitive discourse on a higher level than the other two groups ($F = 12.6$; $\eta^2 = 0.63$).
- (3) The unsolicited-prompts group used the help resources more than the other two groups ($F = 11.7$; $\eta^2 = 0.95$). Additionally, a positive correlation was found between the use of help resources and the level of the mathematical discourse, as well as between use of help resources and understanding of the problem ($r = 0.81$).
- (4) In the complex topics in the graph unit, which demand high levels of abstract thought, the solicited-prompts group felt they were under heavier cognitive load than the other two groups ($F = 4.16$; $\eta^2 = 0.62$).
- (5) Qualitative analysis of the discourse and interviews showed that mathematical discourse was directly affected by the number of prompts used. Students who used more clues understood the problems better, dealt better with situations where they did understand the problem, and had higher motivation by the end of the learning session.

Conclusions and Implications

This study has both theoretical and practical applications. It shows the importance of providing the learner with unsolicited prompts as a means for constructing mathematical knowledge. In practice, the study recommends using a multimedia environment for the teaching of mathematics in a challenging manner. It is recommended to continue examining the effects of the various prompts over time, their effects on problem-solving skills and especially on the

learner's cognitive load. It is also important to examine the effects of solicited and unsolicited prompts on the different types of learners, such as higher achievers vs. lower achievers.

Effects of written and auditive metacognitive hints on mathematics performance and accuracy in CBLe

Annemieke Jacobse, University of Groningen, Netherlands; Willem de Kock, University of Groningen, Netherlands

Currently, it is widely recognized that metacognitive skillfulness can greatly contribute to student learning. The call for interventions stimulating metacognitive skills is strong. In this respect, the use of computer programs is an attractive option since computer programs are easy to use in practice and generally appeal to students. Stimulation of metacognitive skills in upper elementary school especially seems to be important in contextually rich domains as comprehensive reading and mathematics. In mathematics, word problems are often used which require students to use various strategies to acquire the correct answer. Students frequently experience difficulties solving such problems. One way to support effective problem solving is providing students with metacognitive hints alongside word tasks in a computer environment. It is hypothesized that practice in a computer environment where cognitive as well as procedural content is practiced will enhance mathematics performance. This is tested in a quasi-experimental design in grade 5 ($N = 106$). A control condition working with a computer program with word tasks is compared with two experimental groups with metacognitive hints added to the word tasks (either auditive or written hints). Preliminary results show positive effects of both metacognitive hint-conditions over the control group. Additionally, effects on metacognitive variables measured by accuracy indexes are discussed.

1. Introduction

Metacognitive skillfulness can greatly contribute to learning. In mathematics, word problems are often used. Primary school students frequently experience difficulties solving such problems. Researchers conclude that difficulties in solving word problems often originate from a lack of metacognitive skills (Hegarty, Mayer, & Monk, 1995; Schoenfeld, 1992; Verschaffel et al., 1999).

One way to support problem solving is providing students with metacognitive hints alongside cognitive content in a computer environment. An important aspect of enhancing transfer is giving students a certain level of control over their instructional decisions (compare Harskamp and Suhre, 2007; Mathan & Koedinger, 2005; Pol, Harskamp, Suhre, & Goedhart, 2008). It is also important that the metacognitive content is explicitly linked to the cognitive content (Azevedo, 2007).

2. Materials

A computer program applied in previous research is used (Jacobse & Harskamp, 2009). In this program, students are free to choose hints themselves. The hints contain metacognitive questions combined with cognitive prompts over the steps: orientation (I read carefully), planning (I make a plan), evaluation (I check my answer) and reflection (What did I learn?).

The hints are presented through text or through audio. Based on previous studies, it is expected that support by a human voice will be more effective (Litman, Rose et al., 2006; Moreno, Mayer, Spires & Lester, 2001).

3. Research questions

What is the effect of practice with a computer program with metacognitive hints on mathematical problem solving of upper primary school students? What is the effect of practice with a computer program with metacognitive hints on accuracy of performance estimation of upper primary school students? Do the effects of the auditive hints differ from the effects of written hints?

4. Method

4.1 Design: The study has been set up as a quasi-experimental design with a division over 3 conditions. The students practiced with the computer program for 2 times 20 minutes per week over 6 weeks.

4.2 Sample: The research is performed in grade 5 with a total number of 106 participants (47 boys / 59 girls). The students had a mean age of 10.91 years ($sd .44$).

4.3 Mathematics: Mathematical problem solving performance is measured with a pre- and posttest of 20 word tasks. Both tests have a good reliability of a .88 and a .86 respectively.

4.4 Accuracy: Accuracy of the estimation of one's performance is indicative for one's metacognitive processes. In this study the students were asked to rate their accuracy by filling in a traffic light with 3 options: red (I am sure I will execute this task wrong), orange (I am not sure whether I will execute this task correct) and green (I am sure I will execute this task correct). The traffic lights were given in reference to 4 different word tasks in the pre- and post-test.

As an absolute accuracy measure bias indexes are calculated. With a correct estimation a score of 0 is given while overconfidence is represented by a positive score and under confidence with a negative score (table 1).

5. Results

Results of an ANCOVA show that the conditions differ significantly on the post-test mathematics ($F=3.15$; $p=.05$). Contrasts show no difference between the two experimental groups with written or auditive hints (mean difference 1.1%; $p=.39$). However, both the text (mean difference 7.9%; $p=.03$) as the auditive condition (mean difference 8.99%; $p=.01$) perform significantly better than the students in the control condition

However, the conditions vary significantly on the bias indexes in the post-test ($F=3.15$; $p=.00$). Contrasts show that there is no difference between the two experimental groups with written or auditive hints (mean difference 3.1; $p=.61$). But both the text (mean difference 14.8; $p=.01$) and the auditive condition (mean difference 17.87; $p=.00$) overestimate their performance to a significantly smaller degree than students in the control group.

Moreover, it was found that overestimation negatively correlates with performance ($r=-.34$; $p=.00$). Thus the more students overestimate their performance, the less well they perform on the test.

6. Conclusion

The effect of practice with a computer program with metacognitive hints on performance and accuracy was tested. Preliminary results make clear that there are no differential effects between the auditive and written metacognitive hints. However, both experimental conditions do have a positive effect on problem solving on the posttest mathematics as well as on the estimation of one's own performance. This is probably due to the fact that the metacognitive questions give students a more realistic insight in their own working method. The relationship between overestimation and performance confirms that the metacognitive skill of accurately estimating one's proficiency indeed is indicative of performance.

Metacognitive prompts in fostering science understanding with MetaTutor

Roger Azevedo, McGill University, Canada; Amy Johnson, University of Memphis, United States; Candice Burkett, University of Memphis, United States; Reza Behnagh, mcgill university, Canada; Zohreh Khezri, Mcgill university, Canada; Marooful Moral, mcgill university, Canada; Engida Gebre, Mcgill university, Canada; Melissa Stern, mcgill university, Canada

This presentation focuses on a laboratory experiment that was conducted to test the effectiveness of MetaTutor, an intelligent and adaptive multi-agent hypermedia system designed to prompt and scaffold the use of self-regulated learning (SRL) processes during learning about the human circulatory system. Sixty-nine ($N=69$) undergraduate students learned about the human circulatory system under one of three conditions: prompt and feedback (PF), prompt-only (PO), and control (C) condition. The PF condition received timely prompts from animated pedagogical agents to engage in planning processes, monitoring processes, and learning strategies and also received immediate directive feedback from the agents concerning the deployment of the processes. The PO condition received the same timely prompts, but did not receive any feedback following the deployment of the processes. Finally, the control condition learned without any assistance from the agents during the learning session. All participants had two hours to learn using a 41-page hypermedia environment which included texts describing and static diagrams depicting various topics concerning the human circulatory system. Log-file, eye-tracking, concurrent think-aloud protocols, and facial recognition data were collected during learning as well as pretest-posttest data. Overall, the results showed significant difference those in the PF condition significantly outperformed those in the other two conditions. Those in the PF condition also spent significantly more time creating relevant sub-goals, spent more time on relevant text and diagrams, and deployed significantly more SRL processes associated with learning gains. These results are discussed in the context of development of a fully-adaptive hypermedia learning system intended to scaffold self-regulated learning.

Aims

This experiment used a mixed-methodology design that combined product and process data to examine the effect of various types of SRL prompting and scaffolding delivered by pedagogical agents (PAs) in an adaptive intelligent hypermedia learning environment. Three learning conditions were used to determine the efficacy of scaffolding SRL through pedagogical agents: 1) prompting with feedback condition (PF), 2) prompting only condition (PO), and 3) no prompting condition (NP). Participants were randomly assigned to one of the three conditions and asked to learn about the human circulatory system using a hypermedia learning environment, MetaTutor, during a two-day experiment. This experiment included the collection of concurrent think-aloud protocols, eye-tracking data, human-agent dialogue, learning outcome measures, log-file data, metacognitive judgments during learning, embedded quizzes, and facial recognition data for affect classification. Due to the complexity of the data analyses, we only report on a few of the log-file variables and the learning outcomes data (presented here as learning efficiency).

Methodology:

Participants: 69 undergraduate students from a large public university in Southeastern US. The mean age of the participants was 23. All participants were paid up to \$40 for completion of the 2-day, 4-hour experiment.

Conditions. We designed and tested three versions of the MetaTutor environment that covered the human circulatory system. In the Prompt and Feedback (PF) version, participants were prompted (by PAs) to use specific self-regulatory processes, and given immediate feedback about their use of those processes. In the Prompt only (PO) version, participants received the same prompts as the ones provided to those in the PF version. However, the agents in the PO version did not provide feedback. The timing of the prompts used in both the PF version and the PO version was adaptive to the individual learner and was determined using various factors of learner interaction, including time on page, time on current sub-goal, number of pages visited, relevancy of the current page for the current sub-goal, etc. In the No Prompt (NP) version of MetaTutor, participants did not receive prompts or feedback. All three versions (PF, PO, NP) provided an SRL palette which allowed participants to self-select any SRL processes they would like to use during the learning session.

Procedure: On day one of the experiment, participants completed a demographics questionnaire and the pretest on the human circulatory system. Learners were given up to 20 minutes to complete the pretest. On day two, the learners engaged in the learning session and completed the posttest on the human circulatory system. Before beginning the learning session, the Tobii T60 eye-tracker was calibrated to each participant individually. All participants were then instructed in the think-aloud procedure and shown a short video demonstrating thinking aloud. Next, each participant was shown another short video explaining and demonstrating the various functionalities of MetaTutor and providing the learners with their overall learning goal. This introductory video also demonstrated the use of an electronic note-taking feature within the environment and instructed the participants to use the peripheral drawing pad if and when they chose to draw. Following the introductory videos, the learners were given two hours to learn about the human circulatory system using MetaTutor. All participants were provided the opportunity to take a break during the two hours, although not all chose to do so. During the learning session, participant verbalizations and gross looking behaviors were recorded using an embedded webcam within the eye-tracker monitor. Immediately after the learning session, participants were given up to 20 minutes to complete the posttest. Finally, all participants were paid and debriefed before leaving the lab.

Findings

Learning Time with the Science Content. Learning time was calculated by summing the amount of time spent viewing the instructional content. Interactions with the agents, in which the instructional content was not visible, were not included in learning time. An ANOVA indicated a significant difference among the groups in learning time, $F(2,66) = 40.71$, $p < .001$, $M = 87.94$, $SD = 12.42$) when compared to both the PO condition ($M = 68.31$, $SD = 11.18$) and the PF condition ($M = 56.84$, $SD = 11.82$), $p < .001$. The PO condition had a significantly longer learning time compared to the PF condition, $p < .001$. **Number of Pages Visited.** An ANOVA indicated a significant difference among the groups in the mean number of pages visited (out of 41 possible) during the learning session, $F(2,66) = 22.17$, $p < .001$, $M = 38.87$, $SD = 3.84$) than both the PO condition ($M = 33.26$, $SD = 8.39$; $p < .001$) and the PF condition ($M = 23.56$, $SD = 10.07$; $p < .001$). The PO condition visited significantly more pages than the PF condition, $p < .001$. **Amount of Time on Pages and Diagrams.** The results indicate that students did not differ significantly in the amount of time spent on each page. On average, students spent anywhere from 60 seconds to 90 seconds on each page ($p > .05$). By contrast, an ANOVA revealed a significant difference among groups in the mean time spent viewing individual diagrams within the environment, $F(2,66) = 3.02$, $p = .052$. LSD Post-hoc analyses revealed that mean diagram view time was greater for the PF condition ($M = 1.05$ min, $SD = 0.99$) compared to the Control condition ($M = 0.54$ min, $SD = 0.46$), $p = .016$. The PO condition did not differ significantly from the remaining two conditions ($M = 0.75$ min, $SD = 0.51$).

Theoretical and Educational Significance

Our study contributes to an emerging body of evidence which illustrates the critical role of SRL in students' learning with hypermedia, and extends recent research regarding the role of intelligent, adaptive scaffolding in facilitating students' learning with hypermedia. Converging temporally-aligned, multi-level data will allow us to examine the critical role of PAs as external regulatory agents whose scaffolding methods facilitate students' self-regulated learning. Lastly, both our product and process data can be applied to inform the design of intelligent multi-agent hypermedia environments as Metacognitive tools to foster learners' self-regulated learning of challenging science topics by providing adaptive scaffolding.

SYMPOSIUM

The role of working memory in the development of mathematical skills

Chairperson: Pirjo Aunio, University of Helsinki, Finland

Organiser: Evelyn Kroesbergen, University of Utrecht, Netherlands

Johannes E.H. Van Luit, Langeveld Institute, Netherlands

Discussant: Liane Kaufmann, UMIT-Private University for Health Sciences, Medical Informatics and Technology, Austria

Recent research has shown that working memory can explain a large part of the variance in mathematical performance. Furthermore, it appears to be one of the causal factors underlying mathematical learning disabilities. In this symposium the role of working memory and executive functions in math is further explored. Three studies will be presented, in which the role of different working memory components or executive functions in math are investigated, in primary schools in Belgium and Germany. The first study focuses on the role of phonological and visuo-spatial working memory in children with dyscalculia (and ADHD). The results show specific deficits in visuo-spatial working memory. The second paper relates working memory and other cognitive factors as magnitude comparison to the children's math performance. Given the found relations between the cognitive factors and math, in the third study it was investigated if these factors could also be related to behavioral manifestations of executive functions. Together these three papers give an important contribution to the question which factors are important in the development of mathematical skills. The results provide suggestions for early identification and possibilities for remediation of mathematical learning disabilities.

Working memory functioning in children with dyscalculia and/or attention deficits

Claudia Maehler, Institute of Psychology, Germany; Kirsten Schuchardt, Institute for Psychology, Germany

Working memory deficits have recently been identified as possible causal factors underlying learning disabilities. Specific patterns of impairment have been found for different learning disorders (dyslexia, dyscalculia). Often these learning disorders come along with attention deficits that also are being associated with working memory problems. Could this comorbidity be caused or at least influenced by common working memory deficits?

This question was examined in a study in which several functions of working memory according to Baddeley (1986) were explored. A working memory battery with tasks for the phonological loop, the visual-spatial sketchpad and central executive skills was presented in individual sessions to children with dyscalculia or attention deficits or both (comorbid group), and to a typically developing control group. Results reveal specific working memory problems in the different groups, i.e. visual-spatial deficits in children with dyscalculia and deficits in executive functioning in children with attention deficits, while comorbidity is influenced by both single disorders. Our results enhance our causal understanding of learning problems and might lead to a more careful interpretation of different learning problems at school followed by more specific interventions.

Aims

Working memory deficits are widely being discussed and identified as possible causal factors underlying learning disabilities. In his influential model of working memory, Baddeley (1986) distinguished three components of the working memory system: the modality-free central executive, which is responsible for the control, regulation, and monitoring of complex cognitive processes, and two modality-specific and limited-capacity components, the visual-spatial sketchpad and the phonological loop. Children with dyslexia or dyscalculia have been examined concerning their functioning of working memory. For children with dyscalculia results were mixed, revealing problems in one, two or all three components of working memory (phonological loop, visual-spatial sketchpad and central executive). However recent studies have reported especially visual-spatial deficits in children with specific arithmetic disabilities. On the other hand working memory problems have also been detected in children with attention deficit (hyperactivity) disorders. Especially impaired selective attention or inhibition - both functions being located within the central executive of working memory - can be observed in children with attention deficit disorders. Yet there is not much research with children who show both learning and attention deficit problems, although there is a significant rate of comorbidity.

Given this theoretical background the central question of the reported study was: What patterns of working memory deficits underlie dyscalculia vs. attention deficits? Or put more precisely: Can specific and distinct patterns be identified in children with dyscalculia or attention deficits or both? The answer to these questions could lead to specific recommendations for schooling and treatment.

Methodology

The reported study compared working memory functioning of children with different characteristics. Four different groups took part in the study: A group of children with maths problems, that fulfilled the criterion of discrepancy between (below-average) school achievement and (normal) IQ and therefore met the ICD-10 criteria of dyscalculia (N = 18); a second group characterized by attention deficits, reported by parents and teachers in a clinical questionnaire

(N = 34); a comorbid group (N = 21) with dyscalculia and attention deficits and a typically developing control group (N = 31). The groups of children with learning and attention disabilities were recruited from our counseling center. All of them attended regular primary schools (2nd, 3rd or 4th graders) but did not reach sufficient achievement. Data were available for intelligence (K-ABC) and scholastic skills (DEMAT, WRT, SLRT) in order to match the groups. The control group and the group with attention deficits performed on average in all these measures, the children with math problems were below average in the DEMAT but did not have problems in reading or writing. A rather long battery of working memory tasks was presented to the children in individual sessions. The phonological loop was examined by different memory span tasks (memory span for images, mono-syllabic and three-syllable words, numbers, mono-syllabic and three-syllable non-words, non-word repetition). To test the visual-spatial sketchpad children were presented with three memory span tasks for locations (corsi-block) and patterns (matrix), and the central executive functioning was tested by a double span, backward spans for words and numbers and a counting span.

Findings

Scores on the working memory tasks were entered in a multivariate analysis of variance with dyscalculia and ADHD as fixed factors. IQ was included as covariate in all subsequent analyses. The significance level for all analyses was set at $\alpha = .05$. For the phonological loop the multivariate main effect for dyscalculia, $F(14, 170) h^3 = .34$, attention deficit, $F(14, 170) = 1.15$, $h^3 = .087$, $p > .05$ and the dyscalculia by attention deficit interaction were not significant, $F(14, 170) = 2.11$, $h^3 = .103$, p proved significant; in contrast, the multivariate main effect for attention deficit, $F(10, 180) h^3 = .048$ and the dyscalculia x dyslexia interaction, $F(10, 180) h^3 = .033$, were not significant. Finally, for the central executive the multivariate main effect for dyscalculia, $F(8, 186) = 1.41$, $h^3 = .057$, $p > .05$. was not significant. In contrast, the multivariate main effect for attention deficit, $F(8, 186) = 2.31$, $h^3 = .090$, $p F(4, 92)$

Theoretical and practical relevance

Taken together, the results reveal special deficits in working memory in the different groups (dyscalculia vs. attention deficit compared to the control group). While children with dyscalculia have problems within the visual-spatial sketchpad, children with attention deficits show problems in the central executive tasks. Comorbidity comes along with the addition of problems in both subsystems of working memory. Our results enhance our causal understanding of learning problems and might lead to a more careful interpretation of different learning problems at school followed by more specific interventions.

Domain-general and domain-specific cognitive correlates of individual differences in arithmetic

Kiran Vanbinst, Katholieke Universiteit Leuven, Belgium; Pol Ghesquiere, Katholieke Universiteit Leuven, Belgium; Bert De Smedt, University of Leuven, Belgium

It is an important goal in educational science to unravel the unique contribution of cognitive factors to individual differences in specific math skills, such as single-digit arithmetic and strategy use. The present study addresses this issue by examining the influence of domain-general cognitive abilities, such as working memory, verbal short-term memory, retrieval from long-term memory and phonological awareness, and domain-specific cognitive skills, such as the representation of numerical magnitudes, on individual differences in single-digit arithmetic and strategy use. Participants were 61 typically developing children of third grade who completed various cognitive measures and an arithmetic task. Findings indicated that particularly the ability to represent numerical magnitudes was strongly and uniquely associated with individual differences in arithmetic and strategy use. Domain-general cognitive correlates only had limited influence on arithmetical performance. These data indicate that the ability to represent numerical magnitudes is an important determinant of individual differences in arithmetic. These findings further suggest that instructional methods or targeted interventions, that aim to reduce or eliminate achievement gaps in school mathematics, should focus on the representation of numerical magnitudes.

Aims

Understanding the origins of individual differences in mathematical achievement represents an important goal in educational science. Previous studies have highlighted that working memory, verbal short-term memory, retrieval from long-term memory and phonological awareness correlate with individual differences in mathematical achievement. In addition to these domain-general cognitive factors, it has been suggested that more domain-specific numerical processing skills, such as the representation of numerical magnitudes, are an important predictor of mathematical achievement. One major limitation to these studies is that most of them have assessed mathematical achievement with general standardized mathematical achievement tests. These tests, however, typically yield a total score which reflects performance averaged over a wide range of mathematical skills. From these general tests it is not possible to determine the cognitive correlates of more specific mathematical skills. The present study therefore aimed

to investigate the cognitive correlates of individual differences in single-digit arithmetic and strategy use during arithmetic.

We focused on single-digit addition, subtraction and multiplication. These problems can usually be solved either by directly retrieving the (correct) answer from long-term memory (retrieval strategy) or by using a procedural strategy, such as counting or decomposing the problem into small facts. There is large inter-subject variability in the use of these strategies (Dowker, 2005), yet the cognitive correlates of these individual differences remain to be determined. This was precisely the aim of the current study.

Methodology

Participants were 61 typically developing children (30 girls, 31 boys), who attended third grade (mean age = 8 years, 8 months; SD = 4 months). All children completed a computerized experimental arithmetic task during which they had to solve single-digit addition, subtraction and multiplication problems. Both speed and accuracy were registered. After each problem, children had to verbally report which strategy they used to solve that problem. Strategies were classified into retrieval (i.e., if the child immediately knew the answer and there was no evidence of overt calculations), procedural (i.e., if the child indicated that he or she used counting or decomposed the problem into smaller sub-problems to arrive at the solution) or other (if the child did not know how he or she solved the problem). We investigated the frequency and efficiency (i.e., the average accuracy and speed) with which these strategies were used.

Domain-general cognitive correlates were evaluated by means of several paper-and-pencil tests. Working memory was measured by means of a listening span task (De Smedt et al., 2009) and verbal short-term memory was assessed using a nonword repetition test (De Smedt et al., 2009). The speed of retrieving information was evaluated by means of a color naming task (Van den Bos et al., 2003) and phonological awareness was assessed with a phoneme deletion task (Boets et al., 2010). Turning to the domain-specific cognitive correlates, we administered a classic computerized number comparison task that measured children's representation of numerical magnitudes, in which children had to indicate the larger of two presented numbers.

Pearson correlation coefficients were calculated to examine associations between arithmetic strategy use and the administered cognitive variables. Additionally, regression analyses were executed to unravel the unique contribution of cognitive factors to individual differences in arithmetical performance and strategy use. To simplify interpretation, the signs of the speeded measures were reversed (thus, a positive relationship indicates that better performance on one task was associated with better performance on the other task).

Findings

Children solved the arithmetic task with a mean accuracy of 95% (SD = 4%) and a mean speed of 3599.45ms (SD = 1128.08 ms).

Only phonological awareness ($r(61) = .35$, $p = .002$, $b = .35$, $t = 2.84$, $p = .002$). Turning to reaction time, children's representation of numerical magnitudes was the sole variable that correlated with speed in single-digit arithmetic ($r(61) = .52$, $p = .000$, $b = .52$, $t = 4.12$, $p = .000$). The average frequencies of retrieval and procedural strategy use were 70% (SD = 14%) and 30% (SD = 18%), respectively. Retrieval strategies were executed significantly more accurately ($F(1,40) = 25.54$, $p = .000$, $\eta^2 = .40$) and faster ($F(1,40) = 133.79$, $p = .000$, $\eta^2 = .77$) than procedural strategies. Because the accuracy of retrieval (M = 97%, SD = 2%) was very high and at ceiling level, only associations with strategy frequency and strategy speed were considered. Surprisingly, no significant associations between strategy frequency and the cognitive variables were found. Working memory ($r(56) = .26$, $p = .010$).

Theoretical & educational significance

The current findings indicate that particularly the ability to represent numerical magnitudes was strongly and uniquely associated with individual differences in arithmetic and strategy use. In contrast to earlier studies, domain-general cognitive correlates, such as working memory, verbal short-term memory, retrieval from long-term memory and phonological awareness, exerted only limited influence on individual differences in arithmetic. These data indicate that domain-specific factors, such as the ability to represent numerical magnitudes, are a crucial determinant of individual differences in mathematical achievement. These findings further suggest that instructional methods or targeted interventions that aim at reducing or eliminating achievement gaps in school mathematics should focus on the representation of numerical magnitudes.

Behavioural manifestations of working memory and inhibition in children with MLD

Annemie Desoete, Ghent University, Belgium; Frauke De Weerd, Ghent University, Belgium

This study investigated working memory, inhibition and fluency skills in 14 average intelligent children with a severe and persistent mathematical learning disability (MD) compared to 17 age-matched typical achieving (TA) children without learning disabilities. All children were followed from kindergarten till grade 4. Behavioral manifestations as well as results on experimental tasks are analyzed in grade 4.

Children with MD had higher behavioral manifestations of inhibition (IN) problems according to parents and teachers. Moreover there was a trend towards behavioral manifestations of working memory (WM) problems according to the teacher. In addition children with MD experienced more problems with categorical but not with verbal fluency (FL) tasks. From theoretical perspective our data underline the importance of IN, categorical FL and WM in the comprehension of problems of children with MD. From educational perspective, it might be a good idea to concentrate on IN, WM, and categorical FL strategies, besides focusing on mathematics. In that way, children might learn to cope their problems in a more profound manner. In the classroom, it could be helpful if children were supported in tasks with a high inhibition and working memory load.

Theoretical Background

Children with a mathematical learning disability (MD) have a significant degree of impairment in the arithmetical skills (with substantially low performances). In addition, children do not profit from (good) help. Recently the problems of children with MD are often explained as results of a 'core' deficit in 'number sense' a term denoting the ability to picture and manipulate numerical magnitude on an internal number line. In addition, several authors also propose that deficits in working memory (WM), inhibition (IN) and speed of processing or fluency (FL) underlie MD. However, most of the studies on WM, IN and FL have been based on experimental and/or performance-based tests only. Consequently, little is known about the behavioral manifestations of WM, IN and FL in daily live.

Aim

We aim to investigate if children with with severe and persistent MD have more problems with FL, WM and IN compared to typical achieving children without learning disabilities. In addition we aim to look for those problems in behavioral manifestations in daily life as well as in experimental tasks.

Method

Therefore, a study was conducted on 31 school aged children that were followed from kindergarten during five consecutive years. Only at least average intelligent children were included in the analyses.

Children were retrospectively classified as having mathematical disabilities (MD) if they had disabilities non-responsive to remediation and if they scored \leq the 25th percentile in at least two grades on tests used to assess procedural or semantic disabilities ($n = 14$). The TIQ on the WISC-III (Wechsler et al., 2002) of the MD children was 104.00 ($SD = 10.41$).

The control group consisted of children who scored $>$ the 25th percentile on all arithmetic achievement tests in all grades, these children were classified as typical achievers (TA, $n = 17$). The TIQ on the WISC-III of the TA children was 106.18 ($SD = 9.86$).

A socio-economic status was derived from the total number of years of education of the parents (starting from the beginning of elementary school). No significant differences in SES were found between the MD and TA groups ($F(2, 25) = 0.55$; $p = NS$), with $M = 15.38$ ($SD = 2.87$) for MD, $M = 15.73$ ($SD = 1.16$) for TA for number of years of scholarship of mothers and $M = 14.92$ ($SD = 3.49$) for MD, $M = 16.00$ ($SD = 2.33$) for TA for number of years of scholarship of fathers.

All children were assessed on WM, IN and FL. Several experimental WM tasks were completed, i.e. Digit Recall and Word Recall (phonological loop), Block Recall (visuospatial sketchpad), Listening Recall, Spatial Span, Backward Digit Recall and Backward Word Recall (central executive). These tasks were computerized versions of subtests of the Working Memory Test Battery for Children (WMTB-C; Pickering & Gathercole, 2001) and the Automated Working Memory Assessment (AWMA, Alloway, 2007). Both WMTB-C and AWMA are based on Baddeley's WM model. Also IN was measured by experimental computerized go-no go, stop signal and stroop-tests. FL was experimentally measured by looking at the verbal and categorical fluency of the children. In addition all parents and teachers completed a questionnaire on behavioral manifestations in daily life of problems with executive functions, namely the BRIEF (Gioia, Isquith, Guy, & Kenworthy, 2000).

Findings

Behavioral results: Children with MD scored according to the parents (on the BRIEF) significant higher on IN ($F(1,28) = 4.76$; p partial $\eta^2 = .14$) and emotion regulation problems ($F(1,28) = 71.08$; p partial $\eta^2 = .26$). Moreover a trend was found for WM problems ($F(1,29) = 2.79$; $p = 0.10$; partial $\eta^2 = .09$) and for planning problems ($F(1,29) = 3.17$; $p = .08$; partial $\eta^2 = .09$).

No significant differences between children with MD and TA peers was found on FL according to the parents and teacher ($F(2,28) = 1.44$; $p = NS$).

Moreover, on the teacher questionnaire children with MD scored significant higher on emotion regulation problems ($F(1,29) = 43.88$; $p_{\text{partial } \eta^2} = .14$) than TA peers. A trend was found for IN problems ($F(1,29) = 37.31$, $p = .10$; $\text{partial } \eta^2 = .07$) and WM problems ($F(1,29) = 13.07$; $p = .10$; $\text{partial } \eta^2 = .06$) in MD children compared to TA peers. Significant correlations were found between the behavioral ratings of teachers and parents on IN ($r = .74$; p

Experimental measures

For the experimental measure of FL, the MANOVA with as dependent variables the number of correct answers on the two verbal fluency tasks and on the two categorical fluency tasks and group (MD, TA) was significant on the multivariate level ($F(4, 26) = 2.97$; $p_{\text{partial } \eta^2} = .31$). Both categorical fluency tasks and non of the verbal fluency tasks were significant on the univariate level.

The data on the experimental measures of WM and IN and the relationships with the behavioural data are currently being analysed but will be presented at the conference.

Theoretical & educational significance

The replication of the deficits in WM, IN and FL in children with DC as found in experimental and clinical studies (e.g., Bull & Scerif, 2001) and the finding that parents gave significantly higher scores on the IN scale and teachers gave higher scores on WM and IN scale of the BRIEF to children with MD than to TA children, might have both theoretical and educational implications for children with MD.

From theoretical perspective our data underline the importance of IN, categorical FL and WM in the comprehension of problems of children with MD. From educational perspective, it might be a good idea to concentrate on IN, WM, and categorical FL strategies, besides focusing on mathematics. In that way, children might learn to cope their problems in a more profound manner. In the classroom, it could be helpful if children were supported in tasks with a high inhibition and working memory load.

SYMPOSIUM

Self-processes under the measurement spotlight

Chairperson: Dennis McNerney, Hong Kong Institute of Education, Hong Kong

Organiser: Dennis McNerney, Hong Kong Institute of Education, Hong Kong

Discussant: Benjamin Nagengast, University of Oxford, United Kingdom

Self-processes such as motivation, self-concept, self-regulation, and self-efficacy have been the focus of considerable research for many years and the results of this research have impacted educational practice in many ways. What is to be noted about much self-processes related research today is the increasing sophistication in the methodological and measurement tools used. Building on the existing substantive-methodological research corpus on self-processes this symposium will focus on a range of methodological and measurement advances by presenting a set of papers utilizing cutting-edge approaches to examine issues of theoretical and applied significance. These include multilevel and multidimensional RASCH, and ESEM -- exploratory structural equation modeling -- an evolving statistical tool that integrates many of the best features of exploratory factor analysis, and confirmatory factor analysis. The paper will make a significant contribution to advances in quality research in the educational and psychological domains.

Exploratory Structural Equation Modeling in motivation and engagement research

Herb Marsh, University of Oxford, United Kingdom; Gregory Arief D. Liem, University of Sydney, Australia; Andrew J. Martin, University of Sydney, Australia; Alexandre J. S. Morin, University of Sherbrooke, Canada; Benjamin Nagengast, University of Oxford, United Kingdom

The most popular measures of multidimensional constructs typically fail to meet standards of good measurement: goodness of fit, measurement invariance, lack of differential item functioning, and well differentiated factors that are not so highly correlated as to detract from their discriminant validity. Part of the problem, we argue, is undue reliance on overly restrictive independent cluster models of confirmatory factor analysis (ICM-CFA) in which each item loads on one, and only one, factor. Here we demonstrate exploratory structural equation modeling (ESEM), an integration of the best aspects of CFA and traditional exploratory factor analyses (EFA). Based on responses to the 11-factor Motivation and Engagement Scale ($n = 7,420$, $M \text{ age} = 14.22$), we demonstrate that ESEM fits the data much better and results in substantially more differentiated (less correlated) factors than corresponding CFA models. Guided by a 13-model taxonomy of ESEM full (mean structure) measurement invariance, we then demonstrate invariance of factor loadings, item intercepts, item uniquenesses, and factor variances-covariances over time. ESEM has broad applicability to other areas of research that cannot be appropriately addressed with either traditional EFA or CFA, and should become a standard tool for use in psychometric tests of psychological assessment instruments.

Participants

Sample comprised 7,420 students (mean age=14.22, SD=1.56; 45% girls) and 1,866 (38.8% girls) students were part of studies in which test-retest data were collected approximately one year later. The average age of the participants was 13.86 years (SD=1.28) at Time 1. Motivation and Engagement Scale (MES) version designed for high school students (MES-HS) comprises 11 motivation and engagement scales, each assessed by four items on with a 7-point response scale: 1 (Strongly Disagree) to 7 (Strongly Agree).

Results

MES Factor Structures and Correlations: ESEM vs. CFA: the critical starting point for the present investigation is the hypothesis that the ESEM model provides a better fit to responses to the MES items than a traditional ICM-CFA model and that it reduces the size of the typically large factor correlations. The ICM-CFA solution provides an acceptable fit to the data (CFI=.935, TLI=.928, RMSEA=.033). However, the corresponding ESEM solution fits the data even better (CFI=.977, TLI=.958, RMSEA=.025). We then proceeded with an evaluation of parameter estimates in the ESEM and ICM-CFA solutions. In terms of the 44 target factor loadings, the sizes of most loadings are substantial. When both target and non-target factor loadings are considered together, the ICM-CFA and ESEM solutions resulted in a very similar pattern with a profile similarity index=.925 suggesting that the ESEM and ICM-CFA factor loadings were highly related.

An evaluation of the factor correlations among the MES factors demonstrates a critical advantage of the ESEM approach over the ICM-CFA approach. Although patterns of correlations between the ESEM and CFA solutions are similar (PSI=.803), the ICM-CFA factor correlations (-.70 to +.77; $|M|$ =.40, SD=.22) tend to be systematically larger than the ESEM factor correlations (-.33 to +.38; $|M|$ =.17, SD=.11). Thus, for example, the negative correlation between Valuing of School and Disengagement is $r=-.70$ based on the ICM-CFA solution but $r=-.33$ for the ESEM solution. Similarly, the correlation between Planning and Study Management is $r=+.77$ for the ICM-CFA solution, but $r=+.38$ for the ESEM solution. These show that the 11 motivation and engagement factors are substantially more distinct in the ESEM solution than in the CFA solution.

Invariance over Time: Latent Mean Structure Approach Marsh et al. (2009, Marsh, Lýdtke et al., in press) suggested that, with some adaptations, it is possible to apply the same set of 13-model taxonomy to test the invariance of ESEM factor structures over with test-retest data. In this longitudinal ESEM application, we constrain an a priori set of 44 cross-wave correlated uniquenesses (CUs) to account for the residual associations between matching items at 44 MES items at T1 and T2. Indeed, when the same item is used on multiple occasions, a correlation between the unique components of each item on the two occasions that cannot be explained by the correlations between the factors is likely to exist. The failure to include these CU is likely to systematically bias parameter estimates such that test-retest correlations among matching latent factors are systematically inflated (Marsh et al., 2004). Thus, we first tested the configural invariance of the responses to the MES with and without these 44 a priori CUs (Models LGI0 and LGI1). Fit indices for Model LGI0 and LGI1 clearly support the inclusion of 44 CUs (.934 vs. .960 for TLI; .951 vs. .970 for CFI; .024 vs. .019 for RMSEA). Consistent with a priori expectations, the test-retest correlations for the 11 MES factors in LGI0 were inflated (.49 to .73, $M = .58$) compared to those in LGI1 (.47 to .68, $M = .55$).

Based on these initial analyses, these a priori CU are included in all subsequent models. Tests of weak factorial/measurement invariance (LGI2 vs. LGI1) demonstrate the invariance of factor loadings over time. Fit indices controlling for model parsimony are slightly better for the more parsimonious LGI2 than for the less parsimonious LGI1 (TLI=.963 vs. .960; RMSEA=.018 vs. .019), whilst the CFIs are the same (.970). Tests of strong measurement invariance (LGI2 vs. LGI5) requires that item intercepts – as well as factor loadings – be invariant over time. Differences in fit indices for LGI5 and LGI2 (.962 vs. .963 for TLI; .018 vs. 0.18 for RMSEA; .969 vs. .970 for CFI) are small in relation to traditional guidelines. Results based on LGI5 support strong measurement invariance of MES responses (and a lack of differential item functioning) and justify the comparison of latent means over time. Tests of strict measurement invariance (LGI5 vs. LGI7) require the invariance of item uniquenesses – as well as item intercepts and factors loadings. Fit indices for LGI7 are comparable to those of LGI5 (.961 vs. .962 for TLI; .967 vs. .969 for CFI; .019 vs. .018 for RMSEA), supporting the more parsimonious model in relation to traditional cut-off values. Results based on LGI7 support the strict longitudinal invariance of the MES responses. The invariance of the latent factor variance-covariance matrix (LGI4 vs. LGI2) provides good support for the invariance of these parameters (Δ CFI=.001, Δ TLI=.000, Δ RMSEA=.000). Models LGI10 - LGI13 each test the invariance of latent means in combination with the invariance of other sets of parameters. In each case, the fits of these models positing no latent mean differences is equally good and acceptable to the corresponding models in which latent mean differences are freely estimated: Δ CFIs (.002), Δ TLIs (.002), and Δ RMSEAs (.000 to .001) based on comparisons of Models LGI10 and LGI5, LGI11 and LGI7, LGI12 and LGI8, and LGI13 and LGI9. These findings suggest that the 11 MES factor means do not differ systematically over time.

In summary, the ESEM approach applied to the motivation and engagement factors based on response to the MES provides reasonable support for the invariance of factor loadings, item intercepts, item uniquenesses, factor variances-covariances, and latent means over time.

Theoretical and educational significance of the research

The present investigation is a substantive-methodological synergy that explores the utility of ESEM in testing (a) the invariance of the factor structure (factor loadings, variances-covariances), (b) the invariance of measurement parameters (item uniquenesses, item intercepts, and latent factor means), and (c) its potential for reducing otherwise high correlations that can pose problems of multicollinearity and threats to support for discriminant validity. These issues cannot be appropriately addressed with either traditional EFA or CFA approaches and so this study offers methodological insights to those interested in measurement and substantive insights in relation to diverse psychological assessment instruments.

Using Exploratory Structural Equation Modeling (ESEM) to Provide Further Evidences on its Construct

Frederic Guay, Laval University, Canada; Feng Bei, Université Laval Québec, Canada; Pierre Valois, University of Luxembourg, Luxembourg; David Litalien, Université Laval Québec, Canada

The Academic Motivation Scale (AMS) is a widely used instrument that measures students' motivation. This instrument is made of 7 factors derived from Self-Determination Theory (SDT). The AMS has been criticized in the past because fit indices from a CFA solution are not very high and that correlations among motivation subscales are not in line with the theory. The goal of this research is thus to verify if some of the problems highlighted in past studies with the AMS are reproduced when using an Exploratory Structural Equation Modeling (ESEM) approach. In two studies, a total of 1417 college students completed the AMS. Fit indices based on the ESEM approach were higher than those from the traditional CFA approach. Correlations from the CFA solution were higher than those from the ESMS one. Interestingly, the correlations were in line with theoretical expectations when based on the ESMS solution, which was not the case for correlations based on the CFA. Results thus provide reasonable evidence that an ESEM approach is more appropriate than a traditional CFA approach when analyzing responses from the AMS. Instead of rewriting old items and/or writing new items to have a more optimal version of the AMS, we rather encourage researchers to use the ESEM method to analyse their data based on the AMS.

Aims

Educational researchers and practitioners recognize that motivation is vital for academic achievement and persistence (Pintrich, 2003). According to Self-Determination Theory (SDT; Deci & Ryan, 2002), motivation is not a global and undifferentiated concept. Rather, motivation is a multidimensional concept that varies in terms of quality. SDT has proposed various types of motivation that vary in quality or in levels of self-determination. From high to low levels of self-determination these are intrinsic motivation (behaviour is regulated by satisfaction and pleasure), integrated regulation (behaviour is congruent with the individual's values and needs), identified regulation (behaviour is regulated by choice and because the activity is important), introjected regulation (behaviour is regulated by internal pressures), external regulation (behaviour is regulated by rewards and punishment), and amotivation (neither intrinsic nor extrinsic). Student motivation is high quality or highly self-determined (i.e., associated with optimal indices of functioning) when primarily based on intrinsic, integrated and identified regulations, and is poor quality or low self-determined (i.e., associated with negative indices of functioning) when based on external and introjected regulations as well as on amotivation. Many efforts have been made to measure these types of regulations at school. In fact, carefully designed instruments are required to make genuine advances in motivational research and theory as well as to derive practical applications. Vallerand and his colleagues (1989) have thus developed the Academic Motivation Scale (AMS), which assesses three types of intrinsic motivation (knowledge, accomplishment and stimulation), three types of extrinsic motivation (identified, introjected and external), and amotivation. Results of Vallerand et al. (1989) provide some support for the factor structure, the construct validity, and reliability of the AMS (see also Vallerand et al., 1992, 1993). In addition, the construct validity of the AMS has been supported in studies focusing on the determinants and outcomes of types of motivation (Otis, Grouzet, & Pelletier, 2005; Ratelle, Larose, Guay, & Senécal, 2005). Recently, Grouzet, Otis and Pelletier (2006) went a step further by showing that the AMS is time and gender invariant. Finally, some studies (Grouzet et al., 2006; Otis et al., 2005; Vallerand et al., 1989) using the AMS have shown proximal motivations on the self-determination continuum (e.g., intrinsic motivation and identified regulation) were more highly and positively correlated with each other than with distal ones (e.g., intrinsic motivation and external regulation). This correlation pattern supports one of SDT's central postulates, which is that the energy underlying a given behaviour varies in terms of quality. Despite these encouraging results, the AMS has been criticized in the past because fit indices from CFA are not very high (Cokley et al., 2001; Fairchild et al., 2005). For example, in Vallerand et al. (1992) the NFI, GFI, and AGFI values are all below .90 when no post-hoc modifications are performed. Furthermore, in some studies the expected pattern of correlation among the AMS subscales was not perfectly

supported. For example, in contrast to what the theory predicts some studies have found strong and positive correlations between the introjection subscale and the three intrinsic motivation dimensions (Fairchild et al., 2005).

The aim of this research is to verify if some of the problems highlighted in past studies with the AMS are reproduced when using a more sophisticated method, namely the Exploratory Structural Equation Modeling approach (ESEM see Marsh et al., 2009). ESEM is more powerful than a traditional Independent Cluster Model (ICM; all indicators load on the respective construct without any cross-loadings) based on a CFA because ESEM takes into account all cross-loadings thereby attenuating correlations among factors. This aim will be accomplished within the confines of two studies.

Method

Study 1 includes 583 college students with a mean age of 19 years (217 girls and 365 boys). Study 2 comprises 834 college students (236 men, 581 women, and 17 without gender identification) with a mean age of 18 years. In these two studies, the French version of the AMS (Vallerand, Blais, Bri  re, & Pelletier, 1989) was used. Participants indicated, on a 7-point scale, the extent to which they pursued their studies out of IM to know, IM to accomplishment, IM to stimulation, identified regulation, introjected regulation, external regulation, and amotivation. There are four items per types of motivation for a total of 28 items.

Results

Fit indices of the traditional CFA-ICM method (study 1: $\chi^2 = 570.651$, $df = 78$, CFI = .932 , TLI = .971, RMSEA = .104; study 2: $\chi^2 = 1129.747$, $df = 85$, CFI = .879 , TLI = .963 , RMSEA = .121) were lower than those obtained from the ESMS solution (study 1: $\chi^2 = 527.813$, $df = 203$, CFI=.996, TLI .993, RMSEA = .052; study 2: ($\chi^2 = 744.365$, $df = 203$, CFI=.996, TLI=.992, RMSEA = .057). For both studies, correlations from the CFA-ICM solution were higher than those from the ESMS one. Interestingly, the expected pattern of correlations among AMS subscales was more supported when correlations are based on the ESMS solution, comparatively to correlations based on the CFA-ICM method. For example, in study 1 and 2 the correlation between introjected and intrinsic motivation is positive with the CFA-ICM solution, whereas this correlation is negative with the ESMS solution as expected by the theory.

Theoretical and educational significance of the research

Based on responses of 1417 college students, results provide very good support for the AMS factor structure and its construct validity as evidenced by the pattern of correlations obtained. Results also provide reasonable evidences that an ESEM approach is more appropriate than a traditional ICM-CFA approach when analyzing responses from the AMS. Thus, instead of rewriting old items and/or writing new items to have a more optimal version of the AMS (Fairchild et al., 2005), we rather encourage researchers to use the ESEM method to analyse their data based on the AMS.

Using Multidimensional Rasch to enhance measurement precision: The case of self-processes scales

Mo Ching Mok, The Hong Kong Institute of Education, Hong Kong; Rebecca Wing-yi Cheng, The Hong Kong Institute of Education, Hong Kong; Dennis McInerney, Hong Kong Institute of Education, Hong Kong

The Rasch model (Bond & Fox, 2007) is a stochastic model that applies the logarithmic transformation to estimate log-odds (logit) of each item and each person. Benefits of the Rasch model over Classical Test Theory approaches in scale construction are well documented, and substantial increase in using the Rasch approach are observed in recent years. Nevertheless, the application of multidimensional Rasch models is still limited, particularly among self-processes studies. Scales designed to measure self-processes are usually multidimensional. The conventional approach is to ignore the correlations among the latent traits in these scales and estimate the scales individually. Such unidimensional approach yields imprecise estimates. This study therefore, sets out to demonstrate how the multidimensional Rasch method can be used to enhance measurement precision. Participants were 8,354 junior secondary students (4,358 males, 3,702 females) who joined a 3-year longitudinal study entitled, "Optimizing the Potential of Hong Kong Students: Harnessing the Interaction between Psychological Variables and Student Achievement". Seven scales, each comprised a number of subscales and designed to measure key psychological variables, were used in the study, namely: Inventory of School Motivation, Academic Self-Concept, Self-Directed Learning, Basic Values, Future Goals, Learning Strategies and Utility Values of Education. Each scale was analysed using both the multidimensional and the unidimensional Rasch approach, and precision of estimates compared using the Averaged Relative Efficiency statistic. Results indicated that the multidimensional approach yielded better measurement precision for the majority of scales, particularly for short scales with a small number of items.

Sample.

Participants comprised the first wave of data collected in 2009-2010 for a 3-year longitudinal study entitled, "Optimizing the Potential of Hong Kong Students: Harnessing the Interaction between Psychological Variables and

Student Achievement". Total sample size comprised 8,354 students between Secondary 1 and Secondary 3. 4,358 of them were males, and 3,702 females.

Instrument.

Seven multidimensional Likert-type scales, each comprised a number of subscales, designed to measure key psychological variables were used in the study. The scales are:

1. Inventory of School Motivation (ISM) – a scale designed to measure eight dimensions of school motivation, namely, task, effort, competition, social power, affiliation, social concern, praise and token (McInerney & Ali, 2006). The ISM has been translated and validated in Chinese populations (Watkins et al, 2003). Factor analytic studies have demonstrated the validity and reliability of the eight measures drawn from the ISM, as well as four second order factors, across a wide range of cultural groups (e.g., McInerney & Ali, 2006; McInerney & Sinclair, 1992; McInerney, Marsh, & Yeung, 2003; Watkins et al., 2003).
2. Academic Self-Concept (SC) – a scale drawn from the Academic Self Description Questionnaire (ASDQ) (Marsh, 1992). The scales measures two dimensions, namely, self-concept in Mathematics, and self-concept in English. The scale has been shown to demonstrated good Rasch reliability and validity with Hong Kong students (Mok, Wong, Lau, 2010).
3. Self-Directed Learning (SDL) – a scale designed to measure three dimensions of secondary students' capacity for self-regulated learning (Mok, Cheng, Moore, & Kennedy, 2006). It includes processes such as planning and managing time, attending to and concentrating on instruction, organizing information, establishing a productive work environment, and seeking help effectively
4. Basic Values (BV) – a scale designed to measure five dimensions of basic values held by secondary students, namely perseverance, self-control, commitment, code of conduct and civic oriented behavior. (REFS)
5. Future Goals (FG) – a scale designed to measure five self-relevant, self-defining goals that provide incentive for action and help give meaning to school tasks. The five dimensions reflect students' pursuit in learning in order to become famous, to establish work or career, wealth, establishing a family and making a contribution to society. (Lee, Liem, & Ortiga, 2009; McInerney & Liem, 2008; McInerney, McInerney, Liem, Ortiga, Lee, & Manzano, 2008)
6. Learning Strategies (LS) - the scale is drawn from the Learning Process Questionnaire (LPQ) (Biggs, 1987). It has two dimensions, namely Deep and Surface scales which measures students' approaches used in their learning.
7. Utility Values of Education (UOE) – perceive values of schooling instrumental to obtaining particular desired outcomes, such as advancing one's fame, career prospects, wealth, establishing a family, and making a contribution to society. The scale has five dimensions. The scale has five dimensions. Fifteen items were written by Dennis McInerney parallel to the fifteen items in the FGO scale to measure students' perception of the importance of schooling to achieve the goals.

Method.

Each scale was estimated using two methods: (a) the multidimensional random coefficients multinomial logit model (MRCMLM; Adams, Wilson, & Wang, 1997); and (b) unidimensional Rasch model. The Average Relative Efficiency (ARE) (Wang, Chen, Cheng, 2004) was used to estimate the ratio of precision of the multidimensional approach over the unidimensional approach averaged over the range of person abilities. Building upon derivation from Wang, Chen, Cheng (2004, pp. 121-122), ARE can be estimated from the equation that shown in Figure 1, where VARIANCEU and VARIANCEM are variances of the scale estimated using unidimensional and multidimensional approaches respectively, and RELIABILITYU and RELIABILITYM are reliabilities of the scale estimated using unidimensional and multidimensional approaches respectively. The ARE ratio indicates the number of times the multidimensional approach is more precise than the unidimensional approach on average.

Results

Results indicated that the multidimensional approach improves measurement precision for the majority of scales, particularly for short scales with small number of items. Results show that that the multidimensional approach yielded better measurement precision for the majority of subscales.

Theoretical and educational significance of the research.

This paper addressed the important issue of precision in the estimation of scale values. Based on responses of 8,354 secondary students and 7 scales, which involved 30 measurement subscales commonly used by self-researchers, results provided strong evidence in support of substantial gain in precision if analysis capitalized on multidimensionality of the scales. The Average Relative Efficiency (ARE) ratio averaged 1.33, which means that the multidimensional approach was on average 33% more precise than the unidimensional approach. The maximum ARE ratio was 1.91. Putting in efficiency terms, this means researchers might be able to administer much shorter surveys (on average using only 2/3 of the original items) to achieve the same level of precision if multidimensional approach was used. This study further found that the gain was most significant for scales with small number of items. Given that

concepts involved in self-research are often complex and hierarchical in nature, we encourage researchers to consider exploiting correlations among subscales by using multidimensional approach for better measurement precisions.

SYMPOSIUM

Understanding the relationship between the approximate number system and mathematics education

Chairperson: Camilla Gilmore, University of Nottingham, United Kingdom

Organiser: Matthew Inglis, Loughborough University, United Kingdom

Discussant: Bert De Smedt, University of Leuven, Belgium

Recently psychologists have proposed that there is an innate cognitive system that is involved in the development of early number skills. Using the so-called Approximate Number System (ANS) humans and some non-human animals are able to form rapid, but approximate, representations of numerical stimuli. The system can be used to support various numerical operations including the comparison, addition and subtraction of two numerosities. It has recently been found that the accuracy of children's ANS representations are related to their achievement on whole-number problems of the sort taught in school mathematics. This result raises the possibility that the ANS may be implicated in the development of formal mathematical competence.

This symposium brings together three presentations which shed further light on the link between the ANS and school mathematics. Siegler, Thompson and Schneider present evidence which demonstrates that the previously established link between the ANS and school mathematics that has been demonstrated in the context of whole numbers also extends to the domain of fractions. Inglis, Attridge, Batchelor and Gilmore find that, although there is a correlation between ANS accuracy and mathematics achievement in children, the same relationship does not hold in adults. They discuss possible developmental trends that might account for such a discrepancy. Finally, Piazza reports new data from an Amazonian indigene population which she argues demonstrates a causal relationship between ANS accuracy and mathematics achievement. The discussion following the presentations will focus on prospects for how early mathematics education can be developed using our expanding knowledge of the ANS.

Magnitude Representations Are Central to Fractions Understanding

Robert Siegler, Carnegie Mellon University, United States; Clarissa Thompson, The University of Oklahoma, United States; Michael Schneider, ETH Zurich, Switzerland

Numerical magnitude representations are related both causally and correlationally to a wide range of mathematical capabilities. However, past research has left unclear whether these relations are unique to whole numbers or whether magnitude representations play a similarly central role in understanding fractions. The present findings indicate that accuracy of fraction magnitude representations are closely related to both fractions arithmetic proficiency and overall mathematics achievement test scores. The fraction magnitude representations also account for substantial variance in mathematics achievement test scores beyond that explained by fraction arithmetic proficiency. Considerable learning was found to occur between 6th and 8th grade, though even 8th graders were far from proficient in understanding fraction magnitudes and fraction arithmetic. Instructional implications of the findings are discussed.

Introduction

Numerical magnitude representations are central to mathematical knowledge. Strong correlations are present between accuracy of magnitude representations and many other important aspects of numerical knowledge: arithmetic, counting, estimation, categorization, memory for numbers, mathematics grades, and mathematics achievement test scores (Booth & Siegler, 2006; Geary et al., 2007; Halberda, Mazzocco, & Feigenson, 2008; Opfer & Thompson, 2008; Opfer, Thompson, & Furlong, 2010; Schneider et al., 2008; Thompson & Siegler, 2010). Experiences designed to improve accuracy of magnitude representations also improve other numerical competencies, including counting, categorization, and ability to learn answers to novel arithmetic problems.

The vast majority of studies examining numerical magnitude representations have focused on whole numbers. This is understandable, given the importance of whole numbers, but restricts generality of understanding of numerical cognition and its development.

In the present research, we examine whether theories and methods that have proved useful for studying the development of knowledge of whole numbers (e.g., privileged domains, neo-Piagetian, and information-processing theories) can also increase understanding of the development of fractions knowledge. The main goal of the research is to increase understanding of developmental and individual differences in acquisition of fractions knowledge and thus to provide an empirical base for theories of numerical representation that are more general and more differentiated than existing theories.

Method

To pursue this goal, we examined 6th ($N = 24$, Mean age = 11.69 years) and 8th graders' ($N = 24$, Mean age = 13.69 years) performance on three tasks that assessed knowledge of fractions magnitudes—estimation of the position of fractions on number lines ranging from 0-1 and 0-5 and magnitude comparisons of fractions in the range of 0-1—and also the students' performance on fractions arithmetic (e.g., addition, subtraction, multiplication, and division) and standardized mathematics achievement tests. Immediately after children answered number line estimation and fractions arithmetic problems, they described the strategies used to solve each problem.

Results and Discussion

Most 6th and 8th graders showed little understanding of fractions magnitudes on number line estimation and magnitude comparison problems. Performance was better for fractions in the 0-1 range than in the 0-5 range; for example, percent absolute error ($PAE = [?Child's Answer - Correct Answer?] / Numerical Range$) on number line estimation was 13% on 0-1 number lines and 24% on 0-5 number lines. For purposes of comparison, kindergartners' PAE on whole number estimation for the 0-100 range tends to be around 20%. Eighth graders' number line estimation ($PAE = 15\%$) was more accurate than that of 6th graders ($PAE = 22\%$), showing that fractions knowledge is still developing years after fractions are first taught. The mean of the median solution times across number lines and age groups was 9.5 s suggesting that fractions number line estimation is a controlled, strategic process, unlike whole number estimation. The magnitude comparison task in the 0-1 range yielded similar findings: 6th graders were correct on 68% and 8th graders on 79% of comparisons.

Considerable strategy use was apparent on fractions number line estimation, particularly on 0-5 number lines. Moreover, frequency of strategy use was related to accuracy of estimates. Two main types of number line estimation strategies were numerical transformation strategies (e.g., participants transformed presented fractions to more convenient numbers), and number line segmentation strategies (e.g., participants generated subjective landmarks on number lines to locate fractions). The most common numerical transformations were rounding the fractions, simplifying them, or translating them into different forms. The main number line segmentation strategies were division into halves; division into fifths or whole number units; division into units corresponding to denominators; flawed approaches; and none/unknown. Transformation and segmentation strategies were used on some trials by the majority of 6th and 8th graders. Among 8th graders, 75% of children used a numerical transformation strategy at least once on 0-1 number lines, as did 79% on 0-5 number lines. The corresponding percentages for the segmentation strategy were 83% and 92%. Among 6th graders, 50% used a numerical transformation strategy at least once on 0-1 number lines, as did 58% on 0-5 number lines. The corresponding percentages for segmentation strategies were 83% and 79%.

The most striking findings concerned consistency of individual differences. Tables 1 and 2 show the quality of fractions magnitude representations correlated highly with both fractions arithmetic accuracy and with overall Pennsylvania System of School Assessment (PSSA) Math achievement test scores. Correlations were even higher than ones previously observed with whole numbers (e.g., Booth & Siegler, 2006). Accuracy of number line estimation was related to math achievement test scores above and beyond variance in achievement test scores that could be accounted for by arithmetic performance, but arithmetic proficiency did not add to variance that could be accounted for by number line estimation.

Children used four main fractions arithmetic strategies across trials: 1) correct strategies yielded the correct answer if executed correctly ($M = 49\%$), 2) independent whole numbers strategies involved performing the arithmetic operation on the numerators and denominators separately ($M = 27\%$), 3) wrong fractions operation strategies involved treating the numerator or denominator incorrectly in a way that would be correct for that component in a different fractions arithmetic operation (e.g., maintaining the common denominator on a multiplication problem) ($M = 15\%$), and 4) none/unknown strategy ($M = 6\%$). Idiosyncratic incorrect strategies accounted for 3% of trials.

In summary, the mental number line is a useful construct for thinking about whole number magnitude representations, and the present findings indicate the mental number line is also a useful way of thinking about fractions magnitudes. In the United States, fractions instruction emphasizes part-whole interpretations (e.g., $1/5$ is one of five slices of pizza) far more than other interpretations (Ni & Zhou, 2005). Our results imply emphasizing fractions are measurements of quantity (e.g., $1/5$ is 20% of distance from 0 to 1 on a number line) might improve learning about fractions and dispel common misconceptions like thinking about numerators and denominators as independent whole numbers. Magnitude representations are a key component of fractions understanding, just as they are with whole numbers.

Non-symbolic number acuity correlates with formal mathematics achievement: But only in children

Matthew Inglis, Loughborough University, United Kingdom; Nina Attridge, Loughborough University, United Kingdom; Sophie Batchelor, University of Nottingham, United Kingdom; Camilla Gilmore, University of Nottingham, United Kingdom

The process by which adults develop competence in symbolic mathematics tasks is poorly understood. Non-human animals, human infants, and human adults all form non-verbal representations of the approximate numerosity of arrays of dots, and are capable of using these representations to perform basic mathematical operations. Several researchers have speculated that individual differences in the acuity of such non-verbal number representations provide the basis for individual differences in symbolic mathematical competence. Specifically, prior research has found that 14-year-old children's ability to rapidly compare the numerosities of two sets of colored dots is correlated with their mathematics achievements at ages 5-11. Here we demonstrate that although when measured concurrently the same relationship holds in children, it does not hold in adults. We propose that, if indeed non-verbal number representations are the cognitive basis of mathematical skill, they fulfill a bootstrapping role and do not hold the key to explaining the wide variety of mathematical performance levels in adults.

The ability to deal accurately with numerical quantities is a fundamental goal of education. On a daily basis we are asked to make judgments about concepts that are expressed numerically, but what is the cognitive basis for such abilities? Recently it has been proposed that the answer to this question is an innate and inexact analog system known as the Approximate Number System (ANS). This evolutionarily ancient system enables us, for example, to rapidly decide, without explicitly counting, which of two orange trees has the greatest number of fruit, or which of two herds has the greatest number of gazelle. The ANS supports approximate numerical operations, such as comparison and addition, on both visual and auditory arrays, in adults, children and perhaps even in non-human animals (e.g. Dehaene 1992, 1997).

Halberda et al. (2008) gave 14-year-old children a non-symbolic comparison task, calculated each individual's ANS acuity (a measure of the accuracy of their ANS), and related these to standardized mathematics achievement tests which had been taken at ages 5-11. They found strong relationships between these two measures at each testing-point, and raised the possibility that the ANS is implicated in the development of symbolic mathematical skills.

Both ANS acuity (Halberda & Feigenson, 2008) and symbolic mathematics achievement are developmental and consequently, since Halberda et al. did not test their participants concurrently on the two tasks they were investigating, it is possible that their ANS measure (taken at age 14) had been influenced by developmental patterns not reflected in the standardized mathematics achievement tests taken by participants at ages 5-11. Some support for this possibility comes from Luculano, Tang, Hall & Butterworth's (2008) finding that the non-symbolic addition performance of 8-9 year old children did not correlate with their exact symbolic addition performance.

To investigate this issue, in Experiment 1 we measured the ANS acuity of 39 schoolchildren aged 7.6-9.4 years ($M=8.4$) using a nonsymbolic comparison task. In 128 trials children were asked to select the more numerous of two arrays of coloured dots (stimuli were prepared following the method of Pica et al., 2004). We also measured participants' scores on the calculation subtest of the Woodcock Johnson III Tests of Achievement and the matrix reasoning subtest of the Weschler Abbreviated Scale of Intelligence.

Participants who appeared to be using strategies based on continuous quantities correlated with number (i.e. those who were not using their ANS) on a majority of trials were eliminated from the sample. In addition we removed participants whose performance was not above chance. This left 24 participants for the main analysis. Accuracy rates were subjected to an ANOVA with ratio as a within-subjects factor. There was a significant effect of ratio, $F(3,69)=11.76$, $p<.001$, and a significant linear trend, $F(1,23)=50.32$, $p<.001$. As is characteristic of the ANS, accuracy rates were lowest when the two numerosities had ratios close to 1. ANS acuity (as measured by w parameters, Barth et al., 2006) was found to negatively correlate with WJ-Calc scores, after controlling for age-standardized WASI scores, $r=-.57$, $p=.005$. In other words, high ANS acuities (w parameters close to zero) were related to high scores on the Woodcock-Johnson calculation subtest.

These results, found using concurrent testing, replicated Halberda et al.'s (2008) findings. They suggest that a child's ANS acuity is related to their achievement in symbolic mathematics. To explore this relationship further, and in particular its developmental trajectory, in Experiment 2 we investigated whether a similar relationship holds in adults.

Participants were 101 adults aged 18-48 ($M=23$). Participants were undergraduates or postgraduates studying a variety of disciplines and had varying levels of experience of mathematics (from school to PhD level). Again

participants were asked to select the larger of two arrays of coloured dots in 120 trials. Scores on the WJ-Calc and WASI matrix reasoning subtests were again recorded.

Accuracy rates were subjected to an ANOVA with ratio as a within-subjects factor. Again, responses showed the ratio effect characteristic of the ANS, $F(2,136)=103.9$, $p<.001$, and a significant linear trend, $F(1,68)=220.3$, $p<.001$. Unlike in Experiment 1, ANS acuity, as measured by w parameters, was not found to correlate with WJ-Calc scores, after controlling for age-standardized WASI scores, $r=+.17$, $p=.184$. This non-significant positive correlation was found to be significantly different to the negative correlation found in Experiment 1, $z=3.26$, $p<.001$.

These results are consistent with the suggestion that the ANS could act as a bootstrapping mechanism for mathematical competence. It is possible that the ANS starts the development of symbolic number skills, but then co-develops with symbolic mathematics until some point during adolescence where the two systems decouple (presumably because the ANS reaches ceiling level). Studying the developmental pattern of the relationship between ANS acuity and mathematics achievement as participants gain in maturity and mathematical experience may ultimately shed further light on the cognitive basis of the wide range of numerical operations that we each perform during day-to-day life; and, consequently, how effective instruction can be designed to help support children's mathematical development.

Barth, H., La Mont, K., Lipton, J., Dehaene, S., Kanwisher, N., & Spelke, E. (2006). Nonsymbolic arithmetic in adults and young children. *Cognition*, 98, 199-222.

Dehaene, S. (1992). Varieties of numerical abilities. *Cognition*, 44, 1-42.

Dehaene, S. (1997). *The number sense*. Oxford, UK: Oxford University Press.

Halberda, J. & Feigenson, L. (2008). Developmental Change in the Acuity of the "Number Sense": The Approximate Number System in 3-, 4-, 5-, and 6-Year-Olds and Adults. *Developmental Psychology*, 44, 1457-1465.

Halberda, J., Mazzocco, M. M., & Feigenson, L. (2008). Individual differences in non-verbal number acuity correlate with maths achievement. *Nature*, 455, 665-668.

Iuculano, T., Tang, J., Hall, C. W. B., & Butterworth, B. (2008). Core information processing deficits in developmental dyscalculia and low numeracy. *Developmental Science*, 11, 669-680.

Pica, P., Lemer, C., Izard, V., & Dehaene, S. (2004). Exact and approximate arithmetic in an Amazonian indigene group. *Science*, 306, 499-503.

Neurocognitive start-up tools for symbolic number representations

Manuela Piazza, Neuroimaging Unit, Neurospin Center, France

Attaching meaning to arbitrary symbols (i.e., words) is a highly complex and lengthy process. In the case of numbers it was previously suggested that this process is grounded onto two early pre-verbal systems for numerical quantification, the approximate number system (ANS or "analogue magnitude"), and the object tracking system (OTS or "parallel individuation"), which children are equipped with prior to symbolic learning. Each of these systems is based on dedicated neural circuits, characterized by specific computational limits, and undergoes a separate developmental trajectory. Reviewing the available cognitive and neuroscientific data, I argue that evidence is more consistent with a crucial role for the ANS, but not the OTS, in the acquisition of abstract numerical concepts that are uniquely human.

Attaching meaning to arbitrary symbols (i.e., words) is a highly complex process that takes years during infancy. In the case of numbers it was previously suggested that this process is grounded onto two early pre-verbal systems for numerical quantification, the approximate number system (ANS or "analogue magnitude"), and the object tracking system (OTS or "parallel individuation"), which children are equipped with prior to symbolic learning. Each of these systems is based on dedicated neural circuits, characterized by specific computational limits, and undergoes a separate developmental trajectory. Here I review the main features of these two systems, and critically review the available cognitive and neuroimaging evidence supporting the idea that they play a foundational role in symbolic numerical acquisitions.

I define two criteria which I claim being definitional for a foundational system:

1. Its integrity should be a necessary (albeit not sufficient) condition for efficient learning. Thus, early impairments in a foundational system should systematically lead to specific learning difficulties (in this case, dyscalculia).
2. Its computational constraints should predict speed and ease of cultural knowledge acquisition in children.

I also assess a third criterion, which is a less stringent one, stating that traces of the computational constraints of foundational systems may be found even in adults after successful learning. Even if this criterion is not a necessary

one, because a foundational system might be qualitatively transformed or totally replaced during development, its fulfillment supports a key role of the system for the cultural acquisition of more elaborate concepts.

Following these criteria, the provided literature review indicates that:

1. there is ample evidence that ANS, but not the OTS is impaired in dyscalculia,
2. detailed analysis of the developmental trajectory of the ANS, but not of the OTS, suggests a direct explanation of the seriality and timing of lexical acquisition of the first number words in children before they learn the counting procedures.

Finally, behavioral and neuroimaging data indicate the presence of computational signatures of the ANS, but not of the OTS in symbolic numerical representations.

I thus conclude that evidence supports a crucial role for the ANS, but not the OTS, in the acquisition of abstract numerical concepts that are uniquely human, and offer possible speculations on the neural mechanisms by which symbolic number acquisitions may stem upon pre-existing pre-verbal representation of numerical quantity. I finally provide novel behavioral data gathered from the Mundurucu, an Amazonian indigene population with a reduced numerical lexicon and highly variable access to education. We test a group of Mundurucu subjects spanning a large age range (from 4 to 60 years of age) with a test devoid of verbal content, developed to assess the ability to compare sets on the basis of their approximate number of elements. On an individual subject basis, using the accuracy distribution on this test, we derive, using a very simple psychophysical model, the acuity of the internal representation of number (ANS acuity). Results show that, in the absence of mathematical education, even adult subjects remain at a very coarse ANS acuity, equivalent to that observed in 6-year-old Western children. Conversely, in Mundurucu subjects who received some schooling, the acuity of the approximate non-symbolic number sense is drastically refined. Indeed, years of schooling remain a significant predictor of the ANS acuity even after controlling for the effect of age. Our results establish that training with numerical symbols and exact numerical concepts in turns deeply modify the pre-existing evolutionary ancient pre-verbal quantity representations. Direct demonstration of a causal link between pre-symbolic and symbolic numerical thinking might be of capital importance for developing efficient educational and re-educational programs, which could capitalize on the use of intuitive pre-verbal numerical abilities to strengthen the efficacy of the more classical training methods.

SYMPOSIUM

Language and Thought Provoking Interaction: Powerful Features for Teacher Professionalization

Chairperson: Resi Damhuis, Marnix Academie, University of Professional Education, Netherlands

Organiser: Resi Damhuis, Marnix Academie, University of Professional Education, Netherlands

Discussant: David Clarke, University of Melbourne, Australia

Teacher-pupil interaction is a key factor in pupils' successful learning according to sociocultural and constructivist approaches to learning (Alexander, 2008; Barnes, 2008; Mercer & Littleton, 2007; Renshaw, 2004; Wertsch & Toma, 1995). The thought-provoking requirement of such interaction has been accentuated (Marzano & Kendall, 2007). Moreover, from a language acquisition perspective (Gass & Mackey, 2006; Snow, 1999; Swain, 2005), interaction must be language provoking: it must allow for ample, varied language production by the children. The provocative aspect is crucial: optimal learning occurs when high support is combined with high challenge (Mariani, 1997). Such teacher behaviour requires new ways of thinking, doing and using language (Gibbons, 2010). School needs to prepare pupils for interaction: the heart of collaborative learning and living in a global society. Aiming at teacher professionalization, we investigate ways in which teachers can be supported to change the nature of interaction towards being more language and thought provoking.

The symposium brings together three research approaches that aim at identifying the ways teachers and pupils realize such interaction: teacher-pupil and peer dialogic interactions when implementing an innovative educational programme in primary school; teacher-pupil group interactions in primary school before and after teachers followed an intensive interaction training; and teacher-second language learner dyadic interaction in secondary school before and after student teachers experienced Socratic Dialogues. Though performed in different settings, all studies address the thought provoking as well as the language provoking aspects of interaction. They share a common goal: to reveal important features of interaction that are concrete enough to incorporate in teachers' professional development.

Scaffolding Dialogue for Reasoning in Primary Students

Sylvia Rojas-Drummond, National Autonomous University of Mexico, Mexico; Kissy Guzman, Universidad Nacional Autonoma de Mexico, Mexico; Guadalupe Vega, El Colegio de Mexico, Mexico; Haydee Pedraza, Universidad Pedagogica Nacional, Mexico; Maricela Velez, Universidad Pedagogica Nacional, Mexico

In this paper we analyzed the nature and quality of primary students' and teachers' dialogic interactions while working on collaborative writing projects. In particular, we investigated how teacher-student and peer interactions could create 'Intermental Development Zones' and 'dialogic spaces', as scaffolds for enhancing children's understanding, reasoning and learning. Our work is underpinned by a socio-cultural perspective to conceptualizing development, and contributes to recent efforts to understand and promote 'dialogic approaches' to learning and teaching in classroom settings (Alexander, 2008; Mercer, 2000; 2009; Wegerif, 2007).

Children created their projects in the context of an educational programme called Learning Together, designed to: 1) foster the development of 'learning communities' within which children and adults co-construct knowledge, and 2) promote social, cognitive, psycholinguistic and technological abilities in the children. Participants were 120 Mexican sixth graders (11 to 12 y.o.), and their corresponding teachers. Four focal triads were randomly selected and their work was videotaped during selected sessions. This enabled micro-genetic analyses of adult-child and peer dialogic interactions during different phases of the creation of the projects.

To illustrate our approach to the in-depth microanalyses of such interactions, we present some representative examples of dialogues by specific focal triads and their teacher. Results exemplify ways in which these dialogical interactions can lead to elaborate ways of understanding and reasoning by the children. The theoretical and practical contributions of the findings are discussed in relation to understanding and enhancing oracy and literacy, as well as reasoning and learning in school settings.

In this paper we analyze the nature and quality of primary students' and teachers' dialogic interactions while working on collaborative writing projects using ICT. As part of these projects, triads of children carried out investigations, produced and published articles in magazines and delivered conferences. Throughout this process, we investigated how teacher-student and peer interactions could create Intermental Development Zones (Mercer, 2000) and 'dialogic spaces' (Wegerif, 2007), as scaffolds for enhancing children's understanding, reasoning and learning.

Our work is underpinned by a socio-cultural approach to conceptualizing processes of development, teaching-and-learning. Inherent in this approach is the notion that if we are to understand the nature of thinking, learning and development we need to take account of the intrinsically social and communicative nature of human life. Socio-cultural theory posits that intellectual development is achieved through dialogue and that education is enacted through the interactions between students and teachers. These reflect the cultural and social practices of the communities in which educational institutions exist.

Research in the field of educational practices has explored two functional aspects of interaction and communication in classrooms. The first is teachers' use of dialogue as a means for promoting guided participation and 'scaffolding' children's learning and development (Rogoff, 1990, 2003; Rogoff, Goodman-Turkianis & Bartlett, 2001; Wells, 2001). The second is the potential value of peer group interaction and talk as another means of promoting these processes, but in a more symmetrical environment (Mercer & Littleton, 2007).

In the work reported we attempt to integrate these two lines of research by analysing the quality of both teacher-student and peer dialogic interactions in child-led discussions. Our work contributes to recent efforts to understand and promote 'dialogic approaches' to learning and teaching in classroom settings. Dialogic interactions are conceived as those that harness the power of talk to stimulate and extend children's thinking. These interactions are collective, reciprocal, supportive, cumulative and purposeful (e.g. Alexander, 2008; Lyle, 2008; Mercer, 2009; Mercer & Littleton, 2007; Skidmore, 2006; Wegerif, 2007).

The context of the study: The Learning Together Programme

Children created their writing projects in the context of an innovative Mexican educational programme called Learning Together (Rojas-Drummond et al., 2010). The programme has been designed to: 1) foster the development of 'learning communities' within which children and adults co-construct knowledge, and 2) promote social, cognitive, psycholinguistic and technological abilities in the children, and particularly oral and written communication.

Throughout the implementation of the programme, teachers use diverse instructional strategies. These include: (a) the creation of situated learning environments rich in social interactions where the diverse activities carried out are meaningful and mediated by cultural artefacts, including ICT (Cole, 1996; Lave & Wenger, 2001; Wegerif & Daws, 2004); (b) guided participation between experts and novices where adults scaffold children's learning activities (Bruner, 1978; Koole & Elbers, 2010; Rogoff, 1990); (c) dialogic styles of interaction between adults and children and among peers which encourage elaborate ways of thinking and understanding (Alexander, 2008; Mercer, 2009; Rojas-Drummond, 2000; Wegerif, 2007); and (d) collaborative learning where peers engage in diverse creative projects and

joint problem solving (Littleton, Miell & Faulkner, 2004; Rojas-Drummond et al., 1998; Rojas-Drummond et al., 2008; Rojas-Drummond et al., 2010).

Method

Participants were 120 Mexican sixth graders (11 to 12 y.o.) from four groups, and their corresponding teachers. These groups participated in the Learning Together Programme over the academic year. Children worked in triads to carry out investigations on a topic of their choice, and eventually produced an article, which was published in a popular magazine. They also created a conference supported by a Power Point presentation and delivered it to an audience conformed by members of the whole learning community, as part of a cultural fair. Throughout the implementation of the programme, adults supported children's activities so that they learned: a) to use exploratory talk for discussing and solving problems effectively; b) to comprehend and produce texts of different genres, and c) to use ICT for specific purposes. Four focal triads were randomly selected and their collaborative work was videotaped during selected sessions of the creation of their project. This enabled micro-genetic analyses of adult-child as well as peer dialogic interactions during different phases of the overall process. (In total, 32 hours of videotape furnished the corpus of data). In addition, the consecutive and final drafts of the digital texts produced by the four focal triads were collected and integrated into this corpus.

Analysis of data

For data analysis, all videos were transcribed verbatim together with a description of the context, following procedures developed by Edwards and Mercer (1987). Videos and transcripts were consecutively analyzed qualitatively using methods created by Mercer and colleagues (e.g. Mercer, 1995, 2000; Mercer & Littleton, 2007). These were complemented by qualitative and quantitative analyses by adapting methods derived from the Ethnography of Communication (Hymes, 1972; Saville-Troike, 2003). In particular, we employed the system of hierarchical and nested units of analysis they proposed to investigate conversations among participants, consisting of communicative acts embedded in communicative events, which are in turn part of broader communicative situations. In addition, the texts produced by the focal triads were analysed qualitatively and quantitatively, using rubrics designed ex-professo.

Results

To illustrate our approach to the in-depth microanalyses of adult-child and peer interactions, we present some representative examples of dialogues by specific focal triads while working on various phases of their projects. These include events with and without the presence of an adult. Results exemplify ways in which these dialogical interactions can lead to elaborate ways of understanding and reasoning by the children. They also depict the dynamic and iterative nature of some inter-textual processes holding between oral and written modes of communication.

The theoretical and practical contributions of the findings are discussed in relation to understanding and promoting oracy and literacy, as well as reasoning and learning in school settings. In particular, results can inform the development of teacher professionalization and training programmes, so that teachers can be encouraged to engage in effective dialogic interactions which enhance their students' intellectual development.

How to Measure Quality of Content in Language and Thought Provoking Interaction in Primary School

Resi Damhuis, Marnix Academie, University of Professional Education, Netherlands; Akke De Blauw, Amsterdam Center for Language and Communication, Universiteit van Amsterdam, Netherlands

Interaction conducive to learning should be thought provoking (Mercer & Littleton 2007) and language provoking (Swain 2005). Primary school teachers often find it difficult to effectively change their classroom interaction with pupils. Therefore, we developed a training built around teacher-pupil interaction strategies that promote language and thinking. The training combines team meetings and individual coaching sessions on the basis of video recordings. Key strategies concern promoting pupils' extensive output and high quality content of the output. Teachers choose learning objectives individually.

Our research focuses on measuring quality of the content of teacher-pupil interaction. First qualitative explorations indicated that the combination of thought provoking prompts and the quality of children's thinking on the one hand and the extent of children's output on the other hand might well represent differences in interaction quality.

The present paper investigates whether these features can be operationalized for quantitative analyses, in order to assess efficacy of the training and to improve teacher professionalization. We selected four participants with the learning objective 'encouraging a higher level of thinking'. Video recordings before and after the interaction training are compared. 'Encouraging a higher level of thinking' was operationalized in three variables. 'Extent of pupils' output' was measured by an ordinal scale.

The results reveal that features of extent and quality of interaction content can indeed be operationalized for quantitative analysis. The participant teachers did acquire strategies to enhance language and thought. We propose to incorporate the combination of these features explicitly in teacher training.

Aims

The current perspective on learning requires children to participate actively in the learning process. Teacher-pupil interaction constitutes a crucial part of that learning process, providing that this interaction is thought provoking (Barnes, 2008; Mercer & Littleton, 2007; Renshaw, 2004; Wertsch & Toma, 1995). Moreover, from a language acquisition point of view the interaction must be language provoking (Gass & Mackey, 2006; Snow, 1999; Swain, 2005). Thus, interaction that is conducive to learning should be language provoking and thought provoking. Pupils who get accustomed in school to learning and thinking together through interaction, will be better equipped for the increasingly global society in which they will live their adult lives.

Although most teachers are aware of the need for children's active participation in interaction, they often lack the competencies and strategies to effectively change their classroom interaction towards being more language and thought provoking. Demonstrations of good practice are available on video on sites such as 'Thinking Together' (Mercer c.s.) and for the Netherlands LEONED. However, studying models and examples is insufficient to fully acquire the desired strategies. Intensive practice and coaching is required (Damhuis & De Blauw, 2008a). The general goal of our research is to design a training that enables teachers to bring about language and thought provoking teacher-pupil interaction, in order to increase pupils' learning.

Context of the study

We developed a training that includes team meetings, intensive practice of interaction strategies promoting language and thinking in real classroom discourse combined with coaching based on video recordings of classroom discourse (De Blauw & Damhuis, 2006; Damhuis & De Blauw, 2008b). The training covers approximately half a year. In the training a checklist of child behaviour favourable for language and cognitive development and corresponding teacher strategies is presented (Damhuis, De Blauw & Brandenbarg, 2004). The two most important categories of this checklist contain strategies that promote pupil's extensive output and high quality content of pupil's output. Extensive output refers to language production that exceeds a minimal response, and may stretch for several utterances. High quality content goes beyond labelling or describing, and involves reasoning, concluding and other complex cognitive language functions. In the training participants select their own learning objectives from these checklist categories and practice them in their own classrooms. Coaching addresses these points specifically.

Method

The central research question is: to what extent do teachers who follow an interaction strategies training, change their interaction behaviour? An earlier investigation focused on strategies that promote extensive production by the pupils (Damhuis et al., 2009). The study we report on here, focuses on the quality of the content.

First qualitative explorations indicated that the combination of thought provoking prompts and the quality of children's thinking on the one hand and the extent of children's output on the other hand may represent differences in quality of interaction (De Blauw et al., 2010). These two features and their combination are potentially concrete enough to be useful in teacher professionalization.

The specific research question in this paper is: how can we measure the quality of the content of teacher-pupil interaction in the light of language and thought provoking interaction? We distinguish three sub questions:

- Can features of extent and quality of the interaction content be operationalized in a way that allows for quantitative analysis?
- Do these features reveal differences between interactions before and after the training, qualitatively as well as quantitatively?
- Could these features be implemented in teacher professionalization?

This paper presents a pilot analysis. Data are used from an in-service course in Dutch primary schools and from a pre-service course in a Dutch teacher training college for primary education. The data consist of video recordings of classroom interaction between (student) teacher and pupils. We selected two student teachers and two teachers who had chosen as their specific learning objective 'encouraging a higher level of thinking'.

Analysis

Video registrations before and after the interaction training are compared. A ten minute 'window of opportunity' of each video was transcribed and analyzed. Strategies from the checklist with respect to thought provoking prompts and children's thinking were operationalized in three variables: line of enquiry (see also Alexander, 2004), negotiation of meaning, and complex cognitive language functions (see also Anderson & Krathwohl, 2001; Bloom et al., 1956).

Extent of pupils' output was measured by an ordinal scale from minimal answer to extensive answer, analogous to the extent aspect of our question analysis in earlier research.

Results

Student teachers and teachers do acquire strategies to enhance language and thought. Most participants engage their pupils regularly in long lines of enquiry, and do so more after the course than before. A discriminating factor between the two student teachers after the course is the combination of 'complex cognitive language functions' and 'extensive output'. Only one student teacher succeeded after the course in realizing interaction in which pupils were challenged to think and to talk extensively. For the two teachers this combination characterises the difference between their interactions before and after the course. It was not found before the course, but both teachers were successful with it after the course.

Theoretical and educational implications

So we conclude that extent and quality of interaction content can indeed be operationalized for quantitative analysis. This opens up the way to collect evidence for the efficacy of the training. However, the quantitative generalization does not completely cover perceived differences in the quality of the interactions. This has implications for teacher professionalization. It seems to be worthwhile to incorporate the combination of features explicitly in teacher training. The general idea can be emphasized and illustrated in the team meetings. In individual coaching sessions the trainer has to focus specifically on the qualitative features of the actual interaction.

Making Teacher Interaction with Second Language Learners More Thought and Language Provoking

Dubravka Knezic, University of Applied Sciences Utrecht, Netherlands; Maaïke Hajer, University of Applied Sciences, Netherlands; Ed Elbers, Utrecht University, Netherlands; Theo Wubbels, Utrecht University, Netherlands

Research on individual teachers' interaction with individual second language learners in content area classes reveals the need for a specific teacher sensitivity to these learners' language needs (Elbers, Hajer, Jonker, Koole & Prenger, 2008; Gibbons, 2006, 2009). This paper presents research aiming at increasing this sensitivity through fostering teachers' language awareness and improving their interactional skills by means of an intensive experience of Socratic Dialogue. Contrary to Socratic method, the Socratic Dialogue is a group dialogue developed by Nelson (1920's) and Heckmann (1981) in which the participants guided by a facilitator and a number of ground rules strive to reach a consensus in answering a fundamental question. Results show a significant improvement at a macro and micro level of interaction in the learning talks between content teachers and secondary education second language learners before and after the teachers followed a course in the Socratic Dialogues. The MANOVA analysis established significant effects: teachers' micro-scaffolding behaviour has improved. The micro level Conversation Analysis looked at the teacher and pupil behaviour together and revealed some aspects of successful learning talks.

Aims

The paper presents research aiming at increasing learning chances of secondary school second-language learners in dyadic interaction with content teachers. Drawing on sociocultural views of learning as a situated dialogic inquiry (Wells, 1999; Mercer & Littleton, 2007; Wegerif, 2007) we focused on the dialogic skills and strategies student teachers would need in order to respond sensitively to the special linguistic learning needs of their second language learners such as slowing down the pace of the talk (Cazden, 2001) and paying attention to language. We also regarded the language and thought provoking teacher moves such as eliciting the learner's contribution, probing his/her statements and asking follow up questions. These strategies, also recognized in micro-scaffolding (Gibbons, 2009), happen to be extensively employed in the Socratic Dialogue. Contrary to Socratic method, the Socratic Dialogue applied here is a group dialogue developed in the tradition of Plato's Dialogues by Nelson in the 1920's (translated by J. Kessels, 1984) and Heckmann (1981). In the Socratic Dialogue, the participants strive to reach a consensus in answering a fundamental question under the guidance of a facilitator and a number of ground rules. So, the central question was: "Will the quality of student teachers' interaction with their second language learners improve after they had taken part in a series of Socratic Dialogues?" In order to measure the improvement of the dialogic strategies we developed a concept of Teacher Pupil Learning Dialogue and the accompanying scoring scheme. We defined the Teacher Pupil Learning Dialogue (henceforth TPLD) as a dialogue between the teacher and the pupil in which the teacher evidently tries to scaffold the pupils' learning by means of a number of strategies: asking open-ended and follow up questions, slowing down the pace of the dialogue, inviting the pupil to contribute, allowing the pupil time to express him/herself, checking for understanding and paying attention to language. Empirical research on the Socratic Dialogue (Griessler, Littig, Husing, Zimmer, Santos, Munoz, et al., 2004; Pihlgren, 2008) pointed out the positive effects of the Socratic Dialogue on communicative skills. Also Knezic, Wubbels, Elbers and Hajer (2010) recommend integration of the Socratic Dialogue in teacher education. Thus encouraged, we employed this substantive method for

an integrative development of teacher dialogic skills and their thinking and beliefs about some essential aspects of communication in learning and instruction.

Method

Quasi-experimental research was conducted among pre-service Bachelor and in-service Master of Education students in various content subjects in secondary education. The participants were matched into two groups of 16. The experimental group participated in a series of seven weekly two-hour Socratic Dialogues. Three measurements, before, after and a 3-month follow up, consisted of audio files of ten minute TPLDs. The participants were asked to carry out TPLDs individually with three second language learners for each measurement, outside the classroom with the task to check the learner's knowledge of subject matter discussed in class and increase that knowledge.

Analysis

The data was analysed in two steps and at two levels: a macro level analysis of 202 TPLDs followed by a micro level analysis of a selection of 20 TPLDs. Trained observers, their inter-rater reliability established, scored the TPLDs by listening and using the TPLD scoring scheme. They used the TPLD scoring scheme in two steps: they first scored each of the eight separate features and then answered the main question regarding the overall quality of the TPLD. The scores were analysed by means of a two-way between groups MANOVA. The micro level analysis was carried out on a selection of 20 TPLDs by 10 teachers that had been scored as most different in quality on comparison for each teacher before and after the intervention. The micro level analysis employed conversation analysis and focused on the organisation of the talk, the teacher's responsiveness to the learner's level of knowledge and understanding and his or her addressing different levels of thinking skills (Marzano & Kendall, 2007; Wells & Arauz, 2006).

Results

The MANOVA of the macro level quantitative data established a statistically significant effect regarding the overall quality of the talks, $F(1,58) = 7,18$, $p = .01$; partial eta squared = .11. Also the separate features of the TPLD scoring scheme representing the micro-scaffolding strategies appeared to have developed after the intervention. So, not only the overall quality of the TPLDs improved after the intervention, but also the separate features representing micro-scaffolding strategies developed. These results give us reason to believe that the improvement of the overall quality of the TPLDs and the student teachers' micro-scaffolding behaviour was due to the Socratic Dialogue course. Preliminary results of the qualitative analyses have revealed the emergence of the following patterns in the successful TPLDs: the pupil 'leads' the TPLD, teacher addresses higher level thinking skills (Marzano & Kendall, 2007) and the pupil employs them, the continuity of the TPLDs is sustained by placing connections between the concepts discussed, and the teacher's feedback is contingent (Van Lier, 1996).

Theoretical and educational implications

The research contributes to the theory of scaffolding learning and language development. Its educational significance lies in the empirical evidence of improving the teachers' interactional skills in the context of scaffolding the pupil's learning. As such, it informs teacher education programmes aiming at developing teacher dialogic skills indispensable for successful micro-scaffolding.

SYMPOSIUM

Orchestrating learning in TEL – more than just a metaphor?

Chairperson: Bram De Wever, Ghent University, Belgium

Organiser: Bram De Wever, Ghent University, Belgium

Raija Hamalainen, University of Jyväskylä, Finland

Discussant: Rosamund Sutherland, University of Bristol, United Kingdom

Orchestrating learning (e.g. Dillenbourg, Jarvela, & Fischer, 2009) is a term that has lately been introduced within the research area of Technology-Enhanced Learning. The aim of orchestrating TEL is to engage groups in shared knowledge construction processes and high-level collaborative learning (based on research findings) in naturalistic learning settings with the aid of teacher's pedagogic design and timely support. However, since this term is used by a variety of researchers with different research backgrounds, this symposium aims to bring contributions from different strands of TEL research together, in particular research from a cognitive and from a socio-cultural perspective.

The symposium comprises one theoretical paper and two empirical ones.

The theoretical paper focuses on the metaphor of "orchestrating" learning activities. The opportunities and challenges of drawing on "orchestration" as a concept to advance research are discussed and two theoretical and methodological routes are identified and presented.

The first empirical study focuses on orchestrating learning in a formal, inquiry-oriented curriculum unit employed in high school biology classrooms, which used a cognitively oriented, rather quantitative methodology to analyze collaboration processes and their effects on individual knowledge construction.

In the second empirical paper, quantitative and qualitative content analyses are used to study the group knowledge-construction processes. The former analyses study whether shared knowledge construction in two different research settings differ, whereas the latter aim to develop understanding of how teachers' activities enhance high-level knowledge construction.

Both empirical papers present different ways to orchestrate learning activities.
Ros Sutherland will discuss the links drawn between the papers.

Orchestrating learning in TEL: Theoretical and methodological considerations to advance research

Carlo Perrotta, Institute of Education, United Kingdom; Michael Evans, Virginia Tech, United States; Raija Hamalainen, University of Jyväskylä, Finland; Ingo Kollar, University of Munich, Germany; Bram De Wever, Ghent University, Belgium

"Orchestration" is an emerging metaphor in the field of Technology-Enhanced Learning (TEL), reflecting a possible moment of evolution in the design of future learning environments moving from explicit, rote scripting to emergent, interpretive scoring. Scoring, the act of composing an original work in musical terminology, aligns well with the orchestration metaphor while connoting a degree of artistic license granted, in this case, to the teacher or designer. Scoring is submitted to provide contrast to scripting while intending to spur dialogue around the general metaphor. However, with this change arise warranted questions as to whether this advancing metaphor can do sufficient justice to the complexity of teaching and learning in technology-enhanced settings than those already available. Therefore, the main aim of this paper is to summarise the opportunities and challenges noted while exploring the potential of orchestration as a framework or lens to advance research in TEL. In this paper we describe at least two routes that lead to distinct scenarios, each characterised by more or less specific research questions and methodological considerations. Our primary suggestion is that orchestration as a metaphor has the potential to advance research and illuminate important issues in TEL; this is deemed possible on the condition that the metaphor is not used to advocate a new paradigm, but used selectively in two complementary ways:

- (a) a reflection on, and an expansion of, the scripting approach;
- (b) a framework to develop a more critical type of inquiry around the function of teachers in the educational process.

Metaphors can serve empirical investigation when they help generate research questions (Sfard, 1998). Scripting is one such example. The notion of a script originated as a metaphor to equate sequences of tasks and interactions in a computer-supported environment to the behaviours prompted and coordinated during a staged performance.

More recently, however, an existing metaphor (e.g., Brown, 1992) has received renewed attention in TEL, namely the "orchestration" of learning activities (e.g. Dillenbourg, Jarvela, & Fischer, 2009). However, questions arise as to whether this metaphor can do sufficient justice to the complexity of learning in technology-enhanced settings contributing insights beyond those already available. Therefore, the main aim of this paper is to summarise the opportunities and the challenges noted while exploring the potential of orchestration as a concept to advance research, opening previously unconsidered or unexplored avenues.

This proposed agenda is possible by tracing at least two routes that lead to different scenarios, each characterised by specific research questions and methodological considerations. Through this exercise we will attempt to provide a tentative evaluation of orchestration as a means to bring different approaches in TEL under a common paradigmatic umbrella.

The first route is that of isomorphism, that is, the degree to which interactions, tasks, tools and roles in a learning context can be mapped over the kinds of interactions, tasks, tools and roles in an actual orchestra. For instance, the teacher in a classroom may be seen as the conductor, the students may be regarded as members of the orchestra, their learning activities may be understood as an analogue to the music produced by the orchestra, and digital technologies may be viewed as instruments. Further, all must be set to a particular tempo that best benefits teaching and learning.

In line with the original theorisations from Dillenbourg et al. (2009), it is possible to investigate such isomorphic relation by asking whether and how the coordination of the cognitive, pedagogic and technological dimensions across multiple social planes (individual work, group work and whole-class activities) can be equated with the coordination

that is carried out in an orchestra. Isomorphic equation is also useful in exposing the limits of the metaphor when applied to a classroom context; although both classrooms and orchestras are social entities organised around common roles, activities and resources, classrooms typically are much more dynamic and variable, as learners do not all learn at the same rate and in the same way (Watts, 2003).

The second theoretical and methodological route is that of socio-cultural and socio-historical critique, in which orchestration can be regarded as a response to an emerging trend within academia, but also in the wider educational discourse in Europe, North America, and perhaps globally, that seeks to reinstate the centrality of the teacher in contexts characterised by ubiquitous technology, open-access resources, and by many cognitive and socio-cultural factors in need of, indeed, orchestration. Dillenbourg (2010) explicitly refers to orchestration as a “teacher-centric approach” in order to stress the elements of proactive guidance and scaffolding, which may be interpreted as an implicit remark on the frustration with unguided discovery- or experientially-based instruction (see e.g. Kirschner, Sweller, & Clark, 2006).

From such a perspective, the overarching research question would focus on methods of critical social analysis to identify and overcome the barriers to teaching as orchestration in real classrooms. In most educational systems, teachers do not have control over important dimensions of their profession; therefore their role as orchestrators appears seriously compromised. Nowhere is this more evident than with respect to educational assessment, as key aspects of student performance are usually evaluated in the context of summative external exams, which have a negative “backwash effect” (Boud, 1995) on how interactions and tasks are planned and coordinated in many real classrooms (the infamous “teaching to the test”).

In conclusion, we suggest that orchestration has the potential to advance research and illuminate previously under-investigated issues in TEL research. This is possible when the metaphor is used with moderation, not as a completely new paradigm, but in two complementary ways:

(a) A reflection on, and an expansion of, the scripting approach. Whereas scripts aim to foster collaborative learning by shaping the way in which learners interact with one another, orchestrating learning may include collaboration scripts but also consider more complex learning settings (e.g. different social planes, internal and external resources of learning, etc.). From this perspective orchestration may advance research by exploring the different facets and iterations of an overarching research question: how can we develop tools and principles that allow teachers to adaptively choose and implement collaboration scripts on the basis of what different naturalistic settings and different social planes demand?

(b) A framework to develop a more critical type of inquiry around the function of teachers in the educational process. Orchestra conductors are usually highly prestigious figures; hence, orchestration can be a means for reconfiguring teacher professionalism and stimulate an overdue public debate around the necessity to raise the social status of the profession, by acknowledging and empowering the crucial role of teachers as facilitators and, indeed, orchestrators of very complex dynamics. The main aim of such an approach would therefore be to shift the balance from “teacherless” instructional design to the actual educational practice of coordinating and scaffolding learning in highly diverse and dynamic classrooms.

Boud, D. (1995). *Enhancing Learning Through Self-assessment*. London: Kogan Page.

Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2(2), 141-178.

Dillenbourg, P. (2010). Technologies for Orchestration. Presented at World Conference on Educational Multimedia, Hypermedia and Telecommunications 2010. Retrieved from <http://www.editlib.org/p/35263>

Dillenbourg P., Jarvela S., & Fischer F. (2009). The evolution of research on computer-supported collaborative learning: From design to orchestration. In N. Balacheff, S. Ludvigsen, T. de Jong & S. Barnes (Eds.), *Technology Enhanced Learning: Principles and Products* (pp. 3-19). New York: Springer.

Kirschner, P. A., Sweller, J. & Clark, R. E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75-86.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 27(2), 4-13.

Watts, M. (2003). The orchestration of learning and teaching methods in science education. *Canadian Journal of Science, Mathematics and Technology Education*, 3(4), 451-464.

Orchestrating web-based inquiry learning with small-group and classroom scripts

Ingo Kollar, University of Munich, Germany

Christof Wecker, University of Munich, Germany

Sybille Langer, Ludwig-Maximilians-University of Munich, Germany

Frank Fischer, Universität München, Germany

Online search skills may be regarded as an important component of scientific literacy. A promising approach to support learners in acquiring online search skills is web-based inquiry learning. However, to be successful, inquiry learning typically needs to be scaffolded. In a quasi-experimental 2x2 factorial study, we examined to what extent a small-group collaboration script (present vs. not present), two versions of a classroom script (version A: all online search activities located on the small group level vs. version B: online search activities alternately on the small group and the plenary level) and their different combinations may foster high school students' acquisition of online search skills in a web-based inquiry curriculum unit on Genetic Engineering. Results indicate that employing a classroom script that alternates search activities between the small group and the plenary level can make further structuring on the small-group level (through a small-group collaboration script) obsolete. Adding a small group collaboration script to the alternating classroom script did not lead to further improvement, possibly because the modelling phases that were part of the classroom script reduced time for actually performing the proposed search strategy. Currently, process analyses are performed to find evidence to confirm or disconfirm this interpretation. Nevertheless, this study demonstrates that the effectiveness of inquiry learning can be improved by scaffolding, especially when the used scaffold includes activities on the plenary level.

Online search skills are an important component of both information literacy (Kafai & Bates, 1997) and scientific literacy (Laugksch, 2000). However, searching and finding credible and scientifically acceptable information on the Web to form a well-grounded position in a science debate (e.g., whether pre-implantation diagnostics should be allowed or not) is a challenging task, especially for high school students (Lazonder, 2005).

One promising approach to foster high school students' online search skills is (web-based) inquiry learning. Yet, as research has repeatedly shown, inquiry learning needs to be properly scaffolded (de Jong, 2006). When implemented in the classroom, two types of scaffolds can be distinguished: (a) scaffolds on the classroom level (e.g., classroom scripts that distribute learning activities over the different social planes of the classroom such as plenary level, small group level, individual level; see Dillenbourg & Jermann, 2007) and (b) scaffolds on the small-group level (e.g., collaboration scripts that specify, sequence and distribute learning activities and roles among the members of a small group; see Kollar, Fischer & Hesse, 2006).

In this study, we examined the effects of a small-group collaboration script (present vs. not present) and two different versions of a classroom script (online search activities to be conducted in small-groups only vs. alternately in small-groups and in the plenary) and their different combinations in a web-based inquiry learning curriculum unit on the acquisition of online search skills. We expected the combination of a small-group collaboration script and a classroom script that alternated between plenary and small group search activities to produce the highest skill levels.

174 9th graders participated in the study, which was conducted within regular Biology lessons. Students were equipped with laptops and worked on a web-based inquiry learning curriculum unit asking them to develop a well-grounded position towards whether Genetic Engineering should be allowed or not. The learning phase spanned seven regular Biology lessons and included three online search activities. We implemented a quasi-experimental 2x2-factorial design with the independent factors "small-group collaboration script" (present vs. not present) and "type of classroom script" (small-group level only vs. alternations between small-group and plenary level). Classes were randomly assigned to experimental conditions. Both independent variables were manipulated during each of the three collaborative search phases. In all groups, a software tool called S-COL (Wecker et al., in press) was used to allow for collaborative browsing. The small-group collaboration script was implemented as a plug-in in the S-COL software which distributed prompts related to the current step in the search process (selecting search terms, selecting links from a hit list, finding information on a chosen website) among the two learning partners, for example pointing to the scientific quality of a web site. The type of classroom script was also manipulated during collaborative online search. In the classroom script that alternated plenary and small-group search activities, single steps (such as "selecting search terms", or "finding information on a website") were modeled in front of the class before this activity was to be conducted by the dyads. In the classroom script that located online search activities solely on the small-group level, no such modeling on the plenary level took place and the dyads performed all online searches on the small group level.

Online search skills were measured by the students' performance in an individual test that asked them to describe how they would use the Internet to form a position in a different science debate. The responses were analyzed using a

coding scheme capturing adequate steps and important quality characteristics during successful online search. The agreement of two independent coders determined on a subset of the material was sufficient (ICC = .83).

An ANCOVA with the scores in the online search skills post test as the dependent variable, the small-group collaboration script and the classroom script and classes nested within the two kinds of instructional support as independent variables, and prior online search skills as covariate showed a significant interaction effect ($F(1,165) = 12.41$; $p < .01$; partial $\eta^2 = .07$): Students with the classroom script that alternated between plenary and small-group activities, but without the small-group collaboration script reached the highest skill levels; students with the classroom script that located search activities solely on the small-group level and without a small-group collaboration script reached the lowest scores. Students equipped with the small-group script were in between, no matter with which of the two classroom scripts they had learned. Thus, combining modeling phases (as part of a classroom script) and small-group collaboration scripts may produce have called “over-scripting” effects (Dillenbourg & Jermann, 2007). Process analyses are underway to test this assumption. Overall, the results demonstrate that online search skills as an important component of both scientific and information literacy can be fostered by inquiry learning, but that careful orchestration by the teacher is needed. To provide structure, learning activities should obviously be alternated between the different social planes of the classroom. If this is done, further structuring on a small-group level may become obsolete.

de Jong, T. (2006). Technological advances in inquiry learning. *Science*, 312, 532-533.

Dillenbourg, P. & Jermann, P. (2007). Designing integrative scripts. In F. Fischer, I. Kollar, H. Mandl, & J. M. Haake (Eds.), *Scripting computer supported communication of knowledge: Cognitive, computational and educational perspectives* (pp. 275-301). New York: Springer.

Kafai, Y. & Bates, M. J. (1997). Internet Web-Searching Instruction in the Elementary Classroom: Building a Foundation for Information Literacy. *School Library Media Quarterly*, 25(2), 103-111.

Kollar, I., Fischer, F., & Hesse, F. W. (2006). Computer-supported collaboration scripts - a conceptual analysis. *Educational Psychology Review*, 18(2), 159-185.

Lazonder, A. W. (2005). Do two heads search better than one? Effects of student collaboration on web search behaviour and search outcomes. *British Journal of Educational Technology*, 36(3), 465-475.

Wecker, C., Stegmann, K., Bernstein, F., Huber, M. J., Kalus, G., Rathmeyer, S., Kollar, I. & Fischer, F. (in press). S-COL: A Copernican turn for the development of flexibly reusable collaboration scripts. *International Journal of Computer-Supported Collaborative Learning*.

Orchestrating collaboration in 3D learning space for vocational education

Collaborative Learning, Computer supported Learning Environments, Vocational education

Raija Hamalainen, University of Jyväskylä, Finland

Kimmo Oksanen, Finnish Institute for Educational Research, University of Jyväskylä, Finland

The changing needs of people's work lives are creating new challenges for educational settings. Nowadays, work is typically dependent upon interprofessional expertise and the shared construction of new knowledge. Technology can be used to enhance collaboration in learning and working practices—for example, by offering spaces that are more illustrative for practicing interprofessional work. Our previous research has focused on the collaboration scripts as a particular kind of instructional approach to support CSCL, without real-time teacher orchestration. Therefore this study supplements collaboration scripts with teachers' timely support and focus on ways of orchestrating learning in 3D space. The aim of the study is to find out how real-time teachers' orchestration affects knowledge-construction processes. The study used content analysis to compare shared knowledge construction within different scripted 3D-learning conditions (with and without real-time teacher orchestration). Between the groups studying with and those studying without a real-time teacher's orchestration, the findings indicated two main differences in knowledge-construction activities in the categories “providing information” and “other inputs”. More specifically, groups with teacher orchestration used 18 percent of their utterances for explaining their own situation, while groups without teacher orchestration only used 5.9 percent of their utterances for this. The other difference concerned the amount of other inputs; especially off-task talks which was higher with groups without teacher orchestration. Thus, scripted 3D space gave guidance in task solving. However, a teacher's professional competencies were helpful, especially for reducing off task discussions in 3D space and for understanding the interprofessional nature of the task.

The changing needs of people's work lives are creating new challenges for both learning and teaching in an educational setting. Work tasks have become increasingly complicated, and work is typically dependent upon interprofessional expertise and the shared construction of new knowledge (Billett, 2008). As vocational jobs are likely to call for more collaboration, it is necessary to find new ways of supporting collaboration in vocational learning. One way to respond to this need is to create new, technology-enhanced learning spaces that offer learners added incentives to practice interprofessional collaboration. Many researchers have reported on the beneficial effects of

computer-supported collaborative learning (CSCL). As well, the rapid development and improvement perception of 3D spaces offer new potential for learning. Thus, technology can be used to enhance collaboration in learning and working practices—for example, by offering spaces that are more illustrative for practicing interprofessional work. Our previous research has focused on the collaboration scripts as a particular kind of instructional approach to supporting CSCL (typically without real-time teacher orchestration) (e.g. Hamalainen, 2010). Therefore this study supplements collaboration scripts with teachers' timely support and focus on ways of orchestrating learning in 3D space. The concept of orchestrated learning is not new (see e.g. Brown, 1992); along with the development of new 3D spaces, orchestrating has again become a topical issue because new learning spaces challenge teachers to support collaborative learning in new ways. The aim of the study is to find out how real-time teachers' orchestration affects knowledge-construction processes in 3D-learning space.

CONTEXT

The empirical study was conducted in an authentic classroom setting (cameras and recording systems were used). In 2010 (spring), 18 vocational students and two teachers (four groups of five persons) participated in the study. The experiment included a two-to-three hour working period in a scripted 3D learning space at the College of Jyväskylä, Finland. Data were gathered using observational notes on the sessions as well as by videotaping and recording the groups' discussions (6016 transcribed utterances).

METHOD

The aim of the study is to deepen the understanding of the relationship between two different instructional approaches and productive knowledge-construction. More specifically, the study compared shared knowledge construction within different scripted 3D-learning conditions (with and without real-time teacher orchestration). This approach is derived from the methodological development of our earlier studies (e.g. Hamalainen, 2010). After the experiment, all video data were transcribed (four groups with a total of 6016 utterances), and discussion entries were read through several times. Then, all the data were verified: videos were watched, observations were rechecked and transcribed utterances were re-examined (at this stage, 5386 of 6016 utterances were categorised to include activities of shared knowledge-construction). To evaluate whether groups engaged in high-level knowledge construction and how different collaboration settings differed, two types of content analysis were conducted (unit of analysis=utterance). The analysis used quantitative and qualitative content analyses to focus on the group knowledge-construction processes (Berelson, 1952). 5386 utterances were categorized into six main categories ("providing information", "contextual questions", "shared problem solving", "management of interaction", "summing up/discovering solution" and "other inputs"). Then, to find qualitative differences within the knowledge-construction processes, the utterances were sorted further into 26 different data-driven subcategories (for more details, see Hamalainen, 2010). Regarding the quantitative content analysis, the aim was to describe whether shared knowledge construction in two different research settings would be dissimilar, while the aim of the qualitative content analysis was to develop understanding how real-time teachers' activities enhance high-level knowledge construction.

RESULTS

Between the groups studying with (2405 utterances) and those studying without (2981 utterances) a real-time teacher's orchestration, the findings indicated two main differences in knowledge-construction activities in the categories "providing information" and "other inputs". More specifically, in providing information, both groups brought in new knowledge, gave technical and contextual advices to group members and stated their opinions. However, groups with teacher orchestration used 18 percent of their utterances for explaining their own situation, while groups without teacher orchestration only used 5.9 percent of their utterances for this. The other difference concerned the amount of other inputs; especially off-task talks. Groups without teacher orchestration used 36.1 percent (1077 utterances, of which 452 off task) of their utterances for other inputs, while groups with teacher orchestration used 13 percent (315 utterances, of which 35 off task) of their utterances for this. Thus, scripted 3D space itself gave guidance and help in task solving. However, a teacher's professional competencies were helpful, especially for reducing off task discussions in 3D space and for understanding the interprofessional nature of the task.

CONCLUSIONS

The precondition for orchestrating collaboration is the understanding of collaboration processes and the reasons for the differences in the knowledge-construction processes. This study indicated that groups studying with real-time teacher orchestration used more effort for providing information (especially explaining one's own situation) and less effort for other inputs (especially off-task talk). This suggests the potential of real-time teacher orchestration as explaining one's own situation is highly related to interprofessional work and practicing that is one way to respond to the changing needs of the future of people's work lives. Thus, the findings are in line with the notion that real-time teacher orchestration is suited to collaborative learning (Dillenbourg et al., 2009). However, future research needs to

focus further on how to support collaborative learning with both technology and human guidance, as no technology alone can replace the teacher in supporting creative collaboration processes.

Berelson, B., (1952). Content analysis in communication research. Glencoe, IL: Free Press.

Billett, S., (2008). The workplace as learning environment: Introduction. *International Journal of Educational Research*, 47 (4), 209-212.

Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2(2), 141-178.

Dillenbourg P., Jarvela S. & Fisher F. (2009). The evolution of research on computer-supported collaborative learning: From design to orchestration. In *Technology Enhanced Learning: Principles and Products*, (pp. 3-19). Springer, Netherlands.

Hamalainen, R. (2010, accepted for publication). Using a game environment to foster collaborative learning: a design-based study. *Technology, Pedagogy and Education*.

SYMPOSIUM

Beliefs About Being a Teacher: Motives for Teaching and What It Means To Be a Teacher

Chairperson: Stuart Karabenick, University of Michigan, United States

Organiser: Stuart Karabenick, University of Michigan, United States

Fani Lauermann, University of Michigan, United States

Discussant: Julianne Turner, U. of Notre Dame, United States

This symposium explores several aspects and implications of beliefs about being a teacher. First, Author1 and Author2 (Paper 1) examine teachers' motives to choose teaching as a career across two educational contexts—Australia and the USA—and demonstrate that these motives have important implications for teachers' perceptions about the profession, including job satisfaction, leadership aspirations and planned persistence. Second, Author3 and Author4 (Paper 2) utilize Author1 and Author2's theoretical framework to examine the relations between teachers' motives to enter the profession and a different set of beliefs about the profession, namely teachers' sense of professional responsibility and implications for their approaches to instruction. This study also compares two educational contexts: Germany and the USA. Finally, Author5 and Author6 (Paper 3) present a mixed-methods study that complements the previous two studies by exploring students' perspectives on what teachers should be like, as well as what teachers should be responsible for. The researchers adapt Author3 and Author4's theoretical framework to examine potential discrepancies between students' and teachers' beliefs about teacher responsibility. In sum, the presenters employ a diverse set of samples (Australia, USA, and Germany), conceptual frameworks and analytical approaches to examine convergent facets of teachers' and students' perceptions of what it means to be a teacher. These include motives to become a teacher (Papers 1 & 2) and perceptions about the profession (Papers 1, 2 & 3) from the perspective of teachers (Papers 1 & 2) and students (Paper 3).

Teachers' Profiles of Professional Engagement and Career Development in Australia and the U.S.

Helen Watt, Monash University, Australia; Paul W. Richardson, Monash University, Australia

Previous studies of graduate-entry primary/elementary and secondary teacher education candidates in Australia (N = 510) identified three beginning teacher types, based on their profiles of planned persistence, effort, professional development, and leadership aspirations (measured by the PECDA scale, Author1 & Author2, 2008): highly engaged persisters, highly engaged switchers, and lower engaged desisters. These types differed in their initial motivations for having chosen teaching as a career, perceptions about the profession, career intentions, and demographic characteristics. The present study tested whether these teacher types would be detected in other cultures by conducting a parallel investigation with a new sample of preservice elementary and secondary teacher candidates from two midwestern universities in the U.S. (N = 246). Three distinct clusters were identified: highly engaged persisters and lower engaged desisters resembled two of the clusters identified in Australia. However, in contrast to the highly engaged switchers in Australia, a new third cluster emerged in the U.S.: classroom engaged careerists. We will describe the motivational profiles, perceptions about the profession, career intentions, and demographic characteristics of the three teacher types and advance an explanation for the presence of classroom engaged careerists in the U.S.

AIMS

We aimed to explore a typology of beginning U.S. teachers, in light of the 3 beginning teacher types previously identified in the Australian context, based on profiles of professional engagement and career development aspirations, measured by the PECDA scale (Author1 & Author2, 2008). Next, we compared motivations, perceptions, career intentions and demographic characteristics for the derived teacher types, to contrast with our earlier

Australian findings. Our previous study with Australian preservice teachers (N = 510) adopted a multidimensional and person-centered approach to identify different types of beginning teachers at the outset of their careers (Author1 & Author2, 2008). The 3 types had high, lower, and mixed engagement profiles, which also differed on initial motivations for choosing teaching, perceptions of the career, career intentions, and demographic characteristics.

METHODOLOGY

U.S. data were collected from elementary and secondary preservice teachers (N = 246), at two universities in midwestern United States, using the previously validated PECDA scale (Author1 & Author2, 2008) to develop teacher type profiles; as well, the FIT-Choice scale (Author2 & Author1, 2006; Author1 & Author2, 2007) measured teaching motivations and perceptions. As previously, hierarchical cluster analysis (Ward's method) investigated the different types of preservice teachers. The decision regarding the final number of clusters was based on the cluster dendrogram, "steps" in the scree-type plot of fusion coefficients relative to number of clusters, and on substantive interpretability.

MANOVA tested for significant effects of cluster membership on PECDA and FIT-Choice variables. ANOVA compared career intentions to not teach at all, in the short term, or whole career. Repeated-measures ANOVA tested changes in satisfaction with teaching as a career choice through teacher education studies. Chi-square compared beginning teacher types on background demographic characteristics measured as categorical variables (i.e., gender, ethnicity, elementary vs. secondary enrolment, having children or not and whether teaching was their first career choice), and one-way ANOVAs tested for cluster differences on the other background factors of age, socioeconomic background, level of prior qualifications, how many years ago they had decided to teach, having previously pursued or seriously considered another career to teaching (0 = not, 1 = seriously considered, 2 = pursued), and, levels of satisfaction with previously pursued and seriously considered careers.

FINDINGS

Teacher types. Three clusters of beginning teachers were empirically and theoretically supported: "highly engaged persisters" (n = 119) had high responses for all 4 clustering variables (planned effort, professional development, persistence, and leadership aspirations), and statistically significantly highest scores on leadership. This resembled that identified in the earlier Australian sample; 78.2% wanted to teach for their whole career, and 21.8% to teach in the short term.

"Lower engaged desisters" (n = 78) also resembled one of the Australian clusters. They reported significantly lower scores on all 4 subscales than the "highly engaged persisters"; and, significantly lower scores than the following third cluster, on planned effort, persistence and professional development. Although their mean scores on planned effort and professional development were quite high relative to the 7-point scale, they were lower than the other clusters. Planned persistence and leadership aspirations were low relative to both the scale and other clusters. 59% planned to teach their whole career, 37% only in the short term. Only 1.2% (3 participants) planned not to teach at all, and these belonged to the "lower engaged desisters".

The final cluster (n = 49) did not resemble any type we had identified previously. They gave similarly high ratings to the "highly engaged persisters" for planned effort, persistence and professional development, but, significantly lowest scores for leadership aspirations. We named this group the "classroom engaged careerists". The overwhelming majority (95.9%) planned to teach for their whole career, 4.1% only in the short term.

Cluster differences. As predicted from our previous study, "highly engaged persisters" retained high stable satisfaction with teaching as a career choice stable through their preservice teacher education programs; "highly engaged desisters" started out and remained lowest; the newly identified "classroom engaged careerists" increased in their satisfaction. "Classroom engaged careerists" and the "highly engaged persisters" scored significantly higher than their "lower engaged" counterparts on a range of measured FIT-Choice motivations: they were more motivated to teach on the basis of their perceived teaching abilities, intrinsic values, to work with youth, shape the future of youth, and enhance social equity. There were no significant cluster differences on any of the personal utility value motivations (job security, time for family, job transferability), or the negative "fallback career" motivation. For perceptions of teaching, "highly engaged persisters" perceived the expert status of a teaching career higher than "lower engaged desisters"; "classroom engaged careerists" reported significantly least social dissuasion. The 3 clusters held similar perceptions about teaching difficulty, salary, and social status.

The only demographic characteristic on which clusters differed, was higher levels of prior qualification among "highly engaged persisters". There were no significant differences according to age, gender, language spoken at home, parental income background, whether participants had children or not, whether teaching was their first career choice, the number of years prior they had decided to teach, or, whether they had considered or pursued a different career

prior to enrolling in teacher education. Of the 45 individuals who had pursued a career other than teaching (“highly engaged persisters” $n=21$, “highly engaged desisters” $n=14$, “classroom engaged careerists” $n=10$), there were no significant cluster differences in satisfaction with these previously held careers.

CONCLUSIONS

Teacher education and employing authorities need to take seriously these different types of beginning teachers having different profiles of professional engagement and different kinds of motivations for teaching, which likely will lead to different pathways of professional development. Highly engaged persisters and desisters appear robust clusters across the culturally similar two contexts. Australian “highly engaged switchers” and U.S. “classroom engaged careerists” were in some ways a reversal of each other; the former had high leadership aspirations and low planned persistence, the latter had low leadership aspirations and high planned persistence. Explanations are advanced for this difference in terms of cultural differences in teaching career structures in the two settings.

Beliefs about Teaching: Motives for Teaching, Sense of Responsibility and Approaches to Instruction

Fani Lauermann, University of Michigan, United States; Stuart Karabenick, University of Michigan, United States

In the context of strong political emphasis on teachers’ formal obligations and accountability for educational outcomes such as student performance on standardized tests, there has been increasing interest among educational researchers in teachers’ beliefs about their professional roles and sense of professional responsibility. The majority of research, however, has focused on teachers’ formal accountability and its consequences for student performance, but not on teachers’ willingness to accept personal responsibility. The present study explored relations between teachers’ motives to enter the profession, their beliefs about their professional responsibilities, and beliefs about mastery- and performance-oriented instruction. The results indicate that only social motives but not intrinsic or extrinsic motives for becoming a teacher predict teachers’ sense of responsibility for important educational outcomes such as student motivation, student achievement, and relationships with students. Furthermore, structural modeling provided evidence for consistency between responsibility and teachers’ approaches to instruction. Discussion focuses on the potential of responsibility as a critical mediating factor in instructional practices and student outcomes.

AIMS

Teachers’ beliefs about their professional roles have been a major focus in educational research due to the critical importance of such beliefs for teachers’ classroom behaviors, decision making and instructional practices (Berg, 2002; Pajares, 1992; Porter & Freeman, 1986). Furthermore, in the context of strong political emphasis on teachers’ formal obligations and accountability for educational outcomes such as student performance on standardized tests, there has been increasing interest among educational researchers in teachers’ beliefs about their professional roles and sense of professional responsibility (Author3 & Author4, 2009; Linn, 2006; Schalock, 1998). The majority of research, however, has focused on teachers’ formal accountability and its consequences for student performance, whereas teachers’ internal sense of responsibility, the conditions under which teachers are willing to accept personal responsibility, and the things for which teachers feel responsible remain an understudied area of research (Author3 & Author4, 2009, 2010).

We define personal responsibility as a sense of internal obligation and commitment to produce or prevent designated outcomes or that these outcomes should have been produced or prevented (Author3 & Author4, 2009; Author3 & Author4 & Author5, 2010). In previous research, we examined four domains of teacher responsibility—for student motivation, student achievement, relationships with students, and teaching—and demonstrated that our measure is empirically distinguishable from teachers’ sense of efficacy for the same educational outcomes (Author3, Author4, & Author5, 2010). That is, “I can” does not necessarily imply “I feel responsible.” Here, we explore factors that are likely to shape teachers’ sense of responsibility, as well as implications for approaches to instruction. Specifically, the present study examined the relations between: motives to become a teacher (Author1 & Author2, 2007, 2008), teachers’ sense of professional responsibility (Author3 & Author4, 2009), and teachers’ beliefs about mastery and performance approaches to instruction (Midgley, 2002; Roeser, Marachi, & Gehlbach, 2002). We propose that the reasons why individuals decide to enter the teaching profession may shape their sense of professional responsibility, which in turn is likely to predict different approaches to instruction; i.e. teachers would endorse instructional approaches that they believe would help them to fulfill their professional responsibilities.

METHODOLOGY

The research questions are examined in two samples: (a) an online study with 316 German pre-service teachers and (b) in an ongoing replication study with approximately 1000 American pre-service and in-service teachers. The data collection for the American sample will be completed at the end of November, 2010. The following scales are included: intrinsic ($\alpha = .81$), social ($\alpha = .71$), and extrinsic ($\alpha = .86$) motives for teaching (FIT-Choice, Author1 & Author2,

2007); mastery ($\beta = .70$) and performance ($\beta = .71$) approaches to instruction (Midgley, et al., 2000); and a four-factor scale of teacher responsibility for negative educational outcomes, including responsibility for student motivation ($\beta = .84$), student achievement ($\beta = .86$), relationships with students ($\beta = .77$), and teaching ($\beta = .79$). Scales that were not available in both languages, German and English, were translated and back-translated to assure comparability. Sample items are shown in Table 1.

FINDINGS

All analyses were performed with Mplus. Analysis of the German sample indicated that participants preparing to teach in the lowest academic track schools were significantly more likely to report extrinsic motives for teaching and higher personal responsibility for teaching (but not for student outcomes); therefore, academic track was included as a control variable. The model fit was very good (see Figure 1; S-B-Chi-square(396)= 516.467, CFI = .96, TLI = .95, RMSEA = .03 (90% CI .02, .04), SRMR = .05). The four responsibility factors accounted for 21% of the variance in mastery and 6% in performance approach to instruction. Responsibility for student motivation predicted performance approach and responsibility for student achievement and relationships with students predicted mastery approach. Social motives, but not intrinsic or extrinsic motives, predicted teacher responsibility for student outcomes. Alternative models were also tested. The replication study with American teachers will allow us to test the generalizability of these findings across educational contexts.

CONCLUSIONS

The analyses indicate that teachers' motivations for teaching are related to their sense of professional responsibility. Furthermore, after accounting for social motives and academic track, neither intrinsic, nor extrinsic motives predicted responsibility for student outcomes. These findings suggest that extrinsic incentives may have little impact on teachers' willingness to accept personal responsibility, particularly if students' outcomes are negative. In addition, the present findings indicate that teachers' sense of professional responsibility predicts their mastery and performance approaches to instruction. Although prior research suggests that performance-oriented instruction can be detrimental to student motivation and achievement, particularly for low-achieving students (Midgley, 2002; Roeser, et al., 2002), sense of responsibility for student motivation may be one of the reasons why teachers endorse such practices. Thus, good intentions may lead to negative outcomes. Understanding the motivational underpinnings of mastery and performance approaches to instruction is therefore critical.

Teacher Responsibility – What Do Students Think?

Kerstin Helker, RWTH Aachen University, Germany; Marold Wosnitza, RWTHUniversity Aachen, Germany

The present study expands upon prior research on teachers' beliefs about their professional roles and sense of professional responsibility by exploring students' beliefs about different dimensions of teacher responsibility. In a first quantitative study, 205 German high-school students rated four dimensions of teacher responsibility identified in prior research – responsibility for student achievement, student motivation, teaching and relationships with students. In contrast to prior findings with teachers, students did not distinguish between teacher responsibility for teaching and teacher responsibility for having close and trusting relationships with students. A second qualitative study with 196 high-school students was conducted to learn more about students' perceptions of teacher responsibility. Although many of the dimensions identified in earlier research were confirmed in the student sample, new categories of teacher responsibility were also identified, which explained the findings of the first study. These findings indicate that teachers' and students' beliefs about teacher responsibility may not always overlap.

AIMS

Previous research with teachers has focused on four dimensions of teacher responsibility: teachers' sense of personal responsibility for student motivation, student achievement, relationships with students and teaching (Author3 & Author4, 2009; Author3 & Author4 & Author5, 2010). A qualitative study revealed that teachers view teacher responsibility as an overarching concept with ties to intrinsic motivation, locus of control, organizational citizenship, and other constructs closely related to student learning and achievement (Author3 & Author4, 2009). It is unknown, however, whether students share such beliefs about teacher responsibility and whether the responsibility students ascribe to their teachers reflects the same four dimensions identified with teachers.

This paper examines secondary school students' perceptions of teacher responsibility. The main focus is on the domains of teacher responsibility students identify and whether these diverge from previous research studying teacher responsibility from the teachers' perspective. Two consecutive studies were conducted: results of the first (quantitative) study yielded a different pattern of responsibility from that of teachers, whereas the second (qualitative) study provided information that explained results from the first study.

METHODOLOGY

Participants in the first study were 205 secondary school students from different schools in Germany. Participants completed an online questionnaire that included a modified version of a responsibility scale used in prior research on teacher responsibility; the scale was modified with regard to the students' perspective and language. Twelve items represented the previously identified dimensions of teacher responsibility: student achievement, student motivation and teaching and teachers' relationships with students. Students rated these teacher responsibility items on an eleven-point Likert scale (0 = "not at all responsible" to 100 = "completely responsible", in 10-point increments). A sample item is "The teacher would be responsible if I did not like his/her subject.). Data were analysed using factor and reliability analysis, ANOVAs and t-tests.

In the second, qualitative study, 196 students from secondary schools in different locations in Germany completed an online questionnaire that included three open-ended questions asking about domains of teacher responsibility. Students were asked to state their understanding of teacher responsibility and to describe the characteristics of responsible and irresponsible teacher behaviors. Furthermore, students were asked to name the five most important domains of teacher responsibility and to explain why they consider these domains important.

A combination of deductive and inductive approaches was used to analyze the qualitative data with the aim to identify central dimensions of teacher responsibility. In order to maintain high consistency with previous research (Author3 & Author4, 2009), categories identified in those data were used for the students' data as well. Whenever categories could not be identified in the students' data, they were dismissed. Whenever data could not be clearly assigned to a specific category, a new category was created.

FINDINGS

Results of study one show that secondary school students endorse diverging perspectives on teacher responsibility. The postulated four-dimensional structure identified in prior research with teachers could be only partially replicated with the student data. Factor analysis indicated a three-dimensional structure: achievement, motivation and a combined dimension of responsibility for teaching and for relationships with students. Using these three dimensions the study furthermore showed that students hold teachers responsible primarily for teaching and relationships ($M = 69.0$, $SD = 17.8$) followed by achievement ($M = 34.8$, $SD = 17.8$) and motivation ($M = 21.8$, $SD = 20.2$). There were no significant effects of gender, age and grade level.

Results of the qualitative study indicate that in agreement with the quantitative data, students highlight domains of teacher responsibility that are closely connected with their own perspective on the teachers' professional roles. A range of dimensions of teacher responsibility identified in prior research with teachers were confirmed: responsibility for teaching-related activities, student outcomes (e.g., student achievement and motivation), interactions with students, creating a positive classroom atmosphere, communication/interactions with others, school policies and external regulations, school activities (duties and voluntary work) (Author3 & Author4, 2009). In addition, teacher responsibility for interactions between students emerged as a salient theme. Students considered this aspect to be most important, as cooperation and a sense of community in the class are perceived to be crucial factors for a supportive learning environment. According to students, in other words, teachers are responsible to care for friendly interactions between students as part of their responsibility for teaching.

These findings explain the results of the quantitative study as students assigned certain responsibilities to a teacher they perceive to be crucial for fulfilling other responsibilities such as the responsibility for teaching. Good teaching is perceived to be impossible when the relationships with students are not well-established and cared for, which is again seen as attributed to certain characteristics of a teacher's personality.

CONCLUSIONS

Secondary school students' views of teacher responsibility differ from teachers' perceptions of what they are responsible for. The results of the first study support the need for further research, as teacher responsibility appears to be highly dependent on the adopted perspective and cannot be left to personal interpretations of teachers' tasks and liabilities. For students to receive the best education possible, teachers have to be aware of their responsibilities; especially those assigned to them by their students. The chain of causation the students stated in the qualitative study seems particularly important as it has major implications for questions such as who should choose a teaching profession or how teachers' tasks can be defined in a comprehensive and coherent way.

SYMPOSIUM

Scaffolding in dyadic teacher-student interactions: Analyses of learning support in math education

Chairperson: Christine Pauli, University of Zurich, Switzerland
Organiser: Christine Pauli, University of Zurich, Switzerland
Discussant: Pekka Salonen, University of Turku, Finland

Current concepts of learning and teaching on a constructivist and sociocultural basis emphasise both the importance of learners dealing with the learning contents independently and actively, and the social embedding of learning processes. Due to the growing heterogeneity of school classes as a consequence of migration and integrative school models, the important role of individual learning support in instruction in particular is increasingly recognised. Thus, the concept of scaffolding, originally introduced by Wood, Bruner and Ross (1976) as a support that is optimally attuned to a student's current ability and needs, has attracted much attention in educational research in the last years. However, the literature contains numerous and varying conceptualisations of scaffolding, and besides the consensus that it is an effective form of learning support, many questions remain open regarding definition, delimitation and mode of action, and particularly measurement of scaffolding, even though several important core elements like contingency, fading and transfer of responsibility (van de Pol et al., 2010) have been worked out. The symposium incorporates three presentations, all addressing processes of scaffolding in the context of mathematics instruction. Besides the joint focus on scaffolding in one-to-one teacher-student interactions, the research projects differ regarding the aspects focused upon and the methodological procedure of video-based analysis of scaffolding. The symposium should enable a discussion regarding (1) what distinguishes successful processes of scaffolding in teacher-student interactions in mathematics instruction and (2) how different analytical and theoretical approaches can contribute to the measurement and conceptualisation of core processes of scaffolding.

Scaffolding and teachers' use of questions. A conversation analysis of questions in explanations

Ed Elbers, Utrecht University, Netherlands; Tom Koole, Utrecht University, Netherlands

We use conversation analysis to study the process of scaffolding in dyadic teacher-pupil interactions in the classroom. The concept of scaffolding has been diluted by researchers who use the term 'scaffolding' for any assistance teachers offer, without taking into account that scaffolding requires responsive instruction, adapted to the level the student is demonstrating. Conversation analysis allows us to show in detail how teacher and pupil regulate their interaction and how the utterances of the interlocutors are responsive or fail to be responsive to each other's previous contributions. Building upon recent conversation-analytic studies of question-answer sequences, we look, in particular, at the way the teacher uses questions as scaffolding tools. The analysis is based on a corpus of 52 dyadic teacher-pupil interactions (with 12-to-13-year-old pupils) in two classes during mathematics lessons. We analysed how the teacher made use of the preference organization of question-answer sequences. We found three contexts in which the teacher used questions as scaffolding tools. (1) The teacher asked a known answer question as part of the IRF cycle (but this occurred little). (2) The teacher asked a series of easy questions to lead a pupil to the solution of the assignment. (3) The teacher checked the student's understanding with questions that interactionally prefer confirmations. We looked at the extent to which the teacher's questions were responsive to the pupil's expressed difficulties with the assignments.

Aims

We use conversation analysis to study the process of scaffolding in the interaction between teacher and pupils in the classroom. We consider scaffolding as an interactional process between a teacher and one or more pupils. Teachers' scaffolding consists of responsive actions that take account of the competences and knowledge the pupil is demonstrating. Hitherto, most studies of scaffolding in the classroom are concerned with whole class teaching. These studies often concentrate exclusively on teacher actions and do not take account of the interactional context of the teacher's support. In this presentation we will neither look at teacher behavior as a separate process, nor will we focus on whether the pupil succeeds in profiting from the teacher's assistance. Conversation analysis gives us tools to concentrate on the interaction and see what information the interlocutors make available to each other and how they use this information in shaping the interaction. We (1) study dyadic interactions, that is teacher's dialogues with one pupil at a time, in the context of classroom processes. We (2) analyse teacher actions in the context of the conversation and establish whether the teacher actions are responsive to previous contributions by the pupil. We (3) look at the way the teacher uses questions as scaffolding tools, building upon recent conversation analytic studies of question-answer relations, both in educational contexts (Koshik, 2002; Author, 2010) and elsewhere (Raymond, 2002; Schegloff, 2007).

Methodology

The analysis is based on a corpus of video and audio recordings and transcripts of interactions. The recordings were made during mathematics lessons in two first year classes in two secondary schools in the Netherlands with pupils of 12 and 13 years of age. In the two classes a regular mathematics lesson consisted of two broad teaching/learning

arrangements: a part with whole class instruction and a part in which pupils worked more or less individually on their tasks and assignments. During these phases of individual work there was no whole class teaching, but the teacher gave individual pupils the opportunity to ask questions, or asked them to show him their work. This is a pattern which involves private interactions between one pupil and the teacher: the teacher offers help and support, the pupil asks for feedback and clarification.

We selected all dialogic situations between teacher and one pupil at a time which were concerned with mathematical content and which encompassed more than three turns. This resulted in a corpus of 52 dyadic interactions in the two classes. We analysed the conversations and studied in detail how teachers used questions in their reaction to pupil's difficulties and requests for support. We related the questions to the pupil's previous utterances and looked at how the pupil answered the questions. We analysed in detail how the teacher made use of the preference organization of question-answer sequences. Moreover, we looked at the extent to which the teacher questions were responsive to the pupil's expressed difficulties with the assignments.

Findings

We found three contexts in which the teacher used questions as scaffolding tools. In the first context a question was part of the IRF cycle, in which the teacher asked a known answer question in order to check the pupil's knowledge or understanding. Despite the attention given to known answer questions in educational research (e.g., Cazden, 2001), we found only a few instances of this type of question use. This has to do with the fact that the teachers, in interactions with their pupils, made little, if any, attempt to find out what the pupil's problem was and mostly started explaining without giving the pupil the possibility to specify her problem and to clarify why she needed help (Authors, 2010). The second type involved situations in which the teacher exploited the interactional mechanisms of 'preference organization' by asking questions with 'easy' answers. Here, the teacher used questions to lead pupils to the correct answer, such as the solution of the assignment. These questions should be seen interactionally as producing the pupil's knowledge (often in a series of questions that the pupil can answer easily and lead her to the correct answer) rather than as checking their knowledge. Interestingly, despite the correct answer by the pupil, the teacher did not consider this sufficient proof of the pupil's knowledge, because the teacher followed by further explanation. Therefore, we consider this type of questions as interactionally responsive to the pupil's responses. The third context occurred when the teacher checked the student's understanding with questions that interactionally prefer confirmations. These checks were made at the closure of a monological explanation when the teacher asked whether the pupil had understood the explanation. In almost all instances, the pupils provided the preferred answer and answered that they understood the teacher's explanation. Often, the teachers treated this claim of understanding as sufficient evidence and closed the conversation without asking the pupil to further demonstrate her understanding. This can be seen as interactionally non-responsive since these teachers treated the answer as evidence of the pupil's understanding rather than as a response that was projected by the teacher's question.

Scientific and educational significance

Since the introduction of 'scaffolding' by Wood, Bruner and Ross (1976), the concept has gained popularity in studies of learning and teaching. The concept allows showing how teachers can promote learning by adapting their instruction to the comprehension the pupil is exhibiting. However, the concept has been diluted by researchers who use the term 'scaffolding' for any assistance teachers offer, without taking into account that scaffolding requires responsive instruction, adapted to the level the student is demonstrating. By using conversation analysis we can show how teacher and pupil regulate the interaction and how the utterances of the interlocutors are responsive or fail to be responsive to each other's previous contributions. Since scaffolding has become a standard subject in teacher training and in textbooks for teacher education, we think that the conceptual and empirical clarification that our analysis makes possible will contribute to the understanding of scaffolding and teacher support.

Scaffolding dynamics during instruction and its role in problematic learning trajectories

Henderien Steenbeek, Rijksuniversiteit Groningen, Netherlands; Louise Jansen, Rijksuniversiteit Groningen, Netherlands; Paul van Geert, University of Groningen, Netherlands

Currently, most researchers agree that learning is a socially situated, transactional process, in which both the teacher and the learner make their own unique contribution. But how does one get insight into such a complex process, and what are its central properties? The aim of this study is to examine problematic learning trajectories of children with psychiatric and behavioral problems, by focusing on individual scaffolding sessions during math education. Longitudinal data of four primary school students from a group in a special school for children with emotional behavioral disorders were collected, by making videotapes of math lessons in two-weekly intervals over a two-year period. Interaction variables were the teacher-student 'response matches', and the teacher's 'feedback responses'. First empirical results point to few verbal actions initiated by the students in interaction with the teacher.

With regard to the scaffolding dynamics, intra-individual and inter-individual variability occurs over all lessons in all students. Furthermore, students receive far more positive than negative feedback and, most of the times, feedback isn't followed by any form of instruction. In the presentation, we will go into the surplus value of using a case study approach, i.e., in examining 'response matches' per individual student-teacher dyad, and how they are linked to long term developmental trajectories of students' learning processes.

The literature indicates that students with psychiatric and behavioral problems show extremely poor outcomes with regard to both academic and behavioral performance, and that the educational needs of these students continue to be unmet (see Hayling, Cook, Gresham, State, & Kern, 2008). The aim of this study is to examine problematic learning trajectories of children with psychiatric and behavioral problems, by focusing on individual instruction sessions in math education in which scaffolding occurs. What happens in these scaffolding sessions and, by focusing on short-term processes, can we get insight into long-term development of problematic learning trajectories? When studying learning-in-interaction as a dynamic, complex process, it is fundamental to capture it by means of a variable that reflects the important characteristics of the dynamics of that process (Broer & Takens, 2009). Instead of examining the roles of the interaction partners separately, it is important to take the 'iterative action-reaction responses' of both partners together as defining variable. A means to do so is by focusing on scaffolding, which is an important tool for the teacher to promote learning in the student. In our view, scaffolding is an intrinsically dynamic notion (Authors, 2005), in that it describes how a particular level of knowledge or skill in a student changes as a result of the scaffolding process. In addition, we hypothesize that the level of the pupil will determine the level of the scaffold (which should be ahead of the first), while the level of the scaffold will determine the level of the student (Authors, 2006). Given this definition of scaffolding as a mechanism of coupled teaching-learning processes, optimal scaffolding implies optimal learning and optimal teaching at the same time.

A significant part of the scaffolding process is giving the right type of feedback at the right moment. Teacher-student feedback can be either (positive or negative) task related or (positive or negative) personal. The literature indicates that negative task related feedback accompanied by additional information about the task and how to do it more effectively, is most effective for learning (Solomon & Rosenberg, 1964; Hattie & Timperley 2007; Gable, Hester, Rock, & Hughes, 2009). An important question now is: What are the empirical indicators of optimal versus suboptimal scaffolding sessions? We assume that those empirical indicators are reflected in the scaffolding dynamics as present in the unfolding interaction between student and teacher in real time, during e.g. arithmetic scaffolding sessions. But how do those (sub)optimal levels of scaffolding show themselves? First, we hypothesize that those levels are expressed and can be observed in the level of 'response-match-in-interaction', i.e., in a variable that represents the match between an initiation of the student (or teacher), followed by a response of the teacher (or student). Second, we hypothesize that problematic learning trajectories are accompanied by inadequate teacher feedback.

In the present study we will show how we worked on exploring the scaffolding dynamics in interaction between student and teacher, by studying the variables 'response match' and 'feedback of the teacher', in using short-term variability patterns of distinct dyads as important sources of information. Longitudinal data of four primary school students (all boys, mean age 9.7 years, lower limit 9.2 years, upper limit 10.3 years) from a group in a special school for children with emotional behavioral disorders were collected, by making videotapes of math lessons in two-weekly intervals over a two-year period. The participants were selected by the teacher as being representative of the diversity of the group population. All students were still in the starting phase of learning mathematics.

In order to be able to code the variable 'response match', we coded the verbal utterances first. Main categories that were distinguished were: teacher's 'order remarks', 'procedural remarks', 'instructions', 'feedback', and student's 'questions', 'answers', and 'remarks' (see coding system, [Authors, 2008]). The variable 'response matches' is a second-order variable, which is based on all the initial categories as described above. A response match can be defined as an antecedent initiative utterance of a participant (the student or teacher), followed by a consequent utterance of the other participant (the teacher or student) that provides a match to the antecedent and that is – in principle – beneficial for learning to occur. To get insight into the types of feedback that were given during the individual scaffolding sessions, we filtered all the feedback codes out of the transcripts. We made a distinction between task related feedback and personal feedback, and feedback that is positive neutral, or negative. Empirical results point to few verbal actions from the students in interaction with the teacher. With regard to the scaffolding dynamics, intra-individual and inter-individual variability occurs over all lessons in all students. By examining 'response matches' per individual student-teacher dyad, other things come to the fore than would be the case if we would average our findings, which lead us to perform case-study analyses of all four students individually. A striking observation in one of the students' data, is that his 'response matches' occur more frequently in the first phase of the learning trajectory than in the second (p In the presentation, we will go into the surplus value of using a case study approach, i.e., in examining 'response matches' per individual student-teacher dyad, and the link with long term

developmental trajectories of students' learning processes. In addition, we will discuss the applied value of our results, i.e., of working with empirical variables that capture the iterative character of the ongoing dynamics in scaffolding sessions, at the level at which teachers actually act.

Scaffolding in teacher-student dialogues during joint problem-solving activities

Anke Wischgoll, IFE UZH, Germany; Christine Pauli, University of Zurich, Switzerland; Kurt Reusser, University of Zurich, Switzerland

In current approaches of mathematics instruction, individual learning support plays an increasingly important role, owing to the growing importance of independent, demanding problem-solving activities and increasing heterogeneity of students' learning prerequisites. Scaffolding represents an attractive model of productive support. Despite comprehensive research, however, clarification is still required regarding the question of what, precisely, constitutes effective scaffolding in the context of school teaching and learning processes. The current investigation pursues this question using video analyses of 26 tutoring sessions, in which teachers each supported one student in solving an algebraic word problem. Based on students' success in independently solving a transfer task upon completion of the tutoring session, a distinction was made between successful and unsuccessful tutoring sessions. The analyses are based on a qualitatively oriented multi-methods approach. Starting from a task analysis, the analyses of teacher-student interaction and of the problem-solving process focused on the match between teacher support and student behaviour and on the occurrence and tackling of impasses, taking into account the progression of the problem-solving process.

The results indicate the importance of picking up on and tackling all impasses. Compared to unsuccessful tutoring sessions, the successful sessions were distinguished, moreover, by an optimal match between the type of teacher's support and the student's needs, and by fading attuned to the student behaviour and the situation once the impasse was resolved.

Theoretical background and aims

In current approaches, the individual support of students is playing an increasingly important role (not only) in mathematics instruction. On the one hand, on the basis of a social-constructivist and learning theory, increased opportunities for demanding learning activities, such as independent problem-solving, should be created, requiring adaptive support of the students (e.g. Hmelo-Silver, Duncan, & Chinn, 2007). On the other hand, the increasingly heterogeneous composition of school classes necessitates support from the teacher that is optimally attuned to the individual learning prerequisites and learning progress of each student.

Scaffolding (Wood, Bruner, & Ross, 1976), as support which is temporary, adaptive and oriented towards building competence, represents an attractive concept in this regard. Although no uniform definition of scaffolding is available to date, the more recent literature points to three core features of scaffolding: contingency, fading and transfer of responsibility (van de Pol, Volman, & Beishuizen, 2010). Examinations into the relationship between tutoring and learning have, moreover, emphasised the importance of dealing with impasses for learning success (VanLehn et al., 2003). Despite the broad consensus that scaffolding represents an effective form of learning support, there continues to be a need for empirical investigations showing what, precisely, distinguishes productive scaffolding processes in the context of school learning. The current study makes a contribution in this regard.

The goal of the study was to examine scaffolding processes when solving a task that would typically arise in mathematics instruction. To this aim, for each of 26 teachers, a tutoring session outside of the classroom was recorded and analysed, in order (among other things) to answer the following questions: Do successful tutorial dialogues differ from unsuccessful tutorial dialogues (1) with regard to the occurrence and treatment of impasses, and (2) with regard to the responsiveness of the support?

Method

The data base consists of 26 video-taped tutoring dialogues of 26 different teachers from Germany and Switzerland, each with one student (8th/9th school year), which had been obtained in the framework of an earlier video study (Authors, 2009). The task worked on (algebraic word problem) was set by the research team so that all students solved the same task. Following the tutorial session, the students independently solved a similar task. Based on the success of the solution in this transfer task, the tutorial dialogues were divided into "successful" (n=11) and "unsuccessful" (n=15). The analysis was based on a qualitatively oriented multiple methods approach and comprised 4 steps: (1) Based on a task analysis, the problem solving process was segmented with regard to the key steps. (2) Teacher-student interaction: A rating instrument was developed, which assessed, for each segment, (a) the degree of supportive behaviour of the tutor (e.g. "no support" to "complete explanation") and (b) the extent of the student's

contribution. Moreover, the match between (a) and (b) was taken into consideration. (3) Impasses (including errors): Four types of impasses (e.g. misinterpretation of the text, false numerical linking) were identified. Moreover, based on the work of VanLehn et al. (2003), the extent of the impasse with regard to the problem-solving process was determined. The importance of impasses for the problem-solving process was evaluated as a whole. (4) Analyses (1) to (3) formed the starting point for creating progression graphs and narrative descriptions of different types of joint problem-solving based on a type-building procedure.

Results

Results show that impasses related to a misinterpretation of the problem text were the most frequent type of impasse in this analysis. Further results show that in successful tutoring sessions (e.g. for students who subsequently solved the transfer task successfully), all impasses had been resolved. This was not the case for the unsuccessful sessions. With respect to the teacher-student interaction, our analyses show that in successful tutoring sessions, the tutor's support and the student's needs were matching in nearly all segments. In contrast, non-successful tutoring sessions included more segments in which the tutor's support and the student's needs were not matching. When the whole course of the problem-solving process is taken into account, with regard to the scaffolding activities of the tutor, it is apparent that a controlled fading (e.g. fading that is finely tuned to the student's current level of understanding) after impasses was more frequently observed during the successful tutorial sessions than in unsuccessful sessions. In unsuccessful tutorial situations, support and positive reinforcement of the student once the impasse had been resolved was rarely observed.

Conclusion and significance

Our results underline the role of responsiveness of teacher's support and of the productive handling of impasses when supporting problem-solving activities. Support that is optimally attuned to the progression of students' understanding in the course of problem-solving proved to be particularly important for learning success with regard to resolving impasses. This appears to be consistent with three key characteristics of scaffolding (contingency, fading and transfer of responsibility), which were suggested by van de Pol et al. (2010).

The current investigation contributes to clarifying the question of how scaffolding (particularly contingency and fading) can be effectively afforded. This is also important for teacher education and training, as empirical investigations into individual learning support in instruction show that it is predominantly of only modest quality (Krammer, 2009).

From a methodological perspective, the study contributes to the development of instruments aimed at measuring scaffolding. As mentioned, for instance, by van de Pol et al. (2010), the main challenge is to measure scaffolding. With our analyses, which take into consideration the task, the problem-solving process, the handling of impasses, and teachers' and students' behaviour as well as the match between them, we hope to make a contribution in this regard.

SYMPOSIUM

The relational dimension of collaborative learning

Chairperson: Charles Crook, LSRI, United Kingdom

Organiser: Sanna Jarvela, University of Oulu, Finland

Discussant: Michael Baker, CNRS - Telecom ParisTech, France

The way that students try to solve problems together, and what they learn, depends on the relations between three dimensions of their collective activity: what task they are trying to achieve (the cognitive dimension), how they relate to each other (the socio-relational dimension) and what they feel about that (the affective dimensions). In this symposium we address the role of socio-relational aspects in collaborative learning. Although our primary concern here is with the *hic et nunc* of learning that can occur in interactions between students engaged in cooperative problem-solving, the three studies we present also address a broader vision that relates the study of such microgenesis with the levels of ontogenesis (the social elaboration of knowledge) and of sociogenesis, when the social, institutionalised and artefactually mediated organisation of knowledge elaboration is in focus.

(1) The contribution by Crook addresses the social elaboration of knowledge, seen as the striving for shared experiences, leading to "togetherness". This paper discusses factors that are likely to mediate or disturb togetherness.

(2) Sins and Karlgren combine two studies about the role of tensions and their resolution in professional practices: tensions within medical teams, and tensions between teachers and researchers during reflective meetings.

(3) Damsa and Ludvigsen take collaborative learning as a phenomenon which has to be analytically accounted for. The case study focuses on how students deal with disagreements when co-constructing knowledge, in the context of a collaborative research project.

The mediation of 'togetherness' in learning

Collaborative Learning, Social Aspects of Learning, Social Interaction in Learning and Instruction
Charles Crook, LSRI, United Kingdom

This paper will theorise a collaborative experience of learning in terms of the overarching concept of 'togetherness'. The advantage of this conception is that it makes contact with comparative and developmental observations of the human appetite for shared experience. It also invites us to work with a more generous definition of the 'social' in accounts of collaborative learning. In particular, the framework will be deployed to draw attention to the impact of new forms of educational mediation. That is, how a variety of new designs and technologies disturb communication in established educational arena that furnish togetherness. This will be illustrated with unpublished material relating to conversational, expository and communal contexts of learning. It is argued that technologies for managing formative feedback, and technologies for supporting expository presentation can undermine structures of intersubjectivity. On the other hand new designs for the socialisation of learning spaces can create new forms of intersubjectivity in terms of learners' interest in conditions of social ambience during study.

In recent years, a wide range of intellectual traditions concerned with human action have adopted a "social turn". That is to say, theorists have turned away from perspectives centred upon individual minds and turned towards perspectives that highlight social interaction and social practice. Of course such perspectives had already flourished in certain sectors of scholarship. Yet, even in social psychology and sociology, familiar issues of identity, relationships, and authority have now come to be understood in terms of the detailed dynamic of interacting with others (Schiffrin, 1994). More surprising, the mainstream of cognitive psychology increasingly theorises human thinking 'outside of the box': that is, as human activity distributed over social and cultural resources (Clark, 1997).

That the experience of learning should be 'social' is an idea whose time has truly come. Yet it is an idea that deserves further theorising - if policy, practice and design are now to be so clearly guided by it. In particular, it will be important to establish if celebrating the social in human learning can mean something deeper than simply the routine of responding to 'social stimuli' - a perspective that treats the social very much in the manner of other forms of 'input' to learning. It will be argued here that there is indeed an element of human learning that goes beyond such 'social stimuli' simplification: there is something about the social in the human experience of learning that is distinctive and powerful. Simply put: it arises from our natural motive to achieve shared experiences. The realisation of that motive will be discussed in this paper in terms of the experience of 'togetherness'.

This paper will highlight how such experiences of togetherness can be located within a wide range of educational contexts. It will be suggested that young people enter formal education with natural experience of participating in broad three formats of social communication: these are conversational structures, expository structures, and community structures. Educational practice usefully appropriates our familiarity with these formats. Each of them offers the possibility of learning together but offering different routes towards creating a sense of shared experience.

The discussion will stress how such togetherness is inevitably mediated. That may be through distinctive ways of talking but also through the use of particular communication tools, or engagement with particular ecological designs. Several examples remind us how the quality of togetherness in interpersonal communication might be disturbed by re-mediation. For example: by new tools for managing feedback conversations, new tools for supporting expository talk, and newly designed spaces in which students may gather for study.

The paper will report unpublished examples in the three broad formats for social experience identified above as central to the young learners everyday sociality. First, in relation to togetherness achieved within conversational contexts: here it will be noted how new technologies for managing feedback on student assignments disrupt the sense of shared experience. Second, in relation to togetherness that can be achieved in exposition: here we note how new technologies for the visual and virtual support of lecturing disturb the intersubjectivity that is possible in those contexts. Finally, new designs for learning spaces and how they create new forms of togetherness by catering to the student's appetite for a social ambience in learning.

The examples are taken to stress how, with proper attention to the working of such mediation, it should be possible to create educational experiences that take advantage of a human appetite for shared experience and to avoid those that disrupt it..

References

Clark, A. (1997), *Being There: Putting Brain, Body, and World Together Again*, Cambridge Ma.: MIT Press.
Schiffrin, D. (1994). *Approaches to discourse*. Chicago: University of Chicago Press.

Identifying and overcoming tension in interdisciplinary teamwork in professional development Collaboration, Knowledge Creation, Social Aspects of Learning

Klas Karlgren, Karolinska Institutet, Sweden

Patrick Sins, Leiden University, Netherlands

A central interest in developing professionalism resides in the potential for practitioners to learn from and with one another in ways that support transformations of their knowledge practices. However, negotiation between multiple perspectives, interests, practices and traditions intertwines cognitive-epistemic with socio-relational and affective aspects, which may lead to tension and conflict. While tension can disable learning, we argue that identifying these tensions should be viewed as a significant source for change and development. We will present two cases, which show similar patterns. Tension in medical teams is a threat to patient safety. However, an uncritical attitude does not foster learning, and instructors at simulation training courses may therefore put focus on tensions through questioning. Eventually learners may develop skills in analysis, which cover explanations and strategies and which provide a fruitful approach to the problems. The second case investigated teacher-researcher collaboration at a secondary school, and focuses on the design of a learning module. Identification of tensions during meetings helped participants to focus their efforts on the root causes of problems, which led to a reconceptualisation of the current work practices. This subsequently helped team members to deviate from established norms and improve their practices.

A frequently stated argument in collaborative learning research is, that diversity in collaboration between learners is a significant resource for learning. However, negotiation between multiple perspectives, interests, practices and traditions may lead to tensions and conflicts that can possibly disable learning. Nevertheless, several authors have argued that identifying these tensions should be viewed as a significant source for learning (e.g. Engeström, 1987; Wenger, 1998).

Drawing upon the seminal works of Heidegger (1962), Dewey (1966) and Leont'ev (1981), tensions are viewed as a means for revealing the nature of our understanding and are conceptualized as the antecedents of opportunities for creative efforts in collaboration and are as such the driving forces behind learning. The underlying mechanism that explains how tensions can result in learning is based on the premise that awareness of ignorance motivates learning. This means that, in order to overcome tensions, learners have to reflectively analyze their collaborative activities and question and deviate from established norms and practices. This awareness of shortcomings and subsequent search for solutions to overcome these tensions may lead to creative externalization or new ways of doing. This suggests that tensions are not only an opportunity to improve, they are also of crucial importance to coordinate the process of learning. In sum, tensions help learners to counter the blindness that is inherent to the way things are normally done and they may uncover a space of alternative actions in taken-for-granted activity.

However, what is still lacking in accounts and studies of tensions and conflicts as conditions for learning is a (a) consensus on defining and operationalizing terms and (b) complementary description of how tensions get resolved. With respect to the former, several constructs have been put forward from cognitive, sociological as well as sociocultural epistemologies that more or less point in a similar direction but which have not yet been related to one another. Secondly, although some quantitative and qualitative studies have investigated the relation between particular types of tensions or conflicts on learning outcomes, no cross-referencing could be found regarding the way(s) in which learners overcome tensions and how this relates to learning.

In the present paper, we will present the data of two studies in the fields of medical simulation training and of a school-university partnership at a secondary school, respectively, which show similar patterns in the cognitive-epistemic consequences and resolution of tensions.

Method

Multiple, intertwined methodological approaches to data collection and analysis were combined to elaborate dynamics of incremental changes which reflect practice transformations resulting from patterns of tension resolution. The two cases involved ethnographic studies with participatory observation, developmental intervention approaches interviews and event sampling to follow processes towards new practices. Our analyses took tensions in professionals' activities as a point of departure. We look for episodes in the material that express problems and materializes as developmental tensions. Then we can investigate discursive activities between professionals (micro level), elaborate on episodes of tension resolutions over time (meso-level) and examine how patterns of tension resolution relate to transformations of practices at the level of trajectories (macro-level).

Results

The findings show that the interaction between different knowledge trajectories occurred on both the individual and collective platform and showed how professionals stabilized out of flux by changing their practices accordingly. This means that during the meetings of respectively the medical teams and the pedagogical design team, different modes of knowledge intersected and tacit knowledge (represented as the network of implicit epistemological beliefs, attitudes and knowledge) was explicated. We observed that the work around shared objectives and the tensions that emerged from this process, served to elaborate and refine existing knowledge practices, and develop new ones.

In both cases, we have identified similar patterns of managing or resolving tension, namely:

1. Highlighting the tension: Often, tensions are not about the issue at hand (e.g., scheduling a meeting) but rather about what it represents, such as the experience of disrespect or the illegitimate exercise of authority. A tension could only arise as the consequence of one of the partners during their knowledge construction work to describe a particular problem at hand;
2. Identifying the contradiction: as a result of partners knowing what the tension is at hand, the contradiction(s) in perspectives, knowledge, attitudes or affects come to the fore explicating the problematic features of existing practices. These are explicated in the voices of the several partners in their collaborative knowledge construction work;
3. Framing the contradiction: subsequently, the contradiction is framed employing the self-created language, norms and rules of the design team. This framing is necessary for creating a shared understanding of the tension and for constructing a representation of the forces acting in preserving and causing the problematic practices at hand. This eventually enabled teachers to adapt their practices to be able to overcome the tension;
4. Constructing solutions: Finally, partners transform their own or shared practices, construct new tools and implement them in their ongoing knowledge construction work.

Conclusion

In the present paper we aimed at describing patterns of tension resolution in two research cases from the fields of respectively medical simulation training and pedagogical design in the context of a school-university partnership. Based on socio-historical perspectives on learning and development, we have appropriated the notion of developmental tensions as a driving force of change and development. Although we do not claim that developmental tensions are the sole impetus of transformations of work practices, the investigation of tensions and their resolution helps to identify the dynamic forces of change and comprise an important constituent and starting point for investigating such processes.

Dewey, J. (1968). *Democracy and Education: An Introduction to the Philosophy of Education*. New York: Free Press.

Engestrom, Y. (1987). *Learning by expanding: an activity-theoretical approach to developmental research*. Helsinki.

Heidegger, M. (1962). *Being and time* (J. Macquarrie & E. Robinson, Trans.). New York: Harper & Row. (Original work published 1952).

Leont'ev, A.N. (1981). *Problems of the Development of the Mind*. Moscow: Progress Publishers.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press.

Knowledge co-construction - epistemic consensus or relational assent?

Crina Damsa, University of Oslo, Norway; Sten Ludvigsen, University of Oslo, Norway

In this contribution, we investigate learning in collaboration by examining how university students deal with concepts and ideas in the educational research domain. We seek to understand how students co-construct a conceptual system that allows them to pursue their investigation, and how they externalize and appropriate concepts related to a specific domain and task. We analyze the social interaction of a small student group, involved in a collaborative research project as part of their Bachelor thesis. The findings show that students had no problems to attribute meaning to each concept, but that establishing the position and role of these concepts in relation to each other, and to the investigated context, was a challenging task. Co-constructing a conceptual system led to repeated attempts of the individual members to make the others understand and accept their own view. What appeared important was that (tacit) discrepancy was explicated and acknowledged in a considerate way by collaborating partners. Contradictory ideas did not seem to lead to conflict or breakdown in the group's discourse or at relational level, but to participants explicating their thoughts and ideas, becoming aware of the implications of these ideas and creating ground for joint epistemic efforts. In this sense, the disagreements were used as means to challenge the ideas expressed.

Introduction

In this contribution, we investigate learning in collaboration by examining how university students deal with concepts and ideas in the educational research domain. We seek to understand how students co-construct a conceptual system

that allows them to pursue their investigation, and how they externalize and appropriate concepts related to a specific domain and task. The rationale is that, in order to develop pedagogical contexts that increase the occurrence of interactions that may contribute to co-constructing knowledge, we need to understand the elements that allow participants to reach a joint solution and to balance the epistemic, social-relational and affective elements in the collaborative process.

We do not take collaboration for granted but conceive it as a 'phenomenon' that must analytically be accounted for, based on the empirical data at hand. Our stance is based on socio-cultural and dialogical perspectives on human activities and reasoning. In social interaction, participants involve themselves with language, concepts or objects, which become relevant in the interaction. When social interaction breaks down or misunderstandings appear, participants must use repair strategies to continue communication and the knowledge co-construction process.

While various conceptualizations of collaboration capture important aspects of the knowledge co-construction process (i.e., people use each other and each others' expertise and skills to accomplish common goals), many seem to overlook the social-relational aspects inherent to collaboration. A number of studies (Barron, 2003; Engle & Conant, 2002) showed that relational issues can hinder or stimulate participants in dealing with and capitalizing on the insights constructed in the group. Resuming disagreements in a productive manner involves innately addressing these relational issues, but ultimately in a way that creates premises for interaction that assures epistemic progress. This necessitates more than simple accumulation of individual contributions, but negotiation, joint understanding and building on each other's ideas (see Baker, 2009). We can not take for granted that participants have developed their capacity to use key concepts specific to the knowledge domain in a coherent way, i.e., whether they developed their own thematic patterns and communicative repertoire. These capacities develop gradually, through active involvement with the domain knowledge and in interaction with peers.

Methods

The participants in this case study were four female students (average age 25,3, SD=1,6) enrolled in the Bachelor Thesis course at a large Dutch university. This is a 20-week course that aims to support students in applying previously acquired scientific research knowledge and skills. The course was organized according to a project-based model and participants were required to collaboratively set-up and conduct a research project, with research article as final product. This contribution discusses primarily group discussions held throughout the project period. In the analysis, we selected interaction episodes from students' talk, with an episode corresponding to a logical sequence of collective action. We used the concepts of orientation (what students talk about), elaboration (how they talk), and confirmation (uptake of ideas) to make sense of the data. We also used disagreement as analytic concept, depicting a mode for communication that allows the participants to express and problematize divergent ideas.

Findings and discussion

The interaction sequences displayed students' attempts and struggle to understand the concepts they work with. As such, they had no problems to attribute meaning to each concept, but establishing the position and role of these concepts in relation to each other and to the investigated context, was a challenging task. Co-constructing a conceptual system led to repeated attempts of the individual members to make the others understand and accept their own view. Analyses revealed students developing a basic orientation on the concepts they knew and domain-knowledge they possessed. They tried to construct and elaborate thematic patterns by employing domain-specific language and terms (e.g., feedback, motivation, measuring, receiving positive or negative feedback, questioning people, higher motivation, etc.). Elaboration and confirmation were employed at two levels. At linguistic level, students used language devices to make themselves clear or to indicate they understood others' ideas. At content level, when elaborating on their ideas, students employed 'technical' research terms and attempted to present ideas in a scholastic manner. Confirmation was visible from a cross-episode perspective, which revealed that ideas were taken up and elaborated mostly after consensus was verbally expressed.

Various ways of addressing knowledge gaps were identified in the analyzed material, such as posing own views and providing arguments, providing own elaboration or inviting the others to adjust or elaborate further. What appeared important was that (tacit) discrepancy was explicated and acknowledged in a considerate way between collaboration partners. Some of the group members made conscious decisions to overcome communicational breakdown caused by disagreements. As the discussion progressed, this commitment to consensus diminished. Nevertheless, contradictory ideas did not lead to conflict or breakdown in group's discourse or interaction, but to participants explicating their thoughts and ideas, becoming aware of the implications, and creating ground for joint epistemic efforts. In this sense, disagreements were used as means to challenge the ideas expressed. Through negotiation, argumentation and clarification, the group worked toward a convergence of meaning, and partly a shared account of the conceptual system constructed.

Theoretical and practical significance

The theoretical significance of this paper is related both to the empirical findings and the methodology used. By using the described approach we are able to discriminate how interaction makes conceptual understanding possible through social and relational moves. From an educational practice perspective, we maintain that these findings can support teachers to develop interventions that are directed towards guiding students in their efforts to attend joint understanding and build on each others' ideas when working with complex conceptual systems.

Baker, M.J. (2009) 'Argumentative interactions and the social construction of knowledge', in N.M. Mirza & A.-N. Perret-Clermont (Eds.), *Argumentation and Education: Theoretical Foundations and Practices*, Berlin: Springer Verlag, pp. 127-144.

Barron, B. (2003) 'When smart groups fail', *The Journal of the Learning Sciences*, 12(3), 307-359.

Engle, R. A. and Conant, F. C. (2002) 'Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom', *Cognition and Instruction*, 20(4), 399-483.

SYMPOSIUM

Deaf children and mathematics learning

Chairperson: Ines Borges, Universidade Nova de Lisboa, Faculdade de Ciencias e Tecnologia, Portugal

Organiser: Beatriz Vargas Dorneles, Universidade Federal do Rio Grande do Sul, Brazil

Terezinha Nunes, University of Oxford, United Kingdom

Discussant: Margarida Cesar, Universidade de Lisboa, Portugal

Research on young deaf children's mathematical knowledge can help understand why many deaf children are delayed in mathematical achievement throughout their schooling. This symposium considers young deaf children's mathematical knowledge.

It is common to distinguish numerical representations not mediated by counting (iconic) from those mediated by counting (symbolic). One explanation for mathematical difficulties is poor iconic representations, detectable at young ages. Barbosa analysed deaf children's number representation; deaf children are as good as hearing children in iconic representations but underperform in symbolic representations.

Symbolic representation involves understanding additive composition, crucial for learning number systems with a base. Dorneles and Vargas analysed whether deaf children of deaf parents (DoD) differ from those of hearing parents (DoH) in learning additive composition and counting. DoD have greater experience with counting routines in sign and were expected to learn faster during the intervention. However, they found more similarities than differences between the children's response to intervention.

Nunes et al. developed an intervention to promote deaf children's learning of key mathematical concepts at the start of primary school. The intervention was effective in improving the children's mathematical achievement.

Together, these papers suggest that the mathematical delay starts early, and make a strong case for early interventions to promote deaf children's mathematical learning, while indicating specific forms that interventions could take.

An early intervention to improve deaf children's mathematical learning

Terezinha Nunes, University of Oxford, United Kingdom; Peter Bryant, Department of Education, University of Oxford, United Kingdom; Deborah Evans, Department of Education, University of Oxford, United Kingdom; Rossana Barros, Department of Education, University of Oxford, Peru; Diana Burman, Department of Education, University of Oxford, United Kingdom

Deaf children lag behind hearing children in mathematics in standardised assessments and in tests of early mathematical concepts learned informally. We report two intervention studies in which deaf children were taught about three key informal mathematical concepts that are difficult for them: (1) the addition-subtraction inverse relation; (2) additive composition; (3) multiplicative reasoning. We hypothesized that, if the deaf children were able to progress on these concepts, their mathematics achievement could be raised.

Both studies used a quasi-experimental design, with teachers and their pupils assigned to the intervention or comparison group as a unit. In the first study, 75 children from 16 schools participated, and in the second, 86 children from 23 schools.

All children were pre-tested in a Mathematical Reasoning Test (MRT) and a measure of cognitive ability (BAS-Matrices subtest). These measures were covariates in the analyses of the effectiveness of the intervention. At post-test, the children completed the MRT and the Performance Indicators in Primary School (PIPS-Mathematics). In both studies, teachers implemented the intervention after a day of professional development.

Significant differences between the groups were found at post-test in both outcome measures and in both studies; Cohen's d effect sizes ranged from 0.52 to 1.13.

Thus, early interventions on key informal mathematical concepts can significantly improve deaf children's mathematical reasoning and learning in the first years of school.

Deaf children lag behind hearing children in mathematics in standardised assessments as well as in basic informal mathematical concepts constructed by most hearing children before school. Our hypothesis was that, if deaf children learn these concepts in school, they will make substantial progress in mathematics.

We report two intervention studies in which deaf children were taught about three of these key concepts in school: (1) the inverse relation between addition and subtraction; (2) additive composition; (3) multiplicative reasoning. Deaf children are behind in these concepts at school entry. Thus, it was reasoned that, if the deaf children were able to progress on these concepts through an intervention, their mathematics achievement could be raised.

In both studies, a quasi-experimental design was employed. Teachers of the deaf were recruited for participation through an advert in their professional magazine and through emails sent to schools that cater to deaf children. The aims of the intervention were to improve the children's understanding of the inverse relation between addition and subtraction, additive composition, and the use of one-to-many correspondence in multiplicative reasoning. Teachers and students were assigned to the intervention or comparison group using a waiting list model. Statistical analyses appropriate for quasi-experimental designs (ANCOVAs) were used in both studies.

Study 1

Participants: Children ($N=75$) from 16 different schools were recruited. Eight intact classes ($n=30$ children) were assigned to the intervention and eight ($n=45$ children) to the comparison group. The children's mean age at the start of the intervention was 6.5 years ($SD = 1.07$); their hearing loss was at least moderate; 16 had cochlear implants. Unfortunately, there was a loss of 30% of the participants due to different reasons (parents took early holidays, illness); at the end of the year, there were 22 children in the intervention group and 23 in the control group.

Method

Before the intervention, all the children were tested in a Mathematical Reasoning Test (MRT; Nunes & Bryant, 2000) and the British Abilities Scale matrices subtest (BAS, Elliott, 1997). These measures, and the children's post-test age, were covariates in the ANCOVAs. At post-test, the children completed the Mathematical Reasoning Test again and the Performance Indicators in Primary School (PIPS), a standardised mathematics test (Tymms et al, 2003) that has been adapted for deaf children and correlates highly and significantly with the MRT ($r=.81$).

Intact classes were assigned to each group. The intervention teachers participated in a professional development (PD) day before the start of the project; the comparison group teachers participated in a PD after the post-test. Project implementation was monitored through phone calls, emails and visits. The design was an "intention to treat" design so completion and faithfulness of the intervention are not analysed.

Results and conclusion

There were no significant differences between the groups at pre-test in hearing loss, BAS matrices, and MRT. Hearing loss did not correlate significantly with any of these measures, and thus was not entered in the analyses.

The ANCOVAs had three covariates: age at post-test, BAS and MRT at pre-test. Significant differences between the groups were found at post-test in both outcome measures: for the MRT, Cohen's $d=0.99$, and for the PIPS, Cohen's $d=0.52$.

Thus the children benefited significantly from the intervention both in terms of mathematical reasoning, which we set out to improve, and mathematical learning, measure by the PIPS.

Study 2

Participants: Participants were recruited using the same procedure as previously. Because no changes had been made to the national mathematics curriculum since the previous, we decided to include all schools in the intervention group in this year and use the data from the previous year as a comparison group. As inclusion criteria, we restricted the children's age, BAS matrices and MRT to the same range as the comparison group. The intervention group (N=56) came from 23 schools. The mean ages were 6.6 years (SD = 1.17) for the comparison group and 7.59 (SD=0.96) for the intervention group. There was a significant difference between the groups in age and MRT; the BAS matrices scores did not differ significantly. Hearing loss was at least moderate in both samples, but the average loss was significantly higher in the intervention group. The level of hearing loss did not correlate significantly with the BAS matrices scores or with MRT, so it was used as a selection criterion or as a covariate in the analyses. The proportion of children with cochlear implants was 26% in the control and 36% in the intervention group. The difference between children with and without cochlear implants at pre-test was not significant in the BAS matrices but there was a trend in the MRT ($p=.059$) so we decided to control for the presence of a cochlear implant when analysing the intervention effects.

Method

This intervention had the same aims as in study 1; participating teachers were prepared through a PD day. The materials were enhanced with the addition of computer games played on the web, which gave the children further opportunities for working with the target concepts.

Results

Two ANCOVAs with age, BAS matrices, presence of a cochlear implant, and pre-test results on MRT were run; in both, the only significant covariate was MRT. The groups differed significantly at post-test in the MRT and the PIPS; for MRT, Cohen's $d=1.37$; for the PIPS, Cohen's $d=0.76$.

Conclusions and implications

When deaf children start school, they have not developed some key concepts that form the basis for mathematics learning. These concepts are not taught in school, but are required for understanding what is taught. Interventions that promote the learning of these concepts can have significant effects on their mathematical reasoning and learning in the first years of school. The replication of the group differences with two cohorts of teachers and children gives us great confidence in the possibility of improving deaf children's mathematical achievement.

The development of counting in deaf children: comparing a native signer and an oral child

Beatriz Vargas Dorneles, Universidade Federal do Rio Grande do Sul, Brazil; Rosane Vargas, PUC, Rio Grande do Sul, Brazil

This case-study investigated whether deaf children from deaf parents (DoD) are at an advantage to learn number concepts in comparison to deaf children from hearing parents (DoH). The hypothesis was that DoD develop an understanding of the regularities of the counting system and additive composition faster than DoH due to their earlier experiences with sign language. We compared the response to intervention of two six-year old children: a DoD boy and a DoH girl. Both had the same IQ, had attended school for one year, and respected the five counting principles at pre-test.

They participated in a brief intervention (five sessions) designed to improve their understanding of additive composition and their use of appropriate counting strategies in problem solving. Each child worked in individual sessions with an experienced teacher of the deaf. After the five sessions the children were re-assessed. Both improved the use of economic counting strategies and in understanding of additive composition; their counting range also increased to a similar level. The similarities in learning by the DoD and the DoH children suggest that both groups may benefit from the same sort of teaching and show that these interventions do not have to be differentiated according to the hearing status of the parents.

Young children's number knowledge involves recognizing quantities perceptually, without counting, and also learning to count. Counting is the first mathematical cultural tool learned by children. Learning to count requires respecting the counting principles, understanding the regularities of the counting system and using numbers in different situations to quantify sets; thus it involves linking reasoning schemas with language (RESNICK, 1989). Around age three, most hearing children can count to five as they point the objects and respect the first five counting principles: one-to-one correspondence, stable order of labels, cardinality, order irrelevance and abstraction. Less information is available regarding the early mathematical skills of deaf children in the same age range and when they begin to use these first principles. In the domain of number representation without counting, Zarfaty, Nunes & Bryant (2005) observed that deaf children performed as well as hearing children in a number reproduction task in the absence of the model. They also found that the deaf children performed better than the hearing children when the set to be reproduced was

presented as a simultaneous, visual display. Deaf children seem to learn how to count more slowly than hearing children, but within their limited counting range, deaf children aged three to six years are as able as hearing children to use the counting principles (Leybaert & Van Cutsem, 2002). However, they seem to be at a disadvantage in understanding the regularities of the number system (Nunes, 2004).

A recent study (KRITZER, 2009) confirmed that deaf children prior to the onset of formal schooling count to a lower number than hearing children and are already at a disadvantage on informal mathematical concepts. Although Kritzer did not report whether the differences between deaf children were related to their exposure to sign language from an early age, his study contains sufficient information to allow for examining the relationship between the parental hearing status and the children's mathematics results. Of the 29 participants, 17 had at least one deaf parents, and 5 were classified as higher in mathematical ability within the group, 10 as average, and 2 as lower; 12 children had hearing parents, and 1 was classified as higher in mathematical ability, 6 as average and 5 as lower. Assuming ordinal measurement, Kendall's tau for this distribution of scores shows a significant association between parental hearing status ($T=2.26$; $p=.02$). However, it is possible that this association would be due to other factors, such as differences in IQ or previous exposure to schooling.

The present study aimed to investigate, using a case study approach, whether deaf children from deaf parents are at an advantage to learn further number concepts in comparison to deaf children from hearing parents. The concepts investigate here were understanding additive composition and the regularities of the counting system.

Methods

The main hypothesis is that deaf children of deaf parents (DoD) develop an understanding of the regularities of the counting system and additive composition faster than deaf children of hearing parents (DoH) due to their earlier experiences with sign language. To test this hypothesis, we compared the response to intervention of two six-year old children: a DoD boy and a DoH girl. The children had the same measured IQ (by the WISC-R), had attended school for one year, and respected the five counting principles at pre-test.

They then participated in a brief intervention (five sessions implemented over three weeks) designed to improve their understanding of additive composition (which we expected would increase their counting range) and their use of appropriate counting strategies in problem solving. Each child worked in individual sessions with an experienced teacher of the deaf (the second author). During the intervention, the children used counting to represent quantities presented spatially and to "buy" objects in the Shop Task (see Nunes, 2004). These interventions used principles which were shown to be beneficial for hearing children's learning. After the five sessions the children were re-assessed.

Results

Contrary to our expectations, there were more similarities than differences in the children's learning. Both improved the use of economic counting strategies (i.e. in an addition situation, counting up from the larger addend) and in understanding of additive composition; their counting range also increased to a similar level. Being DoD did not turn out to be a crucial factor in how much the children benefited from the intervention.

Conclusions

The study converges with previous investigations that shown that processed in the development of counting are similar in deaf children and hearing children. It also replicates previous findings that brief interventions can help deaf children to improve their understanding of the number system. The similarities in learning by the DoD and the DoH children suggest that both groups may benefit from the same sort of teaching to improving their counting skills and understanding of the number system. This is an important result for education as it underscores both groups' needs for early intervention in number knowledge and shows that these interventions do not have to be differentiated according to the hearing status of the parents.

Gelman, R & Gallistel, C.R. (1978) *The child's understanding of number*. Massachusetts: Harvard Press.

Kritzer, K. (2009) Barely Started and Already Left Behind: A Descriptive Analysis of the Mathematics Ability Demonstrated by Young Deaf Children. *Journal of Deaf Studies and Deaf Education*; 14:409 - 421.

Leybaert, J., & Van Cutsem, M.-N. (2002). Counting in sign language. *Journal of Experimental Child Psychology*, 81, 482-501.

Nunes, T. (2004) *Teaching Mathematics to Deaf Children*. London: Whurr/Whiley.

Resnick, L. B. (1989). Developing mathematical knowledge. *American Psychologist*, 44(2), 162-169.

Zarfaty, Y., Nunes, T., & Bryant, P. (2004) The performance of young deaf children in spatial and temporal number tasks. *Journal of Young Deaf Studies and Deaf Education*, 9, 315-326.

From iconic counting to symbolic cardinality in young deaf Brazilian children using sign language

Heloiza Barbosa, Universidade Federal de Santa Catarina

Studies have demonstrated that deaf children have difficulties acquiring the numerical sequence used in counting. In this investigation, we look at the ability of 6-year old deaf children ($N=11$) using sign language to iconically represent numerical information presented either spatially or temporally, as well as, at their knowledge of the counting sequence and procedures. Two groups of hearing children ($N= 22$) controlling for age and schooling were tested in this study. There was no difference between deaf and hearing children in their ability to iconically represent and recall sets from 2 to 6 items presented spatially and temporally. Deaf signers showed better performance in spatial condition. Regarding the counting abilities, deaf signers and 5-year olds had a low counting range and were more likely to recite a numerical sequence to answer a cardinality question than the 6-year-olds. These results suggest that deaf children and 5-year olds might benefit from educational interventions that support the passage from iconic to symbolic thinking.

Young deaf children have difficulties acquiring the numerical sequence used in counting (Leybaert & Van Cutsem, 2002). It was suggested (Wiese, 2003) that the numerical counting sequence of young children has an iconic function initially, and become symbolic, when they use the last word of the counting to indicate cardinality. The hypothesis in this investigation is that the counting by deaf children maybe be iconic for a longer period than for hearing children. The present study, first, provides data on number representations and sequence recall of Brazilian young deaf children educated in sign language. Second, it investigates the acquisition of the counting sequence and its link with numerical representations.

The participants ($N= 33$) were deaf preschoolers ($n=11$) attending state schools with the mean age in months 73.5 ($SD= 8.5$) and educated in a signing environment. Two groups of hearing children from state preschool programs were selected as comparison groups: (a) age: 6-year olds ($n= 11$; $M= 73.7$; $SD= 3.0$), who have the same chronological age but have been in preschool for a year longer than the deaf children; (b) 5-year olds ($n= 11$; $M= 64$; $SD= 3.0$), who are younger but have been in preschool as long as the deaf children

Task 1- Representation of sets: spatial and temporal.

The children were presented with sets of 2 to 6 heterogeneous objects and asked to reproduce the stimuli set with the items in the same order after the set was no longer visible. The objects were either presented together, as a spatial group, or sequentially, as a temporal group. This task assesses the children's iconic numerical representation and ability to reproduce a sequence.

No differences were found between deaf and hearing children in reproducing sets presented either spatially ($p= .60$) or temporally ($p= .20$), although they took longer in the temporal condition ($p= .009$). The set of six items, which is beyond subitizing skills in this age, was reproduced correctly by 27.3% of both deaf signers and hearing 6-year olds. In contrast, the six-items spatial set was represented by only 9% of 5-year-old hearing children. Thus deaf signers and hearing children are able to represent numerical information presented in both conditions, although the spatial condition seemed easier to deaf children. Deaf and hearing children did not differ in their ability to recall a sequence and in their iconic numerical representation.

Task 2 - Counting sequence and symbolic numerical representations

Participants were requested to count to the highest number they knew and also to count sets of objects (with 6, 10 or 15 items) and printed figures (6, 10, 15 or 30) and say how many items were in the sets, after the sets had been removed from view.

The children were classified as showing basic (1-10), median (11-59) or advanced (60-100) knowledge of the counting sequence. 82% ($N=9$) of the deaf signers were at the basic level; the majority of the deaf children did not know number signs above 10. The majority of the hearing 5-year olds were in the low end of the median level; they stopped counting between 12 and 19. In contrast, the majority of the hearing 6-year olds were in the higher median or advanced levels. The mean difference in the counting score between groups is significant.

When the deaf children were asked to count objects or pictures and say how many there were, they rarely use number signs to count and to inform the cardinality. Instead, they counted by matching fingers and items in an iconic fashion. In sets bigger than ten, they also counted in an iconic fashion and, to inform the cardinality, they unfolded fingers, one at time, up to ten followed by the sign of "many". Surprisingly, the same pattern of results was found in the hearing 5-year olds: they produced counting words sequence in the low range and, in sets beyond their knowledge of counting, they repeated number words to complete the counting by matching word-item; they rarely used referent

number words to inform the cardinality, instead, they recited an unconventional numerical sequence. The older hearing children performed at ceiling on both counting tasks.

Discussion & Implication

Deaf signers and hearing children do not differ in the ability to represent numerical information iconically and to recall a sequence. However, deaf children and hearing 5-year olds with less educational experience have a lower counting range than children with a longer educational history, irrespective of age (5 or 6 years). The former groups also have difficulty with the symbolic representation of cardinality whereas the latter group does not. Wiese (2003) argued that the passage from iconic to symbolic representation is supported by routines, which could be learned in preschool settings. Deaf and hearing children might benefit from mathematics programs that support the passage from iconic to symbolic thinking.

Leybaert, J. & Van Cutsem, M.N., (2002). Counting in sign language. *Journal of Experimental Child Psychology*, 81, 482-501.

Wiese, H. (2003). *Numbers, language, and the human mind*. Cambridge University Press.

SYMPOSIUM

Effects of early education on children's academic progress in Primary: UK, Finland, and Germany

Chairperson: Kathy Sylva, University of Oxford, United Kingdom

Organiser: Kathy Sylva, University of Oxford, United Kingdom

Discussant: Pamela Sammons, University of Oxford, United Kingdom

The importance of early education experiences during the pre-school years is well known, and there is now widespread agreement that high quality home and pre-school environments provide children with a 'head-start' in cognitive and academic development. Children who begin Primary school with a stronger foundation in emergent literacy and numeracy skills are often able to maintain their initial lead in academic achievement compared to their peers. What remains unclear, however, is whether early education experiences fundamentally change children's learning capacity, and if pre-school effects interact with primary schooling to shape individual growth trajectories. This symposium seeks to address these questions through three papers on large-scale longitudinal studies conducted in England, Finland, and Germany. The British study investigates whether high quality pre-school experiences actually enhance children's ability to learn, i.e. not only giving them a stronger 'profile' at school entry, but also enabling them to make greater gains in academic achievement (in English and Mathematics) over the primary school years (ages 7-11). The Finnish study focuses on children deemed to be at-risk for reading disability in kindergarten, and examines how factors in their pre-school 'profile' (i.e. better pre-reading skills, self-concept, and less task-avoidant behaviour) influence the effectiveness of teacher support and remedial reading instruction in Grades 1-2 of Primary school. Finally, the German study explores children's early numeracy development from ages 3 to 7 (preschool to first year of Primary), and examines the interactive effects of pre-school process quality (in fostering early academic skills) and primary school instructional quality.

The effects of pre-school on the rates of academic progress children make during the primary years

Kathy Sylva, University of Oxford, United Kingdom; Edward Melhuish, University of London, Birkbeck, United Kingdom; Pamela Sammons, University of Oxford, United Kingdom; Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Brenda Taggart, Institute of Education - University of London, United Kingdom

Much research has shown that high quality pre-school experiences provide young children with a stronger pre-academic 'profile' upon school entry, and this advantage remains over the Primary school years. Few studies, however, have examined whether early learning actually enhances children's ability to learn, enabling some students to make greater gains in academic subjects compared to their peers who had less favourable pre-school experiences. This paper presents findings from a longitudinal study on a representative sample of 3000 children in the UK. Using an 'educational effectiveness' design, the study examined the 'value-added' by pre-school quality (as measured by the Early Childhood Environment Rating Scale-Extension) to children's academic gains between ages 7 and 11 (i.e. Years 2 to 6 of Primary school) in English and Mathematics. Results from hierarchical linear models showed that pre-school attendance alone (irrespective of quality) was associated with better academic attainment at age 11, but this did not translate into a predictor of better progress in either subject. Instead, the key to becoming a more effective learner was the quality of the pre-school provision. Furthermore, high quality pre-schools also acted as protective or compensatory mechanisms against poor quality home learning environments, giving those children an extra boost. In short, children who had experienced higher quality pre-school provision not only maintained their lead in academic achievement compared to their peers, but they also made greater gains over the primary school period. The benefits

of quality early learning experiences are therefore long-lasting and cumulative, fundamentally improving children's capacity to learn.

Aims:

The contribution of early education to children's cognitive development has been researched for decades. It is often shown that high quality pre-school experiences provide young children with a stronger pre-academic 'profile' upon entry to school, and that this advantage remains over the Primary school years. Few studies, however, have explored whether early learning actually enhances children's ability to learn, fundamentally changing their academic development trajectories. This paper contributes to the literature by presenting findings from the Effective Pre-school and Primary Education (EPPE) Project, a longitudinal study on a representative sample of 3000 children in the UK. The aim was to examine the contribution of pre-school to children's academic progress between ages 7 and 11 (i.e. Years 2 and 6 of Primary) in English and Mathematics.

Methodology:

The EPPE project is Europe's largest longitudinal investigation into the effects of pre-school and primary education on children's developmental outcomes. It was commissioned by the British government and adopts an 'educational effectiveness' design (anonymous, 2007a, 2007b; anonymous, 2004) using mixed methods. Using multilevel modelling, the authors examined the contribution of child, family, home environment, and school characteristics to children's cognitive development in the period of 3 to 11 years. The view of reciprocal influences owes much to the work of Bronfenbrenner (1979), whose theory puts the child at the centre of a series of nested spheres of social and cultural influence, including home and education (anonymous, 2010).

Research questions

The research questions addressed in this paper are as follows: Do the effects of pre-school on children's academic development remain throughout primary school? Does the quality of pre-school have an effect on children's academic progress during primary school? How does pre-school quality interact with the home learning environment to shape children's academic progress over time?

Sample

Five regions in the U.K were strategically selected (including urban, suburban and rural areas, with social and ethnic diversity), and a total of 141 pre-school centres were randomly sampled from different types of provisions (e.g. playgroups, nursery schools, private day nurseries). Over 2800 children were recruited at age 3 and followed until school entry (age 5), when they were joined by an additional 310 'home' children with no pre-school experience. Approximately 2700 of these children were then followed for a further six years until the end of Primary school (age 11).

Child assessments

Children's results in Years 2 and 6 of Primary school on the statutory National Curriculum Assessments in English and Mathematics were collected, and the Year 2 scores served as baseline measures. The correlations between prior and later attainment were 0.77 for English and 0.73 for Mathematics.

Pre-school quality measure: Early Childhood Environment Rating Scale-Extension (ECERS-E) (anonymous, 2003).

Co-variates: Child, family, and home environment variables

Parental interviews and questionnaires were conducted at ages 3 and 7. Information was collected on parental characteristics (socio-economic status, educational level, employment and age), family characteristics (lone parent family and number of children), and child characteristics (ethnicity, birth weight, perinatal difficulties, child's first language, early developmental problems). An index of the Early Years Home Learning Environment (HLE) was also constructed, consisting of the following items rated on an 8-point scale (anonymous, 2001):

- .. Reading to child
- .. Painting and drawing with child
- .. Playing/teaching numbers/shapes to child
- .. Library visits with child
- .. Playing/teaching alphabet/letters
- .. Playing with letters/numbers with child
- .. Playing/teaching of songs/nursery rhymes etc.

Analytic strategy

Multi-level value-added models were used to investigate children's progress over time (i.e. cognitive gains) by controlling for their prior attainment, as well as a wide range of demographic and environmental influences. They also

take into account the amount of variation in the data that is due to the clustering of children within the same pre-school centre (Goldstein, 2003).

Findings:

There was clear evidence that pre-school attendance alone (irrespective of quality or effectiveness) was associated with better attainment in English and Mathematics during Primary school, but this did not translate into a predictor of better progress in either subject. However, there was evidence of the importance of pre-school quality for progress: for English, children who attended high quality pre-schools made greater progress between Years 2 and 6 than 'home' children (See Table 1). Similar effects were found for Mathematics (See Table 2). This suggests that quality pre-school experience not only provides children with an initial boost to attainment levels at school entry, but also helps promote progress (possibly by fostering children's capacity to learn and their motivation). The HLE was one of the most important background factors relating to children's academic attainment and progress in Primary school. Children who enjoyed a rich HLE made greater gains in both subjects over the 4-year period than those who experienced poorer provision. Finally, high quality pre-schools also compensated for the effects of experiencing poor quality home learning environments (See Figures 1 and 2).

Theoretical and educational significance:

This study has shown that children who had experienced higher quality pre-school provision not only maintained their lead in academic achievement compared to their peers, but they also made greater progress over the period. In other words, the benefits of early learning experiences are long-lasting and cumulative, fundamentally changing children's developmental trajectories.

There are three implications for policy and practice: (1) continue to support free pre-school education for all 3 and 4 year old children, (2) ensure good quality of pre-school education, and (3) support parents/carers in providing a high quality HLE (e.g. through structured parenting programmes). This research is therefore relevant to the monitoring of equity in education, and to policies that seek to raise standards, reduce the equity gap and promote inclusion.

The effects of teacher support on at-risk children's reading skills development in early primary

At-risk students, Reading, Remedial education; Marja-Kristiina Lerkkanen, University of Jyväskylä, Finland; Noona Kiuru, University of Jyväskylä, Finland; Anna-Maija Poikkeus, University of Jyväskylä, Finland; Minna Torppa, University of Jyväskylä, Finland; Timo Ahonen, University of Jyväskylä, Finland; Pekka Niemi, University of Turku, Finland; Jari-Erik Nurmi, University of Jyväskylä, Finland

The present study examined at-risk children's reading skill development and its longitudinal associations to the amount of teachers' individual support and attention and remedial reading instruction received at the Grades 1 and 2. The participants were 257 children who were identified at-risk for reading disability on the basis of their preschool pre-reading skills. Further reading skills were assessed twice in the first grade and once in the second grade. The teachers reported the amount of support and attention they gave to at-risk child in their classroom and the amount of remedial reading instruction the child received at school. The results showed, first, that the poorer the reading skills were, the more support and attention the child received from the teacher. Further analyses revealed that the amount of teacher's support and remedial reading instruction decreased across time among those at-risk children whose skills progressed so that they were at age level in reading by the end of grade 2, but teacher support increased and the amount of remedial reading instruction remained stable among children who lagged substantially behind the age level in reading by the end of grade 2. Moreover, children who were found to reach age level skills had better pre-reading skills and self-concept and less task-avoidant behavior in comparison to other at-risk children in preschool. The findings indicate that at-risk children with stronger preskills at school entry show greater progress over the early school years and are better able to benefit from teacher support than other at-risk children.

The Aims

Previous studies have shown that teachers' instruction and high classroom quality contribute to child outcomes (e.g., Howes et al., 2005; Pianta et al., 2008, Stipek et al., 1998). However, classroom instruction often seems to fail to support adequately at-risk children (Hatcher, Hulme, & Snowling, 2004) who require a high extent of individualized support (Torgesen, 2005). Within the tradition of reading intervention studies, little research has been carried out to analyze the extent to which classroom teacher individualized support enhances the reading skill development of at-risk children. The aim of the present study was to examine the longitudinal associations between at-risk children's reading skill development and the amount of teacher support and attention and remedial reading instruction at Grades 1 and 2. The research questions were:

(1) To what extent does the level of reading skills of at-risk children predict the amount of teacher support and remedial reading instruction that the child receives?

- (2) To what extent does the amount of teacher's support and remedial reading instruction predict the development of reading skills among children at-risk for reading disabilities (RD)?
- (3) Is the role of the amount of teacher's support and remedial reading instruction different for three subgroups of children at-risk for RD: those who caught up the age level in reading skills, those with a moderate lag behind the age level, and those with a substantial lag behind the age level by the end of the second grade?
- (4) To what extent do the subgroups of children at-risk for RD differ in factors related to the child (pre-skills and motivation) and to the home environment (parental education, parental teaching, shared reading)?
- (5) To what extent does the development of pre-reading skills at preschool differ between the subgroups of children at-risk for RD?

Methods

The present study used data from the ongoing longitudinal First Steps study, a prospective follow-up of 2057 Finnish children from the beginning of their preschool year (6 years of age) to the end of Grade 4 with simultaneous data gathering from the parents and teachers. The analyses involved 257 children (76 girls, 181 boys) who were identified being at-risk for RD based on scoring lower than 15th percentile in the preschool Spring pre-reading tests. Measures of children's pre-skills (phoneme awareness, letter knowledge, vocabulary, listening comprehension, memory), motivation (self-concept in reading, task-avoidant behavior), and home environment (parental education, parental teaching, shared reading) were derived from preschool Spring assessments. Reading skills (word recognition, word list reading fluency, text reading fluency) were assessed in the Grade 1 Fall and Spring, and Grade 2 Spring. Teacher ($n = 99-105$) measures included classroom teacher ratings on a 5-point scale on the amount of support and attention that they gave to child in reading and the amount of remedial reading instruction that the child received at school, and preschool teachers ratings on the children's task-avoidant versus task-focused behavior.

The first two research questions were analyzed with a longitudinal path model by using the Mplus statistical package. Repeated measures MANOVA analyses were used to investigate the third research question, i.e., whether the amount of teacher support and remedial reading instruction would show mean-level change across time and whether the three subgroups of children at-risk for RD: children who caught up the age level in reading (> -0.75 SD; $n = 108$), children with a moderate lag behind the age level (> -1.5 SD & ≤ -0.75 SD; $n = 78$), and children with a substantial lag behind the age level (≤ -1.5 ; $n = 56$) by the end of Grade 2, would differ in regards to these mean-level changes. Fourth, cross-tabulations and 1-ANOVAs were used to analyze whether the three subgroups of children at-risk for RD would differ in factors related to the child and to the home environment. Finally, repeated measures MANOVA was used to analyze whether the development of pre-reading skills from preschool Fall to Spring differed between the three at-risk subgroups.

Findings

The results showed, first, that the poorer the reading skills were, the more teacher support and attention the child received in the early grades. Further analyses revealed that the amount of teacher support (p partial $\eta^2 = .26$) and remedial reading instruction (p partial $\eta^2 = .18$) decreased across time among children who caught up the age level in reading by the end of Grade 2, but teacher support increased ($p = .05$, partial $\eta^2 = .20$) and the amount of remedial reading instruction remained stable among children who lagged behind the age level by the end of Grade 2. Moreover, children who were found to reach age level reading skills had better phoneme awareness, letter knowledge, listening comprehension skills and self-concept in reading and less task-avoidant behavior in comparison to other at-risk children prior to school entry. No differences between the subgroups were found in vocabulary, memory, and in the home environment measures (parents' education, maternal teaching of reading, or shared reading). Finally, the results revealed that although phonemic awareness and letter knowledge of all the three groups showed increasing lag behind the age level during the preschool, the lag in letter knowledge was smaller among children who caught up the age level in reading than among the other at-risk children.

Theoretical and educational significance

The findings indicate that at-risk children with stronger preskills at school entry showed greater progress over the early school years and were better able to benefit from teacher support than other children at risk. The findings suggest that the benefits of preschool experiences have cumulative effects for children's subsequent learning. They also have implications for recommendations of preschool programme quality and provision of preventive early support and individualized classroom teacher support to prevent later learning difficulties. The findings emphasizing the need for early individualized support complement our previous findings of the First Steps preschool observations (Pakarinen et al., 2010; Pakarinen et al., in press) using the CLASS (Pianta, LaParo, & Hamre, 2008) which has showed associations between high classroom quality and high motivation, and, further, between motivation and academic pre-skills.

The effects of preschool and primary school quality on children's early numeracy skills

Yvonne Anders, University of Bamberg, Germany; Christiane Große, Otto-Friedrich-Universität Bamberg, Germany; Hans Guenther Rossbach, University of Bamberg, Germany; Susanne Ebert, University Bamberg, Germany; Sabine Weinert, University of Bamberg, Germany

Only few studies have investigated so far how preschool and primary school experiences interact in shaping young children's cognitive development. The present investigation is part of the longitudinal study BiKS and explores children's development of early numeracy skills between age 3 (first year of preschool) and age 7 (first year of primary school) in Germany. Three research questions are addressed. First, the study seeks to identify the influences of child, family background and the early years home learning environment on children's developmental progress over that age range. Second, measures of preschool experience are tested as predictors. Third, we look at how influences of preschool and primary school quality interact when children have moved from preschool to primary school. The study draws on a sample of 547 children who attended 97 preschools in Germany. Latent growth curve analyses identify various child and family background factors that are related to numeracy skills at first year and growth over four assessments, particularly gender, migration background, SES, mother's education and the quality of the home learning environment. The effects of preschool quality on the development of numeracy skills persist until the end of the first year of primary school. Value-added regression analyses show that the qualities of preschool and of the mathematics lessons at primary school have independent impacts on progress in the first year of primary school. For policy makers and practitioners in Germany findings point to strengthen the efforts to ensure high quality of preschool and primary school education.

Aims

With regard to children's cognitive development and educational careers, it is well known that a number of child, family, home learning and preschool characteristics are significant influencing factors (e.g. NICHD ECCRN, 2002). But only a limited number of studies have investigated how preschool and primary school experiences interact in shaping young children's development. Until a couple of years ago, public and research interest in early years education was particularly low in Germany and little is known about the effects of preschool programs in this country. This paper seeks to investigate how preschool and primary school experiences interact in shaping the development of numeracy skills of children between the ages of 3 and 7 years in Germany. This age range covers three years of preschool and one year of primary school. Precisely, the paper addresses three research questions: First, it seeks to identify the influences of child, family background and the early years home learning environment on developmental progress. Second, measures of preschool experience are tested as predictors. We are especially interested if beneficial effects of the process quality of preschool settings persist until the end of the first year of primary school. Third, we look at how the instructional quality of the primary school further influences children's progress and how preschool and primary school quality interact when children have moved from preschool to primary school.

Methodology

Procedure and sample: The study is part of the longitudinal project BiKS – 3-8 (Educational Processes, Competence Development and Selection Decisions at Pre- and Primary School Age). The study follows the acquisition of competencies of 547 children in Germany who attended 97 preschool settings since 2005. The project collected a wide range of data on cognitive outcomes of the children, their background, their families and the preschool and primary school settings they attended (von Maurice et al., 2007). The development of early numeracy skills over four measurement points (age 3, 4, 5 and 7 years) is examined.

Measures: Outcome measure: Early numeracy skills were assessed by the subscale "arithmetics" of the Kaufman Assessment Battery for Children (K-ABC, Melchers & Preuss, 2003).

Predictors: Child and family background factors included age in months, gender, migration background, socioeconomic status of the family, maternal education and age at entry to preschool.

Early years home learning environment (HLE): One scale measure to assess the quality of the home environment in terms of promoting verbal literacy and numeracy skills was used considering information from home observations, parental interviews and questionnaires.

Preschool measures: A number of structural characteristics were included: number of children with migration background in the class, class size, child-staff-ratio, m³ per child and average age of children in the class. Process quality indicators were based on environment ratings using ECERS-E (Sylva, Siraj-Blatchford & Taggart, 2003).

Primary school measures: Instructional quality in the first year of primary school was assessed using classroom observations. The study focused on the level of cognitive activation in mathematics lessons.

Statistical analysis: Two sets of analyses were carried out: The first set examined the influences on the development of numeracy skills over time fitting latent linear growth models with four repeated measurements. First child, family background measures and early years HLE were tested as predictors of initial attainment and growth. Subsequent analyses tested the influence of preschool characteristics controlling for child, family background measures and HLE. The second set of analyses further investigated the impact of quality of instruction in primary school on developmental progress between age 5 and 7 years using value-added regression analyses. The sample size for the first string of analyses was $n = 532$ children with at least one valid outcome measure and predictor, $n = 396$ for the second string of analyses respectively.

Findings

Boys, children with migration background, children who grow up in low SES families or with less educated mothers show lower initial numeracy skills (gender: $b = -0.29$, p With respect to the influence of structural characteristics of preschool settings, analyses revealed that a number of structural characteristics like class size ($b = -0.13$, p The effects of preschool quality on the development of numeracy skills persist until the end of the first year of primary school (ECERS-E: $b = 0.19$, p Preschool quality in terms of fostering academic skills (ECERS-E: $b = 0.12$, p

Theoretical and educational significance

This research documented clearly that the development of numeracy skills is associated with the process quality of the preschool setting and confirmed the strong impact of preschool quality also in Germany. Effects of preschool quality on children's progress persist until the end of the first year of primary school, although the quality of instruction at primary school starts to shape children's development at this time. Children not only start with better skills but also move forward faster in primary school when they attended high quality preschool. For policy makers and practitioners findings point to strengthen the efforts to ensure high quality of preschool and primary school education.

SYMPOSIUM

Converging, complementing or contradicting? Multiple theoretical approaches to classroom interaction

Chairperson: Shirley Booth, University of Gothenburg, Sweden

Organiser: Ake Ingerman, University of Gothenburg, Sweden

Discussant: Ference Marton, Goteborg University, Sweden

This symposium focuses researching student learning as constituted in classroom interaction. All contributions report on studies in mathematics and science education aiming to generate instructional advocacy from research findings, and ground that argument in the application of several theoretical perspectives to a body of empirical data.

Xu & Clarke report on parallel analyses of a secondary science classroom using distributed cognition and variation theory as two lenses. They identify similar student learning difficulties, but generate different interpretations for both the nature and the potential source of these difficulties.

Ingerman & Berge report on parallel analyses of university students discussing science problems using variation theory and position theory. Thus they relate an analysis focusing on what is learned to an analysis focusing the context. Sahlström & Melander draw on several studies in primary science and secondary mathematics classrooms and pilot training to demonstrate advantages and disadvantages of content-oriented analytical approaches, such as variation theory, and the recent socio-cultural and conversation analytical approaches, such as conversation analysis. They argue for considering content as an empirically intrinsic aspect of participation.

Each paper approaches the issue of connecting multiple theoretical perspectives in different ways, from discussing the consequences of converging results but complementing/contradicting explanations (Xu & Clarke), to complementing focus of analyses (Ingerman & Berge), and to arguing for a theoretically integrated approach (Sahlström & Melander). In combination, the papers allow for examining the multifaceted ways of making use of the diversity of theoretical perspectives as resources to understand learning and inform instructional practice.

On generating instructional advocacy from research grounded in different theoretical perspectives

Lihua Xu, The University of Melbourne, Australia; David Clarke, University of Melbourne, Australia

This paper discusses issues related to generating instructional advocacy from research findings that are grounded in different theoretical perspectives. Multi-camera on-site video technology and post-lesson video-stimulated interviews were used in a purposefully inclusive research design to generate a complex data source amenable to multiple analyses. Two different theories were employed as analytical lenses to examine lessons on the topic of "States of Matter" from a 7th grade Australian science classroom. This paper illustrates how parallel analyses of same classroom events, employing different theoretical lenses, can identify similar student learning difficulties, but generate different interpretations for both the nature and the potential source of these difficulties. Based on this example, we discuss challenges involved in comparing and connecting research findings of parallel analyses for the purpose of instructional advocacy.

As theories in the field of education become increasingly diversified, a central question is how we can make use of this diversity as resources to inform educational practice. The task of generating instructional advocacy from research findings with different theoretical groundings becomes a very challenging one, especially when we take into account the interdependency of theoretical choice and research findings (Cobb, 2007; Even & Schwarz, 2003).

In this paper, rather than considering convergence or compatibility as the definitive result of the particular combination of theories, we focus on the compatibility of the interpretive accounts generated by their application to a common source of classroom data. In attempting to meet the challenge of providing evidence-based instructional advocacy, we address the question "under what conditions are the interpretive accounts compatible?" In this context, compatibility of the interpretive accounts would strengthen the authority of any recommendations for instructional practice arising from that research. We suggest that such compatibility must be considered as contingent on the events, objects or actions being analysed and on the specific question being addressed by the analysis. This contingent compatibility focuses our attention on the use of theories as interpretive tools. In this paper, we provide an example of parallel analyses of lessons on the topic of "States of Matter" from a Grade 7 Australian science classroom, employing two different theoretical perspectives: Distributed Cognition (Hutchins, 1995) and Variation Theory (Marton & Tsui, 2004). This paper illustrates how parallel analyses of the same classroom events, employing different theoretical lenses, can identify similar student learning difficulties, but generate different interpretations for both the nature and the potential source of these difficulties. In particular, the Distributed Cognitive analysis attends to the affordances and the constraints of physical, conceptual, and symbolic resources in student sense making, and highlights the limited connections between the microscopic model and the macroscopic phenomena. The Variation Theory analysis suggests that the lack of variation in the key attributes of the concepts, such as Changes of State, was a contributing factor to student difficulties in making the differentiations required for effective learning. Based on this example, we discuss challenges involved in comparing and connecting research findings that are differently positioned theoretically for the purpose of instructional advocacy.

The comparison of the two accounts demonstrates that each theory has its strengths in revealing particular aspects of teaching and learning in the particular classroom studied. The two analytical accounts are complementary in several respects (e.g. the use and the sequencing of instructional resources). But in other respects, the two theories appear to emphasize different aspects of the classroom and embody different and potentially conflicting assumptions about the key contributing factors to student learning (e.g. the establishment of common ground). These differences might direct us towards the adoption of divergent instructional and intervention strategies, which may not always be in harmony with each other (e.g. the role of practical work). In this regard, Variation Theory and Distributed Cognition seem to be too differently positioned with respect to their aspirations and the aspects of the classroom to which they attend for integration into a single theory to be either feasible or desirable. However, we suggest that the complementarity (rather than their convergence) of the two theories holds the possibility that in combination, analyses employing the two theories separately should attend to, describe, and explain a broader range of classroom phenomena than might be accomplished by the separate application of either alone. In the case reported in this paper, the results generated from the parallel analyses can be usefully juxtaposed and combined to provide a richer understanding of the teaching and learning of science in this particular classroom.

Cobb, P. (2007). Putting Philosophy to work. Coping with multiple theoretical perspectives. In F. K. Lester (Ed.), *Second handbook for research on mathematics teaching and learning* (pp. 1293-1312). Reston: NCTM.

Even, R., & Schwarz, B. B. (2003). Implications of Competing Interpretations of Practice for Research and Theory in Mathematics Education. *Educational Studies in Mathematics*, 54(2), 283-313.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, Mass.: MIT Press.

Marton, F., & Tsui, A. (2004). *Classroom discourse and the space of learning*. Mahwah, N.J.: L. Erlbaum Associates.

Learning science in groups – on constituting and participating in spaces of learning

Ake Ingerman, University of Gothenburg, Sweden; Maria Berge, Chalmers University of Technology, Sweden

What can be learned by whom in groups discussing physics? This paper offers results based on empirical material from audio and video recorded small groups of three to four university students discussing and solving physics problems in Newtonian mechanics. In addressing the question, we have foregrounded aspects in relation to the knowledge content. However, in order to more fully understand the situation, we have applied two distinct analytical frameworks – phenomenography and position theory – which are primarily focused on how the learning possibilities are constituted in the group discussion and the discursive and social aspects of the group work, respectively. Bringing the results of these two analyses together reveal some interesting connections, like that the character of the storylines links to certain characters of learning possibilities. We will also discuss the basis for and implications of addressing the same learning events with parallel theoretical perspectives, phenomenography and variation theory on the one hand and situated learning and position theory on the other hand, in relation to a pragmatic aim of improving university science teaching and learning and in relation to a research-framed aim of understanding learning processes in science education.

What can be learned by whom in groups discussing physics? This paper offers results based on empirical material from small groups of university students discussing and solving physics problems in Newtonian mechanics. In addressing the question, we have foregrounded aspects in relation to the knowledge content. However, in order to more fully understand the situation, we have applied two distinct analytical frameworks – variation theory and position theory – which are primarily focused on how the learning possibilities are constituted in the group discussion and the discursive and social aspects of the group work, respectively. The purpose of this paper is to discuss the results offered by the two analyses in relation to each other, and what conclusions we might draw for learning science in groups at university.

The empirical material concerns natural small groups formed within pedagogical settings in Swedish university teaching in a first-year engineering context. Discussion meetings, with a selection of groups of three to four students, were audio and video recorded and the subsequent analyses relies on detailed transcriptions and the students' notes as well as the original recordings. The seven groups were distributed across two engineering programmes – Engineering physics and Bioengineering – that both took a course in mechanics with equivalent content and partially the same teachers. The problems discussed concerned force and friction.

In the first analysis, we characterize possibilities for learning in group work as a function of the pedagogical situation (primarily in terms of the design of the task and the group format) taking variation as the basic mechanism for learning. Variation theory, originating from the phenomenographic research tradition, offers tools (see Booth & Hult  n, 2003; Ingerman, Linder & Marshall, 2009; Marton & Booth, 1997; Marton & Tsui, 2004) to understand how the students, working in groups, constitute their space of learning. We look at the object(s) of learning – potentially in the task and empirically activated by the students – classify the kind of possibilities the students develop in terms of (patterns of) variation in dimensions of variation, and look at how the students through experiences of relevance develop their understanding of the physics situation, as externalised in their discussion. We characterize the spaces of learning and associated patterns of variation constituted in the group work in order to explore what may be seen as important qualities (based on qualitative differences) of learning possibilities. The enacted space of learning is also analysed in relation to the potential space of variation of what the problem offers. In other words, we use phenomenography in two layers: one use variation theory as an analytical tool for analysing students' conversation in terms of objects of learning, patterns of variation (and in the end learning possibilities/learning) and one where more traditional phenomenographic thinking is used to look at qualitative differences between patterns of variation.

The seven groups are distributed across two Master's programs at the same University of Technology in Sweden, and we discern some reoccurring differences between the two programs. The physics students tend to formalise the problem, giving possibilities for some learning, while the bioengineering students tend to focus quite more extensively in particular on contextualising the problem in other situations, thus pointing their learning possibilities differently.

In the second analysis, we characterise how the frame of the group work is constituted in the students' interaction. By using situated learning theory as a theoretical framework and positioning theory (Harr   & van Langenhove, 1999) as an analytic tool, we explore methodological grounds for describing the complex and dynamic processes of group work, focusing simultaneously on the person and the community and how they constitute each other. Our approach can be seen as a synthesis of individual and social views of learning.

The results are presented in terms of storylines, which can be said to reflect different facets of the practice represented in both the Engineering Physics program and the Bioengineering program. Further, they all represent 'narrative forms' that exist within this culture. Not surprisingly, the dominating storylines in our data deal with how the students handled the actual problem solving and how the students oriented themselves towards the task given.

These storylines resemble both how students narrowly focus on finding a correct solution to the physics problem as well as attempts to bring understanding for the physics behind the questions to the group. Other storylines deal with how the students position themselves and each other in relation to their communities. The task oriented storylines and the community constituting storylines are interlinked.

We will also discuss the basis for and implications of addressing the same learning events with parallel theoretical perspectives, phenomenography and variation theory on the one hand and situated learning and position theory on the other hand, in relation to a pragmatic aim of improving university science teaching and learning and in relation to a research-framed aim of understanding learning processes in science education.

The content of learning in interaction-oriented approaches to learning

This paper aims at taking part in the development of interaction-based approaches to studying learning in interaction. In focus are the differences in treatments of learning content in recent socio-cultural and conversation analytic studies of learning. Despite a growing interest in learning from approaches such as Conversation Analysis (CA) and interactional linguistics, the treatment of aspects of content in these analyses is still non-existing or at best limited. And despite increased collaboration between approaches focused on interaction, such as CA, and approaches focused on contents of learning, such as variation theory, the efforts have often had limited success. In this paper, we use parts of three sets of video recordings – mathematics teaching in eight grade, science in second grade, and pilot training – to demonstrate advantages and disadvantages of the different approaches. We argue that for an internally coherent approach, the most fruitful way to proceed is to consider content as an emically intrinsic aspect of participation, where the analysis to substantial extent can rely on epistemic stance displays by participants, carried out both verbally and nonverbally. This argument is made possible through the fine-grained participant perspective-based conversation analysis. The reported work also demonstrates how issues of topic and content can be integrated into micro-analyses of learning.

Within variation theory (Marton, Runesson, & Tsui, 2004), there has been a fruitful interest in addressing the question of what is learned. This theoretical and empirical development shares a long-standing interest for the content of learning with other approaches and draws especially upon the phenomenographic approach. However, variation theory research has not been focused on the interactional details of interaction.

In sum one can say that, interaction analyses of learning have not so far to a large extent pursued a stringent, empirical and precise way of reasoning on what is learned, and how differences in learning can be systematically discussed. In variation theory in turn, analyses of interaction have had a poor understanding of the detailed organization of the interaction studied, thus disabling its possibilities of understanding important aspects of how variation comes about.

Our approach here, supported by and generated in work with our data, is to continue already initiated work (Emanuelsson & Sahlström, 2008; Melander & Sahlström, 2009) at dissolving the dichotomy of what and how, by understanding topical orientation as a constituent aspect of participation (for this, we rely to a large extent on the later work of Charles Goodwin, i.e. 2000). Topic is in other words considered an intrinsic element of action. This is an understanding of content which obviously stands in sharp contrast to notions of content as a fixed pre-existing body to be learned, and to understandings of the children's learned content as something of a second-order outcome of the interaction. But it also stands in contrast to most of the prior CA research on learning, where participation generally has been conceptualized more or less solely within a sequential-structural framework.

We use parts of three sets of video and audio recordings – mathematics teaching in eight grade, science in second grade, and pilot training – to discuss ways of approaching learning content in interaction-based analytical approaches, such as Conversation Analysis and variation theory. The results show that when participants take part in interaction, they do not seem to be oriented to the dichotomy of what and how, but rather seem to simultaneously rely upon topical, sequential and other resources for establishing, sustaining and changing their situated understandings. In particular, topical orientation seems to provide a major resource for establishing longitudinal links between different interaction situations. The results of the analyses thus seem to support the proposed internally coherent approach. Analytically, a fruitful way for research on learning in interaction to proceed is to consider content as an emically intrinsic aspect of participation, where the analysis to substantial extent can rely on epistemic stance displays by participants, carried out both verbally and nonverbally. This argument is made possible through the fine-grained participant perspective-based Conversation Analysis.

To educational research, any development in relation to ways of treating how-what relationships is of immediate theoretical value. The results also contribute to the development of methods for studying learning.

Goodwin, Charles, (2000). Action and Embodiment within Situated Interaction. *Journal of Pragmatics* 32, 1489-1522.

Emanuelsson, J & Sahlström, F. (2008). The price of participation. Teacher Control versus Student Participation in Classroom Interaction. *Scandinavian Journal of Educational Research*, 52(2), 205-223.

Lave, Jean, Wenger, Etienne, (1991). *Situated Learning. Legitimate Peripheral Participation*. Cambridge University Press, Cambridge.

Marton, F., Tsui A. B. M., & Runesson, U. (2004). The space of learning. In F. Marton & A. B. M. Tsui (Eds.), *Classroom discourse and the space of learning* (pp. 3-40). Mahwah, NJ: Lawrence Erlbaum.

Melander, H. & Sahlström, F. (2009). In tow of the blue whale. Learning as interactional changes in topical orientation. *Journal of Pragmatics*, doi:10.1016/j.jpragm.2007.05.013 41:8, pp. 1519-1537.

SYMPOSIUM

EXPLAINING STUDY SUCCESS IN THE FIRST YEAR OF HIGHER EDUCATION

Chairperson: Jan Nijhuis, University of Maastricht, Netherlands

Organiser: Jan Nijhuis, University of Maastricht, Netherlands

Discussant: Bart Rienties, University of Surrey, United Kingdom

Study success in the first year is a major topic in higher education for several reasons; 1) it is an indication of study progress through the curriculum; 2) it can be an indicator of the quality of the students or the educational institute, and 3) the lack of study success results in dropout, which means a loss of money and time for both student and the society. This symposium will deal with research on factors influencing study success from different perspectives and different countries. Three empirical papers will be presented and discussed in this mini-symposium. The paper from Finland focuses on learning approaches and study success, the contribution from Belgium analysis the role of academic motivation and learning strategies; the paper from the Netherlands discusses the impact of adaptation as an explanatory variable for dropout. The findings are relevant for educational practice in terms of designing the learning

environment and student counseling. At a theoretical level the papers provide more insight in different factors influencing study success

Relationships between first-year law students' approaches to learning and study success

Anne Haarala-Muhonen, The University of Helsinki, Finland; Sari Lindblom-Ylänne, University of Helsinki, Finland

The present study explores first-year law students' study success in terms of earned study credits and grade point average, as well as the relationship between study success and approaches to learning, using a modified version of the Approaches to Learning and Studying Inventory. More than 550 first-year law students participated in the study. The students were divided into four clusters on the basis of their scores on scales measuring approaches to learning. The results showed significant differences among the clusters in terms of study success. Students applying a deep approach and Organised students earned the highest number of credits and the highest grades, whereas Students applying a surface approach and Unorganised students received the lowest. A more detailed analysis of students' study success showed that the profiles of the approaches to learning were more homogenous among successful students than less successful students.

A deep approach to learning has been suggested to be related to good study success, whereas a surface approach is more likely to be associated with poorer study success (Entwistle & Ramsden 1983; Entwistle et al. 2001; Watkins 2001). On the other hand, some studies have found no relation between a deep approach to learning and study success (Diseth, 2003; 2007; Rytkönen et al. 2009). Furthermore, a combination of deep and strategic approaches has been found among successful students (Entwistle et al. 1991; 2001, Lindblom-Ylänne & Lonka 1999; Meyer et al. 1990) as well as a deep-achieving combination (Biggs 1994; 1988).

Aim of the study

The aim of this study is, firstly, to explore first-year law students' study success from the point of view of both earned study credits and average grades and, secondly, to analyse the relationship between study success and different student groups representing various combinations of approaches to learning.

Method

The questionnaire used was a modified 18-item version of the Approaches to Learning and Studying Inventory (ALSI) which contains items relating to approaches to learning and studying (Entwistle & McCune 2004). Students were asked to response on a 5-point Likert scale to each item. The data were collected from the first-year law students after seven months of studying at the Faculty. A total of 553 first-year students answered the questionnaire from three different cohorts in 2005, 2006 and 2007. The response rate was very high (86.3%). The students were divided into homogeneous subgroups on the basis of their approaches to learning (18 items), using the latent profile analysis in a Mplus statistical program. Four clusters emerged from the data: 1) Organised students, 2) Students applying a deep approach, 3) Students applying a surface approach, and 4) Unorganised students applying a deep approach. The clusters and their features are presented in Table 1. The same cluster structure has been used in a previous study at the University of Helsinki (Parpala et al. 2010).

The students' study success was measured in two ways: by using the number of earned study credits (ECTS= European Credit Transfer System) and the grade point average (GPA). In order to clarify students' study success in more detail, the students were divided in to three equal-sized groups on the basis of their earned study credits and average grades

Findings

The MANOVA analysis showed that the clusters ($f^2 = .034$) significantly explained the variables of study success. Moreover, the univariate analysis (ANOVA) showed that study success variables, study credits ($p = .044$) and study grades ($p = .038$) were significant although the effect sizes remained small. Further, a Scheffé's post-hoc test showed that Students applying a deep approach were the most successful whereas Students applying a surface approach earned significantly less study credits and achieved the lowest grades.

Figure 1 clearly shows in more detail that the relationship between the clusters and study success was not straightforward; all four clusters are represented in all study success groups. The Organised students cluster was relatively constant in every group. The profiles of the good study success groups ECTSaverage/GPAhigh, ECTShigh/GPAaverage and ECTShigh/GPAhigh were very similar. However, there was more variation between the poor study success groups. The groups ECTSslow/GPALow, ECTSslow/GPAaverage and ECTSaverage/GPALow were compatible regarding the Students applying a surface approach and Unorganised students applying a deep approach, whereas the profiles were different in Students applying a deep approach. Further, the profiles in the group ECTSslow/GPAhigh and group ECTShigh/GPALow clearly deviated from the other low study pace groups.

Theoretical and educational significance

Our results are in line with previous studies where a deep approach and organised study methods have been shown to be related to good study success and surface approach to poor study success (Entwistle & Ramsden 1983; Lindblom-Ylänne & Lonka 1999; Vermunt & Van Rijswijk 1988; Watkins 2001).

This more detailed method using nine study success groups showed a variation in terms of study success in each cluster group, and for example Students applying a surface approach were represented in all study success groups, not only among the poor study success groups. This indicates that other factors as well are related to students study success, such as personal characteristics, motivation and family life (Haarala-Muhonen et al. in press; Pintrich 2000). However, our results showed that the profiles of successful students were more homogeneous than the those of students with poor study success. In particular, students' profiles in groups ECTSlow/GPAhigh and ECTShigh/GPALow differed from other profiles of poor study success groups. Similar results has been shown in a previous study where fast and slow study pace law students were interviewed (Haarala et al. in press).

The participants of this study were first-year students' and their transition to the Faculty was incomplete. Therefore the students might not yet have recognised the demands of the teaching-learning environment and their approaches to learning may not have been fully established (Biggs 1993; 2003; Entwistle et al. 2001; Entwistle 1988; 2009; Richardson 2005). During part of this study teacher tutor counselling had begun at the Faculty and the teacher tutors were expected to enhance the first-year students' adjustment to the new teaching-learning environment and promote a clearer understanding of the course requirements and academic skills needed at the Faculty.

Academic motivation, learning strategies and first year students' study progress

David Gijbels, University of Antwerp, Belgium; Gert Vanthournout, University of Antwerp, Belgium; Liesje Coertjens, University of Antwerp, Belgium; Vincent Donche, University of Antwerp, Belgium; Peter Van Petegem, University of Antwerp, Belgium

The present study explores whether learning strategies and academic motivation predict persistence and study-progress in the first year of higher education. 780 Students in a professional bachelor teacher-training programme participated in this study. Students' motivation and learning strategies were assessed using the Learning and Motivation-questionnaire. Logistic regression and linear regression were applied to predict persistence and study-progress respectively. In each case a stepwise approach in data-analysis was used. First, the direct effects of learning strategies and motivation were explored. Second, significant predictors from the initial models were combined into a more encompassing model. Finally, student-characteristics were added to this model. Results on persistence indicate that concrete processing, analysing, lack of regulation and lack of motivation are significant predictors. When these predictors are combined into one model, only concrete processing and lack of motivation are retained. When student-characteristics are added to the model, gender proves to be an additional predictor. After controlling for student-characteristics the effect of concrete processing became non-significant. The final model explains 6.5% of variation in persistence. For study-progress results show that relating and structuring, external regulation, lack of regulation and lack of motivation are meaningful predictors for study-progress. Both gender and study delay are additional significant predictors. The final model explains 8.6% in the variance of study-progress. Results show that learning strategies and motivation are small, but significant factors in predicting study-progress and persistence, in addition to student-characteristics. Especially dimensions signifying 'a lack of' appear to be important indicators. Predicting these outcomes, however remains complex.

Aims

Recently, there is an increasing research-interest in students' persistence and study-progress in the first year of higher education (Berge & Huang, 2004). Previous studies showed that student-characteristics and academic motivation are significant predictors of persistence (e.g. Tinto, 1993; Allen, 1999) and study-progress (e.g. Hofman & Van den Bergh, 2000). It is likely, however, that the quality of student learning also influences these outcomes. However, students' learning strategies have only scarcely been related to persistence or study-progress. Moreover, as initiatives aimed at decreasing drop-out and increasing study-progress in first year of higher education, often focus on enhancing the quality of learning and motivation, it seems valuable to investigate whether and how strongly these variables are linked to persistence and study-progress. This study aims to explore the predictive value of learning strategies and academic motivation for persistence and study-progress in the first year of higher education. The following research questions are addressed: · (RQ1) Do students' learning strategies and motivation at the start of higher education predict students' persistence in their first year; · (RQ2) Do students' learning strategies and motivation at the start of higher education predict students' study-progress in their first year; · (RQ3) To what degree do students'

learning strategies and motivation at the start of higher education predict their persistence and study-progress in their first year, after controlling for other students-characteristics (gender, prior education, study delay).

Methodology

Participants were 780 first year students enrolled in a professional bachelor teacher-training programme. Students were questioned on their motivation and learning strategies using the Learning and Motivation questionnaire (Donche & Van Petegem, 2010). This instrument combines adapted scales from Vermunt's Inventory of Learning Styles (Vermunt, 1998) with adapted and selected items and scales from the Academic Self-Regulation Scale (Ryan and Conell, 1989) and the Academic Motivation Scale (Vallerand et al., 1997). Persistence is measured through the fact whether a student re-enrolled in the same program for the next academic year. Study progress is defined as the ratio between the amount of study credits a student obtained after the first year and the total amount of credits the student was enrolled in during that first year. Prior education refers to the type of secondary education a student was enrolled in. A distinction was made between general, technical and vocational prior education. Study delay alludes to whether the student encountered any delays during his or her prior education. Information on student-characteristics, enrolment and study-progress was obtained through the student administration office. Logistic regression was applied for analyses with persistence as dependent variable and linear regression was used for analyses on study-progress. In each case, a stepwise strategy in data-analysis was used. In a first step the 'unique/direct' effects of processing strategies, regulation strategies and motivation on persistence or study-progress were investigated. In a second step significant predictors from the first step were brought together into a more encompassing model. In a final step, the students-characteristics were added to this model.

Results

Results of the logistic regression analyses show that concrete processing and analyzing are cognitive processing strategies that significantly predict persistence. Students who apply the learning-content onto real-life situations and students who thoroughly work themselves through the learning content have a higher chance of persisting in their first year. Lack of regulation proved to be the single significant regulation strategy. Students who experience problems in regulating their learning process have a higher chance of dropping out. With regard to motivational factors, analyses demonstrate that students who lack motivation have a lower chance of persisting. When these variables are brought together in a single model, only concrete processing and lack of motivation are retained as significant predictors. Lack of regulation proved marginally significant. The entire model explains about 5% in of the variation in persistence. When student-characteristics are added to this model, gender was found to be a significant predictor. Female students have a higher chance of persisting in their first year. As a result of the addition of student-characteristics, the effect of concrete processing became non-significant. The third model explains 6.5% of the variation in persistence. Results of the linear regression on the cognitive processing strategies indicated that relating and structuring as a deep processing strategy significantly predicts study-progress.. For regulation strategies, both external regulation and lack of regulation were found to be significant predictors. Students who are more teacher-dependent when learning obtain more credits, while students who report problems in regulating their learning processes, acquire less credits. Finally, students who generally lack motivation for the program, have a slower study-progress. When these significant predictors are combined in one model, they all remain significant, except for external regulation. The model explains 5% of the variance in study-progress. When adding student-characteristics, both gender and study delay proved significant predictors. Female students and students without a delay in their prior education, progress faster. All learning strategies and motivational factors are retained as predictors. The final model explains 8.6% in the variance of study-progress.

Significance

Results of our analyses show that learning strategies and motivation are small, but significant factors in predicting study-progress and persistence in the first year of higher education, in addition to student-characteristics. Especially dimensions signifying 'a lack of' appear important indicators and seem to be meaningful factors regarding the boundary crossing between first and second year in higher education. The actual quality of learning strategies or motivation seems to matter less in this stage. For research, these results show the value of combining various factors in predicting persistence and progress, but also raise new research-question, e.g. how to enhance these outcomes through instructional methods or study trajectory-coaching For practice, they show the complexity of factors determining in whether students persist or not in the first year. Moreover, they provide practitioners with a glimpse on what factors actually determine study-success in the first-year of higher education.

The grass is greener abroad? The impact of adaptation on dropout; local versus foreign students.
alexandra niculescu, Maastricht University, Netherlands; Jan Nijhuis, University of Maastricht, Netherlands

Dropout in higher education is an issue of emerging interest. In the context of ongoing internationalization and globalization, dropout among international students is nowadays recognized as a reason of particular concern. One of the key factors in explaining dropout is how students are able to adapt in a period of transition. The present study analyses the impact of adaptation in a new learning environment as an explanatory variable for student learning and dropout. The participants were a cohort of 521 Dutch and German students in their first year of bachelor studies at a Dutch University, who were asked to answer the Student Adaptation to College Questionnaire (SACQ). The results of both logistic and linear regression analyses indicate two separate effects of nationality and adaptation on the students' marks and dropout. Being German has a positive effect on the probability of dropping out yet, a positive impact on marks. Furthermore, we found that although nationality is a relevant predictor for the personal-emotional and social adaptation, it is the academic adjustment which explains students' dropout and marks most. Overall, adaptation plays a role, but not as an explanatory variable for the mechanism by which nationality has an impact on students' marks and the probability of dropping out.

Dropout in higher education is an issue of emerging interest. For example, in The Netherlands, a substantial proportion of students who enroll in a study program are leaving university without completing the 1st year (Beekhoven, de Jong & van Hout, 2003; van den Berg & Hofman, 2005). However, dropout is not only a problem in Europe but also worldwide (OECD, 2009). One of the key factors in explaining dropout is how students are able to adapt in a period of transition (Baker & Siryk, 1999). Nowadays, higher education systems are stimulated by government measures to attract foreign students and, at the same time, to encourage local students to gain experience abroad (European Commission 2009). In this context, dropout among international students is recognized as a reason for concern (OECD, 2009). Students studying abroad face not only problems with the transition from high school to university, but have also to adapt to another country. As Tinto (1987) argues, individuals enter institutions with a variety of personal attributes (such as nationality) which can directly impact their adaptation. However, the majority of studies on adaptation were conducted in national samples in the US and only recently, concerns were raised if international students are confronted with the same problems when studying in a new learning environment (Morrison et al., 2005). Although students from abroad may have adaptations problems, it is also known that foreign students sometimes perform better than local students (Tempelaar et al., 2006). Aim and research questions This study analyses the impact of adaptation in a new learning environment as an explanatory variable for student learning and dropout. Therefore we are interested in the following research questions: To what extent does students' adaptation mediate between nationality and dropout? To what extent does students' adaptation mediate between nationality and study marks?

Method

Setting and sample The research setting was a faculty of Economics and Business at a Dutch University, which offers an international program, having English as the language of instruction and a large proportion of students coming from abroad. The participants were a cohort of 521 Dutch and German students in their first year of bachelor studies. The students were asked in November 2007 to complete a questionnaire about their first impressions on university life. **Measures** Information about nationality was collected through the university database. Adaptation was measured through the Student Adaptation to College Questionnaire (SACQ) developed by Baker and Siryk (1999). For the purpose of the present study, dropout was defined as students who leave university without completing the first year. In order to have more variance in the output variable, instead of only dropout information, we also used the marks a student acquired over the academic year. Information of study results was also available via the university database.

Analysis

A series of linear and logistic regressions were carried out to test each of the four criteria mentioned in the Causal Steps approach (Baron & Kenny, 1986). First we checked the zero-order correlations between nationality and outcome variables, dropout and marks. Second we checked the relation between nationality and adaptation domains. Next we conducted a hierarchical regression, predicting the outcome variables, dropout and marks from nationality and adaptation. We then looked at the partial effect of adaptation (controlling for nationality). Fourth we analyzed the direct effects of nationality on the dependent variables, dropout and marks.

Findings

The results of the logistic regression looking for the extent to which nationality influences students' adaptation, which in turn determines the probability of dropping out, provided no evidence for the adaptation variable acting as a mediator. There was indeed a significant relation between students' nationality and dropout, in the sense that being German had a positive effect on the probability of dropping out. Nationality was significantly related to some of the adaptation domains, namely German students were less Personal-Emotional but more socially adjusted than their local colleagues.

When all the variables were tested in one model, after controlling for nationality in step 1, in step 2 was tested the effect of each of the adaptation domains on dropout. In the first step we entered nationality. This model explained 3.8% variance in a student's probability of dropping out. When the adaptation domains were added in step 2, so controlling for nationality, the academic adjustment was the only significant predictor. In other words, students who were more academically adjusted had a lower chance of dropping out. This model explained 14.1 % variance in dropout. The results of the linear regression testing the marks against all the adaptation domains are similar to the findings of the logistic regression. In step 1 we entered nationality and this model explained 5.3 % variance in students' marks. This time, being German had a positive impact on the marks. When the adaptation domains were added in step 2, again only the academic adjustment was a significant predictor of study results. This model was able to explain 17.1 % variance in students' marks. However, since no relation was found initially between students' nationality and their academic adjustment – as required by the Baron & Kenny (1986) approach, there was no evidence for a mediation effect.

Educational and Theoretical Significance

Both analyses indicate two separate effects of nationality and adaptation on the students' marks and dropout. These findings imply that although nationality is a relevant predictor for the personal-emotional and social adaptation, it is the academic adjustment which explains students' dropout and marks most. From an educational perspective the results indicate that in order to reduce dropout it might be worthwhile to design interventions that improve students' academic adjustment. From a theoretical perspective the assumed mediating effect of adaptation on dropout is not present. Furthermore, the role of nationality in our particular educational context deserves consideration. It is probably the case that the German and Dutch differ in some aspects that influence the adaptation, such as the fact that foreign students already made a choice to study abroad. Overall, adaptation plays a role, but not as an explanatory variable for students' marks and dropout.

SYMPOSIUM

The Individual and the Social in Democratic Citizenship Education

Chairperson: Horst Biedermann, University of Fribourg, Liechtenstein

Organiser: Wiel Veugelers, University of Amsterdam, Netherlands

Discussant: Wiel Veugelers, University of Amsterdam, Netherlands

Central issues in citizenship and in citizenship are the interplay between the individual and the social, and the relation of the moral and the political. In theory, in practice and in empirical research people are analyzing the interplay of these concepts. Their interrelatedness shows the kind of citizen people are oriented to and teachers' methodology and learning processes and outcomes of students. Three papers address these issues. The aim of the study of Pnevmatikos and Papadopoulou was to investigate whether schoolchildren and adolescents who adopt collectivist attitudes hold different beliefs on how they resolve contradictions than individualists. They found that the more collectivist the attitudes, the more possible it is for them to compose contradictions and accept a solution in the middle. Biedermann and Oser ask how politic can be combined with morality. They use data from the ICCS 2009 with approximately 130 000 8th grade students (38 countries). Based on the ICCS-results they explore in an interpretative frame why lower rating of value related issues have a moral core. Veugelers found in several empirical studies differences in the combination of autonomy and social involvement which resulted in different types of citizenship and citizenship education. In this paper he will focus on how the academic subjects pedagogy, sociology and psychology contribute to these outcomes. And how they could contribute to a more democratic type of citizenship. In the papers and in the discussion the focus will be on the relationship of the individual and the social, and of the moral and the political.

The interplay between individual and social aspects in children's and adolescents' beliefs about how

Dimitris Pnevmatikos, University of Western Macedonia, Greece, EIRINI PAPADOPOULOU, UNIVERSITY OF WESTERN MACEDONIA, Greece

The way people resolve contradictions within a democratic society is of great importance. Attitudes towards collectivism and individualism as well as the accompanied holistic and analytical reasoning respectively are considered amongst the possible factors that influence the way individuals resolve contradictions. The aim of the present study was to investigate whether schoolchildren and adolescents who adopt collectivist attitudes hold different beliefs on how they resolve contradictions in a different way than individualists. 308 schoolchildren from 10 to 18 years old participated in the study. A well-structured questionnaire consisting of three subscales was used to explore participants' attitudes towards collectivism, individualism and beliefs towards contradiction. The Pearson correlation revealed significant positive correlation between contradiction and collectivism scale and a negative significant

correlation between contradiction and individualism scale. In other words, the more collectivist the attitudes are held by individuals, the more possible it is for them to compose contradictions and accept a solution in the middle. In contrast, the more individualistic the attitudes are held by individuals, the less effort is endeavored to manipulate contradictions and construct a synthesis of two aspects being found in a contradiction. ANOVAs revealed that children and females are more collectivists than the adolescents and males, and children less individualists than adolescents. Females across all age groups were found to be more tolerant towards contradictions than males. Implications for the education are discussed.

Introduction

The way people resolve contradictions is of great importance within any society. Attitudes towards collectivism and individualism and the holistic and analytical reasoning respectively are considered amongst the possible factors that influence the way individuals resolve contradictions. Nisbett and his colleagues (Nisbett, Peng, Choi, & Norenzayan, 2001) described two modes of reasoning that characterize West and East cultures: holistic vs. analytical reasoning. Holistic reasoning, a characteristic of collectivistic societies, is characterized by an orientation to the field as a whole involving attention to relationships between a focal object and the field, and a preference for explaining and predicting events on the basis of such relationships. Furthermore, the preference for holistic approaches to rely on experience-based knowledge than to abstract logic have as a result for individuals with holistic tendencies to be dialectical and tolerant since the emphasis is given on the dynamic and changeable aspect of the reality than to its static one. As the change is constant and inherent part of the nature and the emphasis is given on the change, there is a need for multiple perspectives. Therefore, contradictions are expected while they are acceptable and constant as well. Contradictory propositions may both contain some truth, and there is a need for searching the "Middle Way" between opposing propositions. On the contrary, analytic reasoning, a characteristic of individualistic societies, is characterized by a detachment of the object from its context, a tendency to focus on attributes of the object in order to assign it to categories, and a preference for using rules about the categories to explain and predict the object's behavior. Therefore, the need for decontextualization of structure from the content and the emphasis on logical consistency press individuals to avoid contradictions.

Modern societies are characterized by pluralism and the phenomenon of globalization has transformed the cultural entities into non-homogeneous ones. Thus, there is an increased interest to investigate the differences that appear between the East and West, within West or East contemporary societies or even between subgroups within the same national group. For instance, Loose (2008) showed that although French parents appreciate individualism in their children, French teachers devalued the expression of individualism for their students and encouraged more relatedness and taking others into consideration.

Aims and hypotheses:

The aim of the present study was to investigate the possible effect of attitudes towards collectivism and individualism to beliefs on the best way to resolve contradictions in childhood and adolescence. It is predicted that collectivists should denote more tolerant ways to resolve contradictions than individualists. Moreover, we were interested to examine possible differences in their attitudes as children are growing up, as well as possible gender differences.

Method

Participants: 308 schoolchildren and adolescents from five age groups (10-, 12-, 14-, 16- and 18-year-old) participated in the study.

Instruments: A well-structured questionnaire consisting of three subscales was used to explore participants' attitudes towards collectivism (10 items, $\alpha = .72$), individualism (9 items, $\alpha = .65$) and beliefs towards contradiction (5 items, $\alpha = .69$). Collectivism and individualism subscales come from the INDCOL scale (Singelis, Triandis, Bhawuk, Gelfand, 1995; Triandis, 1996). The subscale "contradiction" comes from the Analysis-Holism Scale (AHS) constructed by Nisbett and his colleagues (2001). Participants were asked to express their point of agreement or disagreement on a 5-point scale (1=strongly disagree, 5=strongly agree).

Findings

Three Univariate Anovas applied to the data [5 (age group) x 2 (gender)] using the means of the three subscales as a dependent variable. Children were found to be more collectivists than adolescents ($F(4,308)=2.823$, $p=.025$, $\eta^2p2=.037$) and females more collectivists than males ($F(1,308)=17.241$, $p.001$, $\eta^2p2=.055$). No significant interaction was found between age and gender ($F(4,308)=.341$, $p=.850$, $\eta^2p2=.005$). Moreover, children were found to be less individualists than adolescents ($F(4,307)=7.144$, $p.001$, $\eta^2p2=.088$), while no significant difference was found between males and females ($F(1,307)=2.078$, $p=.150$, $\eta^2p2=.007$), nor significant interaction between age and gender ($F(4,308)=1.580$, $p=.180$, $\eta^2p2=.021$). Finally, participants' attitudes towards contradictions did not differ across the examined age groups ($F(4,308)=1.137$, $p=.339$, $\eta^2p2=.015$). In general, however, females ($M=3.65$,

SD=.82) reported to be more tolerant towards contradictions than males ($M=3.65$, $SD=1.01$) ($F(1,308)=10.167$, $p=.002$, $\eta^2p2=.033$) and this difference was stable across the age groups ($F(4,308)=1.971$, $p=.099$, $\eta^2p2=.026$). The Pearson correlation revealed significant ($pr=.562$) between contradiction and collectivism scale and a negative significant ($pr=-.298$) between contradiction and individualism scale.

Based on the ascending mean scores on the collectivism and individualism subscales we divided participants in two equal groups, representing the low and high collectivists ($n_{Low}=157$, $n_{High}=151$) and individualists ($n_{Low}=157$, $n_{High}=150$) respectively. Two one-way Anovas were conducted using the means on attitudes towards contradictions subscale as dependent variable and the two levels (low vs. high) we created on the collectivism and individualism subscales. As it was expected, high collectivists ($M=4.22$, $SD=.75$) were found to be more tolerant towards contradictions than the low ($M=3.44$, $SD=.92$) collectivists ($F(1,307)=65.272$, $p.001$). On the contrary, high individualists ($M=3.63$, $SD=.95$) were found to be less tolerant towards contradictions than the low ($M=3.99$, $SD=.87$) individualists ($F(1,306)=11.988$, $p=.001$).

Discussion

As it was predicted, collectivists were found to be more tolerant in resolving contradictions than the individualists. In general, the more highly collectivists the individuals are, the more tolerant to their attitudes towards contradictions they are, compared to low collectivists. The above correlation was found to be evident within all age groups and gender.

The high correlation between collectivist attitudes and tolerance towards resolving contradictions, especially during childhood and among females, allow us to stress out the importance of implementing teaching practices that could enhance children's attitudes towards collectivism. This enhancement could help them to develop more open-minded attitudes and be more tolerant to their everyday life. One of the important aims of the primary education should be the establishment of collectivistic attitudes and every relevant collectivist aspect, so when later in their lives adolescents step to more individualistic attitudes, they will keep their tolerance as an efficient way of thinking.

The Impact of Political Thinking on Morality and Politics of a Society

Horst Biedermann, University of Fribourg, Liechtenstein; Fritz Oser, Universitat Freiburg, Switzerland

In recent years primarily developmental psychologists and later on educational psychologists accepted that different domains have each an independent core structure. Thus political thinking is not the same like moral thinking or social reflecting etc.; and this because of the underlying basic reference. With other words to solve a moral problem refers to different needs as justice, care, and truthfulness; whereas political thinking refers to power, law enforcement and to the concept of maintaining democracy. In 2009, Biedermann and Oser presented empirical evidence that the two structures of thinking and judging are uncorrelated. – In this presentation we explore this topic from the opposite. For instance we ask how low acceptance of gender equality can be morally framed (or blamed). This is not an easy approach: on the one hand it refers to comparative data where different countries have different political and value conceptions; on the other hand it requires interpretative processes (as judging a certain attitude or behaviour in itself – quasi from an universal point of view – as morally problematic. – In this paper we use data from the ICCS 2009 with approximately 130 000 8th grade students (38 countries). Based on the ICCS-results we explore in an interpretative frame why lower rating of value related issues have a moral core and need to be judged from this different point of view. We will elicit the difficulties and pitfalls to do so.

Researchers from different psychological convenience begin to accept that domain differences become a very subtle scientific issue (see Nucci, 2006). At the 13th Biennial Conference EARLI 2009 in Amsterdam we asked whether moral judgment is correlated with political thinking respectively aspects of political identity. Based on a quantitative study (IEA CIVED older population: 1270 16- to 18-years old students in Switzerland) and a qualitative study (Development of Political Understanding: 40 22- to 60-years old people) our main finding revealed no meaningful relationship (Oser & Biedermann 2009). Considering these findings our then-hypothesis, that the moral judgement and political judgment have their own cognitive structures and therefore their own categories of thinking took corroboration. In this presentation we would like to go in the opposite direction asking how politic can be combined with morality without being either an "unhappy moralist" or a "blind politician".

Recently initial findings of the IEA-Study ICCS (International Civic and Citizenship Education Study) were published (Schulz et al., 2010; Biedermann et al. 2010). ICCS studied "the ways in which countries prepare their young people to undertake their roles as citizens" (Schulz et al., 2010, p. 9). Thereby it investigated student knowledge and

understanding, attitudes, perceptions, and activities related to civics and citizenship in 38 countries. As one important finding ICCS provided the thinking of students about civic society and their roles as citizens. With regard to gender equality, equal rights for immigrants, and attitudes towards the own country as well as the perception of the importance of conventional citizenship, perception of the importance of social movement related citizenship, and interest in political or social issues parameter values varied across countries; similar to the situation in CIVED about ten years ago (Torney-Purta et al., 2001). Does it mean, being very low in these important political issues, that these kids are less morally sensitive? Can we infer from results comparing country means in political thinking to moral judgment?

The purpose of this paper is to interlink (a) our finding about the two different cognitive structures of political and moral thinking and (b) the thinking of students about civic society and their roles as citizens. We discuss the political, moral and social impact of political attitudes and thinking in an international perspective.

Methodology

The paper is based on the random sample of ICCS. In 2009 ICCS gathered data from more than 140'000 Grade 8 students (approximately 14 years of age) from 38 countries (five from Asia, 26 from Europe, six from Latin America, and one from Australasia) (Schulz et al., 2010). The ICCS assessment framework was organized around the three dimensions (a) content domains (civic society and systems, civic principles, civic participation, and civic identities), (b) cognitive domains (knowing, and analysing and reasoning) and, (c) affective-behavioural domains (value beliefs, attitudes, behavioural intentions, and behaviours). As aforementioned in this paper we focus on value beliefs and attitudes. All scale considered have an international mean of 50 points and a standard deviation of 10 points.

Results and conclusion

In ICCS we find wide differences between countries regarding student political attitudes and value beliefs. For instance almost all students agree with gender equality, and also the average students in all participating countries tended to agree with equal rights for immigrants. However, there were considerable differences among countries. With respect of gender equality support was highest in Chinese Taipei, Sweden, Spain, Ireland, Denmark, and Norway (scores 54 and 55). Lowest scale score were found in Indonesia, Thailand, Dominican Republic, and Russian Federation (44 and less points). With regard to students' attitudes towards equal rights for immigrants Chinese Taipei, Mexico, Colombia, and Chile, had the highest mean scores (54 points at least). In contrast Belgium (Flemish), England, Indonesia, and Latvia had the lowest national averages (47 and less points). Finally concerning interest in political or social issues there also is wide variation between countries: the highest levels of student interest were found in the Dominican Republic, Guatemala, Indonesia, and Thailand (55 points at least); the lowest interest scores had Belgium (Flemish), Finland, Norway, Slovenia, and Sweden (47 and less points).

Unquestionable, ICCS provided interesting descriptions and comparisons of students' political and social thinking in different countries. But what is the political and morally impact of a country for instance when their next generations little endorse equal rights for immigrants little, express attitudes towards their country moderate, agree with importance of social movement related citizenship moderate, and express interest in political or social issues moderate as in Switzerland? And what does it mean politically and morally when young people value high gender equality, equal rights for immigrants, when they are on one hand interested in political or social issues highly, but on the other express positive attitudes towards their country only little as in Chinese Taipei? As one example only, it seems morally problematic to not accept the integration of immigrants, but from the political will of the nation this issue is taboo. Can we say this people is political positively active, but immorally in the deepest meaning of the word? When can we frame politically criticism as immoral? How can we set limits to the respective "democratic will"?

In this regard we explore why lower rating of attitudes and value beliefs have a moral core and therefore need to be judged from different points of view. Concerning this matter we introduce the concept of "framing politically or morally" as one solution possibility, the concept of "political share" as an other one. The presentation ends with conclusions and recommendations with regard to civic education.

Biedermann, H., Oser, F., Konstantinidou, L. & Witorski, D. (2010). Staatsbürgerinnen und Staatsbürger von morgen: Zur Wirksamkeit politischer Bildung in der Schweiz. URL: www.unifr.ch/pedg/iccs/bericht1.pdf.

Oser, F. & Biedermann, H. (2009). Morality and Civics: Two Powerful Domains Each Having its Own Basic Core ("Mother" structure). Paper presented at the 13th Biennial Conference Earli 2009, Amsterdam, August 25 - 29, 2009.

Schulz, W., Ainley, J., Fraillon, J., Kerr, D. & Losito, B. (2010). Initial Findings from the IEA International Civic and Citizenship Education Study. Amsterdam, The Netherlands: International Association for the Evaluation of Educational Achievement (IEA).

Torney-Purta, J., Lehmann, R., Oswald, H., & Schulz, W. (2001). Citizenship and education in twenty-eight countries. Amsterdam, The Netherlands: International Association for the Evaluation of Educational Achievement (IEA).

Autonomy and Social Involvement in Practice and Theory of Citizenship Education

Wiel Veugelers, University of Amsterdam, Netherlands

Citizenship education is a concept encountered in many discussions and publications. This concept though is often very differently addressed in politics, in conversations in schools, in public opinion and among scholars. Also pedagogical goals and educational practices differ. In our empirical studies we could distinguish between three types of citizenship: adaptive, individualizing and critical democratic citizenship (Veugelers, 2007; Leenders, Veugelers, & De Kat, 2008a, 2008b). These three types have different combinations of clusters of pedagogical goals: discipline, autonomy and social involvement. It is remarkable that parents, teachers and students alike, evaluate that the cluster of discipline is better learned than the clusters of autonomy and in particular social involvement.

In analyzing these results we look at different levels. In educational practice we analyze the results from the point of view of social and cultural diversity and the way school culture reflects society and functions as a learning environment for citizenship education. At the system level, we consider: the educational policy discourse; curriculum policy; civil society; autonomy of schools; differences between schools, and the pedagogical discourse. In the paper we will focus on the pedagogical discourse in different academic disciplines: pedagogy, sociology and psychology.

Introduction and Method

It is often suggested that everyone attaches the same meaning to citizenship, that we all know what good citizenship is. In many empirical studies though, we have found that there are different understandings of citizenship education. We find these differences among teachers, school leaders, parents, and students as well. In our data-analysis we could distinguish between three types of citizenship: adaptive, individualizing and critical democratic citizenship (Veugelers, 2007; Leenders, Veugelers, & De Kat, 2008a, 2008b). These three types have different combinations of clusters of pedagogical goals: discipline, autonomy and social involvement. The adaptive type combines discipline and social involvement, the individualizing type combines autonomy and social involvement, and the critical democratic type combines discipline and social involvement.

It is remarkable that parents, teachers and students alike, indicate that the cluster of discipline is more easily realized than the clusters of autonomy and in particular social involvement. A survey among teachers in secondary education showed that 53 % of the teachers aim at a critical democratic type of citizenship, 39 % at an adaptive type, and 18 % at an individualizing type. In vocational education the emphasis was slightly more on adaptation, while in pre-university education an individualizing type was slightly preferred (Leenders e.a., 2008a).

The three types of citizenship education have a differing emphasis in their goals and are connected with differing pedagogical and didactical practices. Methodically, the adaptive type emphasizes the transfer of values and the regulation of behavior; the individualizing type independent learning and developing critical thinking, and the critical democratic type cooperative learning and developing critical thinking through inquiry and dialogue (Veugelers, 2007). Westheimer and Kahne (2004) found a similar three-split (see also Westheimer, 2008 and Johnson & Morris, 2010). They identify a personally responsible citizen, a participating citizen and a citizen who strives for social justice. These studies show that developing citizenship is not a linear process from passive to active, but that citizenship can have different meanings.

In analyzing these results we look at different levels. In educational practice we analyze the results from the point of view of social and cultural diversity and the way school culture reflects society and functions as a learning environment for citizenship education. At the system level, we consider: the educational policy discourse; curriculum policy; civil society; autonomy of schools; differences between schools, and the pedagogical discourse. In the paper we will focus on the pedagogical discourse in different academic disciplines: pedagogy, sociology and psychology.

The dominant pedagogical discourse in Dutch secondary education is a combination of child centred, advancing personal autonomy, and an individualized form of equal opportunity thinking. These pedagogical accents are also promoted in academic disciplines. In pedagogy the center stage is taken by the individual and his development and well-being. In educational psychology it was until recently that self-regulated learning was dominant. A more social and dialogical oriented organization of learning processes hardly received any attention. Sociology of education is characterized by promoting individualization by a strong focus on selection and equal opportunities and the complete disappearance of any attention for socialization processes and outcomes and for curriculum issues.

Presently it seems that a rectification might be underway in those academic disciplines, possibly out of criticism on over-the-top individualization in Dutch society. The problem though lies as much at a more theoretical level, where the individual is disconnected from the social, where the person is not situated and society is not characterized by connections and social and political power relations but by a total of freely floating individuals (Mouffe, 2005).

The individual oriented pedagogical discourse even in its advanced contemporary expressions does not succeed to make practical connections between the individual and the social. Attention for the social is demanded within the dominant approach of individualization. Therefore this attention for the social will remain limited to regulating in an instrumental way the behaviors between individuals. From the perspective of democratic citizenship it would be desirable to regard the individual as being situated and connected. This means a central place for democracy, not only as a political concept but as a life-style or 'way of life' (Dewey, 1923). For education this means more learning, inquiry and dialogue in groups, society-oriented by connecting persons and institutions, also outside one's own community, analyzing persons in their social and political power relations, and empowering all students not only the elite..

Bandura, A. (Ed.). (1995). *Self-efficacy in changing societies*. Cambridge: Cambridge University Press.

Banks, J. A. (Ed.). (2004). *Diversity and citizenship education*. San Francisco: Jossey-Bass.

Dewey, J. (1923). *Democracy and education*. New York: Macmillan.

Giroux, H. A. (1989). *Schooling for democracy*. London: Routledge.

Haste, H. (2004). Constructing the citizen. *Political Psychology*, 25, 3, 413-440.

Johnson, L., & Morris, P. (2010). Towards for a framework for critical citizenship education. *The Curriculum Journal*, 21, 1, 77-96.

Leenders, H., Veugelers, W., & Kat, E. de (2008a). Teachers' views on citizenship in secondary education in the Netherlands. *Cambridge Journal of Education*, 38, 2, 155-170.

Leenders, H., Veugelers, W., & Kat, E. de (2008b). In Oser, F.K. & Veugelers, W. (Eds.),

Getting involved. Citizenship education and sources of moral values. (57-74). Rotterdam/Taipeh: SensePublishers.

Mouffe, C. (2005). *On the political*. London: Routledge.

Parker, W. (2004). *Teaching democracy*. New York: Teachers College Press.

Power, F.C., Higgins, A., & Kohlberg, L. (1989). *Lawrence Kohlberg's approach to moral education*. New York: Columbia University Press.

Putnam, R.D. (2000). *Bowling alone*. New York: Simon and Schuster.

Schuitema, J. A., Boxtel, C. van, Veugelers, W., & Dam, G. ten (in press). The quality of student dialogue in citizenship education. *European Journal of Psychology of Education*.

Veugelers, W. (2007). Creating critical-democratic citizenship education: empowering humanity and democracy in Dutch education. *Compare*, 37, 1, 105-119.

Veugelers, W. (2008). Youngsters in transformative and reproductive processes of moral and citizenship education. In Tirri, K. (Ed.), *Moral sensibilities in urban education* (79-91). Rotterdam/Taipeh: SensePublishers.

Veugelers, W. (2009). Active student participation and citizenship education. *Educational Practice and Theory*, 31, 2, 55-70.

Veugelers, W. (in press). The moral and the political in global citizenship education. *Globalisation, Societies and Education*, 9, 2.

Westheimer, J. (2008). On the relationship between political and moral engagement. In Oser, F. & Veugelers, W. (Eds.), (2008). *Getting involved. Global citizenship development and sources of moral values* (17-30). Rotterdam/Taipeh: SensePublishers.

SYMPOSIUM

The assessment of competence: new edumetric pathways in Higher Education

Chairperson: Alda Pereira, Universidade Aberta, Portugal

Organiser: Luis Tinoca, University of Lisbon, Portugal

Isolina Oliveira, Universidade Aberta, Portugal

Discussant: Effie Maclellan, University of Strathclyde, United Kingdom

The assessment of competences requires an approach where knowledge, abilities and attitudes are integrated, naturally implying the resource to a variety of assessment strategies. Within this context, we have seen the emergence of what has been called by several authors the Assessment Culture.

The methods, techniques and criteria traditionally used in psychometrics, are recognized as insufficient to assess learning in competence based programs, framed by contexts strongly influenced by technology use. So being, we have

watched the emergence of new edumetrical strategies, targeted at redefining the concepts of validity and reliability and so assuring the quality of the current assessment strategies.

Within this framework, this symposium is composed by three studies, one presenting a theoretical framework supported by four dimensions – authenticity, consistency, transparency and practicability, aimed at promoting the quality of the assessment strategies being used; and two empirical studies, one evaluation the quality of Competence Assessment Programmes (Baartman et al. 2007) developed in 7 faculties of Higher Education, and another one presenting research on three new modes of assessment targeted at enhancing student learning through assessment, with students in the areas of public-law, international business strategy and elementary teacher training. Our goal with this symposium is to promote the discussion of the dimensions and criteria that enhance assessment quality, in the assessment culture, based on the three presented studies. We hope to contribute to the development of new assessment quality criteria sustained by an edumetric approach, and support the quality of the assessment strategies being used.

Enhancing student learning through assessment: research on three new modes of assessment

Katrien Struyven, University of Brussels (VUB), Belgium; Mien Segers, Maastricht University, Netherlands; Filip Dochy, K.U.Leuven, Belgium; David Gijbels, University of Antwerp, Belgium

During the past decade traditional assessment practices in schools have been advocated to be replaced by so-called new modes of assessments. As learning environments are redesigned according to constructivist principles, it seemed that traditional examinations are no longer appropriate (Macdonald, 2006). This paper gives information on three empirical studies, recently conducted by this research group. The first study explores if student performance can be improved by formative assessment, through the use of embedded assessment tasks. The second study addresses students' learning approaches and how they are influenced by the assessment practice. It focuses on the relation between the students habitual study strategies, the perceived assessment demands and students' approaches to learning. The third study explores the influence of student hands-on experiences with a mode of assessment on their assessment preferences. The aim is to emphasise assessment as a vehicle to encourage student learning; the 'assessment for learning' purpose.

Although assessment is high on the international agenda at various levels (e.g. government, schools, parents), assessment is merely implemented as a tool of learning instead as a 'tool for learning'. Today's students face a world that will demand new –continuously changing– competencies to become life-long learners. In this 21st century, students need to understand and update the basic knowledge of their domain of study and need to be able to use this knowledge base as a tool to handle ill-structured problems. Helping students to develop these skills will also require changes in the assessment practice at the school and classroom level.

Three studies are represented, conducted by our research group. The three studies try to unravel how assessment influences student learning, defined in terms of performance as well as approach to learning. The first study explores if student performance can be improved by formative assessment, through the use of embedded assessment tasks and which conditions influence this effect. The second study addresses student's learning approaches and how they are influenced by the assessment practice. The third study explores the influence of student hands-on experiences with a mode of assessment on their assessment preferences.

Study 1: Integrated assessment tasks and students' performance

The first empirical study aimed to investigate the effects of written assessment-tasks integrated in a problem-based learning environment on students' performance. The following question is central to the study: do students who work on the integrated assessment tasks do better in their final exam compared to students who do not?

A total of 164 students, following a course on public law in the second year of their law study, participated fully, completing all six assessment-tasks. Assessment in the course was twofold. The final exam consisted of 40 multiple-choice questions and took place at the end of the course. During the course, students had the opportunity to complete the six assessment-tasks on a voluntary basis, which could result in an extra 'bonus point', added to the score of the final exam.

Results showed that working with assessment tasks has a significant positive influence on the performance of students, not only of the related topics in the tasks, but also of the non-related topics. This is confirmed by the results of the survey, indicating that students in the integrated assessment tasks condition worked in a different way, in terms of learning approach as well as time management. A crucial condition for the integrated assessment tasks to

affect learning seemed to be the feedback students receive; the clarity of goals and criteria of the assessment tasks and the implementation of the assessment tasks.

Study 2: Case-based assessment and students' learning strategies

As Biggs (1996) states, assessment can only steer learning when there is a constructive alignment between learning, instruction and assessment. Therefore, in order to enhance deep learning with students, in the present study not only the mode of assessment was changed, but also the learning environment. The research question central to this study is to what extent these changes result in students adapting their learning strategies.

The participants in this study are two subsequent cohorts of second-year students attending the course International Business Strategy of the International Business Program. An assignment-based format was used for the course in year 1 (N=406). In the following year, the course was redesigned according to the problem-based learning format (N= 312).

The findings of the study tend to be disappointing as in the new learning and assessment environment the students used more surface learning strategies. A plausible explanation is found in the linear relation between students' perceived workload of the learning environment and surface approaches to learning (Kember, 2004). Moreover, results indicate that in both conditions, students who enter the course with the intention to employ a deep study strategy, perceive the assessment demands as deep and employ a deep study strategy. Students, who intend to employ surface strategies, show a higher tendency to employ surface strategies.

Study 3: The effects of hands-on experience on students' preferences of assessment

Though innovation is a key concept of educational policy, the associated processes are often a source of anxiety and concern for many teachers. It is only when familiarity grows that fears are allayed and the new, changed situation is accepted. This fearful disposition towards changes and the process of allaying these fears are central to this study, which investigates the effects of student teachers' hands-on experience of new evaluation modes on their assessment preferences.

The investigation had a quasi-experimental pre-test/post-test design. A Child Development course was delivered to five research conditions involving 669 students in their first year of elementary teacher training. The first group of pre-service teachers was instructed within a lecture-based learning environment, assessed by means of a multiple choice examination. The remaining four groups learned in the same student-activating learning environment. The assessment mode that accompanied this learning setting distinguished between conditions, namely: (1) a multiple choice test, (2) a case-based assessment, (3) a peer/co-assessment, and finally (4) a portfolio assessment.

Results show that unknown assessments become positively regarded when familiarity grows and the hands-on experience is positive. Interestingly, conclusions do apply to both traditional tests and new modes of assessment. The good use of the assessment method and its orientation towards knowledge construction serve explanatory purposes. As such, students' assessment perceptions are not stable, unchangeable student characteristics and evidence is provided that hands-on experience with "new" assessment tools serves as an incentive for change to occur.

In conclusion to the three studies, it is clear that the statement 'assessment steers learning' is surely correct (Gijbels et al., 2005) but at the same time far too simple (Segers et al., 2006). Simply changing the mode of assessment does not always result in changes in learning strategies, nor in improved performance (Struyven et al., 2008).

Biggs, J. (1996). Assessing learning quality: Reconciling institutional, staff and educational demands. *Assessment and Evaluation in Higher Education*, 21, 5-15.

Gijbels D., van de Watering G., & Dochy F. (2005). Integrating assessment tasks in a problem-based learning environment. *Assessment and Evaluation in Higher Education*, 30, 73-86

Kember, D. (2004). Interpreting student workload and the factors which shape students' perceptions of their workload. *Studies in Higher Education*, 29(2), 165-184.

Segers, M., Nijhuis, J., & Gijssels, W. (2006). Redesigning a learning and assessment environment: the influence on students' perceptions of assessment demands and their learning strategies. *Studies in Educational Evaluation*, 32(3), 223-242.

Struyven, K., Dochy, F., & Janssens, S. (2008). The effects of hands-on experiences on students' preferences of assessment methods. *Journal of Teacher Education*, 59 (1), 69-88.

Does self-evaluation of CAP quality lead to improvements in assessment and curriculum?

Liesbeth Baartman, Eindhoven University of Technology, Netherlands; Asha Dijkstra, Avans University of applied science, Netherlands; Han Blankert, Avans Hogeschool / Avans University of Applied Sciences, Netherlands

Many institutions for higher vocational education are implementing competence-based education. The literature often suggests to start these development processes by changing the assessment, which should work as a leverage for changing the entire curriculum. Therefore, this paper focuses on the evaluation of the quality of Competence Assessment Programmes (CAPs). A self-evaluation method was used to stimulate institutions to reflect on and improve the quality of their CAP. It is unclear, however, if such self-evaluations lead to concrete points for improvement of CAPs – and the entire curriculum.

In this study, seven faculties of a University of Professional education evaluated their CAP. Evaluators were 5-7 teachers and 3-5 students per faculty. Evaluation was based on 12 quality criteria and quantitative ratings and qualitative examples were collected. Research questions were: (1) How do the seven faculties evaluate their CAP on the 12 quality criteria, (2) What are the effects of the self-evaluation in terms of concrete points for improvement of the CAPs?

Preliminary results show that the CAPs were generally thought to be transparent, fair and feasible. Knowledge and skills are assessed integrally, but attitudes are not generally assessed. Concrete points for improvement were identified. For example, when criteria were not clear to students, the teachers decided to integrate them into their lessons by presenting the assessment at the start of a course and discussing the criteria. In general, the self-evaluation seemed to cover and influence the entire curriculum, corroborating the literature on this topic.

Theory and aims

Higher vocational education aims for students to become competent professionals, integrating knowledge, skills and attitudes to master relevant job situations. At the moment, many institutions for higher vocational education are implementing competence-based education. The literature often suggests to start such development processes by changing the assessment. This will work as a leverage on the entire curriculum (Barnes et al., 2000) and influence learning and instruction processes (Gibbs, 1999). Therefore, the focus of this paper is on the evaluation and improvement of assessment. As single assessments are only seldom used to assess competence, the quality of entire Competence Assessment Programmes or CAPs is evaluated (Baartman, Bastiaens et al., 2007). In such CAPs, different assessment methods – both traditional and newer ones – are combined depending on the context and the goals of the educational programme.

Concerns have been expressed about the quality of new assessment methods and the ways to establish their quality. Different quality criteria have been suggested, including psychometric (Messick, 1995) and edumetric ones (Dierick & Dochy, 2001). This paper uses 12 quality criteria developed by Baartman, Bastiaens et al. (2007), including ideas of validity and reliability, complemented by criteria deemed important in competence-based education specifically, for example authenticity, meaningfulness and self-regulated learning. To stimulate institutions to evaluate and improve the quality of their CAP, a self-evaluation method was developed. A self-evaluation method was chosen because it is assumed to stimulate reflection and internal school improvement (McNamara & O'Hara, 2005). However, it is unclear whether self-evaluation leads to concrete points for improvement that can actually be used by institutions to improve their assessments – and eventually the curriculum as a whole. Therefore, this study follows seven faculties of an institute for higher vocational education. They evaluated the quality of their CAP using the self-evaluation method. Research questions are: (1) How do the seven faculties evaluate their CAP on the 12 quality criteria, (2) What are the effects of the self-evaluation in terms of concrete points for improvement of the CAPs?

Data and Methods

Participants: This study was carried out at a large University of Professional Education in the Netherlands, a type of higher vocational education. Seven faculties carried out a self-evaluation of the quality of their CAP: teacher education, Marketing & Business Management, ICT & Business, Construction & Infrastructure, Social studies, School of International studies, Education for healthcare. In each faculty, the evaluators were about 5-7 teachers and 3-5 students (numbers varied slightly depending on availability).

Self-Evaluation Procedure: The self-evaluation procedure consisted of three phases. First, the evaluators received a short training on the 12 quality criteria and the CAP to be evaluated was defined. Second, all evaluators individually evaluated their CAP by giving a rating and an example for all criteria, using a web-based questionnaire. Third, all individual evaluations were collected and summarised by the researchers in a short powerpoint-presentation, to be discussed in a two-hour group interview. The goal of the group interview was to identify strengths and weaknesses and formulate concrete points for improvement of the CAP.

Data analyses: The results of the individual evaluations and the group interview were summarised in a report for each faculty, which was checked by the evaluators for correctness (member checking). To compare the seven self-evaluations, Miles and Huberman's (2003) method of cross-case comparison was used. The qualitative and quantitative data were first meaningfully reduced, then organised into different matrices, from which conclusions were drawn and verified on the original data. To answer the first research question, matrices were ordered for the 12 quality criteria. For the second research question, points of improvement that were mentioned in the individual evaluation or group interview were noted down and verified on the original data by two of the researchers.

Preliminary results

First results show that most CAPs are deemed transparent, fair and feasible. Knowledge and skills are integrally assessed, but attitudes are not generally included in the assessments. Students want more and deeper feedback, while teachers do not explicitly address feedback during the assessments. In general, the evaluators learned about new forms of assessment, such as peer assessment. They mentioned various points of improvement of their CAP. Some examples are:

- integrating the assessment criteria in the lessons, to familiarize students with the criteria;
- giving feedback according to SMART goals;
- starting lessons with the assessment and using the assessment to explain learning goals.

Also, the self-evaluation seemed to influence the entire instructional design process, not only the assessments. Full results, including citations of the evaluators, are presented at the conference.

Theoretical and educational significance

The self-evaluation used in this study seems to be a valuable method to get a grip on the strong and weak aspects of a CAP. It seems to provide concrete handles for improvements and influence the entire development process of competence-based education, corroborating the literature on this topic (e.g., Barnes et al., 2000).

Baartman, L.K.J., Bastiaens, T.J., Kirschner, P.A., & Van der Vleuten, C.P.M. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review*, 2, 114-129.

Barnes, M., Clarke, D., & Stephens, M. (2000). Assessment: the engine of systemic curricular reform? *Journal of Curriculum Studies*, 32, 623-650.

Dierick, S., & Dochy, F.J.R.C. (2001). New lines in edumetrics: new forms of assessment lead to new assessment criteria. *Studies in Educational Evaluation*, 27, 307-329.

Gibbs, G. (1999). Using assessment strategically to change the way in which students learn. In S. Brown & A. Glaser (Eds.), *Assessment matters in higher education* (pp. 41–53). Buckingham, United Kingdom: SRHE.

McNamara, G., & O'Hara, J. (2005). Internal review and self-evaluation – The chosen route to school improvement in Ireland? *Studies in Educational Evaluation*, 31, 267-282.

Messick, S. (1995). Validity of psychological assessment. Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, 50, 741-749.

Miles, M.B. & Huberman, A.M. (2003). *Qualitative Data Analysis. A Sourcebook of New Methods*. Beverly Hills, CA: Sage Publications.

Assessment Culture dimensions: contributions for quality development

Alda Pereira, Universidade Aberta, Portugal; Isolina Oliveira, Universidade Aberta, Portugal; Luis Tinoca, University of Lisbon, Portugal

The assessment of competencies requires an approach where knowledge, abilities and attitudes are integrated, naturally implying the resource to a variety of assessment strategies. Within this context we have seen the emergence of what has been called by several authors the Assessment Culture. Furthermore, higher education e-learning environments have also promoted the used digital assessment strategies. It is important to consider the concept of quality in education and e-learning, and particularly how to develop it in the present learning landscapes. For this reason, we propose a theoretical framework supported by four dimensions – authenticity, consistency, transparency and practicability – each composed by a set of parameters, aimed at promoting the quality of the assessment strategies being used. This proposition, framed by an edumetric approach, aims to set the stage to a Competency Assessment Program (Baartman et al., 2007), and in this way contribute to the discussion of assessment quality in higher education, particularly in the case of e-learning.

The new learning culture has promoted the implementation of new assessment strategies aligned with the most recent paradigm of assessment design (Birenbaum, 2003; Brown, Bull & Pendlebury, 1997). Assessment tasks communicate to students the kind of intellectual work which is valued and thereby influence the way students behave

as learners (Maclellan, 2004). Given the recognition of traditional assessment forms inability to promote learning, as a consequence of their focus in classification and ranking of the participants, the last two decades have seen the emergence of a variety of alternative assessment strategies. Dierick and Dochy (2001) label this new culture as the assessment culture as opposed to the testing culture.

The assessment of competencies requires a new approach where knowledge, abilities and attitudes are integrated (Baartman, Bastiaens, Kirschner and van der Vleuten, 2007; Gulikers, Bastiaens and Kirschner, 2004). It should make use of a variety of different assessment strategies and tools (Dierick and Dochy, 2001; Maclellan, 2004), so as to better assess performance in authentic activities. Moreover, given the complexity of the concept of competence, one single assessment mode is recognized as insufficient to assess the development of competencies (Baartman et al., 2007; Pereira, Tinoca and Oliveira, 2010; Pereira et al., 2009). For this reason, other criteria have been proposed in order to measure and promote the quality of these new assessment strategies, and so contribute to the implementation of quality control and establish new lines in edumetrics based in the assessment culture.

Assessment Culture: dimensions

We propose four dimensions for the assessment culture to be considered in the definition of competence based assessment strategies: authenticity, consistency, transparency, practicability (see figure 1). These dimensions represent the main domains for the characteristics of the assessment strategies to be developed, contributing in this way to the definition of the implemented assessment culture, and its impact in the educational process. We now present the main criteria contributing to the definition of each of the four dimensions (see figure 2). These criteria are important not as contributors to the characterization of each of the dimensions, but also to illustrate their degree of implementation.

The concept of authenticity is related to the degree of similarity between the competencies being assessed by a competency assessment program and the ones required in real/Professional life. It includes:

Similarity – refers to the way in which the assessment strategy is related to the real life context, meaning that assessment should reflect the competencies needed in real/professional life.

Complexity – refers to the nature of the assessment tasks, more specifically, to the cognitive challenges that are imposed by its resolution/development.

Adequacy – is connected with the need to provide adequate performing conditions (time, resources, etc.) for the assessment tasks, in accordance with their complexity.

Significance – includes the significative value of the assessment task for students, instructors and employers.

The consistency dimension emerges as answer to the traditional demands for validity and reliability, usually associated with psychometric indicators. It includes:

Alignment instruction-assessment – refers to the need to provide assessment scenarios that are representative of the learning situations experienced by the students.

Multiplicity of indicators – is related to the need of employing a variety of assessment methods, contexts, moments, and assessors.

Adequate criteria – considers the correspondence between the assessment criteria being used and the competencies that are being assessed.

Alignment competencies-assessment – is related to the need of assuring the coherency between the competencies that are intended to be developed and the assessment strategy being used.

The transparency dimension intends to make the entire competency assessment program visible and comprehensible for all the participants. It includes:

Democratization – refers to the availability and possible participation in the definition of the assessment criteria.

Engagement – is related to the availability and possible participation in the definition of the learning goals and performance criteria.

Visibility – refers to the possibility of presenting/sharing their learning processes and/or products with others.

Impact – is related to the effects that the assessment strategies have in the learning process and in the design of the educational program.

The practicability dimension is related with the feasibility of the assessment strategy. It implies an effective management in terms of time and cost/efficiency balances to both assessors and organizations. It includes:

Costs – referring to the time costs, as well as the resources or additional investments.

Efficiency – goes beyond costs, to consider the relationship costs/effects of the assessment strategies for the institutions, instructors and learners, particularly considering the expected results.

Sustainability – is related to the need of assuring that it's possible to successfully implement and sustain the proposed assessment strategies.

The presented dimensions can be used as a framework for the development of a competency assessment program and as guidelines for the quality evaluation of the assessment strategies being used. The criteria allow for the operational description the stage of implementation, and so contribute to the evaluation of the achieved assessment strategy quality level. Finally, even though the present work is included in a still ongoing debate, it intends to contribute to the clarification of the Assessment Culture and introduce/develop a theoretical framework to support decisions related to the assessment strategies to be used.

- Baartman, L.K.J., Bastiaens, T.J., Kirschner, P.A. & Vleuten, C. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review*, 2, 114-129 Bates & Pool, 2003;
- Birenbaum, M. (2003). New insights into learning and teaching and their implications for assessment. In M. Segers, F. J. R. C. Dochy, & E. Cascallar (Eds.), *Optimising new modes of assessment: In search of qualities and standards*, 13–36. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Brown, G., Bull, J. and Pendlebury, M. (1997). *Assessing Student Learning in Higher Education*. New York: Routledge.
- Dierick, S., & Dochy, F. J. R. C. (2001). New lines in edumetrics: new forms of assessment lead to new assessment criteria. *Studies in Educational Evaluation*, 27, 307–329.
- Gulikers, J. T. M., Bastiaens, T. J., & Kirschner, P. A. (2004). A five-dimensional framework for authentic assessment. *Educational Technology Research and Design*, 53, 67–87.
- MacLellan, E. (2004). How convincing is alternative assessment for use in higher education? *Assessment & Evaluation in Higher Education*. 29(3), 311 – 321.
- Pereira, A., Tinoca, L. & Oliveira, I. (2010). Authentic assessment contribution to competence based education at Universidade Aberta: Questions and challenges. In Siran Mukerji and Purnendu Tripathi (Eds.) *Cases on Technological Adaptability and Transnational Learning: Issues and Challenges*. IGI Global.
- Pereira, A., Oliveira, I., Tinoca, L., Amante, L., Relvas, M.J., Pinto, M.C. & Moreira, D. (2009). Evaluating continuous assessment quality in competence-based education online: the case of the e-folio. *European Journal of Open, Distance and Elearning: EDEN*

SYMPOSIUM

What Explains the Development of Interest and Intrinsic Motivation for Learning?

Chairperson: Birgit Spinath, Heidelberg University, Germany

Organiser: Birgit Spinath, Heidelberg University, Germany

Discussant: Katariina Salmela-Aro, Helsinki Collegium for Advanced Studies, Finland

Interest and intrinsic motivation are both important prerequisites for learning and desired outcomes of learning processes in their own right. Therefore, there is a vital interest among researchers and educators to understand how these motivational variables develop. The present symposium brings together three studies that investigate determinants of interest and intrinsic motivation development in high school students and undergraduates. All studies rely on theoretical approaches with a focus on goals, values, and expectations. To detect potential causal mechanisms, two studies use a longitudinal design (Spinath & Steinmayr; Harackiewicz et al.) whereas the third employs an experimental approach (Sansone et al.). Katariina Salmela-Aro will discuss the findings with regard to their implications for motivation theory building and educational practices.

The Roles of Competence Beliefs and Goal Orientations for the Change in Intrinsic Motivation

Birgit Spinath, Heidelberg University, Germany; Ricarda Steinmayr, University of Heidelberg, Germany

The present study investigates three theoretically plausible explanations for changes in school-related intrinsic motivation. A sample of N = 348 German 11th grade students was followed over one year. At two measurement occasions, students completed self-reports on their school-related intrinsic motivation, goal orientations, and competence beliefs. In line with previous studies, cross-lagged analyses provided little evidence for the hypothesis that prior competence beliefs affect subsequent intrinsic motivation after controlling for prior intrinsic motivation. Considering goal orientations as a moderator did not change this result. Instead, it could be shown that learning goals, but not performance goals, directly predicted the change in students' intrinsic motivation, but not vice versa. Findings are discussed with regard to motivational theory development and practical implications.

Intrinsic motivation is not only an important prerequisite for learning but also a desired outcome of education. Therefore, there is a vital interest among researchers and educators to understand the reasons underlying characteristic changes of intrinsic motivation observed throughout school trajectories. It is consistently observed that intrinsic motivation for school-related learning diminishes throughout elementary school and beyond. This development stagnates when students are about 16 years old and afterwards even an increase in intrinsic motivation

can be observed in some disciplines. While this developmental trajectory of intrinsic motivation has been established in many studies, the reasons for these characteristic changes are still unknown. The present study investigates the roles of competence beliefs and goal orientations for the change in intrinsic motivation.

In the present study, three theoretically plausible ways in which competence beliefs and goal orientations might affect intrinsic motivation are investigated. First, it is tested whether competence beliefs are not only closely associated with intrinsic motivation but might also predict changes in intrinsic motivation. Second, it is tested whether the association between competence beliefs and intrinsic motivation varies systematically according to students' goal orientations. Specifically, theory suggests that in the presence of learning goals, competence beliefs should be less important for the development of task enjoyment than in the presence of performance goals. Third, the assumption is put to a test that goal orientations directly predict changes in intrinsic motivation. To our knowledge, this is the first study that assessed competence beliefs, goal orientations and intrinsic motivation at more than one point in time which is a prerequisite for a cross-lagged design and the analysis of reciprocal effects.

Method:

A sample of $N = 348$ German 11th grade students was followed over one year. At two measurement occasions in March 2007 and 2008, students completed self-reports on their school-related intrinsic motivation, goal orientations, and competence beliefs. To cross-validate the results for different domains, self-reports were collected for school in general, math, and German. Data were analysed on a latent basis with three or four manifest indicators per latent construct and by means of cross-lagged structural equation models.

Results:

Results indicated that intrinsic motivation was stable in terms of absolute, mean changes (for the domains math and German) or even increased (for school in general) over the time investigated. Moreover, performance-approach and performance-avoidance goals for school in general slightly decreased over time. All other variables showed no significant mean changes. In terms of relative stability (auto-correlations), both intrinsic motivation (ρ between .53 and .70) and competence beliefs (ρ between .65 and .83) were moderately stable over time.

With respect to the first theoretical explanation of change in intrinsic motivation, inspection of the cross-lagged paths indicated that prior intrinsic motivation did not predict subsequent competence beliefs in any domain. Complementary to this, prior competence beliefs did not predict subsequent intrinsic motivation in two out of three domains (school in general and math) but did so for German. Thus, only weak support was found for the hypothesis that competence beliefs affect intrinsic motivation.

The second research question focused goal orientations as potential moderators of the association between competence beliefs and intrinsic motivation. Multi-group analyses were used to compare cross-lagged paths between competence beliefs and intrinsic motivation in groups of either high or low expressions of goal orientation. Taken together, results of multi-group analyses provided no support for the assumption that goal orientations moderate the association between competence beliefs and intrinsic motivation.

The third research question addressed the question whether goal orientations have direct effects on intrinsic motivation. The temporal stability of the three goal orientations across the three domains was moderate (ρ between .53 and .73). In all three domains, prior learning goals predicted change in intrinsic motivation (ρ between .21 and .35) but not vice versa. None of the performance goals predicted change in intrinsic motivation in neither domain or vice versa. Taken together, the results of the cross-lagged analyses supported the hypotheses that learning goals but not performance goals directly affect change in intrinsic motivation.

Implications:

The present study provides further evidence that it is not the absolute level of normatively-based ability self-perceptions that stimulates task enjoyment and sustained motivation. Instead, the goal frame under which learning takes place and achievement outcomes are interpreted is important for the development of intrinsic motivation. This means that even in the face of realistically held low ability self-concepts, learners can develop an optimistic, learning-oriented perspective in which they consider low competencies as learning opportunities and learning as an end in itself.

For educational practice it might be followed that educators should put emphasis on creating a learning oriented environment when they want to foster intrinsic motivation. This can be achieved by choosing methods that let students experience their learning progress. For example, educators can encourage students to intra-individually compare their work results and competences over time and see the learning progress. This technique requires an

honest appraisal of initial competences because only a realistic appraisal allows for perceiving learning progress. On the grounds of the present findings, educators need not fear that confronting students with initial competence deficits might undermine their intrinsic motivation, as long as a learning goals framework is set.

Moreover, learning goals can be highlighted by evaluating students' performance in terms of criterion-based standards and individual progress instead of social norms. Offering information about individual progress and the degree to which task-inherent criteria were met leads students attention to learning goals. In contrast, comparing students' performance with a social norm distracts attention from individual learning progress. Although it will not always be possible to avoid evaluations according to social norms, criterion-based and individual feedback can counterbalance a predominant social comparison perspective.

My Obsessions Come and Fade as Opposed to Come and Go': Young Adults with/out AS and their Interest

K. Ann Renninger, Swarthmore College, United States; Idit Katz, Ben-Gurion University, Israel

People diagnosed with Asperger's Syndrome (AS) typically have an intense interest for specific subjects. Such interest has been described as both an obstacle to learning new material and interpersonal relations, and, more recently, as potentially important to the development of self-esteem and social relations. The structure and form of AS interest has not been detailed, as such, it is an open question as to whether and how interest supports the learning of populations with AS, and what its potential as a scaffold for the development social relationships is. Semi-structured in-depth email interviews that included a retrospective component were conducted with 10 young adults with AS (19-28 years-of age) and 10 young adults without AS (20-28 years-of age). Both nonparametric analyses and discourse analysis were employed in order to evaluate: (a) cognitive and affective components of interest, (b) change in the structure and form of interest over time, and (c) the role of the environment in interest development. Briefly, findings from this study suggest that interest may be a tool for supporting and working with population with AS in ways that have not previously been identified. Interest for participants with and without AS is central, although differences in its structure and form are apparent. For both groups, interest appears to provide a scaffold to working with and learning from others. Similarities and differences between the interest and learning trajectories of both groups are summarized.

Regulating Interest: The Role of Utility Value, On-Task, and Off-Task Behavior

Carol Sansone, University of Utah, United States; Jonathan Butner, University of Utah, United States; Joseph Zachary, University of Utah, United States; Tamara Fraughton, University of Utah, United States; Sarah Ripley, University of Utah, United States

The Self-regulation of Motivation (SRM) model suggests that both goals-defined motivation (i.e., value and expectancy of learning), and experience-defined motivation (i.e., whether interesting) are key to sustained learning. It is thus important to understand how students regulate their interest experience via on-task AND off-task behavior. We used data from the Regulating Motivation and Performance Online (RMAPO) project. Undergraduates (N = 108) worked on an online HTML programming lesson in the lab, and their time spent off-task and on-task was recorded. The initial lesson description described the skills to be learned (no value added), or further described how these skills could be used when creating personal or organizational web pages (value added). We examined whether, relative to students in the no value added condition, students in the value added conditions: 1) spent more time on-task; 2) spent more or less time off-task; and 3) accessed off-task sites more during the lesson or after assignment submission. Compared to the no value added condition, students in the value added conditions spent more time on-task and off-task before submitting their assignment, and submitted their assignment later. Both on-task and off-task time predicted greater interest at lesson's end. These results suggest that when given reasons to value learning, students will engage in behaviors that enhance their experience, even if some of these behaviors are off-task.

Summary:

The Self-regulation of Motivation (SRM) model (Sansone & Thoman, 2005) suggests that two kinds of motivation are important for maintaining learning: Goals-defined (i.e., value and expectancy) and experience-defined (i.e., whether interesting while working towards goals). Although initial actions may be directed by goals, these actions also affect the experience. Moreover, subsequent (maintenance) actions may be in service of reaching goals or in service of enhancing the experience, particularly over time. The SRM model thus suggests that in order to understand the development of interest, it is important to understand how students regulate the process of learning over time.

To examine this process, the Regulating Motivation and Performance Online (RMAPO) project created a paradigm in which undergraduates complete an online HTML lesson in the lab. The lesson session was designed to maximize the role of self-regulation, with measures that allowed us to examine how students regulated the process. The session

was of sufficient length (1 ½ hours) to ensure that students needed to maintain their attention and effort over a period of time. In addition, students were told that at the end of 90 minutes the final survey would start whether or not they had submitted the assignment (i.e., making it clear that they were responsible for managing their time). Students were also told that 90 minutes should be enough time (i.e., downplaying time pressure), that they could take breaks, and that if they finished prior to 90 minutes they should sit quietly until the post-lesson survey began. We subsequently recorded the sites (on-task and off-task) that students accessed while working through the lesson, when they accessed them, and the time spent on each.

In the first variation in this paradigm, we varied the initial description of the lesson such that it just described the skills to be learned (no value added), or further added how these skills could be used when creating personal or organizational web pages (value added). Initial results (Sansone, Zachary, et al. 2010) suggested that the added value information was associated with more active engagement while working on the lesson (i.e., more manipulating and modeling sample HTML codes in optional examples and exercises). Higher levels of engagement predicted greater interest at lesson's end.

These previously reported results thus suggested that subsequent interest was associated with the use of optional on-task sites that enhanced the experience while working. However, the SRM model suggests that off-task behavior may also be relevant to regulating the experience. The present paper thus used data from the RMAPO project to examine students' off-task as well as on-task behavior. We examined whether, relative to students in the no value added condition, students in the value added conditions: 1) spent more time on-task; 2) spent more or less time off-task; and 3) accessed off-task sites more during the lesson or after assignment submission. Finally, we examined the relationship between these patterns and subsequent interest.

Methods/Data sources:

Undergraduates (n=108; 67% female) were randomly assigned to one of the three conditions described previously. We measured the total amount of time (minutes) students spent on on-task lesson sites. We then identified the point at which students submitted their assignment, and calculated the total amount of time (minutes) spent on off-task sites prior to assignment submission. Finally, we calculated the total amount of time (minutes) students spent on off-task sites during the entire session. At lesson conclusion, lesson interest was assessed via self-reported ratings (5 items, rated on 1 to 5 scales, $\alpha=.88$).

Results: We created the condition contrast code Value Added v. No Value Added. This contrast was significant in predicting total time spent accessing on-task sites, indicating that students in value added conditions spent more time on-task. When we examined time spent off-task prior to submitting the assignment (controlling for time spent on task), the contrast was also significant, showing that students in the value added conditions spent more time off-task. However, when total time off task was regressed on the same model, the model was not significant. This suggests that the point at which students accessed off-task sites differed by condition, such that students in the value added conditions were more likely to access off-task sites while they were still working on the lesson. A survival analysis of the point during the 90 minutes session that students submitted their assignment further showed that students in the no value added condition submitted their assignment sooner than students in the value added condition. Finally, we regressed interest on the time measures. Greater interest was significantly associated with both greater time spent on-task and off-task prior to assignment submission.

Theoretical/Educational Significance.

Together, these data suggest that when students had greater motivation to learn HTML (utility value added), they spent more time while working through the lesson both on-task AND off-task. This pattern was associated with taking longer to complete the lesson and assignment, but also with greater interest. In contrast, in the no value added condition, students spent less time both on-task and off-task while working through the lesson, and finished sooner. These students appeared to be more likely to wait to access off-task sites until they had finished their "work." However, this pattern was associated with lower interest. Over time, when students believe what they will learn is useful, they may be more likely to engage in behaviors that enhance the experience, and this may include both on-task and off-task behaviors. This may come at a cost in terms of time needed to complete an assignment, but also with the benefit of developing greater interest.

Sansone, C., & Thoman, D.B. (2005). Interest as the missing motivator in self-regulation. *European Psychologist*, 10, 175-186.

Sansone, C., Zachary, J.L., Fraughton, T.B., Heiner, C., & Butner, J. (2010, May). Initial orientations, interest and online learning: What students do is as important as why. In K. Ann Renninger (chair), *Studying Motivation and Learning*

Online: Prospects and Challenges. Presented at the annual meeting of the American Educational Research Association, Denver, CO.

SYMPOSIUM

Improving science education for young children in pre- and primary school

Chairperson: Paul Leseman, Utrecht University, Netherlands

Organiser: Paul Leseman, Utrecht University, Netherlands

Discussant: Paul Leseman, Utrecht University, Netherlands

Playful science education for young children is increasingly considered to lay the fundament for science learning in the later grades of primary school and in secondary school. However, although several approaches to an early childhood science curriculum are available, few have been empirically tested. This symposium brings together three studies on science education in early pre- and primary education, examining complementary approaches and using randomized controlled trials to determine their effectiveness. Leuchter and Saalbach present the results of a four-week curriculum for kindergartners and first and second graders on floating and sinking, involving sequenced exploration of counter-evidence. Children in the experimental condition revealed better understanding at posttest. Henrichs and Leseman focus on the ways in which kindergarten teachers can support children in learning to map language representations onto their intuitive understanding of science. After the training, both teachers and children used more domain-specific vocabulary, more complex multi-clause sentences, and higher-level scientific reasoning. Koerber and Sodian compare the use of verbal explanations and graphic information to improve children's reasoning in the domain of biology, in particular concerning how to take evidence into account. Both providing explanations for counter-evidence and the use of graphics improved their scientific reasoning substantially. The three papers together outline essential building blocks of an effective early childhood science curriculum. Guided sequenced exploration of counter-evidence can be supplemented by providing explanations and graphics, and by training teachers in domain-specific knowledge and academic language.

Science teaching in pre- and primary school: The role of situational domain-specific knowledge

Miriam Leuchter, University of Munster, Germany; Henrik Saalbach, ETH Zurich, Switzerland

Research on competencies of secondary and late primary school teachers suggests that teachers' domain-specific knowledge has a high impact on the students' learning gains. However, research on early science teaching in kindergarten and early primary school shows that teachers lack knowledge about the concepts to be taught and about children's learning processes and have a low self-concept regarding science teaching. This may be one of the reasons why analyses of instructional situations in kindergarten and early primary school show that teachers seldom take into account children's naïve conceptual understanding and neither promote children's conceptual change. In order to gain insight into the relation between teachers' situational domain-specific knowledge and children's learning within early science instruction we developed a four-week curriculum in the context of "floating and sinking" for kindergarten and primary school which we implemented in 15 Kindergarten and 15 primary school classes (first and second school year) with all in all 444 children. Results reveal a decrease in children's misconceptions from pre-test to post-test due to the curriculum. The children were able to produce significantly more correct predictions about the sinking or floating of objects after the curriculum than before, also in comparison to the control group. More importantly, we found a negative impact of teachers' errors on children's learning gains, which strongly emphasizes the role of the teacher's domain-specific knowledge for a successful support of children's learning processes.

Aim

The understanding of learning and teaching processes in kindergarten and primary school has been significantly enhanced by research on learning and instruction. (Sylva et al., 2004). Research in the field of teachers' competencies show that the instructional action of teachers is closely linked to their professional knowledge about teaching and learning, and that situational knowledge related to concrete subjects, contents and instructional situations and actions plays a distinctive role (Mena Marcos & Tillema, 2006). Furthermore, it is well known that teachers' domain-specific knowledge has a high impact on the students' learning gains. However, research on teaching in kindergarten and primary school shows that teachers a) lack knowledge about the concepts to be taught and about children's learning processes and b) find it hard to take into account children's naïve conceptual understanding. This seems to be especially relevant for early science teaching. Teachers' low self-concept regarding science indicates that they are aware of their shortcomings (Appleton, 2006)

In order to gain insight into the relation between teachers' situational domain-specific knowledge and children's learning within early science instruction we developed a four-week curriculum in the context of "floating and sinking"

for kindergarten and primary school. This learning environment consisting of four sequential and problem-based units was devised in cooperation with experienced teacher educators to support the development of children's concept of material kind as a precursory knowledge of a density concept. The material of the first and second week was designed in a manner to challenge children's misconceptions concerning shape, size and weight. In the third week, learning activities aimed to develop children's conception of material kind. In the fourth week, children's understanding of the relevance of material was challenged by introducing the concept of buoyancy. Teachers were instructed to support children's construction of knowledge by, for example, stimulating comparison processes, emphasizing material labels, activating prior knowledge and assisting conceptual restructuring through sustained shared thinking.

Method

The curriculum was implemented by trained pre-service and in-service teachers in 15 preschool and 15 primary school (1st and 2nd) classrooms with a total of 444 children (mean class size 19 children) in two age-mixed cohorts. Children of both cohorts attended a school located in middle-class rural areas of Central Switzerland. The age of the preschool children was between 4.4 – 7.1 years (mean: 5.1 years); the age of the primary school children was 6.2 – 9.6 years (mean: 7.9 years). Although, from a developmental psychological perspective, it can be assumed that children at this age do not acquire the concept of material kinds by themselves, we wanted to rule out that the potential learning gain took place due to natural learning processes or maturation processes, or a test repetition effect. For this purpose, twenty-two children were randomly assigned to a control group.

A series of individual pre-tests and post-tests were carried out to capture children's learning progress. 15 minutes of the teachers' support of the children during the first implementation week was videotaped. Due to the standardized content, the videotaped lesson units showed a very high degree of comparability, thus providing a basis for a microanalysis of teachers' instruction. Instruction during implementation underwent a video analysis by two raters where the domain-specific errors made by the teachers were identified, thus allowing us to capture the teachers' situational professional knowledge in the scientific domain of floating and sinking. This design allowed us to use frequency analysis as well as correlation and regression analysis to test whether and to what extent teacher's instruction was supporting or hindering children's construction of knowledge and how it determines children's learning gains.

Results

Our results reveal a decrease in children's misconceptions from pre-test to post-test. Initially, no difference in prior knowledge could be found between the experimental and the control group with regard to the classification of the material ($F(1,240)=.133$, $p=.72$, $\eta^2=.001$). In the classification of items to floating or sinking, the experimental group showed a significantly higher rise between pre- and post-test than the control group ($F(1,227)=46.98$, $p2=.171$). The results at the teacher level show that 50% of the teachers made major domain-specific errors during the videotaped interaction time. Hierarchical linear modelling shows significant negative effects of the observed teachers' domain-specific errors on the children's learning gains ($b = -.39$, $p=.00$) to a similar degree as the positive effects of the previous knowledge of the children ($b = .30$, $p=.00$).

Implications

The results show that children were able to produce significantly more correct predictions about the sinking or floating of objects after the curriculum than before, also when compared to the control group. This suggests that a well-structured curriculum which promotes comparison and scientific reasoning by means of inquiry learning supports children's conceptual change in a specific domain. More importantly for the present research question, the negative impact of teachers' errors on children's learning gains emphasizes the role of the teacher's situational domain-specific knowledge for a successful support of children's learning processes. These findings not only provide a deeper insight into the structure of kindergarten and primary school teachers' competencies enhancing science learning but may also have important practical implications for teacher training and teachers' professional development.

Appleton, K. (2006). Science Pedagogical Content Knowledge and Elementary School Teachers. In K. Appleton (Ed.), *Elementary science teacher education. International perspectives on contemporary issues and practice* (pp. 31-54). Mahwah: Lawrence Erlbaum.

Mena Marcos, J. J., & Tillema, H. (2006). Studying studies on teacher reflection and action: An appraisal of research contributions. *Educational Research Review*, 1(2), 112-132.

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2004). *Effective Pre-School Education. The Final Report*. London: University of London, Institute of Education.

Promoting academic language use in early science interactions:

Paul Leseman, Utrecht University, Netherlands; Lotte Henrichs, Utrecht University, Netherlands

This study focuses on the linguistic content of science lessons for 5-year-olds. We examined how teachers can promote 5-year-olds' developing abilities to verbalize their intuitive understanding of physics phenomena. Even though children have such intuitions, based in sensorimotor representations of previous exploration experiences, sharing insights in an efficient and meaningful way with peers and teachers can be challenging, yet is necessary to increase more abstract-conceptual understanding of science phenomena. In this study, we present the results of a teacher-focused intervention study. In a randomized design, 59 teachers and 230 children were observed twice (winter and late spring) during science lessons about light reflection and air pressure respectively. After the first round of observations, thirty teachers were randomly assigned to a training session in which they learned about AL and were made aware of the many affordances of early science lessons to promote AL in 5-year-olds. A second round of observations was used to determine whether training made a difference. Results show increased lexical richness of the conversations in the experimental group. More specifically, unlike in the control group, both teachers and children in the experimental group made more use of domain-specific words, such as air pressure and reflection, in the second observation compared to the first observation. For the use of general academic words, such as explore and discover, an increase was found for the children in the experimental group.

Aim

From infancy, children form visuo-spatial and sensorimotor representations of their personal experiences that include information about the temporal and causal structure of actions and events, its obligatory and optional components, and the associated functions (French, 2004; Nelson & et. al, 1986). In the present study, we focus on children's early understanding of physics; in particular the phenomena light reflection and air pressure. We presuppose that children as young as 5 years of age already have an intuitive understanding of these phenomena based in sensorimotor representations of previous exploration of these and similar phenomena. However, they still need to learn to map particular scientific words and expressions onto these representations in order to be able to articulate their insights in a conventional way and to share them with others. We propose that, in order to do so efficiently, children need to master command of what we refer to as 'academic language' (AL); the set of linguistic tools needed to efficiently convey cognitively complex content (Schleppegrell, 2001; Snow & Uccelli, 2009). Being able to share, to compare and to contrast intuitive ideas about scientific phenomena is seen as a prerequisite for developing deeper and more abstract knowledge of these phenomena.

Particular linguistic features distinguish academic language from daily informal language and determine the fact that academic language is needed to efficiently convey cognitively complex content. These features are (amongst others) a rich and technical vocabulary, the use of specific references to space, time and entities rather than relying on shared situational cues, and the use of multi clause sentences, connected by means of connective and cohesive devices. It is proposed that teacher's guidance is invaluable to children's process of mastering academic language (Henrichs, 2010). Science-related conversations provide excellent opportunities for children to practice academic language skills. While 'doing science' children can still partly rely on the shared physical environment, but are simultaneously challenged to find accurate wording for the phenomena they observe.

In this paper, we will describe how promoting teachers' knowledge of academic language and stressing the affordances of early science lessons for academic language use can in turn promote academic language use in children.

Method

Fifty-nine teachers and 230 children participated in the study. All teachers were observed twice during brief science lessons on the topics of air pressure and light reflection. The researcher provided the teachers with the relevant teaching materials and a basic (standardized) instruction on the content of the lessons. The first round of observations (henceforth: pretest) took place in winter, the second round of observations (henceforth: posttest) in late spring. All interactions were verbatim transcribed and coded for academic language features and scientific reasoning elements such as predicting, comparing, explaining, and generalizing.

The teachers were randomly assigned to an experimental group and a control group. The experimental group attended a half-day researcher-led training session in early spring. The comparison group received no training. The training consisted of two parts; theory and practice. In the theoretical part, teachers were provided with theoretical background on the concept of academic language, and the affordances of science lessons to promote academic language. In the practice part, teachers watched a pretest video and discussed in groups the presence of academic language features in the teacher-student discourse they observed.

Results

The pretest data show that teachers used very general wording to talk about the activities (air pressure and light reflection). For instance, the key word air pressure did not occur at all, and also the word reflection was highly infrequent. Teachers were reluctant to use these words, which they seemed to perceive as too complex. Also, more general academic words, such as explore, discover or result were not found as often as might be expected in science activity. Sentences were relatively short and aimed at describing the phenomena observed (e.g. "What do you see?" or "What is happening?") rather than challenging the children to reason about what they saw in terms of predictions, comparison, explanation and generalizing.

In the posttest data, the discourse of the experimental group showed quite a different pattern. Unlike in the comparison group, overall lexical richness of the conversations in the experimental group increased substantially. More specifically, both the trained teachers and their students showed increased use of domain-specific words (e.g. air pressure, force, reflection). For general academic words, such as explore and discover, however, only an increase was found for the children in the experimental group.

In addition to changes on the word level, we also found training effects on the syntactic level. Sentences containing causal, temporal and contrastive connectors occurred significantly more frequently in the discourse of the trained group (words such as because, by means of and constructions such as "the more...the more..."). Finally, the teachers from the trained group engaged the children more often in scientific reasoning rather than simply labeling or describing, challenging the children to produce more detailed and linguistically accurate verbalizations.

Implications

Our results indicate two key findings. Firstly, with a relatively light intervention, teacher-student discourse in science activities can be enriched substantially. Secondly, children need teacher guidance to optimize their linguistic potential. Merely providing interesting, science-related material does not suffice to elicit rich discourse. When teachers, however, are made aware of the affordances of these science lessons for academic language learning, this has positive implications for the quality of the conversations.

French, L. (2004). Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly*, 19, 138-149.

Henrichs, L. F. (2010). Academic language in early childhood interactions. A longitudinal study of 3- to 6-year-old dutch monolingual children. University of Amsterdam).

Nelson, K., & et. al. (1986). *Event knowledge : Structure and function in development*. Hillsdale, New Jersey: Lawrence Erlbaum.

Schleppegrell, M. J. (2001). Linguistic features of the language of schooling. *Linguistics and Education*, 12(4), 431-459.

Snow, C. E., & Uccelli, P. (2009). The challenge of academic language. In D. R. Olson, & N. Torrance (Eds.), *The cambridge handbook of literacy* (pp. 112-133). New York: Cambridge University Press.

Formal scientific reasoning in preschool: Evaluating evidence

Susanne Koerber, University of Education Freiburg, Germany; Beate Sodian, University of Munich, Germany

Evaluating and – if necessary – revising own hypotheses in the light of new evidence is central to scientific reasoning. However, children often ignore, distort or only selectively attend to evidence that is inconsistent with a favored hypothesis/belief. We based our study on two positions which stress the impact of attending to evidence on the one hand and that of theory based reasoning (stressing explanations) on the other hand. In a between subject design 46 kindergarteners and 75 second-graders were presented with counterevidence of their belief about the relationship between two variables. In addition, half of the children received explanations for the counterevidence, illuminating the underlying mechanisms of the relationship between the two variables. The other children were presented with empirical data displayed in a bar graph, confirming the unexpected counterevidence. In both age groups we found significant numbers of belief revision with high certainty ratings concerning their new belief. This belief change was even more pronounced in elementary school, where the 2nd graders showed significantly more changes in the bar graph condition than in the explanation condition. In sum, our results demonstrate that the visualization of data might be especially helpful for children to acknowledge evidence and to reconsider own hypotheses.

Aim

Evaluating and – if necessary – revising own hypotheses in the light of new evidence is central to scientific reasoning. However, children often ignore, distort or only selectively attend to evidence that is inconsistent with a favored hypothesis/belief. The prominent role of prior knowledge and beliefs on individuals' evaluation of evidence is an often-cited phenomenon. Children tend to reconcile data and their own beliefs, but are usually biased in favor of their prior beliefs. Thus, they often seem to ignore, distort, or only selectively attend to evidence that is inconsistent with a

favorable hypothesis/belief. Recent studies have shown that these problems cannot be explained convincingly by a deficit theory (e.g., Kuhn, Amsel & O'Loughlin, 1988) that claims children might lack a general understanding of the relation between theory and evidence. In contrast, Koslowski (1996) claims that children's reluctance to give up their prior beliefs is based on a strong emphasis on beliefs and subjective theories, such that children have to be provided with explanations or alternative theories in addition to the counterevidence. Other researchers, such as Chinn and Malhotra (2002), focus more on the role of the evidence, showing that children often have problems with correctly perceiving the evidence in the first place. Correct inferences from data are thus only possible when evidence is correctly represented and taken seriously. In our study we examined these two positions more deeply and investigated the effect of an explanation about the mechanism of the relation between the two variables as well as the effect of graphically visualizing empirical data on children's understanding of the hypothesis-evidence relation.

Method

In a between-subject design we presented 46 kindergarteners and 75 second-graders with counterevidence of their strong belief about the relationship between two variables. For instance, children who believed that eating carrots would be more helpful for good vision than eating spinach were presented with evidence showing that in fact both vegetables are equally healthy. In addition to the counterevidence, half of the children in each age group received explanations for the counterevidence, illuminating the underlying mechanisms of the relationship between the two variables (e.g., carrots and spinach contain an equal amount of beta carotene / Vitamin A which supports good vision). The other children were presented with empirical data displayed in a bar graph confirming the unexpected counterevidence. Altogether, the children were presented with four tasks. In two tasks non-covariation served as counterevidence, in the other two tasks perfect covariation evidence counter to the child's hypothesis was presented. After check questions they were asked what they would think about the relationship between the two variables now, after seeing the data or listening to the explanation. In order to test for depth and consistency of the answers we included questions concerning the certainty of the children's own beliefs and another person's belief (change).

Results.

In both age groups we found significant numbers of belief revision with high certainty ratings concerning their new belief. Preschoolers changed their belief in a mean of 2.25 (sd = 1.15) and 2.09 (sd = 1.19) out of 4 contexts in the explanation and in the bar graph condition, respectively. This belief change is even more pronounced in elementary school, where the 2nd graders showed significantly more changes in the bar graph condition (mean = 3.3; sd = .7) than in the explanation condition (mean = 2.8; sd = 1.2), $F(1,72) = 5.9$, p

Implications.

Together, the findings suggest that even preschoolers are able to revise their beliefs when being presented with explanations for the counterevidence or when the perceptual salience of the counterevidence was emphasized via graphs. With increasing age the salience of the evidence seems to gain even more impact.

SYMPOSIUM

Religious and Spiritual Education: Issues of Effectiveness and Competence

Chairperson: Theo Van der Zee, Radboud University Nijmegen, Netherlands

Organiser: Terence Lovat, The University of Newcastle, Australia

Theo Van der Zee, Radboud University Nijmegen, Netherlands

Discussant: Kirsi Tirri, University of Helsinki, Finland

The symposium will explore updated research around the central issue of the effectiveness and competence of religious and spiritual education to address and deal with issues of concern and substance in society generally and among youth in particular. Issues around belief in the after life among primary students and of intercultural and interfaith conflict among secondary students will be explored as instances. Conceptual and empirical research will be used as means of illustrating effectiveness or not, as well as evaluating these programs. Additionally, the specific competence of the teacher and how best to train teachers to deal with such issues will be the subject of updated research.

Interfaith Religious and Values Education: A Judeo-Christian-Islamic Instance

Terence Lovat, The University of Newcastle, Australia; Robert Crotty, University of South Australia/Ethics Centre of South Australia, Bahamas

The works of Dietrich Bonhoeffer, John Hick and Mohamed Talbi will be used as examples of interfaith theology designed for relevance to a globalized community. Far from being movements towards reducing belief, as often purported by their accusers, they are deemed to be means of strengthening it in a world of competing faiths and non-

faith. Neither are they signs of a weaker or more marginalized theology but, on the contrary, of theology with capacity to play a vital role in humans understanding better their condition in the twenty-first century, the century's particular challenges and the role of faith in their midst. In this context, the role of religious education must broaden beyond its traditional denominational boundaries to match the globalized perspective and potency of interfaith theologies of the type proposed by Bonhoeffer, Hick and Talbi. The paper will expose the proposed shape, form and ramifications for religious and values education designed to explore the positive and negative perspectives on the relationship between Islam and the Judaeo-Christian 'West' and so prepare students for these realities. It will also explore ways in which such curricula can be and, in some cases have been, tested and evaluated for their effects.

The works of Dietrich Bonhoeffer (1959, 1998), John Hick (1973, 1980, 1988, 1995) and Mohamed Talbi (1995, 2002, et al., 2002) will be used as examples of interfaith theology designed for relevance to a globalized community. Far from being movements towards reducing belief, as often purported by their accusers, they are deemed to be means of strengthening it in a world of competing faiths and non-faith. Neither are they signs of a weaker or more marginalized theology but, on the contrary, of theology with capacity to play a vital role in humans understanding better their condition in the twenty-first century, the century's particular challenges and the role of faith in their midst.

In Bonhoeffer and Hick, we find reactions from within the Christian faith to traditional forms of Christian dogmatism and evangelical claims to be the only true religion. In Talbi, we find an equivalent critique from within Islam, a critique that employs Islam's own sacred sources to show that Islam should be a leader of interfaith dialogue and its allied theologies, rather than the exclusivist tradition that has become its stereotype in the early years of the twenty-first century. The paper will explore these conceptions and their pertinence to the kinds of religious and values education needed to inform and prepare students well for their multi-faith, multi-values world and in ways that maintain credibility for such curricula, including through their own testing and evaluation. It will furthermore explore the potential for building much-needed bridges between Christianity and Islam whose history is more around conflict between their narrow claims to be exclusively God's chosen faith. This conflict presents as arguably at the heart of the twenty-first century's principal threat to peace and so its resolution must present as a particularly urgent task for twenty-first century education to address.

The paper will expose the proposed shape, form and ramifications for religious and values education designed to deal with these issues. The religious and values education required for Westerners, and especially those of direct Jewish and Christian origin, to truly understand Islam is one that must make a difference, a difference not only to head knowledge but a difference in the way these Westerners ultimately act towards their fellow human beings. Concomitantly, the religious and values education required for Muslims, especially in Western environments, are ones that engage them in the fullness of learning about the verifiable facts of their own religious history, in contrast with the increasing attempts by Islamist commentary to skew these facts, and to bring the beliefs and values of Islam into the marketplace where they can be negotiated and evaluated along with all other beliefs and values of a polyglot society that is functioning for the benefit of all its participants.

The paper will explore two religious education syllabuses and one values education program that have been used in this way in recent times (Lovat, 2010; Lovat et al., 2010). Through the two religious education syllabuses, students have increased opportunity on those in former years to come to a fairly sophisticated knowledge and understanding of Islam and to bring Muslim and non-Muslim students into active conversation with each other about matters of faith. This knowledge and understanding is beyond descriptive knowing of the details about Islam's history, creeds and morality. The pedagogy, impelled by an explicit epistemology that distinguishes between technical, interpretive and reflective knowing, aims to engage students in learning that challenges their own beliefs and life-worlds and that can therefore make a difference in the way they approach Islam, either as their own faith or as the faith of the other.

The values education project was designed specifically to address issues of cultural and religious difference, in each case combining within-school pedagogy with an experiential component that impelled interfaith engagement. Schools were drawn from Muslim, non-Muslim and Government school sectors, with the specific and central focus being a broadening of understanding between Muslim and non-Muslim cultures. Beyond learning targeted at understanding the 'other' within the school, the cluster was involved in an array of organized excursions that took students out of their own environment and placed them in the environment of the other, complete with pedagogical attachment that ensured engagement with the other. The beyond-school pedagogy was heavily focussed on 'place' and 'space', with careful and even-handed movement of students from their own comfort zones into the comfort zones of the 'other'. One such place was a site where a particularly violent and public exchange had occurred between allegedly Muslim and non-Muslim youth and so served as a particular focus for the project in question, providing a sharp example of what can transpire when the goals of the project are not attempted and a mixed

community is left without communicative capacity, empathic character and self-reflectivity of the kind proposed as crucial to the aims of the values education intervention.

The paper will provide details of these programs as well as an evaluation that was conducted, with special reference to the latter project, designed to test and measure its effects (Lovat et al., 2009; Lovat et al., 2010). This involved quantitative and qualitative method and particular reference to the issue of intercultural tolerance purported to be central to the issue of interfaith engagement.

Bonhoeffer, D. (1998). *Letters and papers from prison*. London, UK: SCM.

Hick, J. (1995). *A Christian theology of religions: The rainbow of faiths*. Louisville, Kentucky, USA: Westminster John Knox Press.

Lovat, T., Toomey, R., Dally, K. & Clement, N. (2009). *Project to test and measure the impact of values education on student effects and school ambience. Final Report for the Australian Government Department of Education, Employment and Workplace Relations (DEEWR) by The University of Newcastle*. Canberra: DEEWR

Lovat, T. (2010). Improving relations with Islam through religious and values education. In K. Engebretson, M. de Souza, G. Durka & L. Gearon (Eds.), *International handbook of inter-religious education*. (pp. 695-708) New York: Springer.

Lovat, T., Clement, N., Dally, K. & Toomey, R. (2010). Addressing issues of religious difference through values education: An Islam instance. *Cambridge Journal of Education*, 40, 213-227

Talbi, M. (1995). Unavoidable dialogue in a pluralist world: A personal account. *Encounters: Journal of Inter-cultural Perspectives*, 1 (1): 56-69.

Primary school students' beliefs about the afterlife. A developmental perspective

Theo Van der Zee, Radboud University Nijmegen, Netherlands

In Religious Education (RE) students learn about various aspects of life as death and afterlife from a religious perspective. The plausibility of religious beliefs on these matters, however, is challenged by advanced biological knowledge. How do students deal with this challenge? From an educational perspective this question is in particular important because it touches the issue how students develop when they are exposed to seemingly incompatible conceptual systems.

Aim of our research is to find out how primary school students' beliefs about the afterlife develop. It can be expected that these students tend to develop two different conceptualizations of death: a biological and a religious one. What also isn't known yet is whether religious children deal with seemingly incompatible conceptualizations differently from non-religious children.

Our research questions are:

- (1) which functions do children attribute to people after death?
- (2) does age influence the attribution?
- (3) does religious affiliation influence the attribution?
- (4) does religious affiliation influence the explanation of attribution?

To answer our research questions, we interviewed 162 primary school students: 81 of grade 2 (7-8 years) and 81 of grade 6 (11-12 years of age), and from four different religious backgrounds. Results of analyses show that students attribute biological functions to a low and mental functions to a high extent, and also an influence of age and of religious affiliation. Findings are discussed with a view to the question how students cognitively develop when they are exposed to seemingly incompatible conceptual systems.

In Religious Education (RE) students learn about various aspects of life as death and afterlife from a religious perspective. These latter aspects aren't easy to grasp, because they pose perceptual and conceptual challenges. By participating at RE classroom practices, students can acquire religious beliefs about the afterlife. The plausibility of these beliefs, however, is challenged by advanced biological knowledge about life and death (Spilka, Hood, Hunsberger & Gorsuch, 2003). An intriguing question is how students deal with this challenge. From an educational perspective this question is in particular important because it touches the issue how students develop when they are exposed to seemingly incompatible conceptual systems (Gelman, 2009; Harris & Koenig, 2006).

Aim of our research is to find out how primary school students' beliefs about the afterlife develop. It can be expected that these students tend to develop two different conceptualizations of death: a biological and a religious one. It also appears that this tendency is more pronounced among older children (Bering & Bjorklund, 2004; Harris & Gimenez,

2005). What isn't known yet is whether religious children deal with seemingly incompatible conceptualizations differently from non-religious children (cf. Bering, Blasi, Bjorklund, 2005; Harris & Koenig, 2006).

From a cognitive science perspective on religion, it is hypothesized that people use various mental tools as theory of mind to process information about reality and to generate beliefs. These mechanisms all involve the concept of agency. Afterlife beliefs reflect how people understand reality after death. The understanding of death as the cessation of agency could be an important clue to the explanation how afterlife beliefs tend to develop and spread (Barrett & Behne, 2005; Barrett, 2004). Research provided evidence that people distinguish between biological (physical, sensory, psychobiological) and mental functions (desire, epistemic, emotional, moral) (Bering & Bjorklund, 2004; Harris & Gimenez, 2005).

Our research questions are as follows:

- (1) which biological and mental functions do children attribute to people after death?
- (2) does age influence the attribution?
- (3) does religious affiliation influence the attribution?
- (4) does religious affiliation influence the explanation of attribution?

To answer our research questions, we interviewed 162 primary school students: 81 of grade 2 (7-8 years) and 81 of grade 6 (11-12 years of age). The students are from four different religious backgrounds: Catholic, Protestant, Islamic and Non-religious, and they were recruited by teachers at their primary school and participated when their parents have given their consent. Three instruments are used: a questionnaire on personal characteristics, a test for vocabulary, and an interview on afterlife beliefs. The interview was composed of two narratives about the death of an elderly grandmother and grandfather, and of two times 14 questions about biological and mental functioning of the deceased and two times three open questions about the explanation of the functioning after death.

Results of descriptive analyses show that students attribute biological functions to a low extent ($M=.27$, $sd=.30$) and mental functions to a high extent ($M=.63$, $sd=.33$). Results of ANCOVA show that age (controlled for scores on vocabulary tests) influences the attribution of biological and mental functions, and results of Oneway ANOVA show that religious affiliation influences the attribution of biological functions, but not of mental functions. Results of content analyses on the answers of students on the open questions show differences with respect to religious affiliation. In particular, Protestant primary school students tend to explain afterlife differently than other students do.

Findings are discussed with a view to the question how these students cognitively develop when they are exposed to seemingly incompatible conceptual systems.

Barrett, J. (2004). *Why would anyone believe in God?* Lanham: Alta Mira Press.

Barrett, H.C. and T. Behne (2005). Children's understanding of death as the cessation of agency: a test using sleep versus death. *Cognition*, 96, 93-108.

Bering, J.M. and D.F. Bjorklund (2004). The natural emergence of reasoning about the afterlife as a developmental regularity. *Developmental Psychology*, 40, 217-233.

Bering, J.M., Blasi, C.H., and D.F. Bjorklund (2005). The development of 'afterlife' beliefs in religiously and secularly schooled children. *British Journal of Developmental Psychology*, 23, 587-607.

Gelman, S.A. (2009). Learning from others: children's construction of concepts. *Annual Review of Psychology*, 60, 115-140.

Harris P.L. and M. Gimenez (2005). Children's acceptance of conflicting testimony: the case of death. *Journal of Cognition and Culture*, 5, 143-164.

Harris, P.L. and M.A. Koenig (2006). Trust in testimony: how children learn about science and religion. *Child Development*, 77, 505-524.

Spilka, B., Hood, R.W., Hunsberger, B. and R. Gorsuch (2003). *The psychology of religion: an empirical approach*. New York: Guilford Press.

Perceptions of competence during training among RE student teachers

Martin Ubani, University of Helsinki, Finland

The purpose of this study is to explore the perceptions of competence among Finnish RE student teachers during their one-year pedagogical training. The concrete research questions are: 1. What do the RE teacher students perceive as the characteristics of a competent RE teacher during their pedagogical training? 2. How do they perceive their personal competence in teaching during their training? The participants were RE student teachers from the University of Helsinki, Finland ($N=86$). The data included qualitative and quantitative questionnaire data along with interviews.

According to the study, the perceptions on competence remained stable while perceptions of personal competence developed and generally feeling of self-efficacy increased.

The purpose of this study is to explore the perceptions of competence among Finnish RE student teachers during their one-year pedagogical training. In literature, the term competence refers to the combination of knowledge, skills and attitudes which actualise in the problem-solving task relevant to the area of competence (Baartman, et al., 2007). Research shows that the main difference in favour of experts over novices is grounded in the differing amounts of experience and motivation (Berliner, 1991; Pikers & Paas, 2005). Pedagogical expertise resembles other areas of expertise: it is a sophisticated form of knowledge which is not easily gained or mastered (Berliner, 1991). Self-efficacy refers to the amount of confidence the individual has in his/her ability to carry out a given courses of action or to achieve a desired outcome and has been verified as important element in effective teaching (Bandura 1982; 1997; 1995).

The concrete research questions are:

1. What do the RE teacher students perceive as the characteristics of a competent RE teacher during their pedagogical training?
2. How do they perceive their personal competence in teaching during their training?

Method

The data was gathered 2007-2008 and 2008-2009. The participants were RE student teachers from the University of Helsinki, Finland (N=86). There were 64 female participants and 22 male participants aged 20-43 years. Eight students were interviewed on personal views on expertise, profession and pedagogy in the beginning, middle and end of the training. Data was analysed with qualitative content analysis (Bos & Tarnai 1999).

The questionnaire data was gathered with a two-part form at the beginning and at the end of the. The first part of the form has open-ended questions and provides qualitative data. The second part is a survey questionnaire with 64 items. The questionnaire included 56 statements (5-point Likert: 1 = fully disagree, 5 = fully agree) based on Eraut's (1994) constructivist theory of professional development and competence (1-6) with three additional RE specific areas of competence (7-9): (1) knowledge of people, (2) situational knowledge, (3) knowledge of educational practice, (4) propositional knowledge, (5) process knowledge, (6) control knowledge, (7) theological content knowledge, (8) content specific psychological knowledge and (9) knowledge of context. In addition there was a question: "Please evaluate your personal competence at this moment" (1-5). T-test analysis was used (SPSS).

Perceptions of competence: Qualitative results

The categories were called Virtuous Personality, Skilful Practice and Expert Knowledge. Each of these categories consisted of three or four sub-categories (Table 1 & 2). The emphasis on Virtuous Person became less in Spring (33.1%-28.1%) and the emphasis on Expert knowledge increased in Spring (32.8%-37.2%). Skilful Practice remained relatively stable in size (34.0-34.7%).

The largest sub-categories were mastery of subject matter (C2), mastery of practice (B1), social communication (B3) and empathy and caring (A2). The size of the sub-categories remained relatively stable. Among other things, the comparison shows some decline in empathy and caring (13.3%-10.0%) and social communication (16.3%-13.2%) while mastery of subject matter (21.4%-23.8%) and mastery of practice (16.9%-19.5%) was emphasized more in the end of the pedagogical year.

Quantitative results

In the quantitative data there were no statistically significant changes in the perceptions of competence areas (Table 3). Generally all categories scored relatively high which is quite likely due to the fact that the study focused on ideals. It should be noted, however, that the statements included also negative claims. The participants appreciated both in the beginning and in the end process knowledge ($M1 = 4.2$, $SD = .31$ – $M2 = 4.2$, $SD = .35$), situational knowledge ($M1 = 4.1$, $SD = .26$ – $M2 = 4.3$, $SD = .42$), content specific psychological knowledge ($M1 = 4.1$, $SD = .29$ – $M2 = 3.9$, $SD = .46$) and contextual knowledge ($M1 = 4.1$, $SD = .26$ – $M2 = 3.9$, $SD = .44$). In principle the standard deviation in the end of the studies was higher than in the beginning implying some differentiation during the pedagogical training among participants.

However, there was a statistically significant increase in perceived self-competence ($t(155) = -6.90$, p). The interviews showed that the each of the students had one or two constant foci concerning competence in RE teaching throughout their pedagogical training year. All shared subject matter as a focus while the second focus varied between methods and classroom interaction. Generally the perceptions concerning subject-matter shifted from emphasising content-

knowledge to information skills, sense of incompetence concerning methods remained stable while confidence increased concerning classroom interaction and management.

Concluding remarks

In addition, to self-efficacy, future studies concerning RE student teachers should include areas such as professionalism and vocation, and more qualitative changes in the understanding of teacher competence.

Baartman, L., Bastiaens, T. J., Kirscher, P. & van der Vleuten, C. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review* 2(2), 114-129.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Bandura, A. (1995). Exercise of personal and collective self-efficacy in changing societies. In A. Bandura (Ed.), *Self-efficacy in changing societies* (pp. 1-45). New York: Cambridge University Press.

Bandura, A. (1982). Self-efficacy mechanisms in human agency. *American Psychologist*, 37, 122-147.

Berliner, D. (1991). Educational psychology and pedagogical expertise: New findings and new opportunities for thinking about training. *Educational Psychologist*, 26 (2), 145-155.

Bos, W. & Tarnai, C. (1999). Content analysis in empirical social research. *International Journal of Educational Research* 31, 659-671.

Eraut, M. (1994). *Developing professional development and competence*. London: Falmer.

Pikers, R. & Paas, F. (2005). Recent advances in expertise research. *Applied Cognitive Psychology*, 19, 145-149.

SYMPOSIUM

Immoral Behavior: A Result of a Lack of Moral Motivation?

Chairperson: Karin Heinrichs, Goethe-University in Frankfurt, Germany

Organiser: Karin Heinrichs, Goethe-University in Frankfurt, Germany

Fritz Oser, Universität Freiburg, Switzerland

Discussant: Karin Heinrichs, Goethe-University in Frankfurt, Germany

People are getting more and more involved in global communication processes via the internet, email and online-games. We register that in these contexts new kinds of immoral behavior emerge, e.g., cyberbullying, in addition to immoral behavior which is apparent all over the world. In order to prevent immoral behavior and to support moral development, we need deeper insights in how immoral behavior develops and how moral behavior can be fostered. In this symposium we refer to James Rest's (1999) four component model of moral action. The model assumes that moral motivation is one necessary component for acting in a morally adequate manner. To date, a large body of research exists of two Rest's components: moral judgment and moral sensitivity. But we do not know enough about the impact of these components on moral behavior. Additionally the component of moral motivation has been insufficiently elaborated for a long time, but is now becoming the focus of an increasing number of studies. In this symposium the papers represent some of the current approaches to moral motivation. The contributions all (a) focus on the question whether immoral behavior can be explained by a lack of moral motivation; and (b) point out empirical results from both quantitative and qualitative studies. In the general discussion, new ideas about potential ways to foster moral motivation in childhood and adolescence will be presented.

Moral Emotions - Motives For (Im)Moral Behavior?

Eveline Gutzwiller-Helfenfinger, The Institute of Pedagogical Professionalism and School Culture, Switzerland; Brigitte Latzko, University Leipzig, Germany; Luciano Gasser, PH Luzern, Switzerland; Tina Malti, University Toronto, Canada

Schools and teachers are highly relevant for the socialization of the upcoming generation who is responsible for the future global networked society. Facing the bold changes in modern societies due to globalization, educators have to foster children's and adolescents' moral growth to enable them to preserve moral and democratic values in these increasingly diversified societies.

This paper provides an empirical approach to discuss how developmental research on children's and adolescents' moral emotions can help us understand how both immoral and morally relevant behavior evolve. Are moral emotions related to children's moral, prosocial behavior, as well as to their immoral, aggressive behavior? We present three studies that investigate the link between these aspects. Based on the findings we discuss how moral emotions might serve as motives for (im)moral behavior. We argue that studying how moral emotions can serve as motives for (im)moral action tendencies may not only be of conceptual significance to developmental researchers, but also of practical importance to educators.

Facing the bold changes in modern societies in the course of globalization, it is highly relevant for all educators to foster children's and adolescents' moral growth to enable them to preserve moral and democratic values in increasingly diversified societies. Moreover, being able to understand themselves as socially embedded, mutually interdependent (i.e., networked) agents helps students to become more open towards and tolerant of various kinds of "other-ness", for example cultural diversity. Moral learning and understanding encompass far more than just knowing about rules and values. If these rules and values are to become relevant to the self, children and adolescents must attach valence and meaning to them and gain a deeper understanding of what it means to consider other peoples' welfare. Because emotions give meaning and valence to interactions, actions, and events (e.g., Ellsworth & Scherer, 2003) they play a central role in moral learning.

Accordingly this paper provides an empirical approach to discuss how developmental research on children's and adolescents' moral emotions can help us understand how both morally relevant and immoral behaviour evolve. The central question is whether moral emotions are related to children's moral, prosocial behavior, as well as to their immoral, aggressive behaviour. We present three studies investigating the link between moral emotions and eventual (im)moral behaviour. Based on the findings we discuss how moral emotions might serve as motives for (im)moral behavior.

Study 1 investigated the question how moral emotions evolve during the course of childhood by comparing at-risk children's moral emotions and moral judgments with those of children attending an ordinary elementary school. At-risk children differ from "normal" children by having problems with discipline, being more aggressive towards both teachers and classmates, and by behaving immorally and transgressing moral rules. Drawing conceptually on the happy-victimizer-approach, at-risk children were assumed to a) accept moral rule transgression more often; b) attribute positive feelings to the victimizer more often; and c) express less empathy towards the victim than control children. 80 boys aged 9 to 11 were asked to judge moral rule transgressions as well as to attribute emotions to the transgressor and to the victim and to justify these judgements and attributions. Content analysis (Mayring, 2002) was performed (Cohen's $k = .84$). Although no differences were found for rule knowledge, we found notable differences regarding moral reasoning and emotion attributions. At-risk children showed a higher acceptance of rule transgressions and less moral justifications for non-acceptance. With respect to the victim, the at-risk group had difficulties attributing any emotions at all, and more frequently reported to have no idea what harming someone means as compared to control children. The results show that educating moral emotions seems to be as important as educating moral reasoning. Emotional experiences can be meaningfully used as a basis for initiating children's moral learning.

Study 2 investigated the relations between physical and relational aggression and moral knowledge and emotions in a sample of 237 7- and 9-year-old primary school children. Firstly, we expected that physical aggression would be associated with deficits in moral knowledge and moral emotions. Secondly, we hypothesized that relational aggression is negatively associated with moral emotions, but is not associated with moral knowledge. Both relational and physical aggression were assessed by peer nominations and teacher ratings. Moral knowledge was measured by moral judgments and justifications of these judgments', moral emotions were measured by emotion attributions and corresponding justifications. Hierarchical regression analyses revealed that physical aggression was associated with deficits in moral knowledge and moral emotions. Relational aggression, however, was not associated with moral deficits, but with an advanced understanding of moral emotions, suggesting that children with high levels of relational aggression use their advanced understanding of moral emotion for strategic purposes.

Study 3 investigated whether children's moral judgments, emotion attributions, and justifications produced in real-life narratives differ from those generated in hypothetical scenarios. The sample consisted of 190 Swiss kindergarten and primary school children. Based on Wainryb et al.'s (2005) procedure, a narrative of an own interpersonal moral transgression was elicited from each child, followed by a half-standardized interview to probe children's motives, moral judgments, justifications for these judgments, emotions attributed to both themselves (perpetrator) and others (victim), and justifications for the emotions attributed to the self. Children were also presented with two hypothetical scenarios of moral transgressions. They had to morally judge these transgressions, justify their judgments, attribute emotions to both perpetrator and victim, and justify the emotions attributed to the perpetrator. Narratives were content analysed (Cohen's $\kappa = .74$). Results revealed distinct patterns for real-life and hypothetical transgressions: 9-year-old girls attributed more fear to the perpetrator than 9-year old boys in the hypothetical context, whereas no differences were found in the real-life context. Children gave more moral, sanction-oriented, legitimate, hedonistic, and undifferentiated justifications for hypothetical transgressions. Hypothetical transgressions were judged as more severe than real-life transgressions and were given more moral justifications (by older children) and more undifferentiated justifications (by younger children). In contrast, real-life transgressions were more often

presented as justified or legitimate, and moral judgments were more often justified by proposing an alternative strategy.

The data of the three studies indicate that although children understand the validity of moral rules, they do not necessarily understand the emotional consequences of following or breaking them. This is especially true for at-risk and physically aggressive children. Accordingly, we argue that immoral conduct is, in part, related to this deficit regarding moral emotions. Therefore it is important to systematically introduce a wide range of moral emotions into educational practice. Studying how moral emotions can serve as motives for (im)moral action tendencies is not only conceptually significant to developmental researchers, but also of practical importance to educators, in particular to teachers. Before establishing educational programs on moral learning in school settings we need to know more about the underlying developmental mechanisms. By studying specific real-life conflict situations and the emotions invoked in the child, teachers can help inculcate sociomoral sensitivity. Sensitizing educators to the variety of interventions they can use in specific situations is a key to stimulating children's moral growth.

Juvenile Delinquency: Lack of Moral Motivation or Moral Ambivalence?

Stefan Weyers, Institut für Erziehungswissenschaft, Germany

Initially, this presentation deals with approaches to moral motivation and to denial of responsibility. Subsequently, it examines 30 imprisoned delinquents, examining their moral judgment, moral orientations and biographical self-interpretations. The findings show that many delinquents have an ambivalent attitude toward moral norms. Six different types of biographical self-presentation could be identified, that represent different moral perspectives concerning themselves and their offences and different structures of motivation. It is argued that the actual process of maintaining moral identity is more important than the moral-cognitive structure with respect to delinquency and its retrospective interpretation. All in all, juvenile delinquency seems to relate more to an ambivalent moral motivation than to a lack of moral sense. However, the findings clearly indicate that the subjects differ strongly from one another with regard to important dimensions of moral development. These different developmental conditions must also be taken into account in social work with juvenile delinquents. Finally, some educational implications of the study are discussed. For example, the results imply that purely cognitive approaches of moral education have only a limited impact.

Aims:

Delinquency is often attributed to moral deficits. However, the relationship between morality and delinquency is still unclear and is intensely debated. Depending on the point of view, relevant factors can include a lack of moral sense, a sub-cultural system of norms, an alternative identity or strategies for denial of responsibility (Cohen 1955; Emler 1984; Shields/Whitehall 1994). In contrast, Kohlberg (1978) hypothesized that juvenile offenders have strong developmental delays and that their moral judgment is predominantly at low moral stages 1 and 2. These assumptions are used as the basis for programmes to facilitate moral judgment in penal institutions. In this contribution, an alternative moral-theoretical interpretation of delinquency is depicted, which focuses instead on the moral motivation and the biography of the subjects. The empirical basis is a study of detained juvenile delinquents. It examines their moral judgments, moral orientations and biographical reconstructions of their offences. The results should contribute to an empirical basis for theories of moral development and socialization, and of educational interventions.

Methodology:

The sample consisted of 30 randomly selected male inmates of a German juvenile detention centre, between 16 and 23 years of age. The subjects mainly committed more serious offences – including murder, robbery and assault - and were given sentences ranging from 1.5 to 8 years. A wide empirical analysis included cognitive as well as motivational moral aspects. Additionally, the way how the subjects reconstructed their own biographies and offences were taken into account, because the retrospective reaction to the own immoral behaviour is an important indicator of the moral self (Blasi 1993). The moral level was assessed using Kohlberg's "Moral Judgment Interview" and evaluated with the "Standard Issue Scoring". The biographical self-presentation and reconstruction of the offences were obtained using biographical interviews for data collection. Interpretative methods of biography research were applied for analysis. The biographical descriptions were also compared with the factual reconstructions as exposed in the official court documents.

Findings:

The findings contradict Kohlberg's assumption that juvenile offenders' moral judgment is predominantly at the low moral stages. A relationship between moral stage and the seriousness of the offence could also not be found.

However, the results show a connection between the "moral type", which encompasses motivational orientation to a greater extent, and the seriousness of the offence (Weyers 2004).

The results of the biographical interviews indicate that many delin[®]quents have an ambivalent attitude towards moral norms. The subjects strongly differ from one another with respect to their biographical self-presentations and to their reconstructions of their own offences: Six types, representing different moral perspectives on themselves and their actions, could be identified. The presentation introduces the six types: the "remorseful sinner", the "victim", the "hero", the "stupid boy", the "new adult" and the "criminal deviant". Moreover, the interviews suggest that moral development can play an important role for biographical changing with regard to delinquency. All in all, juvenile delinquency seems to relate more to an ambivalent moral motivation than to a lack of moral sense.

Theoretical significance:

The findings are discussed, with emphasis on the ambivalent attitude of many delin[®]quents towards moral norms. It is argued that processes of maintaining moral identity are more important than moral-cognitive structures with respect to delinquency and its retrospective interpretation (Blasi 1993): moral knowledge is learned early, but the development of moral self-obligation is a separate process, which is completed more or less (Nunner-Winkler 1993). The deciding factor is how comprehensively moral standards are established. Interacting with other persons makes people learn that moral standards are valid, but they also recognize that moral standards are ignored in many contexts. When children are exposed to a strong discrepancy between the need for moral standards and their application it becomes increasingly difficult to establish stable moral standards. The consequence is an ambivalent attitude: standards are generally accepted, but they are only applicable in certain contexts. In other situations, violations of these standards are considered acceptable and do not endanger self-perception. The biographical interviews indicate that the majority of subjects consider their offences as wrong, but not as badly wrong. Many crimes are not even perceived as morally relevant. This goes hand in hand with the use of strategies of neutralization to resist moral obligations and with creating a consistency between actions and self-perception.

Educational significance:

The results imply that purely cognitive approaches of moral education have a limited impact. Methods for facilitating moral development in penal insti[®]tutions have to take into account the motivational dimension of morality and the coping strategies with regard to criminal actions. The findings indicate that the subjects differ strongly from one another. These differing conditions of moral development must be taken into consideration in social work with juvenile delinquents. The biographical interviews also indicate that moral development can play an important role in modifying the self-biography. When working with juveniles who describe their delinquency in terms of the "remorseful sinner" or "new adult" types, there is a chance to influence the self-biographical changes positively. With the "hero", "victim" or "criminal deviant" types however, more substantial psycho-social measures are required to avoid further embedding of the delinquent behaviour and orientation.

Blasi, A. (1993): The development of identity. Some implications for moral functioning. In: Noam, G./Wren, Th. (Eds.): The moral self. Cambridge: MIT Press, 199-122

Cohen, A. K. (1955): Delinquent boys. The culture of the gang. Glencoe, Illinois
Emler, Nicholas (1984): Differential involvement in delinquency: Toward an interpretation in terms of reputation management. In: Maher, Brendan/Maher, Winifred (Eds.): Progress in experi[®]mental personality research, Vol. 13: Normal personality processes. Orlando, 173-239

Kohlberg, L. (1978): The cognitive developmental approach to behavior disorders: A study of the development of moral reasoning in delinquents. In: G. Serban (Ed.): Cognitive defects in the development of mental illness. New York, 207-219

Nunner-Winkler, G. (1993): The growth of moral motivation. In: Noam, G./Wren, Th. (Eds.): The moral self. Cambridge: MIT Press, 269-291
Shields, Ian/Whitehall, Georgia (1994): Neutralization and delinquency among teenagers Criminal Justice and Behavior 21, 223-235.

Weyers, Stefan (2004): Moral und Delinquenz. Moralische Entwicklung und Sozialisation straffälliger Jugendlicher. Weinheim: Juventa.

Self-centeredness as Drive Towards Antisocial Behavior

Daniel Brugman, utrecht university, Netherlands

Several theories that aim to explain the origin, development, and maintenance of antisocial behavior stress the importance of self-serving cognitive distortions (SSCDs). SSCDs are deficiencies in the interpretation of social events that enhance antisocial behavior. Primary SSCDs are self-centered attitudes and beliefs that may drive individuals towards antisocial behavior. Secondary SSCDs are pre- or posttransgression rationalizations that serve to neutralize

conscience, potential empathy, and guilt, and thereby prevent damage to the self-image when an individual engages in antisocial behavior. The prevalence of SSCDs in adolescents is related to gender, educational level, ethnic background, and delinquency. Results of a MTMM study are presented that show an increase in the amount of explained variance in antisocial behavior by SSCDs. Moreover findings of SSCDs in children (aged 7 to 12 years) are presented. Possibilities for prevention in school programs are discussed.

SYMPOSIUM

Classroom Assessment and Feedback as Tools to Foster Learning in Mathematics and Science Education

Chairperson: Katrin Rakoczy, German Institute for International Educational Res, Germany

Organiser: Katrin Rakoczy, German Institute for International Educational Res, Germany

Birgit Harks, German Institute for International Educational Research, Germany

Discussant: Peter Tymms, University of Durham, United Kingdom

Assessment of student competencies is an essential component of instruction. Particularly formative assessment turned out to be important because there is strong evidence that it has the potential to support student learning. Formative assessment implies competence diagnostics and competence feedback as two central elements. It should be designed to inform students about their strengths and weaknesses and how they should continue in order to reach their learning goals. In spite of the consensus on the importance of formative assessment in the scientific context, practices of formative assessment are rarely realized in everyday instruction. Taking this contrast into consideration the symposium tries to clarify the preconditions for formative assessment and investigates how formative assessment impacts student learning. In detail, the first contribution (Taut) analyses the preconditions for formative assessment in policy and teacher practice at the example of Chile. The second paper (Rakoczy et al.) examines the impact of written teacher feedback on motivation and achievement development. And the third contribution (Gan) takes a closer look at peer feedback. It investigates how the coaching of students influences students in providing each other with feedback. The symposium contributes to the understanding of how teachers and students can be supported in providing learners with helpful feedback, finally clearing the way for a more frequent and more appropriate implementation of formative assessment practices in school.

Classroom assessment in Chile: A diagnosis of policies and practices

Sandy Taut, P. Universidad Catolica de Chile, Chile; Daniela Jimenez, German Institute for International Educational Research, Germany

This study addresses classroom assessment policies and practices in Chile. The paper explores the policy context related to classroom assessment and describes assessment practices in math and science classrooms using data from (a) teacher surveys that are part of the national student achievement testing system (SIMCE), (b) the national teacher performance assessment system, and (c) the Third International Math and Science Study (TIMSS). Preliminary findings suggest that policies as well as teaching practices focus mainly on summative assessment, with the exception that the official teaching standards explicitly demand a formative use of classroom assessment. The teacher performance assessment data show that assessment skills are consistently among the weakest performance areas, both regarding the quality of the assessment instruments and the use of these assessments for teaching and learning. SIMCE survey data indicate that math and science teachers' assessments are mostly graded written exams delivered at the end of (but not at the beginning or during) a learning cycle, and that these exams often consist of a mix of constructed-response and multiple-choice items. TIMSS responses are similar, although here teachers report somewhat more use of constructed-response-only exams in math, but not in science, where assessment formats differ substantially from the TIMSS international average.

Significance for research and policy

Student assessment is an important part of what teachers do in the classroom. Particularly formative assessment plays an important role because there is strong evidence of its potential to support student learning (Black & Wiliam, 1998; Marzano, Pickering & Pollock, 2001; Wiliam, Lee, Harrison & Black, 2004). An OECD review of Chile's education system stated that classroom assessment was particularly weak (OECD, 2004) and another recent review of the education assessment system calls for more research on the topic (Ramirez, 2010). This paper responds to the need to fill the research void regarding classroom assessment policies and practices in Chile. Findings will inform a future research agenda and help policy-makers understand the needs in this area.

Aims and research questions

The aims of this study are to analyze educational policies relevant to classroom assessment (CA) and to learn more about teachers' actual CA practices and competencies in Chile:

1. What does the CA policy context look like, particularly regarding formative assessment?

2. What CA practices in math and science do teachers report?
3. What are math and science teachers' CA competencies?
4. How do these practices and policies relate to research-based best practices and successful implementation policies internationally?

Contextual background

For this study an important first step is analyzing relevant policy approaches related to CA in Chile. For example, we found that legislative documents focus on summative assessment, leaving the main responsibility for defining assessment practice in more detail in the hands of each school (MINEDUC, 1997, 1999, 2001, 2003) but so far we do not know what these local definitions actually look like. In the guidelines on effective teaching (MINEDUC, 2004), which are the basis for the national teacher performance assessment system, classroom assessment is mentioned by three specific criteria, one of which focuses on summative purposes (A.5) while the other two require formative assessment strategies and uses (C.6 & D.1). The paper will provide more detailed information on the following issues: (a) leadership, tools, and exemplars, (b) innovative programs, (c) teacher initial training and professional development, (d) alignment of summative and formative approaches at different levels of the system (see OECD, 2005).

Research methods

We descriptively analyze relevant items from existing educational databases:

- a) teacher survey from national student achievement testing system (SIMCE) 2008 10th grade math and 2007 8th grade math and natural science;
- b) TIMSS 2003 8th grade math and science teacher survey for Chile;
- c) national teacher performance assessment, 2006 – 2009.

SIMCE tests all students of the country in 4th, 8th and 10th grade in language, math, social science and natural science. TIMSS covered a representative sample of 8th grade students in math and natural science. The national teacher performance assessment provides data for all public school teachers in the country.

Additionally, the study includes document reviews, and interviews with a small purposive sample of professionals in charge of curricular decisions in initial teacher training programs (N=3), professionals at the Ministry of Education (N=3), and municipal education authorities (N=3).

Preliminary empirical results

SIMCE teacher survey

- Most common assessment procedure are traditional written exams, especially those using a mix of question formats (e.g., constructed-response and multiple-choice items);
- most teachers apply graded written exams at the end of a teaching unit, but only occasionally use graded and non-graded exams as diagnostic tools at the start or during the implementation of a teaching unit.

Further analyses will explore the correlations between assessment practices on the one hand, and student achievement on the other hand.

TIMSS teacher survey

- Similar to the international average, the majority of Chilean 8th grade math teachers report using exams containing only or mostly constructed-response items (corresponding to 55% of tested students);
- large majority of Chilean science teachers (corresponding to 71% of tested students) use tests containing about half constructed-response and half multiple-choice items, while internationally this type of test is used by 60%.
- Science tests containing only constructed-response questions are used less frequently (13% - compared to the international average of 28%).

Further analyses will look at the contents covered by Chilean math and science assessments, as well as the relationship with TIMSS student achievement.

National teacher performance assessment

- Eight dimensions of teaching performance are assessed by the assessment's portfolio instrument;
- two of them have to do with CA: (C) "Quality of the teaching unit's assessment"; (D) "Reflection on classroom assessment results;"
- evaluation scale: 1=unsatisfactory, 2=basic, 3=competent (expected performance described by the standards), and 4=outstanding;
- using data from 2006-2009, these two dimensions consistently among the three dimensions with lowest results, that is, fluctuating between 1.7 and 2.1 (total N=56 323);
- cross-tabulation by subject matter: overall, math and science teachers do not differ from teachers of other subjects regarding CA skills.

Further analyses will consider information at indicator level, as well as correlations with overall performance and the relationship with teacher characteristics.

Black, P. & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education*, 5, 7-73.

Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: Association for Supervision and Curriculum Development.

Ministerio de Educaci n [MINEDUC] (2004). *Marco para la buena ense anza*. Santiago, Chile: Ministerio de Educaci n.

Organisation for Economic Co-operation and Development [OECD] (2004). *Review of national policies for education: Chile*. Paris, France: OECD.

Organisation for Economic Co-operation and Development [OECD] (2005). *Formative Assessment: Improving learning in secondary classrooms*. Paris, France: OECD.

Ramirez, M.-J. (2010). *Chile's education assessment system*. World Bank internal document. Washington, D.C.: The World Bank.

Wiliam, D., Lee, C., Harrison, C. & Black, P (2004). Teachers developing assessment for learning: Impact on student achievement. *Assessment in Education*, 11(1), 49-65.

The Impact of Process-Oriented Feedback on Motivation and Achievement in Mathematics

Katrin Rakoczy, German Institute for International Educational Res, Germany; Birgit Harks, German Institute for International Educational Research, Germany; Anika Buergermeister, DIPF, Germany; Eckhard Klieme, Deutsches Institut fur Intern. Padagogische Forschung, Germany

Feedback theories as well as self-determination theory provide empirical evidence that feedback which contains information how the discrepancy between current and desired understanding can be reduced (process-oriented feedback) has a positive impact on motivation and achievement development. In the present study we want to take a closer look at how and under which conditions these positive effects come about by investigating three research questions: 1) Do students experience process-oriented feedback as more useful and competence supportive as social comparative feedback which is the most frequent version of feedback in everyday instruction? 2) Does the positive experience depend on the goal orientation? 3) Does the process-oriented feedback show an indirect effect on achievement development via the experience of usefulness and self-efficacy (a) and an indirect effect on motivation via the perceived competence support and interest (b)?

To test our research questions a one factor experiment was conducted with 146 ninth grade students in Germany. Students were assigned to either process-oriented or social comparative feedback. The other variables were assessed by questionnaires or achievement tests.

Results of path analyses confirm that process-oriented feedback is experienced as more useful and competence supportive compared to social comparative feedback (1). They also show the expected moderation effect for the experienced usefulness but not for the perceived competence support (2). Finally, our results show that process oriented feedback has an indirect effect on achievement via usefulness, but not via self-efficacy (3a) and an indirect effect on motivation via competence support and interest (3b).

Theoretical Background

For formative assessment to unfold its positive impact on student learning it is essential that feedback is designed theoretically well-founded. Feedback theories (e.g. Hattie & Timperley, 2007) as well as self-determination theory (e.g. Ryan & Deci, 2002) provide criteria how feedback should be designed to foster achievement and motivation. Hattie and Timperley distinguish four levels on which feedback can operate: the level of a) task performance, b) process of understanding, c) the regulatory or metacognitive process level, and d) the self level. Feedback has differing effects across these levels. Feedback on the levels of task performance and process of understanding (referred to as process-oriented feedback in the following) contains information how the discrepancy between current and desired understanding can be reduced. There is much empirical evidence that this kind of feedback is experienced as particularly useful by the learners to reach their learning goal and that it shows a positive impact on achievement development, as well. To describe „useful“ in more detail and to understand how the impact of feedback on achievement via the experience of usefulness comes about we refer to the construct of behavioural adaptivity investigated by Dresel and Ziegler (2007). They prove a positive impact of behavioural adaptivity after failure on future achievement as well as a positive relationship with self-efficacy.

Scholars in the context of self-determination theory assume that feedback is particularly supportive for motivation and achievement development when it supports the need for competence. The support of the need for competence,

in turn, was shown to lead to a higher interest in the learning activity (e.g. Krapp, 1999) and to a higher level of intrinsic motivation (Sansone, 1986). An interested learning activity, again, is accompanied with positive emotional experience, including intrinsic motivation. However, the assumed indirect effect of feedback on motivation and achievement via the support of the need for competence is rarely empirically tested (Deci, Koestner & Ryan, 1999). Several studies revealed that feedback impacts learning differently depending on specific preconditions of the learners. According to Butler & Winne (1995) goal orientation is an important precondition for the impact of feedback. They summarise that feedback which focuses on the individual learning process is particularly beneficial for students with a learning goal orientation.

Aim and Research Questions

With the present study we want to better understand how and under which conditions process-oriented feedback has a positive impact on motivation and achievement development by investigating three research questions: 1) Do students experience process-oriented feedback as more useful and supportive with regard to the need for competence as social comparative feedback which is the most frequent version of feedback in everyday instruction? 2) Does the positive experience of process-oriented feedback compared to social comparative feedback depend on the goal orientation? 3) Does process-oriented feedback show an indirect effect on achievement development via the experience of usefulness and self-efficacy (a) and an indirect effect on motivation via the perceived support of the need for competence and interest (b)?

Methods

To test our research questions a one factor, bivariate experiment was conducted with 146 ninth grade students of the intermediate school track in Germany. Students were assigned to two feedback conditions and tested individually according to the following procedure. First of all, the students were asked in a questionnaire about their goal orientation. Then, the students worked on a mathematics test on Pythagorean Theorem, Linear Equations or problems of the German national standards. Third, they received a written feedback on their test performance which was process-oriented in the experimental group and social comparative in the comparison group. Fourth, the students filled in a questionnaire in which we asked them how useful and supportive with regard to the need for competence they experienced the feedback. Moreover, the questionnaire contained items to examine students' self-efficacy and interest with regard to a second mathematics test. Finally, students worked on the second mathematics test on the same topic and filled in a questionnaire on their intrinsic motivation.

Findings & Conclusion

Results of path analyses confirm that process-oriented feedback is experienced as more useful and supportive with regard to the need for competence compared to social comparative feedback (1). The results also show that process-oriented feedback is experienced as particularly useful by students with a high learning goal orientation. Against our expectation this moderation effect could not be shown for the perceived support of competence (2). Finally, our results show that process oriented feedback has an indirect effect on achievement via the experience of usefulness, but not via self-efficacy (3a) and an indirect effect on motivation via competence support and interest (3b).

In summary, it can be stated that process oriented feedback is experienced as useful and supportive with regard to the need for competence and this positive experience leads at least partly to a better achievement and higher motivation in a second mathematics test. So, process-oriented feedback seems to be a promising tool for teachers to implement formative assessment in mathematics instruction.

Butler, D. L. & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125, 627-668.

Dresel, M. & Ziegler, A. (2007). Zur Abhängigkeit handlungsadaptiver Reaktionen nach Misserfolg von Attributionsstil, Fähigkeitsselbstkonzept, Impliziter Fähigkeitstheorie, Zielorientierungen und Interesse. Paper, 10. Tagung der Fachgruppe Pädagogische Psychologie der Deutschen Gesellschaft für Psychologie (DGPS), Berlin.

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81-112.

Krapp, A. (1999). Intrinsischen Lernmotivation und Interesse. *Forschungsansätze und konzeptuelle Überlegungen. Zeitschrift für Pädagogik*, 45, (3) 387-406.

Ryan, R. M., & Deci, E. L. (2002). An overview of Self-Determination Theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (pp. 3-33). Rochester: University Press.

Sansone, C. (1986). A question of competence: The effects of competence and task feedback on intrinsic interest. *Journal of Personality and Social Psychology*, 51, 918-931.

Peer feedback in chemistry: Supporting cognitive and meta-cognitive engagement during investigations

Mark Gan, University of Auckland, New Zealand

A central tenet of 'assessment for learning' and peer assessment is the need for effective peer feedback (Black & Wiliam, 1998; Dochy et al., 1999; Topping, 1998). While most researchers and educators recognise the crucial role that peer feedback plays in learning, there are fewer consensuses on how best to support that role within the classroom. This study focuses on developing students' ability to engage with peer feedback by explicitly coaching them to recognise the learning gap and how to formulate progressive peer feedback to help their classmates to 'close' the gap and move towards the learning goal. In particular, a graphic organiser was designed based on feedback levels (Hattie & Timperley, 2007) that guide students in generating peer feedback at the task, process and meta-cognitive levels of engagement. Eight classes of students ($n=332$, 14-15 year olds) from four Singapore secondary schools participated in this study. Students in the experimental group received instruction on feedback levels and practice giving written feedback on crafted laboratory reports with the help of a graphic organiser. Students in the control group spent the same amount of lesson time on a lecture about how to carry out an investigation. The results indicated that explicit coaching facilitated the formulation of more task, process and meta-cognitive ($d > .80$) peer feedback compared to the control class. This study supports the view that helping students to visualise peer feedback as progressive, involving task, process and meta-cognitive levels, facilitates cognitive and meta-cognitive engagement with the learning task.

Background:

This study develops the notion of peer feedback quality by building on two interconnecting perspectives that underpin feedback research in the classroom. One view of peer feedback quality suggests that feedback information is useful when it helps learners to close the learning gap (Ramaprasad, 1983; Sadler, 1998). Viewing feedback through this lens has helped to identify the shortcomings of feedback interaction, often construed as a passive receptive-transmissive approach. Another perspective on peer feedback quality builds on the notion of reducing the 'discrepancies between current understanding and performance' by focusing on the learner's engagement with the feedback information at the task, process, meta-cognitive and self levels (Hattie & Timperley, 2007). In this feedback model, interventions involving feedback are likely to be more effective when the learner's attention is drawn to cognitive outcomes related to the task, task processing strategies and the meta-cognitive strategies adopted, rather than focusing on the self. Both perspectives helped to frame the notion of peer feedback quality as involving progressive feedback information targeted at the task, process and meta-cognitive levels. By suggesting a progressive view of feedback, this study suggests a shift in focus on feedback interaction from recognising a learning gap and finding corrective solutions, to supporting one in which the learning gap is seen as an opportunity for the learner to interact with feedback information at different levels of cognitive engagement.

Besides developing peer feedback quality, this study argues for the positioning of peers as a resource for feedback interaction during chemistry investigative tasks. Instead of teachers providing students with the answers to their queries, students can help each other by formulating feedback that focused on improving their investigation. Here, the involvements of peers, who are classmates of the same age group, are seen as important for three reasons. First, peers serve as a rich and available resource for giving and receiving feedback. Feedback from peers can be more immediate, timely, and individualised than teacher feedback (Topping, 2010). Second, engendering peer feedback will mean that students have the opportunity for collaborative peer discourse. Students not only learn with each other but also from each other as well as from the feedback process. Third, the involvement of students suggests that students have the potential to be responsible for their own learning and peer feedback provides an avenue to do so.

Aim:

The aim of the present research was to examine the effects of explicit coaching on students' ability to generate peer feedback at the task, process and meta-cognitive levels of engagement.

Samples:

In this study, eight classes of students (14-15 year olds, $n=332$) from four secondary schools in Singapore participated. All students were in their first year of a two year Chemistry course, leading to GCE 'O' level certification.

Method:

This study adopted a quasi-experimental pretest-treatment-posttest design. There were two conditions: peer feedback with coaching condition and peer feedback without coaching. In both conditions, students were provided with a feedback form with question prompts. Students in the coaching condition received explicit instruction on the different feedback levels (task, process and meta-cognitive) and practise using a graphic organiser (designed with feedback levels) to formulate peer feedback on chemistry investigation reports. Students in the control group were given a

lecture on the design of investigation and practise using the feedback form to give feedback on a crafted task without a graphic organiser. The coaching was carried out by the researcher over two lessons, with each lesson lasting 50 minutes.

Results:

A closer look at the effect size of individual classes showed that for all the treatment classes, there is a large effect of coaching on students providing more meta-cognitive level feedback to their peers ($d > .80$). This is not observed in the control class, which showed a low effect for all three feedback levels

Conclusions:

This finding indicates that instructional intervention which engages students to recognise and differentiate feedback at task, process and meta-cognitive levels, provides opportunities for students to practice and interpret different feedback levels. This enhances students' ability to generate higher-order peer feedback which enables them to engage more deeply with the learning task. The significance of this study can be attributed to the following three aspects:

1. Building on a theory of feedback in relation to task, process and meta-cognition to develop instructional support for peer feedback during investigations;
2. providing further evidence that coaching is a pre-requisite for students to provide quality peer feedback responses; and,
3. developing a coding scheme to characterise the quality of peer feedback in terms of levels.

Implications:

First, the notion of peer learning through the use of peer feedback does not usually occur without instructional support of some kind. The findings of this study showed that instructional support in the form of a visual graphic organiser with explicit examples may enhance the learning experience of students in formulating feedback to their peers. The graphic organiser provides a common platform for teachers and students to engage in discussing how each feedback level can be formulated, the relation to other levels and the matching of levels (as well as challenge) to the receiver's understanding or response.

Second, conceptualising feedback in terms of levels (task, process and meta-cognitive) provides teachers as well as students with a working definition of what feedback looks like and how it can be interpreted and applied to learning.

Third, the practice of giving and receiving peer feedback at different levels opens up opportunities for formative assessment discourse in the classroom, especially in building students' (as well as teachers) capacity for assessment by drawing attention to evaluating criteria, reviewing learning goals and communicating meaningful feedback.

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81-112.

Ramaprasad, A. (1983). On the definition of feedback. *Behavioural Science*, 28, 4-13.

Sadler, R. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119-144.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research*, 68, 249-276.

SYMPOSIUM

Procedural learning, strategy use, and conceptual understanding

Chairperson: Kristina Reiss, Technische Universität München, Germany

Organiser: Kristina Reiss, Technische Universität München, Germany

Discussant: Erno Lehtinen, University of Turku, Finland

Children's experiences with early mathematics have an important impact on their subsequent learning. Research suggests in particular that approving children's spontaneous strategies and independent activities is an important prerequisite for successful learning processes. The symposium aims at sharing knowledge in this field of research. It focuses on the development of mathematical competencies in primary school children from a point of view that takes their individual dispositions into account. Using the examples of basic arithmetics, probability, and early algebra, the contributors will present research how children adopt spontaneous strategies, how their strategy choice differs according to a more mathematical or a more everyday context as well as according to their age and characteristics of the tasks and how they take advantage of self-explaining activities in their learning. These questions will be addressed from an interdisciplinary perspective that regards subject matter education as well as pedagogical and developmental psychology. Accordingly, the symposium contributes to scientific knowledge by analyzing and discussing qualitative and quantitative empirical data of second to sixth graders' mathematical competencies under these different

perspectives. Moreover, the results can be interpreted in terms of their relevance for learning and instruction at school and will be discussed with a specific view on the primary mathematics classroom.

Do children use the indirect addition strategy in the number domain up to 20?

Greet Peters, K.U.Leuven, Belgium; Bert De Smedt, University of Leuven, Belgium; Joke Torbeyns, K.U.Leuven & GROUPE T - Leuven University College, Belgium; Pol Ghesquiere, Katholieke Universiteit Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Mentally solving subtraction problems can be done by means of various strategies, including the indirect addition strategy, in which the subject determines how much needs to be added to the smaller number to get to the larger one. In most of the previous research focussing on indirect addition children were asked to verbally report the strategy they used to solve a problem. However, it could be argued that such verbal protocol data may be less suited to identify indirect addition, because this strategy is typically executed very fast and (quasi) automatic. Therefore, we investigated children's use of indirect addition by means of reaction time analyses. We presented 106 third- to sixth-graders with 32 large non-tie single-digit problems in both subtraction ($12 - 9 = ?$) and addition format ($9 + ? = 12$). For both formats, we examined the fit of 3 regression models, which represented the consistent use of direct subtraction, the consistent use of indirect addition, and the flexible switching between both strategies based on the relative size of the subtrahend. Findings revealed that, in all grades, children did not switch flexibly between the two strategies, as adults do, but that they rely on direct subtraction for problems presented in subtraction format and on indirect addition for problems in addition format. We end with some theoretical, methodological, and educational implications of these results.

Various strategies can be used to mentally solve subtraction problems, including the indirect addition strategy, in which the subject determines how much needs to be added to the smaller number to get to the larger one (e.g., solving $11 - 7$ by doing $7 + 3 = 10$ and $10 + 1 = 11$, so the answer is $3 + 1 = 4$). This strategy can be distinguished from direct subtraction, in which the smaller number is directly subtracted from the larger one (e.g., $11 - 7$ via $11 - [1 + 6] = 10 - 6 = 4$). A rational task analysis indicates that indirect addition is particularly efficient on subtractions with relatively large subtrahends, whereas direct subtraction is more efficient when the subtrahend is relatively small (compare $11 - 9$ and $11 - 2$). Peters et al. (2010a) recently studied if adults choose flexibly between indirect addition and direct subtraction based on the size of the subtrahend when solving large single-digit subtractions. When the distance between subtrahend and difference was large (as in $12 - 3$ or $12 - 9$), indirect addition was used when the subtrahend was larger than the difference, whereas direct subtraction was used when the subtrahend was smaller than the difference. However, when the subtrahend and the difference were close to each other (as in $12 - 5$ or $12 - 7$), strategy selection was not based on the size of the subtrahend and both strategies were used to the same extent. Remarkably, there is hardly any research concerning children's use of indirect addition on large single-digit subtraction problems. The variation and flexibility in children's strategy use have been more intensively investigated in multi-digit subtraction problems (Torbeyns et al., 2009). However, in the majority of these studies, verbal self-reports have been used to infer strategy use, and it could be argued that such data may be less suited to identify indirect addition, because this strategy is typically executed very fast and (quasi) automatic (Kirk & Ashcraft, 2001). When solving a problem such as $12 - 9$, children may be unaware of the calculation steps they executed, they may experience difficulties in articulating how they found the answer, or they may even hide their actual strategy use because they think it is not valued or allowed. In this respect, we refer to a remarkable result of a post-hoc analysis of a study by De Smedt et al. (2010) on two-digit subtractions, which revealed that children's verbal protocol data did not reliably capture the actually applied strategies. More specifically, this analysis indicated that the indirect addition strategy might have been used more frequently than suggested by the verbal protocols. This justifies the application of other, non-verbal, methods to infer strategy use.

We adopted the regression-based approach that Groen and Poll (1973) and Woods et al. (1975) used in the number domain up to 10 – a method that we have already successfully applied for analysing adult's strategy use on two-digit subtractions (Peters et al., 2010b). We presented 106 third- to sixth-graders with 32 large non-tie single-digit problems in both subtraction ($12 - 9 = ?$) and addition format ($9 + ? = 12$), and examined the fit of three linear regression models, which represented different strategy patterns: 1. If children only used direct subtraction (Model_1), their reaction times should be best predicted by the size of the subtrahend, because it takes longer to subtract 9 from a given number than to subtract 3 from that number. 2. If they consistently used indirect addition (Model_2), their reaction times should be best predicted by the size of the difference, because it takes longer to determine how much needs to be added to get at a given number when the difference between both numbers is large than when it is small (compare how much needs to be added to 3 or to 9 to get to 12). 3. If children switched flexibly between both strategies depending on efficiency (Model_3), reaction times should be best predicted by the minimum of subtrahend and difference: Short reaction times are then expected for problems with a small subtrahend

($12-3=?$) because they are quickly solved by direct subtraction, as well as for problems with a small difference ($12-9=?$) because they can be quickly solved by indirect addition. All regression models were fitted to the mean reaction time of each problem per grade.

Findings revealed that, in all grades, Model_1 fitted best to the reaction times of problems in subtraction format, whereas Model_2 fitted best for the problems in addition format (see Table_1). These results indicate that children did not switch flexibly between the two strategies, as adults did (Peters et al., 2010a). Instead, they show that children relied on direct subtraction for problems presented in subtraction format and on indirect addition for problems in addition format. These findings can be of great relevance for elementary mathematics education, since they show that (a) indirect addition is part of children's spontaneous strategy repertoire when solving subtractions presented in addition format, and (b) children's strategy choices for subtraction are determined more by structural than by numerical task features.

De Smedt, B., Torbeyns, J., Stassens, N., Ghesquière, P., & Verschaffel, L. (2010). Frequency, efficiency and flexibility of indirect addition in two learning environments. *Learning and Instruction*, 20, 205-215.

Groen, G. J., & Poll, M. (1973). Subtraction and the solution of open sentence problems. *Journal of Experimental Child Psychology*, 16, 292-302.

Kirk, E. P., & Ashcraft, M. H. (2001). Telling stories: The perils and promise of using verbal reports to study math strategies. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27, 157-175.

Peters, G., De Smedt, B., Torbeyns, J., Ghesquière, P., & Verschaffel, L. (2010a). Adults' use of subtraction by addition in the number domain till 20. *Acta Psychologica*, 133, 163-169.

Peters, G., De Smedt, B., Torbeyns, J., Ghesquière, P., & Verschaffel, L. (2010b). Adults' use of subtraction by addition. *Acta Psychologica*, 135, 323-329.

Torbeyns, J., De Smedt, B., Ghesquière, P., & Verschaffel, L. (2009). Solving subtractions adaptively by means of indirect addition: influence of task, subject, and instructional factors. *Mediterranean Journal for Research in Mathematics Education*, 8 (2), 1-30.

Woods, S. S., Resnick, L. B., & Groen, G. J. (1975). An experimental test of five process models for subtraction. *Journal of Educational Psychology*, 67, 17-21.

The impact of self-explaining and example-generation on learning similar concepts in mathematics

Esther Ziegler, ETH Zurich, Switzerland; Elsbeth Stern, ETH Zurich, Switzerland

An active engagement of students can be seen as an important parameter in learning processes. Such activation can be evoked through various methods, among them the instruction to self-explain given examples or to generate one's own examples. In the current study, we examined the potential of self-explanations and example-generation in a school setting by conducting a training study with a self-learning program on addition and multiplication in algebra. The learning program consisted of worked algebra examples, a self-study part, and tests. A total of 153 sixth-graders (mean age = 12.3) were randomly assigned to two training conditions: (1) the self-explaining condition with a small number of generated examples and (2) the example-generation condition without self-explanations but with an extended generation of examples. In three post-tests (one day, one week and ten weeks later) procedural and conceptual knowledge, including misconceptions, were assessed.

In accordance with our hypotheses, the results showed a significant advantage of the self-explaining group in procedural knowledge. The impact of self explanations on conceptual knowledge was ambiguous: on the one hand the self-explainers showed a reduced amount of misconceptions, on the other hand they performed worse in tests on conceptual knowledge than the example-generators did. The fact that they have many misconceptions may indicate that they do not possess better conceptual knowledge, but that their training focus on examples helped them to formulate the concept rules. Summarized, the self-explaining training fostered students' performance in algebra best. Further investigations have to show where this advantage exactly comes from.

In mathematics classes, teachers often introduce concepts by first demonstrating how to solve a particular problem (e.g. $xy+xy+xy=3xy$) and then ask their students to solve a certain amount of similar tasks. The major problem of this kind of instruction is that students just memorize procedures but do not possess a deeper conceptual understanding (Kamii & Dominick, 1997). This often becomes obvious when students inappropriately apply the strategies to similarly looking problems (e.g. $xy?xy?xy=3xy$). According to a constructivist view of learning, knowledge cannot be directly transmitted from teachers to learners, but rather has to be constructed by the learner on the basis of the already existing knowledge (Bransford, Brown, & Cocking, 1999). Hence, in order to foster the acquisition of conceptual knowledge, learning environments have to prompt active cognitive engagement, which can be evoked through various methods. In our study on understanding addition and subtraction in algebra, we want to investigate the effects of two

established methods: (a) the instruction to self-explain examples (Renkl, 1997; Rittle-Johnson, 2006), and (b) the instruction to generate own examples (Hazzan & Zazkis, 1999; Watson & Mason, 2002). Both learning techniques demand attention and effort and help students to engage in active elaboration of learning materials.

A pilot study, in which we tested a learning program which applied both of these learning strategies, revealed that students who preferred the example-generation part and wrote only minimalist self-explanations showed comparable learning outcomes. Thus, the aim of this study was to differentiate between the contribution of the self-explanation and the example-generation part. We used the existing learning program and constructed an additional condition without self-explanations but with an extended example-generation part. The hypothesis remained: The combination of self-explaining with a small example-generation part helps students more than an extended example-generation.

Method

The self-learning program introduced two mathematical concepts: addition and multiplication in algebra. The programs were processed in 2-hour learning sessions on four successive days and students had to work through 9 self-study work sheets. These sheets consisted of worked examples and a self-study part. After every sheet students did a test as an indicator for immediate learning. A total of 153 sixth graders (mean age= 12.3 years, 52.1% girls) participated and were randomly assigned to one of two training conditions: (1) the self-explaining condition and (2) the example-generating condition. In the self-explaining instruction, students were asked to self-explain worked examples and to generate a small number of their own examples. In the example-generating instruction, students were asked to generate an extended amount of their own examples. Besides this, learning materials were identical.

All students participated in three post-tests (one day, one week and ten weeks later) where we measured procedural knowledge, conceptual knowledge and misconceptions as indicators for long-term learning. In addition, we analyzed conceptual knowledge for the number of defining features students reported in their written explanations. We conducted two successive experiments with different participants and with an adapted post-test instruction: "control all tasks before submitting them".

Results

As the main effect of group was similar in both experiments, with only slightly different significant levels, we merged the two experiments into one evaluation.

There were no group differences in the learning tests, indicating that immediate learning was equal in both conditions. For all the post-test measures, we used repeated measurement ANOVAs with the factor Group (self-explaining versus example-generating) x Time (T1: one day, T2: one week, T3: ten weeks). There was a main effect of Group for procedural knowledge (pDiscussionAs expected, the results suggest that self-explanations help to gain procedural knowledge and to reduce misconceptions. The result concerning conceptual knowledge is ambiguous: the overall conceptual knowledge was higher in the example-generating group, although they had significantly more misconceptions. The fact of high misconceptions in example-generating learners may indicate that they do not have better conceptual knowledge, but that their training focus on examples helped them to formulate the concept rules which they could explicitly illustrate with examples. Further evidence comes from the sub-analyses which showed that there was no difference in reporting defining features in the written concept explanations. In addition, the effect of better conceptual knowledge had disappeared ten weeks later. Interestingly, the self-explaining group performed only better in the post-tests but not in the immediate learning tests. As there is no hint of the self-explaining effect in the learning phase, one can imagine that teachers may fail to notice the advantage of self-explanations. Summarized, the self-explanation training fostered students' performance in algebra best. However, as the self-explainers also generated a few of their own examples, it would be interesting to investigate whether self-explanations work without any example-generation. Hence, future research has to differentiate under which conditions self-explanations bring the best learning benefit.

Bransford, J. D., Brown, A., & Cocking, R. (1999). How people learn. Washington: DC: national Academy Press.

Hazzan, O., & Zazkis, R. (1999). A perspective on "give an example" tasks as opportunities to construct links among mathematical concepts. *FOCUS on Learning Problems in Mathematics*, 21(4), 1-13.

Kamii, C., & Dominick, A. (1997). To Teach or Not to Teach Algorithms. *Journal of Mathematical Behavior*, 16(1), 51-61.

Renkl, A. (1997). Learning from worked-out examples: A study on individual differences. *Cognitive Science*, 21(1), 1-29.

Rittle-Johnson, B. (2006). Promoting Transfer: Effects of Self-Explanation and Direct Instruction. *Child Development*, 77, 1-15.

Watson, A., & Mason, J. H. (2002). Student-generated examples in the learning of mathematics. *Canadian Journal of Science, Mathematics and Technology Education*, 2(2), 237-249.

Children's probability concepts and intuitive strategy use in the evaluation of contingency tables

Petra Barchfeld, Ludwig Maximilians University-Munich, Germany; Anke Lindmeier, Technische Universität München, Germany; Stefan Ufer, University of Munich, Germany; Kristina Reiss, Technische Universität München, Germany; Beate Sodian, LMU München, Germany

The ability to evaluate covariation data is not explicitly addressed in the elementary school curriculum. Although even preschool children can infer causation from perfect covariation between two variables, deficits in reasoning from more complex patterns of imperfect covariation persist into adulthood. In the present study, we address the early development of statistical reasoning abilities in elementary school. A series of 2 x 2 contingency tables were presented to children of the grades 2, 4, and 6 in two context conditions. The results show that children prefer inadequate maximum strategies and additive comparisons between two cells of the tables in both contexts. A failure to understand basic probability concepts was also confirmed by the results of a second study, designed after Shtulman and Carey (2007), indicating context-independent difficulties to differentiate between improbable and impossible events in children up to grade 4. Findings are discussed with respect to the development of basic stochastic knowledge and its relevance in elementary school mathematics education.

The ability to evaluate covariation data is an important aspect of stochastic reasoning. However, it is not explicitly addressed in elementary school curriculum. Data evaluation skills are also necessary for a basic understanding of the theory-evidence relation in science (Kuhn & Franklin, 2006). Even preschool children can interpret perfect covariation patterns (Ruffman, Perner, Olson, & Doherty, 1993; Koerber, Sodian, Thoermer & Nett, 2005). On the other hand, pervasive deficits have been found in children and adults for more complex tasks requiring intuitive statistical reasoning (e.g., Shaklee, Holt, Elk, & Hall, 1988). However, little research has addressed the early development of contingency table analysis in elementary school age. The present research aims at analyzing the initial competencies in statistical reasoning of elementary school children in some depth and relating it to the development of probability concepts. In Study 1, we examined the analysis of 2 x 2 contingency tables of varying difficulty in two context conditions, an everyday and a more formal-mathematical context. The sample consisted of N=186 children (60.2% male, 39.8% female) of grades 2, 4, and 6. 62 2nd graders (mean age = 8.08 years, SD = 0.39), 63 4th graders (mean age = 10.14 years, SD = 0.56) and 61 6th graders (mean age = 12.48, SD = 0.57).

In the everyday context condition, children were told a story about researchers. These wanted to find out whether a red or a yellow fertilizer would work best with different plants. Contingency tables depicting the effect of the two fertilizers on growth of either trees, carrots, flowers or cacti were presented. Children evaluated perfect covariation, non covariation and different types of imperfect covariation including random distributions. Judgments and justifications were assessed.

In the formal context condition, an opaque bag was presented to the children and they were told that this bag contained red and blue marbles and dice. Children were shown contingency tables depicting the distribution of marbles and dice of the particular color after taking one item and putting it back 40 times in a row. The distributions of these game tables were identical to that of the fertilizer tables. The rules demanded to draw a blue item from the bag without looking into it. Students had to make their choice (dice or marble) based on the distributions and had to justify their choice.

The results showed that in case of perfect covariation or non-covariation even 2nd graders, regardless of the context, were able to infer the correct conclusions. However, when the covariation was imperfect or random, no systematic progress from 2nd to 6th grade could be observed, and this did not depend on the specific context. In particular, children tended to consider only those cells which provided a positive effect (in this case cells depicting growth or cells with pieces of the critical color and shape) and which contained a large number of items. These findings are consistent with those of Shaklee et al. (1988) who reported that children used inadequate strategies of addition and subtraction rather than of multiplication or considered only a limited number of cells. The judgments and justifications suggested not only inadequate strategy choice but also basic misconceptions with respect to the probability concept. According to Shtulman and Carey (2007), children up to the age of 8 years had difficulties with basic probability understanding when requested to discriminate between improbable and impossible events. The majority of children rated improbable events as impossible. In Study 2, we replicated and extended Shtulman and Carey's study, including a methodologically comparable abstract setting. Whereas the majority of 2nd graders rated improbable events as impossible in both contexts, 4th and 6th graders could generally differentiate between these conditions, but showed solution rates below 65%.

The results from both studies indicate difficulties with the concept of probability and the analysis of contingency tables. Deficits in basic stochastic knowledge and missing methodological concepts on evidence evaluation (e.g. also

considering cells depicting negative events and comparing the probabilities for different conditions) may have contributed to children's performance. However, it is unclear whether the distributions used e.g. by Shaklee et al. (1988) were suited to assess students' full competencies in analyzing contingency tables. For example, an easy numerical structure of a distribution might facilitate the analysis for primary children. Nonetheless, the items might be used as a starting point to investigate different strategies and the adaptive selection of strategies according to the characteristics of a distribution. Standards for school mathematics postulate that children should be familiarized with these concepts at an early point in time. However, there is hardly any empirical evidence for this proposal. Further studies aiming at a better understanding of the underlying processes should be carried out in order to understand the early development of probability concepts and to design instructional interventions.

Koerber, S., Sodian, B., Thoermer, C., & Nett, U. (2005). Scientific reasoning in young children. Preschoolers' ability to evaluate covariation evidence. *Swiss Journal of Psychology*, 64, 141-152.

Kuhn, D., & Franklin, S. (2006). The second decade: What develops (and how)? In D. Kuhn & R. Siegler (Eds.), *Handbook of child psychology*. Vol. 2: Cognition, perception, and language (6th ed., pp. 953-994). New York: Wiley.

Ruffman, T., Perner, J., Olson, D.R., & Doherty, M. (1993). Reflecting on scientific thinking: children's understanding of the hypothesis-evidence relation. *Child Development*, 64, 1617 – 1636.

Shaklee, H., Holt, P., Elek, S., and Hall, L. (1988). Covariation judgment: Improving rule use among children, adolescents, and adults. *Child Development*, 59, 755–768.

Shtulman, A. & Carey, S. (2007). Improbable or impossible? How children reason about the possibility of extraordinary events. *Child Development*, 78, 1015 – 1032.

SYMPOSIUM

Fostering Metacognitive Monitoring and Regulation of Learning in Children and College Students

Chairperson: Tamara Van Gog, Erasmus University Rotterdam, Netherlands

Organiser: Anique de Bruin, Maastricht University, Netherlands

Discussant: Eduardo Vidal-Abarca, Universidad de Valencia, Spain

Students of all ages exhibit great difficulty monitoring their learning and self-regulating their study behavior. As these metacognitive skills can have a large effect on learning outcomes, research should focus on how these skills can be improved in learners of different ages. The aim of this symposium is to present and discuss a number of studies that examined the effects of different instructional interventions designed to foster metacognitive monitoring and regulation of learning. These interventions (including concept mapping and sentence generation) turned out to be suitable even for primary education students in the domain of text and language learning, and easy to incorporate in everyday education by teachers. Moreover, they allowed for quantitative measurement of metacognitive variables as self-monitoring and self-regulation. Most importantly, the interventions positively affected students' self-monitoring and self-regulatory study behavior. Finally, the third study highlights a thus far neglected, but potentially important cause of poor self-monitoring and self-regulatory behavior, that is, the effect of students' expectations of teachers' grading procedure on students' metacognitive judgments.

Using Concept Map Construction to Improve Metacomprehension Accuracy in 7th Graders

Keith Thiede, Boise State University, United States; Josh Redford, Boise State University, United States; Jennifer Wiley, University of Illinois at Chicago, United States; Thomas Griffin, University of Illinois at Chicago, United States

Across two experiments we evaluated the effects of constructing concept maps on metacomprehension accuracy (the accuracy with which students can discriminate which texts they understood more versus less). We found that 7th grade students were not adept at monitoring their own comprehension. However, constructing concept maps improved metacomprehension accuracy. Moreover, when instruction included practice texts and tests, with explicit instruction on how the concept maps could aid comprehension, producing concept maps produced higher levels of metacomprehension accuracy.

Learning from texts often involves reading and then rereading materials. To make good decisions about what to reread (regulation of study), students must accurately monitor their comprehension (Thiede, Anderson, & Theriault, 2003). Although the accuracy of comprehension monitoring (metacomprehension accuracy) is typically quite poor (Dunlosky & Lipko, 2007), recently, techniques have been discovered to improve metacomprehension accuracy for college students (for a review of research see Thiede, Griffin, Wiley, & Redford, 2009). One of these techniques, for example, requires students to generate keywords of the studied texts prior to judging comprehension (Thiede et al., 2003). In a different study, students were required to first provide a summary of the text (Thiede & Anderson, 2003). In both cases, metacomprehension accuracy improved drastically, but only at a delay after text study. However, these kinds of techniques have not been evaluated with younger students.

Across two experiments, we evaluated whether instructing 7th grade students to construct concept maps prior to judging comprehension would improve metacomprehension accuracy—as it had with college students (Thiede, Griffin, Wiley, & Anderson, 2010). Students were tested in the classroom in a regular teaching situation with the teacher present.

In Experiment 1, prior to completing the experimental procedure of studying texts, judging comprehension and taking a test for each text, 59 7th graders received eight sessions of instruction on how to construct concept maps. For the critical trial, students were randomly assigned to a concept mapping group (who constructed concept maps prior to judging their comprehension) and a no concept mapping—control—group (who reread texts instead of constructing concept maps). Metacomprehension accuracy was calculated as a gamma correlation between students' comprehension judgments and test performance. Metacomprehension accuracy was marginally better for the concept mapping group (mean gamma = .05, SEM = .17) than for the control group (mean gamma = -.41, SEM = .21), $t(43) = 1.70$, p

Experiment 2 differed from Experiment 1 in one respect. In Experiment 2, prior to completing the experimental procedure, 71 7th graders received instruction on how to construct concept maps, AND additional instruction on how concept maps could be useful in answering test questions. All students received five practice texts and tests, which provided experience with the inference test questions used in the experiment. For the critical trial, students were randomly assigned to either a concept mapping group (in which students constructed concept maps prior to judging comprehension, as in Experiment 1) or a comparison group (which was provided a concept map for each text for review prior to judging comprehension). Although metacomprehension accuracy did not differ across groups, $t(48)$ Metacomprehension accuracy was better than chance for the concept mapping group (mean gamma = .34, SEM = .16), $t(19) = 2.08$, $p = .05$; whereas metacomprehension accuracy was not different than zero for the control group (mean gamma = .18, SEM = .17), $t(29) = 1.06$, $p > .05$. Moreover, the additional instruction that emphasized how concepts could be useful in answering test questions produced higher levels of metacomprehension accuracy than those reported in Experiment 1.

In sum, these experiments show that 7th graders are generally not adept at monitoring their comprehension. As the results reveal, the control group in Experiment 1 had metacomprehension accuracy significantly below zero. However, our findings show that constructing concept maps improved metacomprehension accuracy, even though accuracy was still quite low. These results underline that concept mapping might not only have beneficial effects on learning as is usually assumed, but also on students' metacognitive monitoring. Additional instruction that provides information about the utility of using constructing and using concept maps could be a promising approach to improving metacomprehension accuracy adolescents.

Children's Metacomprehension: The Effect of Delay and Sentence Generation on Monitoring and Regul

Mariette van Loon, Maastricht University, Netherlands; Anique de Bruin, Maastricht University, Netherlands; Tamara Van Gog, Erasmus University Rotterdam, Netherlands; Jeroen Van Merriënboer, Maastricht University, Netherlands

Children's metacognitive skills are often poor when they judge their comprehension of text materials, which has the effect that they cannot effectively decide what they need to restudy. We aimed to find an instruction to improve judgments of learning and subsequent restudy skills for young learners in the classroom. Primary school children ($n = 94$, 9 – 13 years) completed a comprehension task. They studied idioms, judged their learning, and selected items for restudy before performing a comprehension test. We used an experimental between-subjects design: participants judged their learning either immediately; after a delay; or after generating new sentences with the previously studied idioms. When judging learning immediately after study, people rely on their short-term memory; whereas after a delay, people rely on retrieval from long-term memory (LTM). It is assumed that, when judging learning after sentence generation, people focus on the way new information is linked to existing knowledge, instead of on isolated retrieval from LTM. Results showed that monitoring of comprehension significantly improved after a delay. In addition, the sentence generation instruction led to the most effective selection of items for restudy, independent of working memory capacity and grade level. These results indicate that the novel sentence generation instruction gives young learners an accurate indication of what they do know and what they need to restudy. This provides evidence that metacognitive skills, and therefore learning outcomes, can be improved in primary education with an easily applicable instruction.

It has been suggested that metacognitive monitoring and regulation play an important role in learning from text (Thiede, Anderson, & Theriault, 2003). Monitoring accuracy refers to knowledge of learning and memory processes; self-regulation refers to the control of these processes. When a person studies, he or she monitors how well the

material has been learned, and the output from monitoring is then used as a basis for deciding whether to terminate or continue to study (Nelson & Narens, 1990). Effective regulation of study is important for academic achievement (Ertmer & Newby, 1996). Unfortunately, monitoring accuracy when trying to comprehend text (which is called metacomprehension) is often quite low. It does not seem likely that learners will then effectively regulate their learning to improve comprehension. The aim of the present study was to improve monitoring accuracy and subsequent regulation of study for young learners in the classroom.

Researchers have found ways to improve monitoring accuracy and subsequent regulation of study. An instruction which improves monitoring accuracy is the delayed judgment of learning (JOL) instruction (Nelson & Dunlosky, 1991). When people study simple materials, such as word pairs, providing a JOL after a delay drastically improves monitoring, when compared to providing a JOL immediately after studying each item. The proposed explanation for this effect is that a delayed JOL instruction helps learners to attend to valid cues which accurately predict future performance on the test. When monitoring at a delay, JOLs will be based primarily on retrieval from long-term memory (LTM). The same kind of LTM retrieval is required during testing, therefore delayed JOLs lead to more accurate judgments of memory.

However, this delayed JOL instruction does not have the same effect when people study more complex materials, for example expository text (Maki, 1998). On a comprehension test, people have to show that they understand the gist information of the studied material, instead of literally providing the studied information. This means that LTM retrieval is not as predictive of future memory on a test as it is when people study simple materials, such as word-pairs. Other instructions have been found to improve metacomprehension (e.g. Thiede et al., 2003). These instructions ask learners to focus on their mental network which is constructed when comprehending text. According to Kintsch (1998), the process of comprehending text exists of forming a mental representation of a text, which is called a situation model and constructed when new idea units from the text form an interrelated mental network with the reader's prior knowledge. It has been assumed that, when people focus on their situation model instead of on isolated retrieval from LTM, metacomprehension and subsequent regulation of study will improve (e.g. Thiede et al., 2003; Anderson & Thiede, 2008).

Little is known about how instructions that ask young learners to focus on their situation model can improve monitoring of comprehension in a classroom setting. Until now, research aiming to improve metacomprehension has mainly focused at adult learners. Only one study has investigated how activation of the situation model can improve metacognitive skills in young learners (De Bruin, Thiede, Camp, & Redford, submitted). Their results showed that instructions, which asked young learners to focus on their situation model, improved metacomprehension accuracy and subsequent regulation of study for 6th and 7th graders. However, in their study, 4th graders still showed poor metacomprehension accuracy. The researchers assumed that the utilized materials and instructions were too complex for young learners. This points out that there is a need for new techniques, suitable for young learners, to improve metacomprehension skills.

Method

We used an idiom comprehension task, a task which is educationally relevant and less complex than the expository text comprehension task used by De Bruin et al. (submitted). We used a sentence generation instruction, which was intended to focus readers on their situation model. This instruction is assumed to be less complex and therefore suitable for younger learners.

Our design was experimental and between-subjects, primary school children ($n = 94$, age 9 – 13) were asked to study idioms with the aim of showing comprehension on a final test. Prior to the comprehension test, participants provided a judgment about their future comprehension. These JOLs were provided either immediately, after a delay, or after sentence generation.

Metacomprehension accuracy was operationalized as the correlation between JOLs and test performance; and regulation of study as the correlation between JOLs and items selected for restudy.

Results

We found a main effect of instruction on metacomprehension accuracy, $F(2, 83) = 11.87$, $p < .01$, $F(2, 86) = 17.462$, $p < .01$ instructions. The delayed JOL instruction improved regulation of study when compared to the immediate JOL instruction.

Discussion

Our results provide evidence that a simple instruction, which focuses readers on their situation model, can improve metacomprehension skills, even for fourth graders. This is an important finding, because improved metacomprehension will lead to improved learning outcomes (Ertmer & Newby, 1996; Thiede et al, 2003). Sentence generation seems to be a promising instruction for young learners, and this instruction is easily applicable in the classroom. However, more research is needed to identify how sentence generation, and focusing readers on their situation model in general, can improve metacomprehension for young learners. In future studies we will examine whether the sentence generation instruction has the same beneficial effect when young readers study other materials, such as expository text, foreign language or key terms.

Expectations of Grading Affect Students' Judgments and Regulation of Learning

Anique de Bruin, Maastricht University, Netherlands; Gino Camp, Erasmus University Rotterdam, Netherlands

College students tend to massively overestimate performance on tests of text material. This poor metacognitive monitoring has a detrimental effect on future study behavior, and thereby on academic achievement. An until now neglected but potentially important factor contributing to overconfidence on test taking could be students' expectations of how their responses will be graded by teachers. Specifically, students might expect to receive at least partial credit for each provided response, irrespective of the quality of the content. In two experiments, we examined how expectation of partial credit affected students' monitoring and regulation of learning from texts. The results revealed that students often erroneously judged their responses as correct when the partial credit option was absent, leading to even greater overconfidence. However, when students were forced to judge whether their responses were indeed fully correct, overconfidence decreased, self-monitoring improved, and study times increased. These findings demonstrate an until now neglected cause of poor self-monitoring and self-regulation. Poor metacognitive skills are in part due to students' expectations of how they will be graded, and their judgments are specifically influenced by the partial credit option, which is omnipresent in everyday testing.

Students are usually poor at judging how they will do on an upcoming test of text material. These inadequate self-monitoring skills are detrimental to learning, as they lead to incorrect estimations of whether the texts need restudying. To improve accuracy of students' judgments, Dunlosky, Rawson, and Middleton (2005) had students predict performance for specific terms of the text, and recall the definition of each term prior to judging performance, to ensure that they self-tested their knowledge. As a result of this procedure students' judgments improved considerably. However, they still overestimated performance on responses that were classified as commission errors (i.e., completely incorrect responses). It is possible that students might have erroneously assumed that a partial answer would at least be awarded some credit. In two experiments, we examined to what extent students' judgments and regulation of learning are affected by perception of how responses are scored. We hypothesized that the partial credit option would lead students to overestimate their performance, as they tended to judge their incorrect responses as partially correct, not needing restudy.

Experiment 1 Method

Thirty-nine undergraduates participated. Twenty students served in the no partial credit group and eighteen in the partial credit group. We used six expository texts (270 - 303 words). Each text contained four key terms, followed by a definition of approximately 20 words. Participants read each text, and afterwards had to provide the correct definition of each key term. Then, participants were required to self-score their responses. Participants in the partial credit group received the instruction: "If the definition you just wrote was being graded, do you think you would receive 0 credit points (incorrect response), half a credit point (partially correct response), or 1 credit point (fully correct response)?" For participants in the no partial credit group the phrase "half a credit point (partially correct response)" was deleted. The self-scores were transformed to 0, 50%, and 100% prior to analysis. Finally, participants indicated whether they wanted to restudy the text, by clicking 'y' (yes) or 'n' (no). As the criterion test, participants were required to provide the correct definitions for each key term.

Results

There was no difference in the percentage of 0 self-scores between the partial credit and the no partial credit group, $t(37) = 1.30$, $p = .20$. However, the no partial credit group provided significantly more 100% self-scores, $t(26.24) = 3.79$, p

A 2 (group) \times 2 (self-score) analysis of variance on the commission errors showed a significant interaction between group and self-score, $F(1, 70) = 4.30$, p

Discussion

Contrary to our expectations, students in the no partial credit group more often awarded their responses a 100% self-score compared to the partial credit group. Possibly, students reasoned that, because they provided an answer, it was

unlikely that it would be awarded 0 credits. The question is, however, whether students believed their answer was fully correct, or whether they merely avoided the 0 self-score because they considered it improbable. This was further examined in Experiment 2.

Experiment 2 Method

The Method was similar to Experiment 1, except that participants in the no partial credit group ($n = 25$, partial credit group $n = 24$) judged whether their prejudgment recall response was completely correct (yes/no) in the self-score phase. Instead of selecting texts for restudy, self-regulation of learning was determined by providing students all texts by text segment for restudy, and analyzing study time allocation. Study times were log transformed prior to analysis.

Results

There was no difference between groups in the number of 100% self-scores, $t(47) = 1.74$, $p > .05$. However, the no partial credit group provided significantly more 0 self-scores, $t(47) = 8.82$, p

Discussion

The data show that judgment options not only affect students' perceptions of the correctness of their responses, but also time dedicated to text studying. Learners tended to judge their responses as completely correct when the partial credit option was absent (Experiment 1), even though they realized that these responses were actually incorrect (Experiment 2). The stricter phrasing of the self-score instruction in Experiment 2 led to longer study times, on both the first and second read of the texts. Students' judgments and regulation of learning are influenced by how they perceive their responses will be graded.

SYMPOSIUM

Research in non-university higher education: perceptions on research competence and its importance

Chairperson: Jan Elen, Katholieke Universiteit Leuven, Belgium

Organiser: Jan Elen, Katholieke Universiteit Leuven, Belgium

Discussant: Lynn McAlpine, University of Oxford, United Kingdom

The role of non-university higher education is changing in Europe. In the Netherlands and in Flanders non-university higher education institutions are recently granted the opportunity to conduct research. Teachers in these institutions are demanded to complement their traditional teaching tasks with research activities. This implies changes in the tasks of teachers and in the way students are taught. This also implies changes for the managers of institutions of non-university higher education, as they have to coach and evaluate teachers on these new tasks.

This symposium aims at illuminating the perception of the importance and the capability to perform different aspects of research. Each paper in the symposium investigates this for a different actor. The first paper (Schouteden, Verburgh & Elen) investigates Flemish teachers' conceptions about the importance of research aspects for students' professional life. The second paper (Griffioen, De Jong, Jak) concentrates on Dutch teachers' self-perception on research competence. The third paper (Boerma, Griffioen, De Jong) illuminates the managers' side of the issue, by investigation managers' opinion about how competent their teachers are on different aspects of research competence.

By focusing on non-university higher education, this symposium provides insight on how teachers and managers make sense of the research challenges coming at them. Potential differences with the more purely academic contexts will be looked at in the discussion part of each paper. The insights are valuable for policy makers, managers, and educational developers in the aim of strengthening research and research integration in non-university higher education.

Non-university teachers' perceptions about research and its importance for students

Wendy Schouteden, K.U.Leuven, Centre for Instructional Psychology and -Technology (Vesaliusstraat 2, 3000 Leuven), Belgium; An Verburgh, Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium

This paper reports on a study on the perception of non-university teachers on research and its importance. Research is a relative new task for non-university higher education, and therefore it is most probable that teachers in these institutions have a different perception of research than their colleagues at the university. It is unclear to what extent the results of studies on conceptions of research of university lecturers are applicable for non-university higher education. Fifty-five teachers participated in focus group discussions about research, research features and their importance for students' professional lives. An analytic framework was developed to analyze these discussions. Four different categories of research features were identified (research steps, sequence of the research steps,

characteristics of the researcher and linking research with practice). Characteristics of the researcher was the most frequently mentioned feature of research. Critical thinking, as an aspects of the characteristics of the researcher, was the most important feature of research relevant for students professional lives. The analyses reveal that non-university teachers think it is not necessary for their students to be able to do each research step by themselves, but that it is more important that they understand research results and that they can transfer it to their profession. In other words they stress the functional nature of research.

Aims

During the last decade there has been a growing debate about the relation between teaching and research in university and non-university higher education (Brew, 2006; Griffiths, 2004; Verhoeven, 2010). As research integration is an intended policy aim, it is important to understand how teachers perceive research and how important they think it is for their students. It is most probable that the perception of research of non-university teachers differs from the perception in traditional universities because in non-university higher education research is a relatively new task. Hence, research and the relationship between research and teaching might be an even more complex and sensitive issue in comparison to universities (Kyvik & Skodvin, 2003, Verhoeven, 2010). Currently it is unclear to what extent results of studies on the perception of research are applicable to non-university higher education.

This study builds on research on university teachers' conceptions of research (e.g. Akerlind, 2008; Brew, 2001; Prosser, Martin, Trigwell, Ramsden, & Middleton, 2008; Visser-Wijnveen, 2009). Brew (2001) interviewed senior university researchers. She identified four qualitatively different ways in which research is understood (trading, journey, layer, domino), according to (a) whether they have an external product or an internal process orientation and (b) the extent to which the researchers' personal concerns influence their research conceptions. Visser-Wijnveen (2009) interviewed academics about their research conceptions using metaphors. She distinguished five categories of research (disclosing patterns, searching for patterns, explaining patterns, pointing out patterns, creating patterns).

A limitation of these studies is that they are restricted to conceptions of research, and these conceptions are rather abstract. Moreover the conceptions of research do not reveal the perceived importance of research for students' professional lives. This perceived importance is relevant because it might be an important factor in designing curricula and implementing research-integration. Therefore, the current study investigates (1) non-university teachers' perceptions about research, more precisely their perception on what (doing) research involves, and (2) how important they assume that these features of (doing) research are for their students' professional lives.

Methodology

Data were collected by focus group interviews (Hannes, 2009). Teachers were first asked to think individually about a person who is doing research, and subsequently visually represent what the person was doing. After five minutes of drawing and drafting, they were asked to explain their drawings to the other participants. These explanations allowed the moderator to inquire deeper about the research conceptions, details of the drawings, etc. Next the moderator identified, in cooperation with the participants, key topics in the descriptions of the drawings, and wrote them down on small cards. The words on the cards form a set of activities or conditions related to research (referred to as 'research features' in the following). The moderator tried to use the words used by the participants, and not her own wordings. Such a key topic could be 'asking relevant questions', 'thinking thoroughly', or 'perseverance'. Then participants were asked to rank these topics according to the importance for their students' professional lives.

In total eight focus groups were organized, and fifty-five teachers from five different non-university higher education programmes participated. Each focus group consisted of four to eight teachers from the same programme. All focus groups were audio taped and transcribed verbatim.

Data in this study were analyzed qualitatively. The drawings were analyzed first, following the approach elaborated by Briell, Elen, Depaepe and Clarebout (in press). This resulted in an analytic framework that was used to analyze the key topics on the cards and the transcripts of the focusgroups. Considering reliability, the analyses were performed by multiple researchers.

Findings

Four main categories of research features were identified. The first category labelled 'research-steps' concerns different steps in undertaking research. Seven steps were discerned: formulating questions, gathering existing information, research approach, data collection, data analysis, formulating conclusions and report. The second category labelled 'sequence of research steps' concerns the order of research steps, for example research is a linear process or a cyclical process. The third category was called 'characteristics of the researcher', as a condition for doing

good research, subcategories are for example critical thinking, organisational capabilities and social interaction skills. A fourth category concerns 'linking research with practice', for example to improve the professional practice.

Overall the category on the 'characteristics of the researcher' is the most frequent mentioned feature of research, more specifically almost half of the cards belong to this category (49/106). The category of the research steps is the next category that is mentioned most frequently (40), of which posing questions (11), is the most common.

Concerning the importance of the different features, data reveal that critical thinking as part of 'characteristics of the researcher' is considered as the most important for students' professional lives, followed by the 'linking research with practice'. Although teachers consider the different identified steps in research as important for doing good research, they do not perceive each research step as important for their students' professional lives. For example they consider it less important that students are able to conduct each research step than that students are able to pose relevant questions, understand research results and that they can identify the relevance of it for their professional practice. In the paper a more detailed analyses will be described.

Discussion

The study reveals that for teachers in non-university higher education (doing) research involves multiple features, and that diverse characteristics of the researcher are considered important in doing research. In comparison with research on research conceptions of university lecturers, the study reveals that teachers in non-university higher educational institutions stress the functional nature of research rather than its theoretical importance. Research is not directed towards questioning theoretical insights or statements but towards using the theoretical insights in professional settings. For students professional lives posing questions and being able to understand results of research is considered as more important than doing research themselves. This finding provides the basis for a better understanding of differences between university and non-university curricula and the specific role of integrating research into teaching.

Self-efficacy of teachers in non-university higher education: research as a new task

Didi Griffioen, Hogeschool van Amsterdam, Netherlands; Uulke de Jong, UVA, Netherlands; Suzanne Jak, Hogeschool van Amsterdam, Netherlands

During the last decade, the relation between university and non-university institutes for higher education has changed. As contribution to the knowledge economy, non-university institutes for higher education are expected to educate their students in research activities, as well as to conduct research. Previously, research activities were virtually non-existent in the past and the means were mostly absent. Teachers were selected on other criteria than their research abilities. This paper reports the outcomes of a study that considers the belief of teachers in non-university higher education in their own research ability (research self-efficacy). In a survey study conducted among teachers (N=790) the research self-efficacy of teachers has been measured. A Structural Equation Model shows the effect of personal aspects, mastery experience, and organisational context on the research self-efficacy of teachers. Research self-efficacy is also modeled in relation to teachers' needs to be trained in research activities. Results show that research self-efficacy is mostly influenced by aspects of mastery experience, in which the context is similar to the requested task. This is in line with Bandura's idea of mastery experience, which influences self-efficacy when sufficiently accommodated to the context and content of a task. Implications are discussed.

Introduction

During the last decades has the relation between university and non-university institutes for higher education changed in several European countries (Kyvik, 2004; Kyvik & Skodvin, 2003; Witte, Wende, & Huisman, 2008). In practice, research activities were virtually non-existent in non-university institutes (Witte, et al., 2008). Today, teachers at these institutions are increasingly expected to be involved in research activities (de Jong & de Jager, 2007; Kyvik & Skodvin, 2003). The focus of this research is on whether teachers belief they are able to perform the new research tasks scheduled, and how these beliefs influence their willingness to participate in training activities.

Research self-efficacy of teachers

Self-efficacy concerns people's own beliefs in their capabilities to produce given attainments in given contexts (Bandura, 2006). The construct of self-efficacy is based on the self-perception of the competence, rather than on the actual level of competence (Bandura, 1997; 2006; Tschannen - Moran & Woolfolk Hoy, 2007). The presumption in this study is that several personal and contextual factors are important in explaining the research self-efficacy of teachers in higher vocational education.

Personal factors. Age and Gender are part of the broader discussion on the accessibility of research as a profession (Brouwer, 2003; Tschannen – Moran & Woolfolk Hoy, 2007) and therefore included as control variables.

Factors of mastery experience are according to Bandura (2006) the most influential aspects in increasing self-efficacy. Previous research shows that personal efficacy scores of teachers increase with a higher level of education (Dembo & Gibson, 1985), and by involvement of teachers in research activities (Henson, 2001). Another aspect of mastery experience is the number of years working in educational context (Dembo & Gibson, 1985; Ghaith & Yaghi, 1997; Hoy & Spero, 2005; Tsannen – Moran & Woolfolk Hoy, 2007).

Factors of work context.

The different research disciplines ask for different skills of their researchers, since their research methods differ. Previous research shows how differences between disciplines matter for research self-efficacy (Busch, Fallan, & Pettersen, 1998), but also what the influence can be of leadership styles and organisational culture (Tsannen – Moran & Woolfolk Hoy, 2007). The differences in organizational context can also be relevant since the research culture of these non-universities higher education institutes is still less developed than, for instance, in research universities (Griffioen & Boei, accepted).

Training needs. Self-efficacy is expected to influence the willingness of teachers to participate in training activities (Clifton, 1997; DeForest & Hughes, 1992; Noe & Wilk, 1993; Runhaar, Sanders, & Yang, 2010). This willingness is important since most teachers were not selected on their research skills, but are nevertheless expected to fulfil (teaching in) research tasks.

Method: Research questions.

- 1) How do teachers in non-university higher education perceive their research self-efficacy?
- 2) What influences the research self-efficacy of teachers?
- 3) How large is the influences of research self-efficacy on training needs in different contexts?

Sample: The employees of five Dutch Universities of Applied Sciences (UAS, non-university higher education) were asked to complete a questionnaire on research-related topics. This research includes only the responses of teachers who have scores on all variables used (N= 790).

Measures: Research in the UAS consists of four different contexts: a) individually, b) with students, c) with colleagues, and d) with external organisations. In conducting research, five aspects play a role: 1) reading, finding and understanding research literature, 2) applying results of research, 3) designing research, 4) collecting data, and 5) interpreting and reporting results. The (4 x 5=) 20 items (Likert-4) combined result in the scale 'research self-efficacy' (C. Alpha = .94).

For all four contexts it is asked whether or not one takes part in research activities (yes/no), and if one has the need to be trained in research (yes/no). Also, personal aspects (gender, age), aspects of mastery experience (educational level, years of working in educational surroundings, currently doing research elsewhere) and the working context (discipline, years of employment at this institution) are measured.

Analysis.

Before conducting the analyses, the data were screened for non-response. This resulted in N=790. For data screening and descriptive analysis, SPSS is used. For path modelling Mplus (Muthéén & Muthéén, 2007) is used.

Results

The descriptive analyses show the teachers of the UAS are rather positive about their own ability to conduct research in all four contexts. The involvement in research with colleagues, external and self is relatively low (23-34%), while the involvement in research with students is rather high (71%). Almost 50% of the teachers have a training need for research skills in each context.

The fit of the first structural model (figure 1) was satisfactory, with CHISQ = 193.825, df = 64, p

Implications

The educational level of the teachers is important for the research self-efficacy of teachers. Also, being involved in research has a positive influence on the research self-efficacy of teachers. On the other hand, doing research outside of the institute where the teacher is employed has no effect on the research self-efficacy of the teacher. One can conclude that the context in which one can contribute to mastery is important for the sense of self-efficacy in that context. Experiences outside that context do not contribute to mastery. The effect of research self-efficacy on the training needs of teachers differs in different contexts, although the explained variance is small. All results seem in line with Bandura's (2006) concept of the relation between mastery experience and self-efficacy: context matters.

The executives' standard on research competence of teachers in Dutch non-university higher education

Josefine Katelijne Boerma, University Of Applied Science Of Amsterdam, Netherlands; Didi Griffioen, Hogeschool van Amsterdam, Netherlands; Uulke de Jong, UVA, Netherlands

In 2001, Dutch non-university higher education institutions gained the financial right and means to conduct research (Netherlands Association of Universities of Applied Sciences, 2004). Today, research activities are expected to be a part of the curriculum. Before 2001, the primary task of Dutch non-university focussed on providing vocational education. Nowadays, in addition to their pedagogical activities and knowledge of a specific vocation, teachers are expected more and more to be involved in research activities. In this paper the results of a study on the executive managers' standard on research related competence of teachers are discussed. It is important to know what their standard is as executive managers are responsible for the overall quality and content of the curriculum. The results of Q-methodology reflect the patterns of viewpoints of executive managers, which are compared to the self-perceived research efficacy of teachers as examined by Griffioen and de Jong (2009c). The outcomes show that the standard of executive managers on research competence of teachers exhibits similarity to the ordering in beliefs of ability by teachers: to be able to conduct research with students is most important while research competence with external organisations is the least important. Additionally, teachers feel that they are able to comply with the research competence requirements of executive managers.

Aim of this research

Nowadays research skills are part of the competencies of higher educated professionals (Borgdorff, van Staa & van der Vos, 2007). Therefore, research activities are part of the educational reality in non-university (van Lieshout & Borgdorff, 2005). The aim of this study is to determine the way, which the teachers' executive managers perceive the necessary competence of this new task. The standard of executive managers might give direction to the nature of research activities in non-university institutions.

In 2008, Griffioen and De Jong (2009b) asked teachers about their research self-efficacy. The present study can be seen as a follow-up, in which the results of a study into the self-perceived research competence of teachers are compared to the standard of executive managers on research competence of teachers. The results indicate in what way norms of executive managers and beliefs in capability of teachers correspond with each other.

Theoretical background

In the context of implementing research activities in the curricula of non-university higher education institutions, little attention has been given to position of the executive managers. The lecturers are responsible for conducting research and thus seen as the carriers of these activities. Nevertheless, it is relevant to study the viewpoints of executive managers as they are responsible for developing the curricula and creating the necessary conditions for teachers in which research competence and research activities can evolve (Geijssels, Meijers & Wardekker, 2007; Moolenaar, Daly & Slegers, 2010).

Teachers, however, are considered to be the link between research activities and the students who need to become the critical professionals. Therefore it is important to understand how teachers perceive their own competence in implementing and carrying out research: research self-efficacy. Self-efficacy relates to the self-assessment of a person to comply with the requirements of a specific situation.

This belief is independent of the actual empirical result, and derived from other concepts of the self, such as: confidence and self-esteem (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998). Generally, when discussing self-efficacy of teachers, they refer to the teachers' level of self-confidence in their dexterity to work as education providers (Tschannen-Moran & Woolfolk Hoy, 2001).

Methodology

Research question. In which way does the standard of executive managers regarding the research competence of teachers match with the perception of teachers on research efficacy?

Sample. Executive managers of a Dutch university of applied sciences were asked to rank-order a set of twenty statements about research related tasks of teachers. Only executive managers with the task to directly monitor the performance of teachers were included (N= 59, response ratio = 82%).

Measures. In order to answer the research question, five stages of doing research within four contexts (Figure 1) are used as a base to design twenty statements. The 5x4 design is comparable to the design of Griffioen and de Jong

(2009a). Each statement represents one research dimension in which one context is combined with one research task. The respondents were presented with a set of twenty cards each containing a statement and a frame for a Q-sort. Q-methodology was used to rank-order the statements. This methodology is an attempt to analyse subjectivity in all its forms (Barry & Proops, 1999; Exel & de Graaf, 2005). The results of Q-methodology were used to establish the viewpoints of executive managers. The respondents were asked to sort the statements into a Q-sort frame (see Figure 2 for an example). Important research tasks had to be placed to the right, less important tasks to the left.

Each statement, based on his position in the Q-sort, received a quantitative score (0,5 – 4). The result of the sorting is a normally divided distribution of statements of each respondent. All distributions combined, reflect the standard of executive managers regarding research competence of teachers.

Findings

The descriptive analyses show a higher mean for the research tasks with students and a lower mean for research tasks with external organisations (e.g. 'the teacher is capable of supporting students to interpret en report results' to 'the teacher is capable of supporting external organizations to collect data').

A Principal Component Analysis confirmed that three out of four scales as used by Griffioen and de Jong (2009b) can be formed out of the data in the current study: a) individual research b) research with colleagues, c) research with external organisations (C. Alpha= .63 to .69). The reliability of the scale of 'research with students' as used in the study of Griffioen and de Jong is too low and therefore excluded for further research. With the three scales used, the explained variance is 67 percent. The ordering of importance of tasks for teachers in the eyes of executives managers shows that the group of statements resembling individual research competence is most important (M= 2.6) and the statements resembling research competence with external organisations (M= 1.3) is least important. This ordering is also confirmed by a student's t-test ($p = .001$).

Based on these preliminary results it can be concluded that the standard on research competence by the direct executives is comparable to the ordering in beliefs of ability by the teachers: research tasks with students are most important, while research tasks with external organisations are least important.

Theoretical significance

Because of the dependent arranging of statements, Q-methodology has proven to be a valuable instrument to establish a holistic view on the importance of educational tasks. However, the different levels of data constrain the statistical comparability between both studies.

Both teachers and managers have a primary focus on educational research competencies such as individual tasks and tasks with students. This outcome is in accordance with the study of Griffioen and de Jong (2009b) in which is shown that research goals with the aim of improving daily the educational practice are most important.

The teachers' research self-efficacy corresponds with the level that is required by executive managers. Concluding: executive managers focus on the same research competence requirements as teachers feel they are able to comply with.

SYMPOSIUM

Invited SIG

Cognitive and Affective Processes in Multimedia Learning: In Memory of Dr. Roxana Moreno - Part I

Chairperson: Jan L. Plass, New York University, United States

Organiser: Babette Park, Saarland University, Germany

Roland Bruenken, Saarland University, Germany

Discussant: Detlev Leutner, Duisburg-Essen University, Germany

This invited SIG 6 symposium on Instructional Design is dedicated to Dr. Roxana Moreno, who passed away in summer 2010. Our community lost one of our most prolific researchers, highly productive scholars, and a wonderful human being who will be missed by many. With this symposium we would like to inspire more research related to Dr. Moreno's Cognitive-Affective Theory of Learning with Media (CATLM; Moreno, 2006). Therefore, seven contributions are presented that focus on cognitive and/or on affective processes in multimedia learning (De Koning, Tabbers, & Paas; Imhof, Scheiter, Gerjets, & Edelmann; Kirschner, Phielix, & Prins; Magner, Schwonke, Renkl, Aleven, & Popescu; Park, Seufert, Moreno, & Brünken; Um & Plass; van den Boom, Kirschner, & van Merriënboer). Kirschner et al. discuss

self- and group awareness of cognitive and social behaviour. Magner et al. concentrate on the effects of decorative illustrations and their distracting or motivating function. Imhof et al. present different visualizations, which facilitate mental animation. Park et al. show that combined effects of different cognitive load inducing factors are not necessarily additive and how to motivate learners to make full use of their cognitive resources during learning. Um and Plass describe how experienced positive emotions facilitate cognitive processing and improve cognitive and affective outcomes. Van den Boom et al. discuss prompting to stimulate self-regulated learning competence. Finally, De Koning et al. present their results on the function of gesturing as a means to foster understanding. Detlev Leutner will be discussant for the papers presented in the symposium.

Self- and Group Awareness of Cognitive and Social Behavior in a CSCL Environment

Paul A. Kirschner, Open Universiteit, Netherlands; Chris Phielix, Leiden University, Netherlands; Frans Prins, Dept of Pedagogical and Educational Sciences, Utrecht University, Netherlands

A major pitfall of collaborative learning in a computer-supported environment is neglecting the social- and affective aspects of working in a group (Kreijns, Kirschner, & Jochems, 2003). Moreno (2006) took this idea a step further in her Cognitive-Affective Theory of Learning with Media, positing that motivational factors mediate learning by increasing or decreasing cognitive engagement. In a series of experiments, the effects of a self- and peer assessment with the aid of a feedback tool and reflection on the feedback via a reflection tool on group performance in a computer-supported collaborative learning environment were studied. The underlying assumption is that group performance can be positively influenced by making group members aware of how their social and cognitive behaviour is perceived by themselves, their peers, and the group as a whole. Results show that groups using tools perceived their team as being better developed, experienced higher levels of group satisfaction and lower levels of conflicts, than groups not using the tools. They also make it clear that awareness, stimulated by self- and peer assessment and reflection tools, enhances the cognitive performance of a CSCL-group.

Background

Computer supported collaborative learning (CSCL) has been found to enhance learners' cognitive performance (Johnson & Johnson, 1999) and stimulate them to construct knowledge (Stahl, 2004). Students working in CSCL-environments report higher levels of learning (Hertz-Lazarowitz & Bar-Natan, 2002), make higher quality decisions, deliver completer reports, participate more equally (Fjermestad, 2004; Janssen, Erkens, Kanselaar, & Jaspers, 2007), and engage in more complex and challenging discussions (Benbunan-Fich, Hiltz, & Turoff, 2003). They also report higher levels of satisfaction compared to students in contiguous groups (Fjermestad). There are, however, also contradictory results. Students in CSCL-environments sometimes perceive discussions as being more confusing (Thompson & Coover, 2003), less productive (Straus, 1997; Straus & McGrath, 1994) and more time-consuming (Fjermestad, 2004). They may also to experience lower participation (Lipponen, Rahikainen, Lallimo, & Hakkarainen, 2003), more conflict (Hobman, Bordia, Irmer, & Chang, 2002), less group-cohesiveness (Straus; Straus & McGrath) and less satisfaction (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002). CSCL learners, thus, do not always reach their full potential. This discrepancy is due to the design of the CSCL-environment, and/or the social and cognitive behaviour of the group members. With respect to design, environments often concentrate on functionality, focussing on the cognitive processes needed for task completion and/or problem solving to the detriment of socio-emotional processes (Kirschner, Beers, Boshuizen, & Gijssels, 2008) essential for developing social relationships, group cohesiveness, feelings of trust, and a sense of community (Jehng, 1997). With respect to social and cognitive behaviour, group members form interpersonal perceptions during interaction (Kenny, 1994). Based on what they experience, they form impressions about themselves, the group, other group members, and what the other group members think of them. These perceptions are based on the cognitive and social behaviours perceived during interaction. Research, however, shows that group members often perceive their own performance (i.e., self-perception) and group performance are unrealistically (Stroebe, Diehl, & Abakoumkin, 1992). Therefore, it is necessary to first make students aware of their group functioning (through peer feedback) AND have then reflect on the feedback to make it more effective (Prins, Sluijsmans, & Kirschner, 2006). To overcome these problems, CSCL environments can be augmented with tools that act as social-contextual facilitators relevant for the learner's social interaction which can positively affect social and cognitive performance (Kirschner, Strijbos, Kreijns, & Beers, 2004). Two such tools were used in a series of research projects, namely a self- and peer feedback tool (Radar) to make group members aware of the social and cognitive behaviour of themselves and their peers and a reflection tool (Reflector) to stimulate group members to reflect upon their own behaviour, why their peers see them the way they do, and to co-reflect on the performance of the group as a whole.

Research Questions

- 1) What are the effects of Radar and/or Reflector on a group's social development?
- 2) What are the effects of Radar and/or Reflector on group learning?

Method

Participants: Participants in the different experiments were either academic high school or university students randomly assigned to dyads, triads and groups of four, and randomly assigned to one of the experimental conditions. Group compositions were heterogeneous in ability and gender.

Design: In the different studies experimental and control conditions were used. The experimental conditions received either one or both of the tools within their CSCL-environment. Control conditions did not received tools during collaboration.

Measures: In the different studies the following measures were used: Social performance. To measure social performance, previously validated instruments (Strijbos, Martens, Jochems, & Broers, 2007) were used, namely the Team Development scale which provides information on perceived group cohesion, the Group-process Satisfaction scale which provides information on perceived group satisfaction, the Intra-group Conflicts scale which provides information on perceived conflict level between group members and the Attitude towards Collaborative Problem Solving scale which provides information on the perceived level of group effectiveness and how group members felt about working and solving problems in a group. Cognitive performance: The grade given to the groups' collaborative writing task.

Tasks and General Procedure: Students collaborated in groups of two, three or four on a collaborative writing task. Every student worked at a computer. The groups collaborated in a CSCL environment called Virtual Collaborative Research Institute (VCRI; Jaspers, Broeken, & Erkens, 2002), which is a groupware program designed to support collaborative learning on research projects and inquiry tasks.

Instruments: The Virtual Collaborative Research Institute (VCRI) is a groupware program that supports collaborative working and learning on research projects and inquiry tasks. VCRI contains more than 10 different tools, but only 5 were used for this experiment. VCRI was augmented with a peer feedback tool for stimulating and facilitating exchange of information on their social and cognitive behaviour visualized in a radar diagram. Radar provides users with anonymous information on how their social and cognitive behavior is perceived by themselves, their peers, and the group as a whole. The information gathered is based on specific traits that have been found to tacitly affect how one 'rates' other people. Radar provides information on four traits related to social or interpersonal behaviour: influence, friendliness, cooperation and reliability and two related to cognitive behaviour: productivity and quality of contribution. These traits are derived from studies on interpersonal perceptions, interaction, group functioning, and group effectiveness (e.g., Bales, 1988; Brok, Brekelmans, & Wubbels, 2006; Kenny, 1994).

Output of group assessment: Reflection tool (Reflector)VCRI was augmented with a tool containing six reflective questions to stimulate reflection on different aspects of the group processes. Four questions were answered individually; reflection and two final questions required writing a shared conclusion and formulating goals; co-reflection.

Data Analyses: For all measures, one way between-groups ANOVAs with planned comparisons and/or multilevel analyses were conducted.

Results

Results show that groups using tools perceived their team as being better developed, experienced higher levels of group satisfaction and lower levels of conflicts, than groups not using the tools. They also make it clear that awareness, stimulated by self- and peer assessment and reflection tools, enhances the cognitive performance of a CSCL-group.

This submission reports on a series of experiments. The word limit prohibits discussing the specific results of each of the experiments, thus the abstract and extended summary only discuss the methods, procedures and results in general.

Distracting or Motivating: The Effects of Decorational Illustrations in Computer-Based Learning

Ulrike Magner, University of Freiburg, Germany; Rolf Schwonke, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany; Vincent Aleven, Carnegie Mellon University, United States; Octav Popescu, Carnegie Mellon University, United States

Do decorational illustrations distract from learning and, thus, decrease learning outcomes, as suggested by Cognitive Theory of Multimedia Learning? Or can decorational illustrations trigger interest and thereby enhance the willingness to learn as suggested by interest theories? Although these approaches seem to contradict each other, we assume that they are compatible: Decorational illustrations may hinder short-term learning but could raise interest and engagement so that in the medium run learning may be enhanced. The assumption was measured with 52 8th grade student of a German secondary school. They had to work with one of two computer-based learning environment for intersecting lines (geometry); either enriched with interesting decorational illustration or without. Our results showed

an interaction effect of prior knowledge and conditions. Students with low prior knowledge who worked with a computer-based learning environment with interesting decorative illustrations learn less than students without interesting decorative illustrations. However, students with high prior knowledge learn more in the condition with interesting decorative illustrations than students who had no decorative illustrations immediately after the learning phase. For the delayed posttest prior knowledge was the only main effect. Decorative illustrations do not distract per se. Actually they seem to support learning for students with high prior knowledge who can be seen as less vulnerable to distraction. However, medium run learning could not be enhanced by decorative illustrations.

Background

Student 1: „Why does your geometry problems show illustrations and not mine? Your one looks much more interesting and than my ones". Student 2: "I prefer your version; you can concentrate on the geometry problems better than me as there are no illustrations to draw away your attention." This real communication between two 8th grade students nicely illustrates our main research question: Are such decorative illustrations seductive details (Harp & Mayer, 1997) that impede learning, or do they trigger interest and, thereby enhance learning? Cognitive Theory of Multimedia Learning (Mayer, 2005) predicts that illustrations which are interesting but not relevant to the central learning goals should be omitted (Harp & Mayer, 1997). Accordingly, computer-based multimedia environments should not contain goal-irrelevant decorative illustrations. In recent years, cognitive researchers increasingly call for the consideration of motivational aspects, especially Moreno (2006) with her Cognitive Affective Theory of Learning with Media. Against this background, the construct of situational interest seems especially relevant (Hidi, 2001). Hidi (2001) defines situational interest as a person-object relation that arises as a reaction to environmental input. Situational interest eases comprehension (Hidi, 2001) and learning (Ainley, Hidi & Berndorff, 2002; Hidi, 2001). Novelty, concreteness, and visual imagery (Hidi, 2001) are factors that trigger situational interest. One way to rely on such interest-eliciting factors in computer-based multimedia environments is the use of concrete, meaningful and context-oriented decorative illustrations. Although the different theoretical perspectives seem to contradict each other ("seduction" versus interest elicitation), we assume they are compatible: Decorative illustration may hinder short-term learning, but can raise situational interest and engagement so that in the medium-term learning is enhanced. We also assume that different prior knowledge levels may moderate the effects of such illustrations, because in particular low-prior knowledge learners may be hindered by distracting features in learning materials. We tested our assumptions in the context of learning in an intelligent tutoring system (Cognitive Tutor ; Anderson, Corbett, Koedinger & Pelletier, 1995)

Method

Fifty-two 8th grade students of a German secondary school (29 male; 23 female; age: $M = 13.46$ years; $SD = 0.65$) were randomly assigned to two experimental conditions. They worked with a computer-based tutored learning environment either with interesting decorative illustrations or without any decorative illustrations. Learning outcomes were assessed by two posttests (immediate and delayed) which included items requiring near transfer (similar tasks) and far transfer (new tasks). A first experimental session lasted about 90 minutes, the second session (two weeks later) took about 45 minutes. In the first session all students were tested about their prior knowledge of intersecting lines (geometry). Then the students had to solve intersecting line problems in the Cognitive Tutor. Afterwards the learning outcomes were measured and the students answered a set of demographic questions. Between the immediate posttest and the delayed posttest, students could solve further geometry problems with an optional learning booklet. In the delayed posttest students had to solve additional tasks (referring to the learning booklet).

Results

An ANCOVA including the immediately posttest scores showed main effects for condition ($F(1,45) = 4.49$, $p = .04$, $\eta^2 = .09$) and prior knowledge ($F(1,45) = 21.27$, p (see Appendix) Figure 1: Learning outcomes (near/far transfer) However, students with high prior knowledge learned more in the condition with interesting decorative illustrations. Additionally, we looked at a potential behavioural effect of interest, that is, the use of the learning booklet. Only 40.6 % of the students worked with the booklet (no condition difference, $t(17) = 0.33$, $p = .75$). In addition, we could not find any differences between the conditions with respect to the duration of the booklet use ($t(18) = -1.70$, $p = .11$). A second ANCOVA including the delayed posttest showed only a main effect for prior knowledge ($F(1,45) = 24.92$, p Discussion In sum, we found an interesting interaction effect of decorative illustrations and prior knowledge, at least with respect to the immediate learning outcomes. For high-prior knowledge learners the effect of interest elicitation seemed to have dominated. It is assumed that learners with a good knowledge base can form larger chunks when encoding the learning materials. They have some cognitive capacity left for successfully "coping" with potentially distracting pictures that do not contain relevant information. For low prior knowledge learners the distraction effect dominated. They are obviously more vulnerable to distraction because they may work near the limit of their cognitive capacity when encoding and processing content-related (i.e., the geometry)

information. We have found no mid-term effects, neither with respect to the use of the booklets provided for further learning nor the delayed learning outcomes. Informal observations show that the pictures raised interest primarily in the computer environment but not in the learning contents.

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology*, 94(3), 545-561.

Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: lessons learned. *The Journal of the Learning Sciences*, 4, 167-207.

Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology*, 89(1), 92-102.

Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review*, 13(3), 191-209.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (pp. 31-48). New York, NY: Cambridge University Press.

Moreno, R. (2006). Does the modality principle hold for different media? A test of the method-affects-learning hypothesis. *Journal of Computer Assisted Learning*, 22, 149-158.

Testing the Additivity Hypothesis of Cognitive Load Theory – A Modality and Coherence Study

Babette Park, Saarland University, Germany; Tina Seufert, Ulm University, Germany; Roxana Moreno, University of New Mexico, United States; Roland Bruenken, Saarland University, Germany

According to cognitive load theory, the multiple sources of cognitive load experienced during learning are additive. Using a 2x2 experimental design we tested this hypothesis by asking a group of high-school students (N = 100) to learn about biology with a multimedia environment that combined one factor related to extraneous load with one factor related to germane load: modality of verbal explanation (narration vs. on-screen text) and support for coherence formation (support vs. no support). In two preliminary studies the beneficial effects of narration and support were shown when using the same multimedia environment. Results of the present study suggest that combined effects of load factors are not necessarily additive. While no main effects for modality or support could be found in transfer performance (learning scale of preliminary studies) and cognitive load, an interaction effect in cognitive load shows a modality-specific pattern. Learners rated their load to be lower under the narration condition, when learning without support. This pattern however reverses, when learning with support. Moreover, we found a support for coherence formation effect in comprehension performance, another learning success subscale of the present study. This effect was comparable for learners of the narration or the on-screen text condition. In line with the idea that students need to become motivated to make full use of their cognitive resources during learning (Moreno, 2006), this result indicates that the support is especially useful to animate learners to learn longer and to use the invested time-on-task to reach higher levels of comprehension performance.

Theoretical Framework and Objectives

According to cognitive load theory's additivity hypothesis, the different sources of cognitive load (intrinsic, extraneous, germane) are additive, therefore, posing the threat of exceeding students' working memory capacity and hindering learning (Paas, Renkl, & Sweller, 2003). Until now, this core assumption of CLT has never been empirically tested. To fill this gap, we have conducted a series of studies on the combined variation of different cognitive load factors. A first study of our research program shows that the combination of two factors related to extraneous load do not result in cumulative effects on learning performance and cognitive load measures (Park, Moreno, Seufert, & Brýnken, in press). However, what happens when combining one of these factors related to extraneous load with a factor related to germane load? According to CLT, when visual representations (e.g., pictures, diagrams, animations) are combined with simultaneous visual explanations (text), they force students to split their visual attention during learning, therefore hurting learning performance (Sweller, & Chandler, 1994). The learning benefits of replacing visual explanations with auditory explanations (also called the modality effect), is quite robust (Ginns, 2005; Rummer, Schweppe, Fýrstenberg, Seufert, & Brýnken, 2010). The modality effect suggests that forcing students to split their visual attention between the text and the pictures creates an extraneous source of cognitive load. Furthermore, several studies have shown that adding support for coherence formation to instructional materials foster learning (Seufert, 2003; Seufert & Brýnken, 2006; Seufert, Schýtze & Brýnken, 2009). This support is associated with germane cognitive load, as it causes effortful learning activities resulting in schema construction and automation (Sweller, 2005). Consistent with these findings, we were able to confirm the beneficial effect of audio-visual material (modality effect: narration vs. on-screen text) and the learning-conducive effect of support for coherence formation (support vs. no support) in two preliminary studies. In the present study we combined the two effects. The additivity hypothesis predicts the highest levels of total cognitive load and a medium level of learning performance when multimedia instruction combines on-screen text with support. The lowest levels of total cognitive load and a medium level of learning performance are

predicted when multimedia instruction includes narration and no support. Under the other two conditions, including only one of the loading factors (on-screen text without support or narration with support), a medium level of total cognitive load is predicted and the learning performance should differ in the way that narration with support should foster learning the best.

Methods and Data Sources

Modality of the verbal explanation (text vs. narration) and support for coherence formation (support vs. no support) were varied in a 2x2 factorial design, leading to four learning conditions: text-support; text-no support; narration-support; narration-no support. Participants (N = 100 high-school students) were randomly assigned to one of the four experimental groups. The learning instruction consisted of a self-paced multimedia environment about the structure and function of a cellular molecule. Spatial ability, prior knowledge, and time-on-task served as control measures. Learning success was assessed with a learning performance test. Total cognitive load was measured by subjective ratings of mental effort (Paas, 1992). Results and Conclusions The first ANCOVA showed that there are no main and no interaction effects in learning success (F_s). In sum, the present findings point to the need to reconsider the additivity hypothesis raised by CLT, which does not predict a compensation of learning effects when combining them in multimedia instruction. Moreover, CLT does not predict any interaction effects as found in the present study in the subjective rating scale of total cognitive load. Within our research program the first study (Park et al., in press) could already show that modality (the first extraneous cognitive load factor of this study) moderates the seductive details effect (the second extraneous cognitive load factor of this study), which is one more interaction effect that was not predicted by CLT. Further research is needed to accomplish our first results. Thus, one more study is in progress in order to test the additivity hypothesis when combining two germane load factors. Moreover, the found modality-specific pattern in cognitive load ratings is perhaps due to the fact that participants rated rather a "management aspect" of the learning material than the invested learning-enhancing effort. Thus, new methods for a sensitive measurement of cognitive load should be implemented to get further insights into cognitive load. Moreover, in line with the idea that students need to become motivated to make full use of their cognitive resources during learning (Moreno, 2006), results indicate that the support is especially useful to animate learners to learn longer and to use the invested time-on-task to reach higher levels of comprehension performance. References see Appendix

SYMPOSIUM

Invited SIG

Variation in Meaning and Understandings of Subject Matter

Chairperson: Jo McKenzie, University of Technology Sydney, Australia

Organiser: Jo McKenzie, University of Technology Sydney, Australia

Discussant: Noel Entwistle, The University of Edinburgh, United Kingdom

Research has shown the value for learning of understanding variation in students' understandings of subject matter and of using patterns of differences and similarity to bring about new understandings. This symposium explores three different ways of researching student learning of subject matter from a variation perspective. The first study focuses on the interplay between understanding, meaning and expressions used by learners. It looks at variation in learners' use of language to approach subject matter in Newtonian Physics, and variation in how learners see themselves as language users. The second study focuses on the outcomes for students and teachers of the use of phenomenography and the variation theory of learning to design and trial a curriculum approach for improving learning of threshold concepts in Law and Physics in higher education. The third study focuses on a controlled learning experiment in Economics that compares students' learning from three sets of independent learning resources that vary only in the relationship between examples that are chosen. The combination of these studies extends research on variation and students' learning from language, learning and teaching perspectives with the aim of improving our understanding of the learning and teaching of educationally important subject matter.

The interplay between understanding, meaning and expressions used by learners

Annika Akerblom, Lund University, Sweden

The aim of this paper is to present research about how children in three age groups use verbal language in making sense of a problem presented to them in a special dialogue setting. The intentional-expressive research approach, focusing on the epistemological role of language was used as theoretical frame in order to look at the interplay between understanding, meaning and expressions used by the learners close to a problem presented. An analysis of the results from three studies based on the same empirical investigation was made in order to distinguish critical educational aspects for learning to make sense with language.

The results show a large variation in the ways children/pupils use language to approach a specific content and how they see themselves as language users. The first study concerns ambiguity of word meaning and the large variation of meanings given the same expressions by the children/pupils. The second study focuses on awareness of language use and the third study describes four different ways to approach the problem presented. The findings point at the importance to consider the epistemological role of language use in learning and to emphasize the active and creative role of the agent in learning to make sense of subject matter.

Aims:

Prior studies emphasizing the role of language use in learning, from an intentional expressive perspective have concerned students in higher education. However the research presented here involves children from preschool to elementary school and how they understand themselves as language users. The overall aim of the studies was to explore, analyze and describe how children/pupils of three different age groups (6, 10 and 14 years) express their way understanding of problems that could be described in Newtonian physics and basic astronomy, using verbal expressions attempting to make sense about these phenomena as well as their own use of language. An additional aim was to consider aspects of language use that are critical for learning, and to discuss theoretical and practical implications for pedagogical contexts. The intentional expressive research approach emphasizes how a learner approaches a phenomenon through use of verbal language. Learning involves a change in the relation between expressions and what is meant by these expressions, as well as in how they relate to the content of the learner's conception. Prior studies point to the dynamic, ambiguous and varying way expressions are used as well as the meanings those expressions are given by the learner related to a specific content.

Methodology:

65 children in preschool and grades 4 and 8 in elementary school (six, ten and 14 years old respectively) participated in the empirical investigation. Data was collected in a dialogue structure, developed within the intentional-expressive approach. The questions were intended to make the children express their understanding of a problem. The children/pupils were asked the questions: What happens when you throw a ball obliquely up in the air? and Why doesn't the moon fall down? Developing their conceptions they were invited to reflect on a number of key expressions they had used when describing their conception of the problem. Thus focus was shifted through the dialogue, from the conception of a problem, towards reflection on how understanding was expressed. The dialogues were recorded and transcribed and the transcript analysed by means of qualitative contextual analysis. The data-collection and the data analysis carried out will be described in detail in the paper

Findings:

In one of the studies the expressions 'air' and 'attraction force' were selected and analyzed. The expressions were given a large variation of meanings by the children and pupils. However although the older pupils used more scientific terms, their conceptions of physical motion didn't differ to the same extent. In another study the children showed a variation of awareness of their own language use and the ambiguity of meanings. Although a part of the six-year olds didn't conceptualize language as something to reflect over and speak about many of them were able to distinguish language form from language meaning. There was a close connection between language awareness and understanding themselves as language users. In a third study the variation of approach to subject matter using language was analyzed and four categories were described as exploring approach, tentative approach, associating approach and conscious approach. In two of these categories, exploring and conscious approach, the children and pupils made efforts to make sense of the problem presented to them. The associating approach concerned mainly some of the 6 year olds who didn't reflect over their language use. Also pupils using a tentative approach did not explore their own language use in any large extent and spoke of their own language use in terms of 'remembering' and to reproduce the 'right' expressions with given meanings. Notably the tentative approach was most common among the oldest pupils (14 years old). In the contrary many 10 year olds were aware of their own active and creative role as language users in conceptualisation and spontaneously referred to the reflective dialogue as a learning activity.

Theoretical/Educational significance of the findings:

The findings point at the importance of considering the epistemological role of language use, when language is used to make sense of a specific object, which is different from a communicative role (where language is not visible to the user in the activity). Making sense with language, in contrast to reproduction of language patterns and correct terms, emphasizes the active and creative role of the agent in learning, where the learner is active in his/her approaching the world, and acts as the author of saying and of making sense. The open character of relation between expressions, meanings and the content of the conception is seen as critical, as the language user must actively constitute the relations in order to make sense. When language is seen as expressive, expressions get their meanings in the actual use, and not as mediating or representing, where language meaning is seen as bound to cognitive or social/discursive systems of meaning. A pedagogic implication of the findings is that children/ pupils should be supported to explore

and become aware of their own language use in relation to subject matter using reflective dialogues in pedagogical settings in order to learn to make sense with language.

Using phenomenography and variation theory to improve understandings of threshold concepts

Gerlese Sachse Akerlind, University of Canberra, Australia; Jo McKenzie, University of Technology Sydney, Australia; Mandy Lupton, Queensland University of Technology, Australia

This paper describes some findings from a project that aimed to develop and trial a model for teaching disciplinary threshold concepts in the curriculum, drawing on phenomenography and the variation theory of learning. The project involved a team of educational researchers working with teams of academics from two contrasting disciplines, Law and Physics, focusing on the concepts of Legal Reasoning and Uncertainty in measurement. Each team conducted phenomenographic research to investigate differences in students' understandings of the concept then used variation theory to redesign parts of the curriculum to enable students to notice and integrate critical features of these concepts and expand their understandings. The redesigned parts of the curriculum were enacted in different ways by different teachers. This paper will present analysis of the relations between the enacted curriculum and students' learning outcomes in some of the classes. It will also describe the benefits of engagement in the project for the participating teachers and highlight the benefits and challenges of implementing a variation theory approach in higher education contexts.

Threshold concepts can transform students' experience of the discipline but are often troublesome for students to understand (Meyer & Land, 2003; 2005; 2006). Ways of improving students' understandings of threshold concepts are consequently an increasing focus of pedagogical research. This paper describes some findings from a project funded by the Australian Learning and Teaching Council (ALTC) that aimed to develop and trial a model for teaching disciplinary threshold concepts in the curriculum, drawing on phenomenography and the variation theory of learning (Marton & Booth, 1997; Marton & Bowden, 1998; Marton & Tsui, 2004; Marton & Pang, 2006). While academics may be aware that particular concepts are troublesome, they may be less certain about how students are (mis)understanding these concepts. Phenomenographic research (Marton & Booth, 1997; Bowden and Green, 2005) provides a way of identifying differences in student understandings of a concept, and the critical features of the concept that students perceive (or don't perceive) that relate to different understandings. The variation theory of learning then provides a way of planning curriculum experiences to focus on patterns of difference and similarity that may enable students to notice and integrate these critical features. Variation theory also enables analysis of how different patterns of examples might create or confuse opportunities for students to develop their understanding. Some empirical research shows dramatic results from the introduction of variation theory into curriculum design (Pang and Marton, 2005). The impact on development of the teachers involved can also be substantial (Pang, 2006). The project described in this paper involved a team of educational researchers working with disciplinary academics from two contrasting disciplines, Law and Physics. The aim was to develop a theoretically and empirically informed curriculum model of broad disciplinary value and trial its potential to improve students' understandings of selected threshold concepts. Methodology: The project was underpinned by a collaborative action research approach. The research team of educational researchers from four universities, worked with teams comprising four Law lecturers from three universities and five Physics lecturers from four universities. The disciplinary teams also involved tutors, who participated at different stages of the project to increase disciplinary collaboration and reduce individual workloads. The action research approach involved a set of phases over two years.

1. Each disciplinary team identified a common threshold concept for first-year students in their discipline and described their usual practices for teaching this concept.
2. Disciplinary teams conducted phenomenographic research into differences in students' (mis)understandings of that concept. The lecturers or their tutors interviewed 24 students in each discipline, using trigger examples and open questions. In Law, eight students were interviewed in each of three universities. In Physics, students were interviewed across four universities. Each lecturer or tutor involved therefore gained some experience of interviewing students. The transcripts were analysed phenomenographically (Marton & Booth, 1997), by the researchers and disciplinary teams working collaboratively to identify critical differences in student understandings.
3. The outcomes of this research and the variation theory of learning were used to collaboratively redesign aspects of the first-year curriculum to focus on the patterns of similarity and difference necessary to improve student understandings.
4. Revised curriculum designs were implemented, to different extents by different members of the disciplinary teams. Selected classes were videorecorded to capture how the designs were enacted in the classroom. Student learning outcomes were assessed using either questions at the end of the selected class or specific questions in examinations or both.
5. The research team analysed the relations between how the revised curriculum design was enacted in the classroom and the learning outcomes achieved by students, in cases where it was feasible to do so. Towards the end of the

project, an independent researcher interviewed the disciplinary lecturers about the effects of their project involvement on their own understandings and practices.

This paper focuses in particular on two aspects. The first is the relation between the enacted curriculum design and student learning outcomes for three curriculum implementations which used the same set of materials in the same session format. The second is the findings of the interviews with lecturers and tutors from both Law and Physics who participated in the project. Findings: The selected concepts were Legal reasoning in Law and Uncertainty in Physics. The phenomenographic research identified four qualitatively different ways in which Law students understood Legal Reasoning and five different ways in which Physics students understood Uncertainty. Interestingly, for both concepts there were critical differences between a focus on procedures alone to an integration of procedures with broader meanings. Aspects of these findings have been reported elsewhere (Akerlind et al, 2010; McKenzie et al, 2010; Wilson et al, 2010). The relations between the phenomenographic findings and the planned and implemented curriculum designs differed between the Physics and Law teams. In the Physics team, one lecturer was able to implement a new design across lecture, tutorial and laboratory sessions while another was only able to implement it in aspects of a lecture. In the Law team, all lecturers agreed on the use of a common case scenario with four variations that progressively opened up different dimensions of a desired way of understanding legal reasoning. Three of the Law tutors at two universities were able to implement the design in single specific classroom sessions designed for this purpose, with the lecturer at the third university integrating it into regular lectures. Analysis is underway of the relations between the patterns of similarity and difference enacted in the three common Law sessions, and students' responses to questions about legal reasoning posed at the end of these sessions. The results will be reported in this presentation. Analysis of the interviews with the lecturers and tutors revealed benefits of their project participation in terms of: their understanding differences in students' understandings of Uncertainty or Legal Reasoning; changes in how they would teach and/or assess these concepts and their own understandings of these concepts. Details of these findings will also be reported.

Significance:

The findings are theoretically significant in extending understandings of how phenomenography and variation theory can contribute to understandings of disciplinary threshold concepts. They have practical significance for illustrating some of the complexities of working collaboratively with variation theory in higher education contexts and the benefits and challenges for students and teachers in engaging with this approach.

Effects of similarities and differences in examples chosen to facilitate learning

Ming Fai Pang, University of Hong Kong, China; Ference Marton, Goteborg University, Sweden

Teachers who teach the same concept, principle, or method of problem solving use different sets of examples to illustrate that concept, principle, or method. In certain cases, examples are chosen systematically, and there is a coherent system of similarities and differences between them. In other cases, although the examples are related to the object of learning (what is to be learned), they are not systematically related to each other. In previous studies conducted, teachers have used a type of learning theory – variation theory – to build systematic relationships, with dramatic positive effects on learning outcomes. By building in theoretical principles in the pedagogical artefact we want to put those principles to test without possible "teacher bias".

We have already carried out one study which supported our assumptions, but are in the process of carrying out a further experiment and it is from that we are going to report. The learning experiment is carried out with the economic concept, the effect on prices of a simultaneous change in supply and demand. Six classes of students from five different schools participate in the study. Within each class, the students are randomly divided into three groups which use three different sets of learning resources to learn the concept in an independent learning session. The learning conditions are identical, except for the relationships between the examples that are chosen. A pre-test, post-test and delayed-post-test which feature an open-ended written task are administered to evaluate student learning with the three sets of learning resources.

The study reported concerns the relationship between what happens in the classroom and what students learn there. We have found that what students learn in different classes may differ radically even when learning is organized in the same way, even if the students are equally capable and motivated, and even if the teachers are equally well-educated and experienced. We have found that these radical differences frequently originate in the way in which learning content is handled and structured in the interactions between teachers and students. These differences involve what the students are able to discern through what is said or exemplified and what the commonalities and differences are in the systems of examples, problems, and illustrations that are used in the classroom. According to the variation theory of learning, learning is seen as a function of the differences and commonalities in what learners experience.

The results of several studies indicate that this theory could be a remarkably powerful tool for teachers to use in bringing about learning. Some of the teachers in these studies made use of the theory, and others did not. The differences in learning outcomes seemed to correspond to whether or not the teaching was theory-based. By building in theoretical principles in the pedagogical artefact we want to put those principles to test without possible "teacher bias". We have already carried out one study which supported our assumptions, but are in the process of carrying out a further experiment and it is from that we are going to report. The theory: Variation theory puts emphasis on the way in which we learn to discern various entities and their different features. To be aware of something, learners must discern it, and to discern it they have to experience how it differs from other things. The way in which something is experienced can be characterized in terms of which features a person simultaneously manages to discern (that is, which differences he/she notices) and focus on (Pang, 2003).

The presence of differences is a necessary, although insufficient, condition for experiencing differences. To experience differences (variation) in certain respects, things have to remain invariant in other respects. This pattern of variation and invariance both constrains and opens up the possibilities of what can be learned. According to the theory (Marton and Booth, 1997; Bowden and Marton, 1998; Marton and Tsui, 2004), the likelihood of learning a concept is a function of the particular pattern of variation and invariance that is experienced when learners encounter it. This relationship between learning and the pattern of variation and invariance that is inherent in the conditions of learning has been demonstrated empirically in a great number of cases (see, for instance, Pang, 2002; Marton and Tsui, 2004; Lo et al., 2004, 2005; Holmqvist, 2006). The pedagogical implications tested in this study originate from the previous study conducted (Pang & Marton, 2005; Marton & Pang, 2006). The aim of the study was to help Grade 10 students to grasp a principle of economics – the effect on prices of a simultaneous change in supply and demand. A pair of teachers engaged in learning study and used variation theory as a resource to plan and carry out their lessons. The mastery of this principle by their students after a series of three lessons was compared with the mastery of the same principle by a group of students who had been taught by another group of three teachers under conditions that were the same apart from the use of variation theory. The difference in learning outcomes in the post-test was striking. About 84.4% of the students in the learning study group showed that they had managed to take into account the relative magnitude of changes in supply and demand when looking at price changes (which was the intended object of learning). In the lesson study group, however, only 22.8% of the students reached this level of understanding. We found a systematic relationship between the differences in the way in which the topic was taught and the differences in student understanding of it. We found that the critical difference in teaching also had to do with the relationship between the examples that were used to illustrate the principle.

Methodology:

We want to create conditions that differ in exactly this particular respect, but remain the same in other respects. Rather than looking at differences in teaching, however, we aim to create different learning resources that three groups of students will use under equal conditions. Six classes of students from five different schools participated in the study. Within each class, the students are randomly divided into three groups. Each group of students is then given a particular learning resource to learn the concept in an independent learning session. The conditions are identical, except for the relationships between the examples that are chosen. To ascertain their existing level of understanding of the object of learning before they engage with the learning resources, the teachers first administer a pre-test to the students. This forms the baseline for a comparison of the learning outcomes of the three groups of students. Immediately after the learning sessions, a post-test is conducted with the students to probe their levels of understanding and to chart their progress. Finally, a delayed post-test is arranged for four weeks later to evaluate the long-term effects of the learning resources. All of the tests feature an open-ended written task, in which students are asked to handle problems that relate to complex real-life scenarios that embody the principles in question. Based on the data that are obtained, both inter- and intra-group comparisons are carried out. Significance: The study makes both theoretical and practical contributions to the field of education. Theoretically, it further tests the tenets of variation theory and thus makes significant contributions to the advancement of this learning theory and also contributes to the current research on student learning in general. Practically, it widens the application of the theory to include the design of instructional tools and learning resources.

SYMPOSIUM

Invited SIG

Collaboration of learners in technologically enhanced inquiry learning environments

Chairperson: Margus Pedaste, University of Tartu, Estonia

Organiser: Margus Pedaste, University of Tartu, Estonia

Zacharias Zacharia, University of Cyprus, Cyprus

Discussant: Sten Ludvigsen, University of Oslo, Norway

Recent studies in the field of technologically enhanced inquiry learning demonstrate that cognitive and metacognitive support given by computers is effective if it is adapted to the learners' individual needs. Innovative data mining techniques for describing and operationalizing variety of learners can provide us with a tool for building adaptive support systems. However, these developments are taking only their first steps. In this reason there should be set emphasis on integrating learners with different knowledge and skills. Peers are able to give appropriate individual guidance and to teach other learners based on their experiences. Therefore, inquiry learning environments should facilitate collaboration of learners. In this symposium, we discover recent outcomes in studies of support and collaboration in the use of computer supported inquiry learning environments and provide important input for building adaptive support systems in an internationally acknowledged level.

Learning with multiple representations in computer-based inquiry environments

Anniken Furberg, University of Oslo, Norway; Anders Kluge, InterMedia, University of Oslo, Norway; Sten Ludvigsen, University of Oslo, Norway

This paper reports on a study of students' engagement with multiple representations within a computer-based inquiry environment aimed at supporting students' conceptual understanding of energy and heat transfer. Previous research on students' engagement with multiple representations show divergent findings. Some studies document positive effects. Nevertheless, several studies also find that students have difficulties of moving across or connecting multiple representations. By taking a socio-cultural approach, the aim of this paper is to explore and understand how students can benefit conceptually from engaging with multiple representations. In order to pursue this aim, the analytical focus is on settings where students' talk and interaction is conceptually oriented while engaging with representations. The empirical data were produced during the initial round of the EU project Science Created by You (SCY). The central resource for introducing students to the energy and heat transfer curriculum was the computer-based learning environment SCY-Lab, containing a variety of visual and textual representations such as graphical representations, diagrams and simulation tools. Analyses of student group interaction show that the students' engagement with the multiple representations enables them to reframe and reconstruct information presented to them either by the teacher or within the computer-environment prior to their use of the representations. In other words the representations become resources students employ in order to reconstruct and make sense of conceptually oriented information presented to them prior to the situation. Findings are discussed and explored in accordance with findings from previous studies on students' engagement with multiple representations.

Aims

This paper reports on a study of students' engagement with multiple representations within a computer-based inquiry environment aimed at supporting students' conceptual understanding of energy and heat transfer. In the learning sciences visual displays of concepts, processes and phenomena are acknowledged as an important part of individuals' learning processes (Gardner, 1987; Säljö, 2000). Accordingly, within science education visualizing and modeling representations has been given a central role.

Findings from studies on students' engagement with multiple representations such as simulations, diagrams and graphs in computer-based settings show divergent findings. Positive findings are for instance that especially students with medium level of prior knowledge seem to benefit from multiple representations. Furthermore, multiple representations seem to be effective for students' recall performances (Seufert, 2003). Other studies demonstrate that students struggle to use multiple representations effectively (Ainsworth, 2006). For instance, in contrast to experts, students have difficulty moving across or connecting multiple representations (Kozma, 2003). Furthermore, a common finding in studies on students' engagement with computer-environments is that the use of these environments is more effective with regards to enhancing students' acquisition of procedural inquiry skills than the students' acquisition of conceptual understanding (van Joolingen et al., 2007). The procedural versus conceptual finding constitute a general challenge for all educational settings, whereas the overall aim of schooling is not only to support the students' acquisition of procedural skills, but also to support their acquisition of conceptual understanding.

Most studies on students' engagement with multiple representations focus on the effect of specific types of representational tools. In contrast, the focus of this study is on the very process where students engage with multiple representations. A socio-cultural approach is taken (Vygotsky, 1978) to investigate this process. The aim is to explore and understand how students can benefit conceptually from engaging with multiple representations. The analytical focus is on settings where students' talk and interaction is characterized by being conceptually oriented while engaging with representations. Based on this background, the research questions are: How do students engage with

multiple representations presented to them in a computer-based inquiry environment?. How are these representations integrated as structuring resources in the students' process of conceptual sense making?

Methodology

The empirical data were produced during the initial round of the EU project Science Created by You (SCY). The project was carried out in 20 school lessons over the course of 4 weeks with 20 participating students aged 16–17 years. The central resource for introducing students to the energy and heat transfer curriculum was the computer-based learning environment SCY-Lab containing visual and textual representations such as graphical representations, diagrams and simulation tools, supplemented with information from the Web. 40 hours of video recorded student group interaction while engaging with the SCY-Lab environment, and the students' textual and visual productions constitute the data corpus. Initial analyses of settings involving engagement with multiple representations in conceptually oriented settings made it possible to identify typical aspects of such situations. In order to visualize and discuss these typical aspects, extracts from students' interaction within two exemplifying settings are analyzed in detail (Jordan and Henderson, 1995).

Findings

Characteristic for both analyzed settings is that the students' engagement with the multiple representations enables them to reframe and reconstruct information presented to them either by the teacher or within the computer-environment prior to their use of the representations. Within the first analyzed setting, the students try to make sense of the teacher's explanation of the solar cellar process by means of using multiple representations such as depictions, models and text found on the Internet. Here the students manage to reconstruct and represent the teacher's explanation by including elements from the textual and visual representations. Within the second setting, the students try to make sense of house construction and energy loss. Arguing for effectiveness, the students manage to try out their self-made hypotheses by manipulating variables in a simulation tool. This finding can be seen in relation to what Cote et al. (1998) refer to as the important link between students' preexisting knowledge and the information provided by e.g. a text. In other words, the analyses show that the representations become resources students employ in order to reconstruct and make sense of conceptually oriented information presented to them prior to the situation.

Theoretical and educational significance

A socio-cultural approach can give deep insight into how students may benefit conceptually from engaging with multiple representations in computer-based inquiry environments. By focusing on local contingencies we can understand how and why productive interaction is constituted and what this means for the students' process of conceptual understanding. Furthermore, under certain conditions, engagement with multiple representations can enhance students' understanding of scientific concepts. These potentials can be realized if the teachers, the technologies and the collaborative patterns create directions that make both procedural and conceptual talk possible and relevant for the students.

This study was conducted in the context of the Science Created by You project and EC Grant agreement 212814

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and Instruction*, 16, 183-198.

Cote, N., Goldman, S. R., & Saul, E. U. (1998). Students making sense of informational text: Relations between processing and representation. *Discourse Processes*, 25, 1-53.

Gardner, H. (1987). *The Mind's New Science: A history of the cognitive revolution*. New York: Basic Books. Basic Books Paperback with new Epilogue, 1987.

van Joolingen, W.R., de Jong, T., & Dimitrakopoulout, A. (2007). Issues in computer supported inquiry learning in science. *Journal of Computer Assisted Learning*, 23, 111-119.

Jordan, B., & Henderson, K. (1995). Interaction analysis: foundations and practice. *The Journal of the Learning Sciences*, 4(1), 39-103.

Kozma, R. (2003). The material features of multiple representations and their cognitive and social affordances for science understanding. *Learning and Instruction*, 13, 205-226.

Seufert, T. (2003). Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13(3), 227-237.

Säljö, R. (2000). *Lärande i praktiken: ett sociokulturellt perspektiv*. Stockholm: Prisma.

Vygotsky, L. (1978). *Mind in society: the development of higher social processes*. Cambridge, MA: Harvard University Press.

Investigating Web-based peer feedback in collaborative, inquiry-based learning

Peer interactions can serve as powerful motivators for learning, as they provide opportunities for exchanging and critiquing ideas. Cases of cognitive conflict can be particularly influential, as peers can argue, negotiate meaning, or even restructure their own understanding. Students' reactions to peer feedback are distinct from students' reactions to adults questioning their ideas: for example, while interacting with teachers most children succumb to the adult ideas because of the asymmetrical nature of the adult-child relationship. In this paper, we explore the relationship of peer feedback, mediated through a web-based inquiry support tool, and students' inquiry process. We report on an exploratory study, examining students' collaborative use of synchronous and asynchronous tools to provide feedback to peers. In this context we pursue the following questions: What peer feedback structures exist? How did the technology mediate peer interactions? Data were collected from two classes of 6th grade students ($n_1=20$, $n_2=19$), working in small groups. The groups were engaged in problem-solving a data-rich, socio-scientific problem, and used a scaffolded, web-based learning environment to critique their paired group's work. Data included videotapes of group interactions, computer logs of the feedback provided, and students' written work on the computer. The topic of peer feedback has primarily been explored in more formalized assessment opportunities in higher education settings and as it related to individual students. Currently, there is a lack of literature examining peer feedback in complex, computer-supported, collaborative settings. This work can contribute to a better understanding of how technology can support collaborative learning.

Aims

In recent years arguments about the potential of learning from peers have become increasingly popular (Kollar & Fischer, 2010; Tsivitanidou, Zacharia, & Hovardas; van Zundert, Sluijsmans, & van Merriënboer, 2010) for pragmatic, cognitive, and pedagogical reasons (O'Malley, 1992). In a review of the literature, van Zundert et al. (2010) concluded that there is scant published work on peer assessment, relating to higher education settings with only a handful focusing on elementary or secondary school students. Furthermore, there appears to be a gap in the literature pertaining to the examination of peer feedback in computer-supported collaborative settings. The goal of this work was to explore a web-based tool, designed to support peer feedback, and peer interactions, as students worked collaboratively to solve a complex, web-based inquiry problem, using Activity Theory (Engeström, Miettinen, & Punamäki, 1999) as the guiding analytical framework. This design-based work can contribute to a better understanding of how technology can support collaborative learning.

Methodology

We report on an exploratory study, examining students' collaborative use of synchronous and asynchronous tools to provide peer feedback. Two intact 6th grade classes ($n_1=20$, $n_2=19$) of a public school in Cyprus participated in this study. Students were working in pairs or triads (7 groups in each class). The context of the investigation, which was hosted on the STOCHASMOS platform (Kyza & Constantinou, 2007), was a topical socio-scientific issue. Each group of students assumed the role of scientists representing different organizations, as a means for illustrating that scientists' agendas may lead to different scientific claims on the same issue. The students' goal was to study the data and construct scientific claims on how the problem could be best solved. The learning sequence included two phases for peer reviewing using the STOCHASMOS collaboration tools (the Workspace Sharing area and the STOCHASMOS chat tool). The tools were used by students in order to apply epistemological criteria for assessing scientific claims which were developed in the context of this learning environment. The Workspace Sharing area offers students the opportunity to collaborate with other groups asynchronously, by allowing them to share their Workspace pages (e.g. data pages) in order to obtain and provide peer feedback. The implementation took place during 12 80-minute sessions and was kept the same in the two classrooms. During the peer review phases, each group was paired with a group from the other class. The data sources included in this study were videotapes of three groups' peer review sessions from each class, computer logs of the peer feedback provided by the 14 groups, and the groups' written work on STOCHASMOS. The data were coded to capture the type of feedback provided and were analyzed qualitatively, according to design-based research principles, to explore peer feedback structures and the socio-technical system mediating peer interactions.

Findings

Based on the Activity Theory framework, three different states of activities were identified, all situated within the community of the classroom: students' written peer-review comments, students' discourse and activity around these comments, and intergroup communication using the chat tool. The examination of each of the states reveals a different aspect of the peer review sessions. Examining the written feedback we found that the paired groups reviewed a total of 34 Workspace pages during Peer Review Session 1 (PRS1) and 13 pages during Peer Review Session 2 (PRS2). A content analysis of the feedback provided by the groups indicated that the written feedback, even though

brief, was contextualized, specific and relevant to the peer review task students were asked to perform, with no off-task comments provided. In addition, the comments provided went beyond what was requested and focused on the reviewed group's interpretations, indicating agreement, or disagreement, and asking for more complete articulations of students' interpretations. An analysis of the chat conversations indicated that students used the chat tool mostly for phatic communication and for coordinating the sharing of data in the WorkSpace Sharing space. In the cases when students argued about claims, these discussions lacked the contextualization and the support of data. A third analysis of the group's videotaped discourse during the peer review sessions revealed that socio-technical and task structuring decisions delayed the process of providing feedback and limited the quality of discussions around the task. This analysis also revealed that the teacher had an important mediating role, which also coupled as a formative assessment mechanism. These results, which will be presented in more detail at the conference, suggest that representational tools can successfully mediate students' feedback providing behavior and that different tools serve different purposes. At the same time, our findings suggest that certain aspects of the feedback system need to be redesigned so that they can serve a more effective communicative role.

Significance

This exploratory study contributes to knowledge about peer feedback processes in collaborative, inquiry based learning, a topic currently understudied. The study has provided evidence that a) peer feedback is feasible even at the elementary school level, and b) representational and communication tools can support different aspects of the peer feedback process. The findings have implications for designing interactive spaces to facilitate peer feedback and for understanding the mechanisms that are guiding peer feedback processes.

Engestrom, Y., Miettinen, R., & Punamaki, R. L. (Eds.). (1999). *Perspectives on Activity Theory*. Cambridge.: Cambridge University Press.

Kollar, I., & Fischer, F. (2010). Peer assessment as collaborative learning: A cognitive perspective. *Learning and Instruction*, 20(4), 344-348. doi: DOI: 10.1016/j.learninstruc.2009.08.005

Kyza, E. A., & Constantinou, C. P. (2007). *STOCHASMOS: a web-based platform for reflective, inquiry-based teaching and learning* [software]. Cyprus: Learning in Science Group.

O'Malley, C. (1992). Designing computer systems to support peer learning. *European Journal of Psychology of Education*, 7(4), 339-352. doi: 10.1007/bf03172898

Tsvitanidou, O. E., Zacharia, Z. C., & Hovardas, T. Investigating secondary school students' unmediated peer assessment skills. *Learning and Instruction*, In Press, Corrected Proof. doi: DOI: 10.1016/j.learninstruc.2010.08.002

van Zundert, M., Sluijsmans, D., & van Merriënboer, J. (2010). Effective peer assessment processes: Research findings and future directions. *Learning and Instruction*, 20(4), 270-279. doi: DOI: 10.1016/j.learninstruc.2009.08.004

Students' regulation of inquiry in a computer-based simulation

Mario Maeots, University of Tartu, Estonia; Margus Pedaste, University of Tartu, Estonia; Tago Sarapuu, University of Tartu, Estonia

In this study we analyzed the application of the web-based learning environment "Young Researcher" (<http://bio.edu.ee/teadlane>) in developing students' transformative and regulative inquiry skills. 268 teams with 536 volunteer students from the 6th to 12th grades (aged 10-18) participated in an all-Estonian competition. The teams of two people registered to a three-week competition. During the competition, five problem-solving tasks in the learning environment "Young Researcher" were solved. The comparison of the process and results in solving the first and the last tasks were used for evaluating students' development in inquiry learning. The learning process of each task contained the problem identification, formulating research questions and hypothesis, experiment planning, carrying out an experiment, analysis and interpretation of the results, and making conclusions. Students had to carry out real or virtual experiments with web-based tools. The tasks were designed for developing students' transformative and regulative skills. In order to increase students' awareness about the regulation of the inquiry processes, different forms of support were offered by the learning environment. Our goals were i) to find how the inquiry learning environment "Young Researcher" developed students' transformative and regulative inquiry skills, and ii) what is the influence of the students' regulative skills on the development of their transformative skills. According to the results, the students' transformative skills developed statistically significantly. Among the processes of regulation, the skills needed for planning, monitoring and evaluating were under investigation. Several problems which might affect students' abilities to regulate their learning process were detected and are discussed in this presentation.

Introduction

The concept of inquiry learning originates from the works of Bruner (Bruner, 1960). In general, we define inquiry learning as a process of discovering new relations, where learner formulates hypothesis and tests them by making experiments or observations (de Jong & van Joolingen, 1998; Zachos, et al., 2000; Wilhelm, 2001). The aim of inquiry

learning is to develop the skills needed for making up discoveries (Pedaste, 2006). De Jong & Njoo (1992) divide inquiry skills into transformative and regulative ones. Transformative skills relate to processes in which domain information is transformed into knowledge (de Jong & Njoo, 1992). While regulative skills refer to executive control of the study process, which keeps track of the progress that has been made in transformative processes (de Jong & Njoo, 1992; Njoo & de Jong, 1993). Several authors have described different skills needed for transformative processes, which can be classified into seven stages: problem identification, research question formulation, hypothesis formulation, experiment planning, carrying out an experiment, analysis and interpretation of results, and drawing conclusions (Freidler et al., 1990; Harlen & Jelly, 1997; Veermans, 2002; Pedaste, 2006). These stages lead a learner step by step towards the solution of the problem (Pedaste, 2006). The success of the transformative activities largely depends on regulation of inquiry. This means that learners regulate their own learning by planning, monitoring and evaluating their task performance (Veermans, 2002; Zhang, et al., 2004, de Jong, et al., 2005). In this study, we define planning as a design of the learning process (setting performance goals; predicting the course of the learning process; planning time; making a strategic plan for learning activities and their sequence), monitoring as a process where learner observes and keeps track of his/her own study process (taking and viewing notes; deciding to change the plan; checking study time), and evaluating as a process where the learner evaluates the learning process and task performance (checking whether learning goals have been reached; commenting the execution of the task and the entire learning progress; checking the correctness of the actions and results at a conceptual level; thinking about the course of learning and information processing for the future).

Methods

Procedure, participants and data analysis: The study was carried out during an all-Estonian competition where participated 268 teams with 536 volunteer students from the 6th to 12th grades (aged 10-18). The teams of two people registered to a three-week competition. During the competition, five problem-solving tasks in the learning environment "Young Researcher" were solved. The tasks and tests were validated by the experts' discussion. 132 teams were used in the data analysis because they finished the competition on time.

Learning environment: The web-based learning environment "Young Researcher" (<http://bio.edu.ee/teadlane>) has been designed for achieving the objectives of Estonian science curriculum for students from the 6th to 12th grades (aged 10-18) through inquiry approach. There are five different inquiry tasks under the topics of "Why is it hard to catch a falling body?", "Why does our pulse and breathing rate change?", "Why muscles wear down differently?", "Why does extra weight accumulate?", and "Why does organism need water?". The learning process of each task contains the problem identification, formulating research questions and hypothesis, experiment planning, carrying out an experiment, analysis and interpretation of the results, making conclusions. Students have to carry out real or virtual experiments with web-based tools. To support student's regulation of inquiry, different forms of support are offered.

Results and discussion: The current research focused on the developing students' transformative and regulative inquiry skills. Analysis showed that all transformative inquiry skills developed statistically significantly: research question formulation ($Z=-8.2$; $p < .001$) has appeared that the regulation of the learning process plays a crucial role in students' learning activities while a statistically significant correlation was found between regulative and transformative skills. Our results demonstrated that the higher level of regulative skills lead to the higher development of transformative skills. De Jong et al. (2005) have shown similar results, where successfulness of the learning processes depends on effective regulation. For conclusion, we can clarify that the learning environment "Young Researcher" is applicable for developing students' transformative and regulative inquiry skills.

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Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, 31, 21-32.

Chinn, C. A. & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of Educational Research*, 63, 1-51.

De Jong, F., Kolloffel, B., van de Meijden, H., Staarman, J.K. & Janssen, J. (2005). Regulative processes in individual, 3D and computer supported cooperative learning contexts. *Computers in Human Behaviour*, 21, 645-670.

De Jong, T. and Njoo, M. (1992). Learning and instruction with computer simulations: learning processes involved, In E. de Corte, M. Linn, H. Mandl, and L. Verschaffel (Eds.), *Computer-based learning environments and problem solving*, Berlin: Springer-Verlag, 411-429.

De Jong, T. & van Joolingen, W. R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research*, 68, 179-202.

Friedler, Y., Nachmias, R. & Linn, M. C. (1990). Learning scientific reasoning in microcomputer-based laboratories. *Journal of Research in Science Teaching*, 27, 173-191.

Harlen, W. & Jelly, S. (1997). *Developing science in the primary classroom*. Essex: Addison Wesley Longman.

- Njoo, M. & de Jong, T. (1993). Supporting exploratory learning by offering structured overviews of hypotheses. In D. Towne, T. de Jong & H. Spada (Eds.), *Simulation-based experiential learning* (pp. 207-225). Berlin, Germany: Springer-Verlag.
- Pedaste, M. (2006). Problem solving on web-based learning environment. Tartu University Press. Tartu: Tartu Ülikooli Kirjastus. PhD Dissertation.
- Zachos, P., Hick, T. L., Doane, W. E. J. & Sargent, C. (2000). Setting Theoretical and Empirical Foundations for Assessing Scientific Inquiry and Discovery in Educational Programs. *Journal of Research in Science Teaching* 37(9), 938-962.
- Zhang, J., Chen, Q., Sun, Y., and Reid, D.J. (2004). Triple scheme of learning support design for scientific discovery learning based on computer simulation: experimental research, *Journal of Computer Assisted Learning*, 20, 269-282.
- Veermans, K. (2002). Intelligent support for discovery learning. Twente: Twente University. PhD Dissertation.
- Wilhelm, P. (2001). Knowledge, skills and strategies in self-directed inductive learning. Leiden: Leiden University. PhD Dissertation.

SYMPOSIUM

Mental versus written computation: Contributions from cognitive psychology

Chairperson: Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Organiser: Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Discussant: Terezinha Nunes, University of Oxford, United Kingdom

Solution strategies for solving mathematical tasks have been an important research topic, not only for (mathematics) educators but also for (cognitive) psychologists. Until recently, the studies were mostly focused on elementary (single-digit and two-digit) arithmetic: solving additions, subtractions, multiplications, and divisions in the number domain up to 100. Complex multi-digit arithmetic, which is part of the curriculum of the middle and higher grades of elementary school, has not received much attention from researchers. However, both from theoretical and practical reasons, systematic empirical research in complex multi-digit arithmetic is needed. Theoretically, because in complex multi-digit arithmetic several aspects (e.g., understanding the decimal number system, self-regulatory skills...) play a more important role. Practically, because several recent surveys in various countries (including the U.S., the U.K., and The Netherlands) suggest that children's performance in this curricular subdomain is (drastically) descending. According to some researchers, this trend is directly related to recent reforms in the goals, content, and methods of (elementary) mathematics education, particularly a depreciation of the standard written algorithms and an overemphasis of mental calculation strategies. The three papers in this symposium address, from a cognitive psychological perspective, this tension between mental and written algorithm, by investigating critical issues such as the relative efficiency of both kinds of strategies, children's choices between both kinds of strategies, and (lack of) transfer from one kind to the other. The papers will be discussed by a scholar who is internationally well-known for her research in this particular topic.

Solution strategies and adaptivity in complex division: A choice/no-choice study

Cornelis M. van Putten, University of Leiden, Netherlands; Marian Hickendorff, Leiden University, Netherlands; Marije Fagginger Auer, Leiden University, Netherlands

The current study systematically investigated mental and written solution strategies for solving complex division problems (e.g., $306 : 17$), with the main focus on strategy adaptivity. Eighty-six Dutch 12-year-olds were tested using the choice/no-choice design. They first solved division problems in the free strategy choice condition, and consecutively with forced mental and forced written computation in the two respective no-choice conditions. Strategy choice and strategy performance (accuracy and speed) were recorded. Findings showed that mental computation was usually chosen for reasons of speed, while choices for written computation were fit to accuracy characteristics. Moreover, there were individual differences in the relative preference for accuracy and speed in choosing between mental and written strategies, and these were related to gender and mathematics achievement level of the student.

The present study focused on solution strategies for complex division problems (problems in which the quotient is a multidigit number and the divisor may be multidigit too, e.g., $306 : 17$). The main focus was on the distinction between written and mental computation. Secondary analyses on Dutch national assessment results showed that this was a very relevant distinction in explaining the negative performance trend on complex division between 1997 and 2004: use of mental strategies increased over time, but their success rates lagged far behind those of written strategies (Hickendorff, Heiser, Van Putten, & Verhelst, 2009).

The findings of a previous study (Hickendorff, Van Putten, Verhelst, & Heiser, 2010) into mental and written solution strategies on complex division suggested that students made a suboptimal strategy choice for mental computation

regarding accuracy. However, in that study strategy speed could not be taken into account, and there were no unbiased strategy efficiency data regarding mental computation. The present study aimed to overcome these two limitations.

The aim was to systematically investigate strategic competence in the domain of complex division problem solving. Lemaire and Siegler's (1995) four-dimensional framework of strategic competence was used, distinguishing between strategy repertoire, strategy distribution, strategy performance (accuracy and speed), and strategy adaptivity. The main focus was on the adaptivity of the strategy choices: To what extent do individual strategy performance characteristics (accuracy and speed) predict the choice of a strategy? Are there group differences in relative preference for accuracy and for speed?

Method

Eighty-six Dutch 12-year-olds solved a total of 12 complex division problems in a choice/no choice design (Siegler & Lemaire, 1997). They first solved 4 problems in the free strategy choice condition, in which they could choose between mental and written computation. Consecutively, they solved 4 similar problems in the no-choice 'written' condition, and 4 again similar problems in the no-choice 'mental' condition. All students were tested individually, and responses - correctness of answer, solution strategy, and solution time - were collected on a trial-by-trial basis. To account for dependency of observations within students in the statistical analyses, (generalized) linear mixed regression models were used.

Results

Strategy repertoire. Approximately half of the students (49 %) used written as well as mental strategies in the choice condition. The majority of the other half used only written strategies (38 %), and a small part used only mental strategies (13 %).

Strategy distribution. The relative frequencies of mental and written strategies in the choice condition showed that each item was solved most frequently by written calculation (average 67 %).

Strategy performance. Accuracy and speed data from the two no-choice conditions yielded unbiased strategy performance data. On average, mental strategies were significantly less accurate than written strategies (proportion correct of .50 versus .61, respectively). However, they were significantly faster than written strategies (mean solution times 80s. versus 91s).

Strategy adaptivity. It was assessed whether the strategy selected in the choice condition was the most 'appropriate' one, as evidenced by the unbiased strategy performance information from the no-choice conditions. Analyses on the student level showed that there were significant correlations between the frequency of choosing a mental strategy in the choice condition and, first, the difference in accuracy between forced mental and forced written strategies (Spearman's $\rho = .28$) and second, the solution time difference between forced mental and forced written strategies (Spearman's $\rho = -.32$). Gender and general mathematics level affected these correlations. Girls' strategy choices were significantly related to accuracy differences ($\rho = .40$) but not to speed differences ($\rho = -.07$), while boys' strategy choices showed the opposite pattern, being nonsignificantly related to accuracy differences ($\rho = .26$) but significantly to speed differences ($\rho = -.52$). Moreover, above-average achievers fitted their strategy choice to accuracy differences ($\rho = .56$) as well as speed differences ($\rho = -.47$), while below-average achievers did neither ($\rho = .00$ and $\rho = -.15$, respectively).

Conclusions and discussion

An interesting finding of the present study is that there were group differences in the adaptivity of choosing between mental and written computation on complex division problems: Girls appeared to take accuracy considerations into account, ignoring speed, while boys fitted their strategy choices more to speed than to accuracy. In addition, above-average achievers' strategy choices were related to both aspects of strategy performance, while below-average achievers' choices were not related to either speed or accuracy.

There are theoretical and educational implications of these results. Theoretically, these individual differences in speed-accuracy preference have not been explicitly addressed in the cognitive models of strategy choice and adaptivity. From an educational perspective, we argue that it is important to acknowledge these individual differences in the classroom, and create an environment in which accuracy is valued over speed, and using an external aid is not necessarily less valuable than working in the head.

Hickendorff, M., Heiser, W. J., Van Putten, C. M., & Verhelst, N. D. (2009). Solution strategies and achievement in Dutch complex arithmetic: Latent variable modeling of change. *Psychometrika*, 74, 331-350.

Hickendorff, M., Van Putten, C. M., Verhelst, N. D., & Heiser, W. J. (2010). Individual differences in strategy use on division problems: mental versus written computation. *Journal of Educational Psychology*, 102, 438-452.

Lemaire, P., & Siegler, R. S. (1995). Four aspects of strategic change: Contributions to children's learning of multiplication. *Journal of Experimental Psychology*, 124, 83-97.

Siegler, R. S. & Lemaire, P. (1997). Older and younger adults' strategy choices in multiplication: Testing predictions of ASCM using the choice/no-choice method. *Journal of Experimental Psychology: General*, 126, 71 - 92.

Children's mental and written computation strategies: A choice/no-choice study with Flemish children

Joke Torbeyns, K.U.Leuven & GROUP T - Leuven University College, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

This study analyzed children's use of mental computation strategies and standard written algorithms in the domain of multi-digit addition and subtraction, using the theoretical model of strategy change and the choice/no-choice method. 21 Flemish fourth-graders solved items that either stimulated the use of mental computation strategies or a standard written algorithm, in one choice and two no-choice conditions. In the choice condition, children could use their preferential strategy on each item; in the two no-choice conditions, they had to solve all items with, respectively, a mental computation strategy (no-choice mental condition) and the standard written algorithm (no-choice written condition). The results revealed that children preferred the use of the written algorithm on multi-digit sums, even on sums that evoke a mental computation strategy. Moreover, they executed the standard written algorithms with high efficiency and flexibility, also on the sums that elicit a mental computation strategy. We discuss these (unexpected) results in terms of the current mathematics educational culture and practices with its strong focus on the mastery of standard written algorithms from an early age on.

Theoretical and empirical background and research question

During the last decades, strategy variety and strategy flexibility have become highly important topics in both cognitive and educational psychological research and math educational practice (e.g., Baroody & Dowker, 2003; Kilpatrick et al., 2001; Verschaffel et al., 2009). Numerous studies focused on the flexible application of different strategies on single-digit and two-digit addition and subtraction. Unfortunately, our insight in these topics is far more limited in the domain of multi-digit addition and subtraction.

Multi-digit sums can be solved using different types of strategies, including mental computation strategies and standard written algorithms. In many reform-based documents, strong pleas are made, on various grounds, for teaching children mental arithmetic strategies before and besides the standard written algorithms. It is expected that children will continue to use these mental strategies to solve multi-digit additions and subtractions involving particular numerical features (e.g., continue to solve $534+299$ with the compensation strategy via $534+(300-1)=834-1=833$, and not the written algorithm). However, empirical studies indicate that children tend to inefficiently and inflexibly rely on (almost) only written algorithms once these algorithms are instructed and practiced in the classroom (e.g., Selter, 2001). In ongoing heated discussions between advocates and opponents of reform-based mathematics education in countries such as the U.S., the U.K., and The Netherlands, these disappointing findings concerning the scarce and inefficient use of mental arithmetic play an important role. Within this scientific and societal context, we aimed at analyzing children's strategy competencies in the domain of multi-digit addition and subtraction, with special attention for the efficiency and flexibility with which they apply mental computation strategies and standard written algorithms.

We employed the model of strategy change (Lemaire & Siegler, 1995) to analyze children's strategy competencies. This model distinguishes among four parameters to examine (changes in) strategy use, namely (a) strategy repertoire, (b) strategy frequency, (c) strategy efficiency, i.e., the accuracy and speed of strategy execution, and (d) strategy flexibility, i.e., the adaptiveness of individual strategy choices, defined as selecting the strategy that leads fastest to an accurate answer to the problem.

Children's strategy competencies were studied using the choice/no-choice method (Siegler & Lemaire, 1997). This method involves offering items in two different types of conditions: a choice condition, in which children can solve each item with their preferential strategy, and one or more no-choice conditions, in which they have to solve all items with one given strategy.

Method

Twenty-one 4th-graders participated to the study. As is typically the case in elementary mathematics education in Flanders, all children had received explicit instruction in mental computation strategies on multi-digit additions and subtractions starting in 2nd grade and had intensively practiced the standard written algorithms for these sums for one year. All children individually solved a series of four additions and four subtractions up to 1000 in three conditions. We selected two item types, namely (a) MC-items, that can be solved efficiently with a mental

computation strategy, i.e. compensation (e.g., 498+263; 601-126), and (b) WA-items, that are not assumed to evoke compensation or any other mental computation strategy (e.g., 456+266; 632-164). In the choice condition, children could choose between mental computation strategies and the standard written algorithms on each item. In the no-choice mental condition, all items had to be answered by mental computation. In the no-choice written condition, a written algorithm had to be used on all items. We expected (a) that children would solve the items in the choice condition using both mental computation strategies and standard written algorithms, (b) that mental computation strategies would be applied more frequently and more efficiently on MC-items, and (c) that children would fit their strategy choices to their individual strategy performance characteristics during the strategy selection process, by using most frequently in the choice condition the type of strategy they mastered best (as evidenced by the no-choice efficiency data).

Results

While most children (57%) applied both mental computation strategies and standard written algorithms at least once in the choice condition, mental computation was used on only 19% of the items from the choice condition. We observed no frequency differences between the two item types ($p > .05$), meaning that not only WA items but also MC-items were answered less frequently with mental computation than with the written algorithms. Next, the accuracy and speed data from the no-choice conditions indicated that the written algorithms resulted in higher accuracy rates (89% correct) and shorter solution times (27s) than mental computation strategies (resp. 67% correct and 37s).

Discussion

This study revealed that, after one year of practice of the standard written algorithms, Flemish elementary school children frequently apply these algorithms to solve multi-digit additions and subtractions. In line with previous findings, they prefer these algorithms even on sums that are assumed to maximally stimulate the use of mental computation strategies. Unexpectedly, children also use the standard written algorithms highly efficiently and flexibly, even on sums that are thought to favor mental computation. These unexpected results might be explained by the strong instructional focus on the routine mastery of the standard written algorithms starting in 3rd grade, accompanied by a serious drop in instructional attention for and practice of mental computation strategies and a general lack of attention to strategy flexibility. These findings, which need to be replicated in future studies, yield important information for the ongoing debate about the relative importance of mental computation and written algorithms in elementary mathematics education.

Training mental addition generalizes to new problems but does not transfer to written addition

Catherine Thevenot, University of Geneva, Switzerland

Over a 6-day period, adults were trained in single-digit and two-digit mental addition. We showed that there was a clear training effect for both type of problems, even if two-digit additions were different from one day to the other. Moreover, participants were tested on their written calculation abilities before and after the training program. We showed that participants who entered the mental arithmetic training program did not progress more in written arithmetic than participants who were trained in a Tetris game or who did not receive any training between the pre- and the post tests. The implications of these results and the possible reasons for the lack of transfer from mental to written arithmetic will be discussed in this presentation.

Theoretical and empirical background

Even if it is common sense to assume that mental and written calculation share common components, neuropsychological evidence shows that written calculation can be dissociated from other numerical abilities. Of course, this is not to say that some arithmetical components are not common to multi-digit written calculation and mental arithmetic. Indeed, good performance in written and mental arithmetic necessarily relies on quick and efficient arithmetic fact retrieval. Moreover, the knowledge of calculation procedures is required to solve written and mental multi-digit calculation. However, these procedures are not necessarily the same. In mental multi-digit addition, two main strategies have been identified (Lemaire & Callies, 2009; Lucangeli, Tressoldi, Bendotti, Bonanomi, & Siegel, 2003 for example). First, the full decomposition strategy consists in decomposing both tens and units (e.g., $53 + 44 = 50 + 40$; $3 + 4 = 7$; $90 + 7 = 97$). Second, the partial decomposition strategy consists in decomposing only the second addend (e.g., $34 + 65 = 34 + 60 = 94$; $94 + 5 = 99$). In written addition, the common strategy is the one taught at school consisting in adding the units, then the tens and so on, using carrying when necessary (Lucangeli et al., 2003).

Research question

It is therefore worth investigating whether or not a transfer from mental to written calculation is possible through the practice of shared components between the two abilities or, on the contrary, if a transfer is impossible because of written calculation specificities.

Method

In order to answer this question, we trained 26 adults on single and multi-digit additions over a 6-day-period. Each training session took approximately 15 minutes. Whereas single-digit additions were the same from one day to another, different multi-digit additions were presented every day. As in previous studies, we logically predicted an effect of training on single-digit problems. Moreover, our participants were tested using the well-known written arithmetic fluency test (i.e., subset of the French kit, French, Ekstrom, & Price, 1963) before and after the training period. It was then possible for us to determine if practicing mental arithmetic transfers to written calculation. In order to ensure that potential score improvement on the French kit was not only due to a test-retest effect, the results obtained by participants trained on mental arithmetic skills were compared to the results obtained by 22 participants trained on a non-numeric task (the famous Tetris game) and by 39 participants who were not trained at all.

Results

In accordance with our first prediction, there was a clear training effect over sessions and participants were quicker to solve one-digit additions during Session 6 (1960 ms) than during Session 1 (2962 ms). It was the same for more complex additions, which were solved faster during Session 6 (4304 ms) than during Session 1 (6718 ms). As already mentioned here, because two-digit additions were different from one day to another, this result attests that training complex mental addition generalizes to new problems. More relevant for the object of this presentation, arithmetic scores on the written test were higher during the post-test than during the pre-test. However, the score progression on this test did not differ as a function of the training group. In fact, all three groups performed better during the post-test than during the pre-test. In other words, the improvement in performance in the arithmetic group can be attributed to a simple test-retest advantage. A similar result was obtained by Imbo and Vandierendonck (2008) who showed that adults who were trained on simple addition did not score better on the French kit than adults who did not receive any practice. However, because their participants were tested on the written arithmetic test only after practice and not before, it was difficult to put forward definite conclusions about transfer.

Conclusion

Therefore, it seems that the procedures used and reactivated by our participants during the training program were irrelevant for written arithmetic. These results comfort neuropsychological research conclusions that written arithmetic is a specific ability, which can be dissociated from other numerical competencies. In written arithmetic, individuals apply routinely the common strategy taught at school, whereas in mental arithmetic, the strategies used by individuals are more flexible because they depend on problems' characteristics. If an adult is asked to solve $59 + 47$ mentally, he or she can use the full decomposition or partial decomposition already described here, but can also figure out that $60 + 47$ is 107 and therefore that $59 + 47$ is $107 - 1$. Again, if the same problem is presented vertically and asked to be solved with a pen and paper, it is more probable that the "units then tens" procedure will be applied mechanically. These interpretations are comforted by Lemaire and Callies' study (2009) where the authors showed that both children and adults use the partial decomposition strategy more often when problems are presented horizontally than vertically.

Educational implications

The results of this study bring to light two new interesting findings that could have implications for education. First, the fact that training complex mental addition generalizes to new problems shows that practice can be considered as a useful method of learning. Of course, as already suggested in the literature, long-term effects of such training are expected if, in combination to procedural training, conceptual knowledge is not neglected (Rittle-Johnson, Siegler, & Alibali, 2001). Second, the fact that there is no transfer of training from mental to written arithmetic seems to indicate that using mental arithmetic as a didactical stepstone to written arithmetic (as is typically done in reform-based mathematics education programs) is not a simple matter, which requires carefully designed instructional interventions aimed at making the transition from mental to written arithmetic transparent to the learners.

SYMPOSIUM

Quantitative methods for research on conceptual change and belief change

Chairperson: Michael Schneider, ETH Zurich, Switzerland

Organiser: Michael Schneider, ETH Zurich, Switzerland

Discussant: Han L.J. van der Maas, UvA, Netherlands

Conceptual knowledge gives students a broad and abstract understanding of general principles and their interrelations in a domain. It is a major aim of school instruction. Therefore, it is an important question how we can measure and model changes in students' conceptual knowledge. Research on conceptual change, belief change and conceptual

development so far has made extensive use of interviews. However, interview data adequately reflect the content of learners' knowledge but yield only very indirect evidence about the structure the learners' knowledge. The symposium is based on the conviction that, with an increasing variety of research questions, researchers should also employ a greater variety of assessment techniques, quantitative models, and theoretical approaches. The studies presented in this symposium set out to explore a range of different data collection and modeling techniques, including their practical applicability and their theoretical implications. The studies employ concept inventories with various item types as well as reaction time measures. The data are analyzed using a multitude of quantitative techniques including factor analyses and latent variable modeling. The results are interpreted with respect to qualitative and quantitative changes in the students' conceptual knowledge, e.g. theory change, belief revision, knowledge fragmentation and integration, and influences of entrenched presuppositions. The investigated content domains are biological evolution, mental models of the earth and number concepts. The discussion will integrate the new empirical findings and focus on the potentials and limitations of the methods for broadening mainstream approaches in research on knowledge acquisition and development.

Natural number bias in adults: In search for reaction time evidence

Wim Van Dooren, K.U. Leuven, Belgium; Xenia Vamvakoussi, Greece; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

Studies conducted from a conceptual change perspective have shown that in several mathematical domains (e.g., rational number, algebraic notation, (non-)linear problems), students' prior knowledge comes in contrast with new information coming from instruction, and interferes with further learning. It has been argued that children's prior knowledge is organized on the basis of certain presuppositions, which children may be unaware of. These robust presuppositions continue to influence their reasoning, even after being exposed to formal instruction. This study focuses on the natural number bias, i.e., the inclination to transfer features and properties of the natural numbers to non-natural numbers.

We looked for evidence that the natural number bias is still present in adults, even when they do not give erroneous responses. To do this, we looked for reaction time evidence in a variety of items that are related to the natural number bias. It was found that for several types of items, adult participants committed more errors to incongruent items (not in line with presuppositions) than to congruent items (in line with presuppositions). Moreover, even in cases when participants committed no errors, generally there was an effect with respect to reaction times showing that adults are still showing a bias.

Theoretical and empirical background

Recent conceptual change research has shown that in several domains, like fractions (Stafylidou & Vosniadou, 2004), rational numbers (Merenluoto & Lehtinen, 2004; Vamvakoussi & Vosniadou, 2004), non-linearity (Van Dooren et al., 2004), algebraic notation (Christou & Vosniadou, 2007), and infinite sets (Tirosh & Tsamir, 2006), students' initial understanding can act as a barrier. It has assumed that children's prior knowledge is organized on the basis of certain tacit presuppositions, that continue to influence their reasoning, even after formal instruction. Evidence shows that adults often make errors similar to those of pupils, indicating that they have not always entirely overcome such presuppositions.

This study focuses on the interference of the so-called natural number bias in students (Ni & Zhou, 2005; Smith, Solomon, & Carey, 2005). Before students are exposed to other kinds of numbers, they have already consolidated a naive theory of number which is tied to their knowledge and experience of natural numbers and comprises tacit assumptions about what a number is and how it is supposed to behave. This phenomenon has been widely documented in various mathematical tasks, targeting the properties of rational and real numbers. Students typically make mistakes reflecting beliefs such as “-b can only be a negative number”, “longer decimals are bigger”, “multiplication always makes bigger”, “adding a number leads to a larger result”, and “between two given numbers, there is a finite number of other numbers”, which are valid in the domain of natural numbers, but not for rational or real numbers.

Adults in principle possess the knowledge to solve the tasks correctly. However, there are indications that they sometimes commit errors similar to students, suggesting that they are still influenced by the presuppositions that also underlie students' reasoning.

Rationale and research questions

With a reaction time study, we wanted to gain process based evidence for the claim that adults – and even adults who do not longer commit errors in the above-mentioned areas – are still affected by the natural number bias.

When presuppositions are not entirely overcome while the correct knowledge is acquired, a dual process theoretical account may explain the occurrence of errors. Dual process accounts of reasoning (e.g., Stanovich & West, 2000) assume that humans have an intuitive/heuristic system (S1) that is fast, automatic, associative and undemanding of working memory capacity, and an analytic system (S2) that is controlled, deliberate and effortful. Fast S1-heuristics often provide correct responses, but sometimes, S2 needs to override responses. Hence, errors may be attributed to the pervasiveness of S1 and the failure of S2 to intervene.

Several of the assumptions of dual process theory have previously been validated in reaction time research. More specifically, the idea is that when students are confronted with a counterintuitive mathematical task, the answer coming to mind first is an intuitive one, in line with the students' presuppositions in the particular domain. This needs to be inhibited for a correct, counterintuitive answer to be given.

Predictions

A natural number bias could therefore be shown in their behavior in two ways: Either subjects commit mistakes which are in line with the above-mentioned naive theories of number, or they do not make mistakes, but take longer to give correct responses to items in which the involved presuppositions have to be inhibited than to items where the involved presuppositions are in line with the correct answer. Therefore, we predicted more correct responses in items where correct responses are inline with the presupposition (congruent tasks) than in items where they are not in line with it (incongruent task). Moreover, we expected correct answers to be given faster in congruent tasks than in incongruent tasks.

Method

A group of 40 adult subjects who possess the required domain-specific knowledge worked on a series of computer-based reasoning tasks, while their reaction times are measured. Each time, they had to judge the correctness of a claim.

The tasks were divided in 10 different blocks, which were all related to the natural number bias. Some related to the dense structure of the rational number system (Vamvakoussi & Vosniadou, 2004), others to algebraic notation (Christou & Vosniadou, 2007), and still others to the effect of operations (e.g. multiplication and addition make bigger).

For each block, congruent tasks (presupposition leads to correct answer) and incongruent tasks (presupposition leads to wrong answer) were used. The tasks were presented on a computer screen and each participant solved a set of tasks with no time limit, and a second set of similar tasks under time pressure.

Results and conclusions

The results of this study are in the process of being analyzed. Preliminary analyses have already shown that for certain items (e.g. those related to the dense structure of the rational number system), subjects make indeed more mistakes to incongruent items than to congruent ones. For these items, the expected effect in reaction times is also present: Responding correctly to incongruent items takes significantly more time than responding correctly to congruent items.

For other items (e.g. in which fractions have to be ordered and in which subjects could be misled by the size of the nominator and denominator), there were no differences in the number of correct responses (there was almost a 100% accuracy for both congruent and incongruent items), but the difference in reaction time was still present.

Taken as a whole, we found evidence of a natural number bias in adult participants – even in cases when they do not commit mistakes – by looking at reaction time patterns. However, for certain types of items, the bias is stronger than for others. In future research, we plan to extend the age/expertise range and do similar research with considerably younger students (in order to see whether certain biases are stronger present in terms of the number of mistakes made and whether similar reaction time patterns can be observed), and with expert mathematicians (who can be expected to make no mistakes at all on our items, but who might still be biased in terms of reaction times).

Children's knowledge of the earth: A new methodological and statistical approach

Marthe Straatemeier, University of Amsterdam, Netherlands; Han L.J. van der Maas, UvA, Netherlands; Brenda Jansen, University of Amsterdam, Netherlands

The question whether children's naive knowledge is coherent or fragmented is highly debated in the field of children's knowledge of the earth. According to adherents of the mental model account (e.g., Vosniadou & Brewer, 1992),

children of all ages, even young children, construct coherent mental models of the earth. In contrast, adherents of the fragmentation account (e.g., Nobes et al., 2003) believe that the development of children's knowledge is characterized by a gradual accumulation of fragments of information up until they acquire the correct scientific theory.

In this study we use a new methodological and statistical approach for studying children's knowledge of the earth to contribute to the coherent versus fragmentation debate. We conducted two experiments with large samples ($N = 328$ and $N = 381$) using a new paper-and-pencil test, denoted the EARTH (Earth Representation Test for cHildren). In these experiments the EARTH was compared to methods used in previous research; drawings and interviews.

We performed latent class analyses on the responses to the EARTH to test whether children construct non-scientific mental models of the earth. Each mental model found in previous research (Vosniadou & Brewer, 1992) was expected to correspond to one of the latent classes in the best fitting latent class model. However, the non-scientific mental models were not detected. Moreover, the results indicated that children's knowledge becomes more consistent as children grow older. These results are consistent with a gradual accumulation of knowledge fragments of the earth (i.e., the fragmentation account).

Introduction

In the field of children's knowledge of the earth, much debate has concerned the question of whether children's naive knowledge is coherent (i.e., theory-like) or fragmented. The mental model account (Vosniadou & Brewer, 1992) states that children of all ages, even young children, construct coherent mental models of the earth. In contrast, the fragmentation account (Nobes et al., 2003) describes the development of children's knowledge of the earth as a gradual accumulation of fragments of information up until children acquire the coherent scientific theory of the earth. In this study (Straatemeier, van der Maas, & Jansen, 2008) we use a new methodological and statistical approach for studying children's knowledge of the earth in order to contribute to the ongoing debate about children's knowledge of the earth, and conceptual development in general.

Children's knowledge of the earth has mainly been studied using drawings and interviews, by which only small samples of children could be tested. We suggest using a structured, nonverbal, forced-choice test that can be administered without one-to-one supervision. With such a test the social interaction is minimal and more children can be tested at the same time. Moreover, the use of complex coding systems and the training of experimenters is not required. Therefore, we constructed a new paper-and-pencil test (the EARTH Representation Test for cHildren; EARTH) in which the most prevalent models found in earlier studies with Western countries were represented (Vosniadou & Brewer, 1992; Vosniadou et al., 2004).

We conducted two studies with large samples using the EARTH. The large samples enabled us to use the more advanced latent class analysis (LCA), as opposed to the rule assessment methodology (RAM; Siegler, 1976), used in previous research. LCA can contribute to the discussion of coherent versus fragmented knowledge of the earth, as this analysis allows children to be classified in underlying discrete latent classes (e.g., Jansen & van der Maas, 2002; Raijmakers, Jansen, & van der Maas, 2004). If the mental model account is correct each latent class of a latent class model should correspond to one of the mental models found in previous research.

Method

Two experiments were conducted with two versions of the EARTH. In Experiment 1 ($N = 328$, age 4-11) the EARTH-1 was compared to drawings, which children made either before or after completing the EARTH-1. In Experiment 2 ($N = 381$, age 4-9) the EARTH-2 was compared to answers to an interview with open-ended questions of 68 of the children, which were also performed either before or after completing the EARTH-2. The EARTH tests were presented in a booklet and consisted of 8 (EARTH-1) or 9 (EARTH-2) items. Every item consisted of a question about the earth with four, five or six pictures printed below the questions, from which the child had to choose the correct picture. The items of the EARTH concerned the shape of the earth, gravity, and the day/night cycle. More information about the EARTH tests and these experiments can be found at <http://users.fmg.uva.nl/hvandermaas>.

Results

The proportion of correspondence between the responses to the EARTH and the mental models, formulated by Vosniadou and Brewer (1992), was calculated with the rule assessment methodology (RAM; Siegler, 1976). Every child was assigned to the mental model with respect to which he or she had the highest consistency score. Figure 1 shows that the percentage of children with a mental model, as established using the EARTH-2 in Experiment 2, is low when strict cut-off scores were used for minimum consistency (.8 to 1). Even with lenient cut-off scores the answers of a large proportion of children could not be classified. Moreover, most children, from whom the responses could be

classified, had a scientific model of the earth. The same pattern was also found for the consistency scores of children's answers to the interview, see Figure 1. Similar results were found in Experiment 1.

Figure 2 shows that in Experiment 1 both the amount of children's knowledge of the earth and the consistency of children's responses with one of the mental models (i.e., almost always the scientific model) increases with age. Moreover, positive associations (Experiment 1: $r_s = .86$, $p < .001$; Experiment 2: $r_s = .67$, $p < .001$) were found between the amount of knowledge children have and the consistency of their responses. Similar results were found in Experiment 2.

LCA was performed on the responses to the EARTH of the two samples. If the mental model account is correct the latent classes of the best fitting latent class model should correspond to the mental models found by Vosniadou and Brewer (1992). However, the LCA provided no evidence for the existence of non-scientific mental models. The scientific model was the only model that was detected.

Discussion

Both the results of the RAM and the LCA question the claim that children form mental models, at least of the kind formulated by Vosniadou and Brewer (1992). Moreover, we found that the older children are, the more knowledge they have of the earth, and the more consistent this knowledge is. These results are consistent with a gradual accumulation of knowledge fragments of the earth (i.e., the fragmentation account).

We believe that our methodological and statistical approach is a valuable new approach for the empirical comparison of the coherence versus fragmentation view of children's knowledge of the earth. This approach can also be applied to advance the coherence versus fragmentation debate in other domains of conceptual development.

The use of qualitative and quantitative measures for tracing conceptual change

Andrew Shtulman, Occidental College, United States

Conceptual change involves more than just a quantitative increase in knowledge; it involves a qualitative restructuring of that knowledge. The qualitative nature of conceptual change has led many researchers to study conceptual change using strictly qualitative methods, like content analyses of written narratives and semi-structured interviews. The present study describes a method for supplementing the descriptive power of qualitative analyses with the inferential power of quantitative data – a method that has proven useful at tracking changes in the interrelations among domain-specific concepts over time. College undergraduates enrolled in a course on evolution and ecology ($n = 151$) completed a series of open-ended tasks designed to assess their understanding of six evolutionary phenomena: variation, inheritance, adaptation, domestication, speciation, and extinction. Content analyses were used to differentiate correct, selection-based conceptions from incorrect, need-based conceptions, which were then converted into a three-point numeric scale. Scores were summed across tasks assessing the same evolutionary phenomena, yielding six diverse measures of evolutionary reasoning along the same interval-scale metric. Statistical comparison of these measures before and after instruction revealed a consistent decoupling of microevolutionary concepts from macroevolutionary concepts in participants' progress toward achieving conceptual change. This decoupling has not been observed in previous studies of conceptual change within the same domain, either by those employing strictly qualitative methods or by those employing strictly quantitative methods, implying that the combined use of quantitative and qualitative measures may capture nuances of conceptual-change learning not captured by either method on its own.

Conceptual change is knowledge restructuring at the level of individual concepts, resulting in a qualitative difference between learners' initial knowledge states and final knowledge states. Because this difference is qualitative in nature, attempts to track conceptual change over time or across instruction have typically employed qualitative methods – i.e., content analyses of verbal responses to semi-structured interviews. These methods allow researchers to ascertain exact, highly detailed descriptions of learners' initial and final knowledge states, but they are not amenable to precise quantification of (a) interrelations among different conceptual dimensions within the same domain or (b) patterns of change within, and across, those dimensions over time. At the other end of the spectrum from semi-structured interviews are multiple-choice concept inventories (e.g., Anderson, Fisher, & Norman, 2002). While such inventories allow for precise quantification of change over time, they run the risk of underspecifying, or even mischaracterizing, learners' actual knowledge states due to their use of experimenter-generated, rather than participant-generated, response options.

Here, I will outline an approach to studying conceptual change that combines the descriptive sensitivity of semi-structured interviews with the quantificational precision of concept inventories. The target domain was biology, and

the target instance of conceptual change was the transition from an essentialist, need-based understanding of evolution to a variational, selection-based understanding of evolution (Shtulman, 2006; Shtulman & Schulz, 2008). A series of inferential-reasoning tasks was developed for diagnosing students' understanding of six evolutionary phenomena: variation, inheritance, adaptation, domestication, speciation, and extinction. Each task was designed to elicit one of two historically antecedent interpretations of the phenomenon at hand: a "transformational" interpretation, consistent with pre-Darwinian theories of evolution in which evolution was (incorrectly) construed as the cross-generational transformation of all species members, or a "variational" interpretation, consistent with post-Darwinian theories of evolution, in which evolution is (correctly) construed as the selective propagation of within-species variation. The tasks were generally open-ended in nature, allowing participants to articulate their own understandings (or misunderstandings) of the relevant phenomena, but responses to those tasks were coded numerically along a common metric. Transformational responses received -1 points, variational responses received +1 points, and vague or ambiguous responses received 0 points. Scores were summed across tasks assessing the same evolutionary phenomena, yielding six composite scores ranging from -5 to +5 (one each for variation, inheritance, adaptation, domestication, speciation, and extinction).

The comprehension assessment was administered to 188 college undergraduates at the beginning and end of a one-semester course on evolution and ecology. Consistent with previous research (Shtulman, 2006), the majority of participants (151, or 80%) demonstrated pervasive transformational misconceptions on the pretest. Those 151 participants were separated from the other 37 in an attempt to determine whether, and how, their misconceptions had changed over the course of the semester. A 6 (section) x 2 (time) repeated-measures ANOVA revealed that participants' scores were significantly greater at posttest than at pretest ($M = -7.1$ vs. $M = -10.9$; $F(1,750) = 41.93$, $p < .001$) but that this difference was not uniform across the six sections, as indicated by a significant interaction between section and time ($F(5,750) = 5.23$, $p < .001$). Paired-samples comparisons for each section revealed significant pre-post gains for all sections except speciation and extinction, as shown in Figure 1. That is, participants who began the semester with inaccurate theories of evolution made significant (though incomplete) progress in their understanding of microevolution (e.g., variation, inheritance, adaptation, domestication) but made no discernible progress in their understanding macroevolution (e.g., speciation, extinction).

While it is possible this difference was due to the nature of the instruction participants received during the intervening semester, the participants actually came from four different classes taught by two different instructors. Separate analyses for each course and each instructor revealed the same pattern of results, indicating that this pattern was robust across different instructional contexts and different instructional strategies. Additional confirmation of the robustness of this pattern came from a factor analysis of the difference in participants' section scores from pretest to posttest. This analysis revealed two main factors (explaining 26% and 19% of the variance in participants' difference scores, respectively): one factor on which the four microevolutionary concepts loaded highly but the two macroevolutionary concepts did not and one factor on which the two macroevolutionary concepts loaded highly but the four microevolutionary concepts did not (see Figure 2). Achieving a variational understanding of macroevolutionary concepts thus appears to be distinct from, and possibly subsequent to, achieving a variational understanding of microevolutionary concepts.

This decoupling of macroevolutionary concepts from microevolutionary concepts in the learning of evolutionary biology is consistent with biologists' claim that "tree thinking" and "population thinking" are fundamentally competencies that require fundamentally different instruction (Catley, 2006) but has not been previously observed in the evolution education literature, either by studies that have relied mainly on open-ended interviews or by studies that have relied mainly on closed-ended concept inventories (e.g., Bishop & Anderson, 1990). While the former may not have been sufficiently sensitive to the interrelations among different facets of evolutionary reasoning, the latter may not have been sufficiently sensitive to the specific nature of students' preinstructional misconceptions. The combined use of quantitative and qualitative measures thus appears to capture nuances of conceptual-change learning not captured by either method on its own.

Anderson, D. L., Fisher, K. M., & Norman, G. J. (2002). Development and evaluation of the conceptual inventory of natural selection. *Journal of Research in Science Teaching*, 39, 952-978.

Bishop, B., & Anderson, C. A. (1990). Student conceptions of natural selection and its role in evolution. *Journal of Research in Science Teaching*, 27, 415-427.

Catley, K. M. (2006). Darwin's missing link: A novel paradigm for evolution education. *Science Education*, 90, 767-783.

Shtulman, A. (2006). Qualitative differences between naive and scientific theories of evolution. *Cognitive Psychology*, 52, 170-194.

Shtulman, A., & Schulz, L. (2008). The relationship between essentialist beliefs and evolutionary reasoning. *Cognitive Science*, 32, 1049-1062.

SYMPOSIUM

Scaffolding: Treasuring learning oriented interaction

Chairperson: Geerdina Van der Aalsvoort, University of Applied Sciences (Hogeschool Utrecht), Netherlands

Organiser: Justine Howard, Swansea University, United Kingdom

Miriam Leuchter, University of Munster, Germany

Discussant: Kathy Sylva, University of Oxford, United Kingdom

Scaffolding, a concept first suggested by Wood, Bruner and Ross (1976) refers ideally to the following. "The teacher explains the problem and involves the child in the problem-solving process, giving him or her a chance to give an answer to the questions that arise at every intermediate stage of the search for the solution" (Grigorenko, 1998, p. 209). There are different opinions as to whether scaffolding refers to the more knowledgeable other (Vygotsky), to assisted performance in general (Tharp & Gallimore), to dialogic enquiry (Wells), to guided participation (Rogoff) or to a dynamic system in which patterns emerge in both adult and child's behavior (Van Geert & Steenbeek, 2005). This symposium bridges the concepts of scaffolding from the perspective of children (Howard), teachers (Leuchter & Saalbach) and from a dynamic perspective (Steenbeek et al.). Howard presents scaffolding as a concept related to play. She states that if children do not accept adults onto their play then scaffolding within the context of a play based curriculum becomes contentious. She reports her findings from several experiments carried out in kindergarten. Leuchter and Saalbach present findings with regard to the extent and the quality of scaffolding processes when kindergarten and primary school teachers work with a challenging science learning environment in their classrooms. Steenbeek, Van der Steen, Meindertsma, Van Dijk and Van Geert explore scaffolding as a microgenetic intrinsic dynamic notion that comes forward during scientific reasoning tasks with young children.

Co-constructing playful learning environments: the scaffolding potential of play

Justine Howard, Swansea University, United Kingdom

By understanding children's perceptions of what makes an activity play or not play, experimental designs have repeatedly shown that when children approach an activity as if it were play (by their own definition), they perform significantly better on problem solving tasks, demonstrate increased meta-cognitive and self regulatory behaviour and are more motivated and engaged, than when they approach the same activity as though it were not play. From a theoretical perspective, it is argued that these beneficial effects of play are a result of the fact that a playful state scaffolds development by providing a protected environment where behavioural thresholds are lowered and as a result, exploration and experimentation can occur. Crucially, children use cues within their environments to make play and not play distinctions and these appear to be based on their experiences. They develop scripts to determine whether an activity is approached as play or not play, and the chosen approach influences their behaviour and performance. Three particular types of cue are common; whether or not an activity is self chosen, whether an activity occurs at a table or elsewhere and, of particular importance to classroom practice and scaffolding techniques, whether or not an adult is present. As to whether or not children hold these cues to play depends on the nature of their previous experiences. The paper utilises findings from multiple studies that focus on children's perceptions of their own classroom activities, to demonstrate how scaffolding children's learning experiences within a play based curriculum can be maximised via co-construction.

Originating from the work of Vygotsky, scaffolding (Wood, Bruner & Ross, 1976) and other similar support mechanisms to enhance learning and development such as assisted performance (Tharp & Gallimore, 1988), dialogic enquiry (Wells, 1999), guided participation (Rogoff, 1990) and more recently, sustained shared thinking (Siraj-Blatchford, 2007) are most commonly associated with children's interaction with others. This can include child-child interaction as well as adult-child interaction. In the context of classroom practice, such forms of support often need to occur within the context of play. The notion that play itself can act as a form of scaffolding is also alluded to in Vygotsky's work and he proposed that "play creates a zone of proximal development [where] a child always behaves beyond his average age, above his daily behaviour.... as though he were a head taller than himself" (Vygotsky, 1978, p. 102). This paper describes a dual conceptualisation of scaffolding in relation to play; the inherent scaffolding potential of children adopting a playful state, and the potential for others to support and enhance opportunities for development via maintenance of this state. The paper utilises findings from multiple studies that focus on children's perceptions of their own classroom activities, to demonstrate how scaffolding children's learning experiences within a play based curriculum can be maximised via co-construction. With reference to studies that have focused on children's perceptions of their classroom activities, the paper will outline what kinds of characteristics or cues, children associate with play and not play (e.g. Wing, 1995; Howard, 2002; Howard & McInnes, 2010; Keating Fabian, Jordan, Mavers & Roberts, 2000). Three particular types of cue are common; whether or not an activity is self chosen, whether an activity occurs at a table or elsewhere, and of particular importance to classroom practice in relation to scaffolding,

whether or not an adult is present. By understanding children's perceptions of what makes an activity play or not play, the paper will then go on to consider experimental designs that have repeatedly shown that when children approach an activity as if it were play (by their own definition), they perform significantly better on problem solving tasks, demonstrate increased meta-cognitive and self regulatory behaviour and are more motivated and engaged, than when they approach the same activity as though it were not play (e.g. Thomas, Howard & Miles, 2006; McInnes, Howard, Miles & Crowley, 2009; Whitebread, 2010). A theoretical model of play that incorporates these findings will then be proposed suggesting that the beneficial effects of play manifest as a result of a playful state which scaffolds development by providing a protected environment where behavioural thresholds are lowered and as a result, exploration, trial and error can occur. The way in which play serves as a resource for children to meet intellectual and emotional challenge will then be presented (Howard, 2010). The cues children use to make play and not play distinctions appear to be based on their experiences. They develop scripts to determine whether an activity is approached as play or not play, and the chosen approach influences their behaviour and performance. This is a crucial point in respect of the utility value of scaffolding techniques associated with quality early years experiences. If children do not accept adults into their play (ie. they regard activities where adults are present as not play), then scaffolding within the context of a play based curriculum becomes contentious. With reference to studies of children's perceptions across contexts and cultures, the paper will demonstrate that whether or not children use particular cues to play (particularly the acceptance of adults as play partners) depends on the nature of their previous experiences. This evidence for the contextual nature of children's perceptions will be used to demonstrate that through informed classroom planning practitioners can support and enhance children's development using scaffolding techniques whilst at the same time maintaining their playful state. The paper will conclude by suggesting that the challenge of reconciling play and pedagogy (Wood, 2007) can be reduced via understanding and attending to children's perceptions of their activities and that this encapsulates an authentic co-constructed approach to play practice.

Howard, J. , & McInnes, K. (2010). Thinking Through the Challenge of Implementing a Play-based Curriculum: Increasing Playfulness via Co-construction. In J. Moyles (Ed.), *Thinking About Play*. Open University / McGraw Hill.

Keating, I., Fabian, H., Jordan, P., Mavers, D., & Roberts, J. (2000). 'Well, I've not done any work today. I don't know why I came to school'. Perceptions of play in the reception class. *Educational Studies*, 26(4), 437-454.

McInnes, K., Howard, J., Miles, G., & Crowley, K. (2009). Behavioural differences exhibited by children when practising a task under formal and playful conditions. *Educational and Child Psychology*, 26(2), 31-39

Rogoff, B. (1990). *Apprenticeship in Thinking: cognitive development in social context*. New York: Oxford University Press.

Siraj-Blatchford, I. (2007). Creativity, Communication and Collaboration: The Identification of Pedagogic Progression in Sustained Shared Thinking. *Asia-Pacific Journal of Research in Early Childhood Education*, 1(2) 3-23.

Thomas, L., Howard, J., & Miles, G. (2006). The Effectiveness of Playful Practice for Learning in the Early Years. *Psychology of Education Review*, 30(1), 52-59.

Tharp, R. G., & Gallimore, R. (1988). *Rousing minds to life: teaching, learning, and schooling in social context*. Cambridge: Cambridge University Press.

Vygotsky, L. S. (1978). *Mind and society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wells, G. (1999). *Dialogic Inquiry: Towards a Sociocultural Practice and Theory of Education*. New York: Cambridge University Press

Wing, L. (1995). Play is not the work of the child: young children's perceptions of work and play. *Early Childhood Research Quarterly*, 10(4), 223-247.

Whitebread, D. (2010). Play, Meta-cognition and Self-Regulation. In P. Broadhead, J. Howard, & E. Wood (Eds.), *Play and Learning in the Early Years: Research into Practice*. Sage. London.

Wood, E. (2007). New Directions in Play: Consensus or Collision? *Education* 3-13, 35(4), 309-320.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychiatry and Psychology*, 17(2), 89-100.

Teachers' scaffolding competencies in science in pre- and primary school

Miriam Leuchter, University of Munster, Germany; Henrik Saalbach, ETH Zurich, Switzerland

Recent research shows that the amount and the quality of teachers' scaffolding activities in kindergarten and primary school need to be improved. Focusing on science teaching these findings are specified in the results demonstrating that teachers find it hard to take into account children's naïve conceptual understanding and to stimulate their comparison processes (Appleton, 2008). The present research investigates teachers' scaffolding competencies with respect to the conceptual learning and teaching of science in the context of "floating and sinking" in K/1+2. In order to gain insight into teachers' highly specific classroom action, we videotaped K/1+2 teachers' instructional support in a science learning environment. The videotaped sequences were part of a four-week curriculum for kindergarten and

primary school which was implemented in 15 preschool and 15 primary school (1st and 2nd) classrooms with a total of 444 children. The videotaped lesson units provided a basis for a microanalysis of teachers' instruction which was rated on the basis of a high-inference rating system. This design allowed us to use frequency and variance analysis to test whether and to which extent teachers' instruction can be seen as scaffolding (i.e. activation of prior knowledge, stimulating comparison) and to find differences in the teachers' scaffolding techniques.

Based on recent research findings on the instructional quality in kindergarten and primary school we know that the stimulation of development and learning should refer to children's previous knowledge and stimulate conceptual change. This can be supported on the one hand by using attractive materials in structured learning environments and on the other hand by the teachers' interaction with the children: sustained shared thinking understood as challenging, stimulating teacher-student interaction and communication can act as "cognitive scaffolds" that help the children grasping the domain-specific contents (Appleton, 2008). However, scaffolding is still found too seldom in kindergarten and primary school. Studying the general quality of the teacher-child interaction, one must conclude that scaffolding is used very rarely and that direct instruction is dominating teachers' interaction in both kindergarten (Siraj-Blatchford & Manni, 2008) and primary school classes (Reiser, 2004). It can be assumed that these deficits in scaffolding activities depend on the lack of preconditions necessary for scaffolding, e.g. teachers' professional knowledge and competencies as well as challenging play and learning environments. Focusing on science teaching, it is known that teachers do not possess enough knowledge to discern children's misconceptions and stimulate their learning as they hardly ever take into account results on research on conceptual change (Appleton, 2008). This may be one of the reasons why especially in science teaching materials that are conducive to learning are not used often enough and that stimulating interaction is used too seldom. In this study we wanted to find out to what extent and in what quality scaffolding processes can be observed when kindergarten and primary school teachers work with a challenging learning environment in their classrooms. Thus, we designed four sequential and problem-based units for science learning which were applied during four weeks. The learning environment aimed at building up precursors of a scientific understanding in the domain of "floating and sinking". For each week the learning environment included three phases: First, learning materials and tasks were introduced in the whole group; on the following days children worked on the tasks on their own or in small groups, supported by teachers. At the beginning of the following week, children's questions, findings, and insights were reflected on in the whole group before the next learning environment was introduced. Teachers received a one-hour introduction where they were instructed about supporting children's construction of knowledge by e.g. stimulating comparison processes, emphasizing material labels, activating prior knowledge and assisting conceptual restructuring through sustained shared thinking. The curriculum was introduced in 15 preschool and 15 primary school (1st and 2nd) classrooms with a total of 444 children (Mean class size 19 children). Children attended school in middle-class rural areas of Central Switzerland. The age of the preschool children was between 4.4 - 7.1 years (mean: 5.1 years); the age of the primary school children was 6.2 - 9.6 years (mean: 7.9 years).

Teachers were 90% female and had at preschool level 3-33 years of experience with a mean of 11.5 years. At primary school level teachers had 4-39 years of experience with a mean of 16 years. The teachers were educated in the former system with a different study structure for the two professions. As a baseline of each teacher, 15 minutes of the teacher's support of the children during the student work phase before the implementation was recorded. This was used to contrast the instructional actions on an individual basis. During the first implementation week 15 minutes of the teachers' support of the children were videotaped. Due to the standardized content the videotaped lesson units of the implementation showed a very high degree of comparability. Videotaped instruction during implementation was rated on the basis of a newly developed high-inference rating system by two raters. This design allowed us to use frequency and variance analysis on specific scaffolding techniques. The videotaped baseline of the teachers showed very little interaction time, teachers being mostly occupied with organizational and disciplinary tasks, and not interacting with the children.

The results of the rated videotaped lesson units of the implementation show that only 30% of the teachers explicitly elicit comparisons or cognitive conflicts, and this also only to a mean extent of less than 10% of the videotaped time. 75% of the teachers asked at some point or other for reasons. This interaction type was observed during a mean of 17% of the videotaped interaction time. 95% of the teachers instructed directly or asked simple knowledge questions to a great extent (a mean of 30% of the videotaped time). During a mean of 2% of the videotaped time 20% of the teachers did not interact with children at all. The results also revealed significant differences between kindergarten and primary school teachers: Primary school teachers spent more time on eliciting cognitive conflicts than the kindergarten teachers (11% vs. 3% of the videotaped time). These results based upon case analysis show that even though teachers show deficits in both eliciting children's scientific reasoning and in stimulating children's comparison processes, the quantity and quality of interaction seems to increase with the use of a well-structured and problem-based learning environment. On the basis of variance analysis we found that kindergarten and primary school

teachers differed in their competencies. This may be the result of a different educational system for both professions. These findings have to be taken into account for actual Swiss pre-service and in-service teacher education, where nowadays both professions are jointly instructed in one study structure.

Appleton, K. (2008). Elementary Science Teaching. In S. K. Abell, & N. G. Lederman (Eds.), *Handbook of Research on Science Education* (pp. 493-535). New York: Routledge.

Reiser, B. J. (2004). Scaffolding Complex Learning: The Mechanisms of Structuring and Problematising Student Work. *The Journal of The Learning Sciences*, 13(3), 273-304.

Siraj-Blatchford, I., & Manni, L. (2008). 'Would you like to tidy up now?' An analysis of adult questioning in the English Foundation Stage Early Years, 28 (1), 5 - 22.

Curious Minds: The role of scaffolding in scientific reasoning talents of young children

Henderien Steenbeek, Rijksuniversiteit Groningen, Netherlands; heidy Meindertsma, University of Groningen, Netherlands; steffie van der Steen, University of Groningen, Netherlands

Young children already show much insight into Science and Technology (STEM, Dijkgraaf, van Benthem & de Lange, 2007). We assume that these talents are 'distributed', emergent characteristics, which come forward in transactions between a talented child and a talent eliciting context, e.g. in interaction with an adult while performing a STEM task (Barab & Plucker, 2002; Dai, 2005). Secondly, we assume that on the basis on these here-and-now experiences, different forms of STEM talent trajectories of children emerge. Scaffolding plays an important role in these here-and-now experiences. Scaffolding can be understood as a microgenetic, intrinsic dynamic notion (Granott, Fischer & Parziale, 2002; van Geert & Steenbeek, 2005): A particular level of knowledge or skill in a student changes as a result of the scaffolding process and vice versa. In this presentation we explore the interplay between the complexity level of insight in the question of the adult and in the answers of the child (first study, van der Steen), and the interplay between level of 'openness' in the question of the adult to the initiatives of the child under different conditions (second study, Meindertsma). Our results indicate that both individual child's level of insight as well as level of insight used by the adult within tasks and over time are highly fluctuating. The level of openness seems to be related to the degree of standardization of the task. In the presentation we will examine the surplus value of using a dynamic process approach to understanding the dynamics of scaffolding.

This research project is part of a Dutch, nation wide program entitled 'Curious Minds', which aims at exploring aspects of scientific reasoning talents of young children in order to be able to stimulate these talents in an optimal manner. Young students of four to six year old already show a lot of insights into science and technology, i.e. they display STEM talents (Dijkgraaf, van Benthem & de Lange, 2007). We assume that these STEM talents are 'distributed', emergent characteristics, which come forward in transactions between a talented child and a talent eliciting context, e.g. in interaction with an adult while performing a STEM task (Barab & Plucker, 2002; Dai, 2005). Secondly, we assume that on the basis on these here-and-now experiences, different forms of STEM talent trajectories of children emerge. Scaffolding plays an important role in these here-and-now experiences; i.e. in these interactions between child and adult while exploring a STEM activity (as can be seen in the CuriousMinds-videoclips; www.TalentenKracht.nl). Scaffolding can be received of as an intrinsic dynamic notion (Granott, Fischer, & Parziale, 2002; van Geert & Steenbeek, 2005) in which a particular level of knowledge or skill in a student changes as a result of the scaffolding process. That is, scaffolding implies a coupling between two changing levels: the level of insights embodied in the student on the one hand, and the level of insights embodied in the level of scaffolding the adult uses, on the other hand. In this presentation, we aim to explore two aspects of this coupling of two changing levels of insight, i.e. of the scaffolding dynamics between child and adult, using a microgenetic perspective. The first study (van der Steen) aims at unravelling the interplay between the complexity level of insights incorporated in the question of the adult and the complexity level of insights of the child, both on the short-term time scale of one task and on the long-term time scale of several months. Our hypotheses is that – under the condition of optimal scaffolding – young children will very quickly display relatively high level of complexity of insights, comparable with the level of insight incorporated in the questions of the adult. The second study (Meindertsma) examines the level of 'openness' in the question of the adult to the initiatives of the child under different conditions of a scientific reasoning task. Four conditions were administered in which the adult had a different role: She used different forms of instruction and scaffolding, ranging from 'static instruction' towards 'free exploration'. We hypothesized that in the most open condition, the child would show the most exploration of the STEM-task. A group of 32 four to six year old children participated. They were working on a STEM-task together with an adult for fifteen minutes. The task was videotaped. Two series of STEM-tasks were used. The first series of tasks was about gravity, inertia and acceleration; the second series was about air pressure and Boyle's law. The Scientific Reasoning Scale (RuG/UU) based on hierarchical complexity scale (Fischer & Bidell, 1998; Fischer & Dawson, 2008) was used to code the level of complexity in the insights of the child, and in the insights incorporated in the questions of the adult. First results indicate that the

individual child's level of insight is highly fluctuating, as is the level of insights the adult uses, both within tasks and over time (van der Steen, Steenbeek, & van Geert, in preparation). In addition, the level of openness seems to be related to the degree of standardization of the task (Meindertsma, van Dijk & van Geert, 2010). In the presentation we will discuss these findings and examine the surplus value of using a dynamic process approach to understanding the dynamics of scaffolding.

SYMPOSIUM

Interventions for students with mathematical learning difficulties

Chairperson: Johannes E.H. Van Luit, Langeveld Institute, Netherlands

Organiser: Evelyn Kroesbergen, University of Utrecht, Netherlands

Ilona Friso-van den Bos, Utrecht University, Netherlands

Discussant: Annemie Desoete, Ghent University, Belgium

In this symposium, three different interventions are presented that focus on improving low-performers basic math skills. Remediating these skills is essential for children to perform adequately at school and in daily life. Two of the studies presented in this symposium focus on the age group in which children have to acquire these skills, and the third is meant for older children who have not adequately achieved basic math skills. Trainings were designed to improve children's basic math skills, such as number knowledge, counting, base-ten system and automatization of basic facts. In one study, the effects of a math intervention were also compared to an intervention that combined mathematics with a possible underlying factor of math difficulties: working memory. One study examined the effects of a computer-based intervention. The interventions in the three studies were given to different groups: a non-selected sample, at-risk children, and children with low math scores. All interventions were effective. Together, these results contribute to the discussion about the effectiveness of distinct interventions, the most beneficial timing of interventions with various areas of focus, and the child-variables that are associated with the effect of the intervention, such as IQ.

Training numerical skills and working memory in Kindergarten: An international perspective

Kaisa Kanerva, University of Helsinki, Finland; Minna Kyttälä, University of Turku, Finland; Maria Chiara Passolunghi, University of Trieste, Italy; Nadia Sollazzo, University of Trieste, Italy; Evelyn Kroesbergen, University of Utrecht, Netherlands

In this study, we aimed to investigate whether simultaneous training of working memory and mathematics is more effective in enhancing young children's early mathematical skills than training mathematics alone. Sixty-one Finnish five to six year-old children (Mean age = 70.4; SD=8.6 months) were assigned to three different groups, 1) mathematics intervention (G1; N=21), 2) mathematics and working memory intervention (G2; N=23) and 3) control group (Gc; N=17). The two experimental groups received training twice a week, for half an hour at the time, during a four-week span. Preliminary pretest-posttest comparisons revealed that the mathematics intervention group (G1) performed statistically significantly better on counting tasks after the intervention. No statistically significant effect between pretest and posttest was found under the mathematics and working memory intervention group (G2) or the control group (Gc). Our preliminary results show that domain-specific mathematics training was more effective than simultaneous training of mathematics and working memory in enhancing young children's counting skills. The results of our study will be compared with the results from Italy and the Netherlands which both took part in the same international intervention project.

Aims

Even before formal schooling, there are significant differences in children's early mathematical skills which predict mathematics development and later performance (e.g. Aunola, Leskinen, Lerkkanen, & Nurmi, 2004). Those early mathematical skills can be successfully enhanced by training (for a meta-analysis, see Kroesbergen & Van Luit, 2003). However, along with early mathematical skills, also working memory (WM) has been observed to be a potential precursor for mathematics learning. The term 'working memory' refers to humans' limited capacity information processing system capable of storing and manipulating information during a range of cognitive tasks (Baddeley, 1986). Research has established close links between WM deficits and mathematical difficulties (Andersson & Lyxell, 2007; McLean & Hitch, 1999). Working memory skills measured at preschool years or at early school years also tend to predict mathematics performance later on (Alloway et al., 2005; Passolunghi, et al., 2007). Previous studies show that training improves WM performance, at least among those individuals with low WM span (Turley-Ames & Whitfield, 2003). Functional MRI-studies have showed evidence of plasticity in neural systems underlying WM induced by WM training indicating a typical skill learning pattern. Some of the studies also show that rehearsing can produce transfer effects to other cognitive functions (e.g. fluid intelligence; Jaeggi et al., 2008), at least in situations when trained tasks and transfer tasks employ overlapping brain regions (Dahlin, et al., 2008).

Deriving from previous studies, it could be hypothesized that training both WM (the supporting system behind math performance) and mathematics could produce better results than training only math. Therefore, in this study, we aimed to investigate whether simultaneous training of working memory and mathematics is more effective in enhancing young children's early mathematical skills than training mathematics alone.

Methodology

The participants in the study were 61 (29 girls and 32 boys) Finnish children from 11 metropolitan kindergartens. At the time of the pretests, the children were about five years old (Mean age=70.4; SD=8.6 months) and about to start preschool in three months.

The participating children were divided into three different experimental groups: G1 (mathematics training), G2 (mathematics and WM training) and Gcontrols group (age-matched control group) based on their age, gender and kindergarten. The pretests were conducted in April 2010 during a two-week span. The intervention took place in May 2010 and lasted for four weeks. There were two intervention sessions per week, each lasting 30 minutes. The interventions were conducted in small groups (4-5 children). The posttests were administered in the beginning of June 2010 during a one-week span.

Pre- and posttests.

Children's early numeracy was measured by using the counting tasks of Early Numeracy Test (Van Luit, Van de Rijt, & Aunio, 2006). Different components of working memory were measured: visuo-spatial storage: Matrix task, visuo-spatial processing: Odd-One-Out, verbal storage: Word recall forward, Digit recall forward, verbal processing: Backwards word recall, digit recall backwards. Intelligence was measured with the subtests Vocabulary and Block design from the WIPPSI.

Interventions.

The domain-specific mathematics training focused mainly on basic number word sequence skills (0-20), enumeration skills and number line skills. In the mathematics-WM training, tasks included same type of numerical materials but with stronger WM demands.

Findings

Preliminary pretest-posttest comparisons revealed that the mathematics intervention group (G1) performed statistically significantly better on counting tasks after the intervention. No statistically significant effect between pretest and posttest was found for the mathematics and working memory intervention group (G2) or the control group (Gc). A repeated measures ANOVA, revealed a significant interaction effect on group by type of training ($F[2,61]=3.51$, $p=.11$). However, in pairwise comparisons, post-hoc tests (Scheffé) could not detect significant differences between the groups ($p > .05$), although the difference between G1 (mathematics only) and Gcontrols was close to the level of statistical significance ($p=.06$). The three groups did not differ on age, intelligence or early numeracy performance before the intervention. We will continue with more detailed analyses and the final results will be presented in the EARLI 2011. The results of our study will be compared with the results from Italy and the Netherlands which both took part in the same international intervention project. The preliminary results from Italy show a statistically significant interaction effect on group by type of training (mathematics, no training; $F[1,53]=10.40$, $p=.17$). The results from the Netherlands show a slightly more positive effect for the combined group than the Finnish data.

Theoretical and educational significance

Our preliminary results suggest that domain-specific mathematics training might be more effective than simultaneous training of mathematics and working memory in enhancing young children's counting skills. The final results from Finland and from other two participating countries will increase knowledge about the possibilities to train WM, and about the possible transfer effects to other skills (theoretical significance). The results will also increase knowledge about the effects of early mathematics training in different cultural and lingual contexts (theoretical significance). Finally, the results can produce information to be used in early childhood education when planning group interventions (educational significance).

Fostering children with learning disabilities in mathematics in secondary school

Elisabeth Moser Opitz, Institut of Educational Research, Switzerland; Okka Freeseemann, Technical University Dortmund, Germany; Ina Matull, Technical University Dortmund, Germany; Susanne Prediger, Technische Universität Dortmund, Germany; Stephan Hußmann, Technische Universität Dortmund, Germany

Research has shown that pupils with learning disabilities in higher grades have not or have only partially acquired specific concepts of primary school mathematics, the so called "basic subject matter" (counting, place value, problem solving etc.). These knowledge deficits prevent students from learning successfully and might negatively affect their chances of achievement. Based on these findings, a longitudinal study in grade 5 (sponsored by "Bundesministerium für Bildung und Forschung") evaluated (a) if the backlog can be cleared, (b) if special needs instruction improves achievement in mathematics, and (c) if the type of instruction influences or affects the progress. The study was conducted with a sample of 125 pupils in Nordrhein-Westfalen (Germany) in two intervention groups (A: instruction in small groups; B: classroom instruction) and one control group (groups matched by math achievement, IQ, age, gender). During 14 weeks, pupils were taught basic concepts like counting, place value and basic operations. Post-tests were carried out at the end of this period and three months later. An ANOVA with post-hoc test (Scheffé) showed a significant effect for the classroom instruction group for post-test 2, and a MANOVA with IQ as a covariate revealed a significant interaction effect for intervention and IQ.

Aims

Research has shown that pupils with learning disabilities in higher grades have not or have only partially acquired specific concepts of primary school mathematics, the so called "basic subject matter" (e.g., Humbach, 2008; Moser Opitz, 2007). These pupils often memorize the mathematical procedures like a recipe and have difficulties in problem solving (e.g., Andersson, 2008). They have problems with retrieving results (e.g., Geary, 2004; Mabbott & Bisanz, 2008), use finger counting strategies, and have difficulties in understanding the concept of place value (Humbach, 2008; Moser Opitz, 2007). Although these issues are widely known, successful intervention programs are lacking. Maccini, Mulcahy, and Wilson (2007) concluded that many studies failed to find practical significance because of inadequate intervention. However, some research revealed important clues for intervention programs (e.g. Kroesbergen & van Luit, 2002; Woodward and Brown, 2006).

The purpose of our study was to develop and to evaluate an intervention program, which improves the knowledge of "basic subject matters" in two different conditions: Instruction in a small group and guided instruction in the classroom.

Hypotheses

H1: Pupils in grade 5 with below average performance in mathematics who participate in an intervention program covering basic subject matter, improve their mathematical competence more than pupils who do not attend the program.

H2: Pupils in grade 5 with below average performance in mathematics who participate in an intervention program in small groups, improve their mathematical competence more than pupils attending a program with classroom instruction.

Methodology

The participants were 5th graders with mathematical competence below average (measured with an own, standardized test). The math pre-test and an IQ-test (CFT-20R) were carried out with a sample of 607 pupils from 9 schools (most pupils in lowest level of secondary school) in Nordrhein-Westfalen (Germany). Based on these results, 143 pupils from 34 classes were selected. Groups of 3-5 pupils from the same class were randomly assigned to two types of intervention and the control group. These groups were matched by math achievement ($F [2,140] = .872, p > .05$); IQ ($F [2,140] = .262, p > .05$), age ($F [2,140] = .972, p > .05$), and gender. Note that the mean IQ of the total sample was rather low ($M = 82, SD = 10.5$).

Math performance was measured with a pre-test at the beginning of grade 5 (t_1), after the intervention (t_2 ; 6 months after the pre-test) and with a follow-up (t_3) three months later. The intervention focused on the base ten system (base ten grouping, place value, number line notation), on developing meaning for the operations, on verbal counting (counting by steps of 2, 10, 100, 1000), and on automation of basic facts (e.g., completion of 100). The material was identical for both intervention groups.

Instruction in small groups (A): During 14 weeks, 12 groups of 3-5 pupils attended the program of 90 min/week carried out by a higher-grade special education student. The instruction included the components (1) warm-up (e.g., automation of basic facts), (2) discussion of the week activity, (3) guided practice on new concepts and problem solving, (4) introduction of the week activity (work sheet).

Guided instruction in classroom (B): This intervention provided material for individual work in classroom (two difficulty levels). 12 groups of 3-5 pupils with learning disabilities in mathematics weekly attended an introduction of 45 minutes. This introduction, carried out by a higher-grade special education student, involved the components (1) "diagnostic check" (assessment), (2) selection of an appropriate math problem for each pupil, (3) pupils' individual

work, and (4) final assessment. Additionally, these pupils worked individually on their program in the classroom 90 minutes per week, assisted by the teacher.

The control group followed the ordinary curriculum.

Findings

Because of some dropouts, the post-test was conducted with 132 pupils, the follow-up with 125 pupils. For the post-test (t2) a 2x3 ANOVA showed a significant effect for time ($F [1, 129] = 218.9, p < .001, \eta^2 = .63$), but no significance for the interaction between time and the type of intervention ($F [2, 129] = 0.94, p > .05, \eta^2 = .01$). A 3x3 ANOVA for the follow-up (t3) showed a significant effect for time ($F [2, 121] = 159.8, p < .001, \eta^2 = .73$) and a non-significant interaction effect for time and type of intervention ($F [4, 242] = .90, p > .05; \eta^2 = .02$). However, post-hoc test (Scheffé) showed a significant effect for the classroom intervention group ($p < .05$). With IQ as a covariate (3x3 MANOVA), a significant interaction effect for time and IQ could be found ($F [2, 120] = 5.22, p < .05, \eta^2 = .08$). Hence, the cognitive ability impacts the increase of math performance. For the interaction between the type of intervention and IQ, we only found a tendency for Roy's largest root ($F [2, 121] = 2.7, p = 0.07, \eta^2 = .04$). Contrast analyses revealed that the classroom instruction group outperformed the control group ($p < .05$).

Theoretical and educational significance

Even if we did not find effects directly after the training, H2 (advantage for the training in small groups) had to be rejected, and the effects for the follow-up reached the significance level with restrictions, some interesting results are available. Firstly, the intervention seems to have a long-term impact on math performance: The difference in math performance between the intervention groups and the control group increased from t2 to t3. Secondly, as the groups were small, it seems reasonable to assume that a larger sample could have shown significant effects. Intelligence seems to be an important factor in terms of progress for children with rather low cognitive abilities. Moreover, the intervention period was very short according to the problems of the pupils. Although more research is needed, this study gives promising results for the remediation of math learning problems.

The effects of the Graphogame Math computer game on early numeracy skills of kindergarten children

Jonna Salminen, Niilo Mäki Institute, Finland; Tuire Koponen, Niilo Mäki Instituutti, Finland; Pirjo Aunio, University of Helsinki, Finland; Pekka Rasanen, Niilo Mäki Institute, Finland

We studied how a short and intensive intervention of playing an educational computer game (Graphogame Math) would support kindergarteners' early numeracy skills (counting skills, enumeration, number knowledge and basic arithmetic). A treatment group of 6 year old children with weak early numeracy skills was assigned to play daily Graphogame Math (GGM) ($n=8$, mean age 79 months) for three weeks. The GGM group was compared to a performance level control group ($n=7$, mean age 78.7 months) matched by the initial level of cognitive (Corsi Blocks, non-word repetition and rapid serial naming of colors) and early numeracy skills and also to a reference group ($n=8$, mean age 78.9 months) matched by age and kindergarten. The control group was assigned to play same amount another mathematical computer game (Number Race). The reference group did not get any extra training. The results of within-group indicated statistically significant gains for counting skills and enumeration for the GGM group and for basic arithmetic skills for the NR group. The reference group gained significantly in counting skills.

Aims

Longitudinal studies have demonstrated that there is a notable difference in the early numeracy skills between children with low and average math performance already in kindergarten and the difference typically increases at school age (Aunola et al. 2004; Desoete and Grégoire 2006; Jordan et al. 2006; McClelland et al. 2006). In the present study a computer assisted intervention (later CAI) method (Graphogame Math) was targeted for kindergarteners (6 year old) to find out the possibilities of CAI to give special support for young children.

The main purpose of this study was to find out to what extent the short and intensive intervention (three weeks daily) of playing Graphogame Math (GGM) computer game supports kindergarteners' early numeracy skills. We measured counting skills, enumeration, number knowledge and basic arithmetic skills separately which enabled us to analyze the effects of intervention in more detail. This study included two control groups. One group was matched with the initial level of cognitive and early numeracy skills and they played the Number Race computer game (NR). The other reference group was typically performing kindergarteners with no extra training.

Methodology

Participants. The original group sizes were thirty children in the low performing and thirty children in the reference group. Because the aim of this study was to exam whether the playing GGM would increase especially weak numeracy skills we selected for the analysis only those children who performed 1.5 SD below the mean in the counting task.

There were eight (6 boys, 2 girls) in the GGM group (mean age = 79.0 months, SD = 3.2) and seven (4 boys, 3 girls) in the NR group (mean age = 78.7 months, SD = 4.3). The reference group consisted of eight average performing children (2 boys, 6 girls; mean age = 78.9 months, SD = 2.9) who followed the kindergarten program during the intervention.

Data collection. The present study consisted of two pre tests and one post test. The first pre test consisted of three cognitive and four numerical tasks which were presented in the following order: Corsi Blocks, Non-Word Repetition, Enumeration (computerized test), Number Knowledge (computerized test), Counting Skills, Basic Arithmetic and Rapid Serial Naming of colors. The second pre test and the post test consisted of four numerical tasks and one cognitive task which were also presented in the same order: Enumeration (computerized test), Number Knowledge (computerized test), Counting Skills, Basic Arithmetic and Rapid Serial Naming of colors. Children were assessed individually. The mean of the two pre tests was used in comparisons. The content of the intervention programs were matching exact magnitudes, number symbols and arithmetical combinations in GGM (Mäkkänen et al., 2010) and activating the approximate comparison process to enhance quantity representation (Wilson et al. 2006a; Wilson et al. 2006b).

Procedure. After two pre tests the experiment groups were randomly divided into two sub groups. Both groups were desired to play individually 12-15 times for three weeks, 4-5 times per week. All sessions were recommended to last 10 to 15 minutes. Teachers were asked to report the number of intervention sessions and playing time. There were no statistically significant differences between two playing groups in the number of intervention sessions (mean of the GGM group 10.75 and the NR group 11.29) nor in playing time (mean of the GGM group 187 minutes and the NR group 232 minutes).

Findings

In the preliminary analysis the performance of the GGM group in cognitive and numerical skills in base line measurement was compared to the performance level control group (the NR group) and to normally performing reference group (the Reference group) with analyses of the Mann-Whitney U-test. The second set of analyses focused on the within-group differences, also with non-parametric tests. There was a significant difference between the GGM and the Reference group in the Corsi Blocks, Mann-Whitney U = 10.5, $p = .01$. There was also a statistically significant difference in the Counting Skills between the GGM and the Reference group U = .00, $p = .055$. In Basic Arithmetic the effect of intervention was significant in the NR group, $Z = -2.333$, p

Theoretical and Educational Significance

Our results are parallel to earlier studies: short and intensive CAIs with specific mathematical contents have found to be effective (Kroesbergen & Van Luit 2003; Kulik & Kulik 1991). Even a short training lasting less than daily 15 minutes for few weeks seems to produce significant effects (Elliot & Hall 1997; Howard et al. 1994; McCollister et al. 1986). This kind of short and intensive CAI will be important to introduce in preschools and kindergartens as well as at homes to support young children's early numeracy skills. Despite of our positive results more evidence for the effectiveness of CAI (e.g., Clements 1986; Din & Calao 2001; McCollister et al. 1986) is needed. Especially the longtime effects (Fuchs et al. 2006) are important to examine.

SYMPOSIUM

Identifying key learning activities in strategy instruction in various ill defined domains. Part III

Chairperson: Raquel Fidalgo, University of Leon, Spain, Spain

Organiser: Gert Rijlaarsdam, University of Amsterdam, Netherlands

Discussant: P. Karen Murphy, The Pennsylvania State University, United States

The symposium aims at the identification of effective instructional strategies in various domains of learning, in ill structured tasks. General idea is to bring together and to analyze intervention studies that focus on strategy development. The symposium will address the question 'What works in strategy instruction and why?' with variations in content (the strategy learned), the learning activity and the content domain.

Therefore, we selected studies that were set up as componential analysis of instructional components (e.g. Fidalgo et al. in this symposium), studies that analyzed data from complex interventions with multi-components to isolate the contributions of each component to the total effect (for instance Glaser et al. in this symposium), and experiments that aimed at studying the effect of a single learning activity (Groenendijk et al., focusing on observation as learning activity). In three sessions, the symposium will deal with various domains (visual arts: divergent thinking; history: historical thinking and language arts: writing and reading literary texts). The domains have in common that they aim at thinking skills, and are seen as ill-structured.

Predicting and questioning story content; Two effective learning activities in the domain of literat

Tanja Janssen, Universiteit van Amsterdam, Netherlands

This contribution focuses on two learning activities, designed to enhance students' reading engagement and story appreciation; 'predicting' and 'self-questioning'. The effectiveness of these approaches was examined in two studies, involving Dutch 10th grade students. Study 1 focused on the effects of predicting story content on students' reading process and story appreciation. 53 Students participated, each reading two short stories under think aloud conditions. The experimental group was asked to predict story content by writing a story guess before reading, the control group did not write. Think aloud responses were analyzed for reading activities used. Story appreciation was measured by having students rate both stories on a ten-point scale. Results showed that experimental students were more emotionally engaged during reading and more appreciative of the stories than the control students. In Study 2 the effects of instruction in self-questioning was examined on students' reading process and appreciation of stories. 67 Students participated, randomly assigned to one of two conditions: an experimental condition, in which students were taught to ask questions in response to short stories, and a control condition, in which students responded to instructor-made questions. Both conditions included five sessions. Pre- and posttests included a think aloud task, a written response to a story, and rating a story on a ten-point scale. Results indicated that the experimental students generated more questions during reading at posttest than the control group, after controlling for pretest scores. In addition, experimental students were significantly more appreciative of stories at posttest than the control students.

One of the major challenges of teachers of literature is how to motivate adolescents to read and interpret literary texts. In the upper grades of Dutch secondary education students' reading motivation appears to diminish (Van Schooten, 2005). Solutions are sought in broadening the range of texts to be discussed in the literature classroom, in incorporating multiple forms of media (video, song lyrics), and/or in matching reading material to the literary competence level of each student (Witte, 2008). In addition, instructional strategies can be implemented that may help students' to become more engaged and appreciative readers of literature. In this contribution two such strategies are discussed: predicting and self-questioning. The first strategy refers to making predictions about what might occur in a story to be read subsequently. By making predictions students are induced to activate prior knowledge and to make connections between their prior knowledge and the text at hand. Students may become curious about a story, wanting to compare their own predictions to the author's solutions. In previous studies beneficial effects have been found of generating predictions on students' story comprehension and recall. Denner, Rickards and Albenese (2003), for instance, gave students key phrases of a narrative, prior to reading. Students were asked to compose a 'story guess' on the basis of those key phrases, and then to read the actual narrative. We applied this method to short literary stories. Instead of key phrases, we provided students with story beginnings. Students were asked to write their own stories, based on these beginnings, prior to reading the authors' stories. The second strategy refers to generating questions during reading. Previous research indicated that self-questioning is an effective reading strategy, improving students' text comprehension and recall (Janssen, 2002; Rosenshine et al., 1996). However, self-questioning is not just an individual reading strategy. It can also be part of dialogical learning, in which authentic, reader-based questions and discussion between peers are valued (Applebee et al., 2003). Therefore, a discussion-based approach was developed, comprising five steps:

- 1) ask yourself questions during reading a story,
- 2) choose a key question for discussion,
- 3) discuss your key question with peers,
- 4) formulate tentative answers to your key question (story interpretations), and
- 5) underpin your interpretations by referring to the story at hand.

The effects of these strategies on students' engagement with short literary stories were examined in two studies, involving 10th grade students from several Dutch secondary schools. The students were enrolled in higher general and pre-university education. Study 1 examined the effects of predicting story content on students' reading process and story appreciation. 53 Students participated, each reading two short stories under think aloud conditions. The stories were written by recognized authors of modern fiction: Jeanette Winterson and Primo Levi. The experimental group (N = 18) wrote a story guess prior to reading, the control group (N = 35) did not write. Students' think aloud responses were transcribed and analyzed for the reading activities students used (Andringa, 1995; Pressley & Afflerbach, 1995). Story appreciation was measured by having students rate both stories on a ten-point scale (strong dislike – strong liking of the story). Results showed that students who predicted story content by writing a story guess, produced significantly more emotional responses (laughs, sighs, exclamations) during reading the actual story than control students. Moreover, the experimental group was more appreciative of the stories after reading than the control group. In Study 2 the effects of instruction in self-questioning on students' reading process and story appreciation were examined. 67 Students participated, randomly assigned to one of two conditions. In the experimental condition students (N= 35) were taught to generate questions in response to short stories, following the five steps approach. In the control condition students (N = 32) did not generate questions themselves, but responded to given questions. Both conditions included five sessions, held after schooltime at the university. Pre- and posttests included a think aloud task, writing a review about a story, and rating that story on a ten-point scale. Students' written reviews were

rated by three independent raters using a three-point scale (weak, fair, good interpretation). Results indicated that the experimental students generated more questions during reading and thinking aloud at posttest than the control group, after controlling for pretest scores. Also, experimental students were significantly more appreciative of stories at posttest than the control students. No difference was found in quality of interpretation between conditions.

All in all, both instructional approaches positively influenced students' reading engagement. However, the utility of predicting story content by writing a story guess is limited, since students are not taught a reading strategy that they can use independently (Denner et al., 2003). Self-questioning on the other hand can be used independently by students, as indicated by the analysis of students' think aloud protocols.

Andringa, E. (1995). Strategieën bij het lezen van literatuur [Literary reading strategies]. *Spiegel*, 13(3), 7-33.

Applebee, A.N., Langer, J., Nystrand, M. en Gamoran, A. (2003). Discussion-based approaches to developing understanding: Classroom instruction and student performance in middle and high school English. In *American Educational Research Journal*, 40(3), 685-730.

Denner, P.R., Rickards, J.P., & Albanese, A.J. (2003). The effect of story impressions preview on learning from narrative text. *The Journal of Experimental Education*, 71(4), 313-332.

Janssen, T. (2002). Instruction in self-questioning as a literary reading strategy: An exploration of empirical research. *L1-Educational Studies in Language and Literature*, 2(2), 95-120.

Pressley, M., & Afflerbach, P.P. (1995). *Verbal protocols of reading: The nature of constructively responsive reading*. Hillsdale, New Jersey: Lawrence Erlbaum.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of intervention studies. In *Review of Educational Research*, 66(2), 181-221.

Van Schooten, E. (2005). *Literary response and attitude toward reading fiction*. Thesis Groningen University. Witte, T. (2008). *Het oog van de meester; Een onderzoek naar de literaire ontwikkeling van havo- en vwo-leerlingen in de tweede fase van het voortgezet onderwijs*. [In the eye of the master; A study of students' literary development in the upper grades of secondary education.] Thesis Groningen University.

Effects of Meta-cognitive Instruction on Divergent Thinking in the Domain of the Visual Arts

Marie-Therese van de Kamp, UvA, Netherlands; Wilfried Admiraal, University of Amsterdam, Netherlands

Divergent thinking is considered to have positive effects on creativity, the quality of creative processes and products. Contemporary art education mainly focuses on learning art-techniques based on the assumption that divergent thinking skills are acquired by producing art works. However, in a previous study with 199 students, many students proved to have difficulties in using divergent thinking skills in the orientation phase of creative, visual-art processes. In a subsequent study, effects of a meta-cognitive instruction are studied on students' declarative and procedural knowledge on divergent thinking in the domain of the visual arts in secondary education in the Netherlands. This intervention is evaluated using a pretest posttest control group design with switching replications (N= 149).

The intervention consists of an instruction on declarative knowledge – students learn about the nature and the relevance of divergent thinking as a learning strategy in creative, visual processes – and procedural knowledge – through a specific training in divergent thinking in the visual arts. Preliminary results of the effect study show that the meta-cognitive intervention has a positive effect on both declarative and procedural knowledge as well as on the level of students' reflection and the quality of their art processes and products. Furthermore, students' divergent thinking is stimulated showing higher fluency, originality, flexibility and elaboration – all indicators of divergent thinking.

Objectives and theoretical framework Divergent thinking skills are crucial in the orientation phase of creative processes showing positive effects on the quality of creative, visual products (cf., Getzels & Csikszentmihalyi, 1976; Ma, 2009). Indicators of divergent thinking are fluency, originality, flexibility and elaboration, including general as well as domain-specific skills (Runco, 1991; Baer, 1993; Chand, I., Runco, M.A., 1993). In a previous study with 199 students in secondary education, 75 percent of the students showed a lack of either declarative or procedural knowledge in divergent thinking in creative, visual processes. Furthermore, many students did not show divergent thinking skills. Therefore, we designed and tested a meta-cognitive instruction, in which students acquire basic knowledge about divergent thinking (declarative and procedural knowledge) and in which students train skills in divergent thinking. The intervention consists of four stages:

(1) Teacher's direct instruction on the nature of creative processes and of divergent thinking (declarative knowledge). They learn about (a) the different nature of divergent thinking compared with other thinking strategies like convergent thinking and problem-solving strategies, and (b) the relevance of divergent thinking skills in the orientation phase of creative, visual processes (conditional knowledge).

(2) Guided practice in divergent thinking skills: a training with various tasks in which students experience visually the nature of divergent thinking, through a metaphorical comparison for divergent thinking – an analogy of focus versus

divergence in visual perception. Students practice with two unusual uses tests (verbal and figural through photography), in which they are asked to think of as many as possible, different kinds of original uses for several items. They learn about the indicators of fluency, flexibility and originality and elaboration and to use specific techniques (synthesis) within the domain of visual art.

(3). Guided practice with (peer- and teacher) feedback to apply divergent thinking to go beyond clichés and produce their own original solutions.

(4) Application in students' own visual art processes. Students first experiment with as many different, common shiny materials they can think of (using divergent thinking strategies) to find their own design-research question (problem finding).

Method

The intervention is tested in a pre-test post-test control group design with switching replications (Shadish, Cook, & Campbell, 2002) on students' knowledge and skills in divergent thinking, their reflection and the quality of their art products. Five groups of students (N=149), aged 16/17, from cultural and arts education participate. Three groups first receive the intervention. Two groups receive it at a later date and initially serve as no-treatment control group. Divergent thinking is indicated by fluency, originality, flexibility and originality. Synthesis is added as a specific variable of divergent thinking skills for the visual domain. Divergent thinking skills are measured by a verbal test (with use of the Creative Task Creator, Pretz & Link, 2009) and a figural test, using photography, supplemented with a score on originality (Silvia et al., 2008; Torrance, 1979). Creative visual products are judged by two rates. A criterion-based rating procedure for both the visual arts process and product is adapted from procedures of Dutch final exams in visual arts, additionally informed by other research (Eça: 2004; Lindstrom: 1999; Pretz & Link : 2008; Seidel et al. : 2009; Silvia et al.: 2009). To measure reflection, participants write a reflection on their process using pre-structured form. Multivariate covariance analyses are used to establish the effects on knowledge and skills in divergent thinking, reflection and quality of visual arts products; participants' ability, school motivation and background variables (age, gender) are included as learner variables.

Preliminary results and conclusions

Preliminary results of the effect study show that the meta-cognitive intervention has a positive effect on both declarative and procedural knowledge as well as on the level of students' reflection and the quality of their art processes and products. Furthermore, students' divergent thinking is stimulated showing higher fluency, originality, flexibility and elaboration – all indicators of divergent thinking.

Baer, J. (1993) Creativity and Divergent Thinking. A Task-Specific Approach. Lawrence Erlbaum Associates, Publishers. Hillsdale, New Jersey.

Chand, I., Runco, M.A. (1993). Problem Finding skills as components in the creative process. In: Person.Indiv.Diff. Vol. 14., No 1, pp. 155 - 162

Eça, T. P. (2004). Developing portfolios for learning and assessment. Education on-line. <http://www.leeds.ac.uk/educol/documents/00003890.htm>

Getzels, J. W., & Csikszentmihalyi, M. (1976). The creative vision. A longitudinal study of problem finding in Art. New York: John Wiley & Sons Inc.

Lindström, L. (1999). Criteria for assessing student performances in the Visual Arts. In L. Piironen (Ed.) Portfolio assessment in secondary Art education and final examination (pp. 43-63). Helsinki: University of Art and Design Helsinki, Department of Art Education.

Ma, H.-H. (2009). The effect size of variables associated with creativity: A meta analysis. Creativity Research Journal, 21(1), 30-42.

Pretz, E. J., Link, J. A. (2008). The Creative Task Creator: A tool for the generation of customized, Web-based creativity tasks. Behavior Research Methods, 40(4), 1129-1133.

Runco, M. A. (1991). Divergent thinking. Norwood, NJ: Ablex Publishing

Seidel, S., Tishman, S., Winner, E., Hetland, L., & Palmer, P. (2009) The qualities of quality. understanding excellence in Arts education. Cambridge, MA: Harvard Project Zero.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental and quasi experimental designs for generalized causal inference. Boston: Houghton Mifflin Company.

Silvia, P. J., Winterstein, B. P., Willse J. T., Barona, C. M., Cram, J. T., Hess, K. I., Martinez, J. L., & Richard, C. A. (2008). Assessing creativity with divergent thinking tasks: Exploring the reliability and validity of new subjective scoring methods. Psychology of Aesthetics, Creativity, and the Arts, 2(2), 68- 85.

Silvia, P. J., Martin, C., & Nusbaum, E. C. (2009). A snapshot of creativity: Evaluating a quick and simple method for assessing divergent thinking. Thinking Skills and Creativity, 4, 29-85.

Torrance, P. E. (1979). The search for Satori and Creativity. Amherst, MA: Creative Education Foundation.

Creating concept maps to trigger historical consciousness in secondary education

An important goal of Dutch history education in primary and secondary education is the development of students' historical consciousness, including historical overview knowledge and historical reasoning skills. Creating concept maps – graphical tools for organizing and representing knowledge – might be an effective tool to trigger historical consciousnesses. In this study we examine the effects of the use of concept maps on historical overview knowledge and reasoning skills in lower secondary education in the Netherlands. A pre-test post-test control group design with some 200 students is used to determine the effects of the use of concept maps on historical consciousness. The process of creating concept maps is taped on video and analyzed qualitatively. Multivariate covariance analysis is used to determine the effects of the use of concept maps on historical knowledge and reasoning, measured by a digital test with a random selection of 50 out of a corpus of 150 multiple choice questions. Prior to the effect study, various concept maps – ranging from pre-structured to ill-structured- have been piloted and evaluated on usability and learning possibilities. Results show that all types of concept maps tested triggered positive effects on pupils' motivation and perceived learning outcomes, albeit the ill-structured concept maps resulting in the least engagement and motivation. Preliminary results of the effect study indicate an effect of the use of concept maps on both knowledge and skills.

An important goal of Dutch History education in primary and secondary education is the development of historical consciousness including a chronological frame of reference (historical overview knowledge) as well as historical thinking skills (Commission historical and social formation, 2001). The overview knowledge includes a frame of reference with ten chronological periods with associate labels characterized by a set of 49 key aspects and some 100 key concepts. With respect to historical thinking, Van Drie and Van Boxtel (2008) used the term historical reasoning for all activities in which a person organizes information about the past in order to describe, compare, and/or explain historical phenomena. In doing this, he or she asks historical question, contextualizes, makes use of substantive and meta-concepts of history, and supports proposed claim with arguments bases on evidence from sources that give information about the past. So, historical reasoning is used for all activities in which a person organizes information about the past in order to describe, compare, and/or explain historical phenomena. In the development of historical consciousness, the use of concepts is very important. Comprehension of these concepts can be promoted by relating specific phenomena to abstract concepts, or by connecting concepts of a lower level of abstraction with concepts of a higher level of abstraction (Wilschut, Van Straaten, & Van Riessen, 2004). Concepts might not only play an important role in historical knowledge; constructing a conceptual framework is an essential historical skill as well. For example, a student who uses the concepts of Enlightenment and French Revolution might conceptualize this linkage as a cause. So, the use of concept maps might be an effective tool to trigger both historical knowledge and reasoning skills. Novak and Cañas (2008,p1) describe concept maps as graphical tools for organizing and representing knowledge including concept,- usually enclosed in circles or boxes of some type- and relationships between concepts -indicated by a connecting line linking two concepts/. Various studies have shown effects of the use of concept maps on achievement (Kou-en, You-Ting, & Ine-Dai, 2002, Oliver, 2009, and for an over view Cañas, et al., 2003). But most of these studies are about Science education; in the current study we focus on History. By using concept maps in History education students visually connect concepts of different levels of abstraction, synthesize a certain chronological era, and reflect on what is important to be included. We have formulated two research questions:

1. Does the use of concept maps increase students' historical overview knowledge, and
2. Does the use of concept maps improve students' historical reasoning skills?

Method

The research has been carried out in two stages. The first stage includes an evaluation study on three types of concept maps – (1) 'fill in the gaps' (pre-structured assignment), (2) 'create a map with pre-selected concepts' (moderate-structured assignment) and (3) 'create a map from scratch' (ill-structured assignment)- with 114 students from lower secondary education. Data has been gathered by a questionnaire on usability, motivation and perceived learning outcomes, by observation of the process to measure the usability and student engagement, and by the resulting concept maps to analyze differences in quality. In the second stage, we redesigned the use of concept maps based on these results and feedback of teachers. The intervention consists of a total of seven concept maps assignments: the first two assignments are pre-structured and the last five are moderate-structured. We did not include The ill-structured assignment as it showed to be too difficult.

In a pre-test post-test control group design we test the effects of concept map creation on historical overview knowledge and reasoning skills. The participants are about 200 students, aged 13-15 from eight groups and two similar secondary schools. Four groups acquire historical knowledge and reasoning skills by creating concept maps. The other four groups use materials provided in the regular Dutch History curriculum. The intervention takes three months. All students participate in a digital pre- and posttest, which is part of the regular curriculum. This test includes

a random selection of 50 out of a set of a corpus of 150 multiple choice questions referring to both historical overview knowledge and historical reasoning. (reliability 0.80 (KR-20)). Multivariate covariance analysis is used to determine the effects of the creation of concept maps. The process of creating concept maps is taped on video and analyzed qualitatively to understand the process and interpret the results of quantitative analyses. Results of stage 1 show that all types of concept maps tested triggered positive effects on pupils' motivation and perceived learning outcomes, albeit the ill-structured concept maps resulting in the least motivation and engagement. Preliminary results of the effect study indicate an effect of the use of concept maps on both knowledge and skills. Low ability students gain more than high ability students (interaction effect).

Caóas, A. J., Coffey, J. W., Carnot, M. J., Feltovich, P. J., Feltovich, J., Hoffman, R. R., & Novak, J. D. (2003). A summary of literature pertaining to the use of concept mapping techniques and technologies for education and performance support. Retrieved on 21 January 2010, from <http://www.ihmc.us/users/acanas/Publications/ConceptmapLitReview/IHMC%20Literature%20Review%20on%20Concept%20Mapping.pdf>.
Commission historical and social formation. (2001). Advies Commissie historische en maatschappelijke vorming. Enschede, the Netherlands: SLO.
Drie, J.P. van & Boxel, C.A.M. van (2008). Historical reasoning: towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review*, 20(2), 87-110.
Kou-en, C., You-Ting, S., & Ine-Dai, C. (2002). The effect of conceptmapping to enhance text comprehension and summarization, *Journal of Experimental Education*, 7(1), 5-23.
Novak, J. D., Canas A. j. (2008). The theory underlying conceptmaps and how to construct them. Retrieved on 10 February 2010, from <http://cmap.coginst.uwf.edu/info/printer.html>.
Oliver, K. (2009). An investigation of conceptmapping to improve the reading comprehension of science texts. *Journal of Science Education and Technology*, 18, 402-414.
Riessen, M. van., Logtenberg, B., & Meijden, B, van. (2009). Oriëntatiekennis toetsen, analyse en handreiking. Enschede, the Netherlands: IVGD.
Wilschut, A., Straaten, D. van, Riessen, M. van. (2004). *Geschiedenisdidactiek, handboek voor de vakdocent*. Bussum, the Netherlands: Coutinho.

SYMPOSIUM

Predictors of Students' Academic Emotions

Chairperson: Gerda Hagenauer, University of Salzburg, Austria

Organiser: Gerda Hagenauer, University of Salzburg, Austria

Discussant: Tina Hascher, University of Salzburg, Austria

Recent research has documented the important role of emotions for students' learning in school (e.g., Schutz & Pekrun, 2007; Hascher, 2010). As a common and important result it was outlined that positive emotions foster the learning process while negative emotions can impede successful learning in school. Thus, there is a need for scholastic instruction to support the development of positive emotions and to prevent maladaptive negative emotions in school. Research, however, also has shown that negative emotions increase and positive emotions decrease after the early elementary school years. As a consequence, research is needed which identifies precursors and predictors of emotions in school.

The symposium, hence, focuses on the origins of students' emotions and their role of emotional development in school. Four research groups present research findings on antecedents of students' emotions. The presentations highlight social (e.g., peers and teachers) as well as cognitive (e.g, achievement and attitudes towards school) aspects; they analyze the general school situation as well as specific learning contexts (e.g, portfolio instruction); they investigate the development of state (e.g., enjoyment, anxiety) as well as trait emotions (e.g., well-being); they include data from qualitative (e.g., interview) as well as quantitative (questionnaire) research; they capitalize on the strengths of cross-sectional as well as longitudinal research designs. The common aim of all presentations is to identify relevant scholastic factors which have to be considered in order to provide supportive learning environments and student-orientated instructional designs in school.

Students' emotions in portfolio based instruction

Michaela Glaeser-Zikuda, University of Jena, Germany; Julia Noack, University of Jena, Germany

In research on learning and instruction it is meanwhile considered that emotional dispositions and emotional experiences in specific learning situations are relevant conditions for learning, information processing, cognition, motivation, and social interaction. As school and instruction are often related to students' negative emotional experiences it is an important aim for research and school development to create learning environments more emotionally-oriented. An intervention study based on the portfolio approach aiming at a positive influence of learners'

emotion, motivation, problem-solving and social competencies, as well as achievement is presented. Main characteristics of the portfolio based learning environment are competence-oriented learning demands, multiple opportunities of self-regulation and self-determination, a high quality of interactions between learners and teachers, and cooperation, and continuous self-reflection. The presentation focuses on instructional and individual conditions of students' emotions in portfolio based and regular physics instruction.

Generally, research on learning and instruction in the last years has recognized that emotional dispositions and emotional experiences are crucial conditions for learning, information processing, cognition, motivation, and social interaction. Emotions have an evaluational relation to learning, instruction, and achievement. In orientation to appraisal theories, and especially for the context of learning and achievement, the control-value approach (Pekrun et al., 2007) points out that subjective control of the learning and achievement situation, as well as the subjective value of learning process and achievement are crucial for the interpretation of a situation. Students experience different situations in instruction and value these situations depending on previous experiences, the social context, their personal goals, their interests, and other personality factors. Instruction, the personal and social value system, concession of autonomy, expectancies and learning and achievement goals, but also teachers' support, assessment strategies, and achievement feedback are assumed to have an influence on students' emotions. Emotions also have an effect on learning and achievement, mediated by attention, self-concept, self-regulation, and motivation, thus directing the person toward or away from learning matters in learning situations. Positive emotions may also facilitate self-regulation in learning. The experience of competence and autonomy in learning has been stressed out as important for self-regulation and the experience of self-determination (Deci & Ryan, 1985). Furthermore, information processing and learning strategies are influenced by emotions.

Generally, school and learning are associated by most of the students with more negative experiences and emotions. And it even seems that school itself contributes to this negative estimation. Therefore, it is an important issue for school, and for research in this context to focus particularly on a reduction of boredom, anxiety, and hopelessness, and an enhancement of enjoyment, satisfaction, or pride. Consequently, a theoretically and systematically oriented development of instructional approaches and interventions is needed. Modifications in school and instruction are essential focusing more on students' individual needs by creating a student and competence oriented learning culture, developing adequate methods of assessment, and by organizing schools as more life oriented environments.

The portfolio approach represents an educational concept with a focus on more student oriented instruction to enable learners to be more self-regulated and self-determined. Similarly to a learning diary or learning protocol, a portfolio combines numerous perspectives and functions. Characteristics of a portfolio are self-reflection, documentation of processes and learning outcomes, as well as their evaluation and assessment (Paulson, Paulson & Meyer, 1991). Portfolios focus on the participation of the learner in planning, realizing, and evaluating the own learning process. Generally, two main perspectives of portfolio in education are discussed: First, the enhancement of self-regulated learning and second, development of criteria and methods of alternative assessment. The application of portfolios may be seen as an example for the shift from teaching to learning. From this point of view educational institutions are seen as a well prepared learning environment to support individual learning processes. Main characteristics of those learning environments are problem centered and competence oriented learning demands and tasks, high quality of interactions between learners and teachers, cooperative and reflexive learning, and a well balanced relation between structured instructional phases and open, self-regulated learning phases. In addition, the portfolio-approach is associated with the positive influence on motivation, and emotion (cf. Gläser-Zikuda & Järvelä, 2008). Up to now, there is a lack of empirical studies that examine the effects of the portfolio approach on learning, competencies, motivation and emotion.

The presentation will focus on first results of an intervention study based on the portfolio approach. Students' emotions were measured in portfolio based instruction and in regular teaching situations in 8th grade physics classrooms. Both, the treatment and control class are taught by the same teacher. In total, four physics teachers and approximately 200 students participate in this study. In a quasi-experimental treatment-control-group design with pre-, post- and follow-up tests different variables were measured: Students' well-being, learning emotions, interest, learning motivation, learning strategies, self-concept, and achievement. As characteristics of the learning environment the classroom climate, and teacher competencies are evaluated. Beyond, teacher interviews and checklists to document the quality of the portfolio implementation are applied. First results from descriptive, and correlative analyses will be reported. Furthermore, students' emotions in portfolio based physics instruction will be compared with regular physics instruction to the same topic. Results and implications for further development of instruction will be discussed.

Deci, E.L. & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York.

Gläser-Zikuda, M. & Järvelä, S. (Eds.) (2008). Application of qualitative and quantitative methods to enrich understanding of emotional and motivational aspects of learning. *International Journal of Educational Research*, (47) 2.

Paulson, F. L., Paulson, P. R. & Meyer, C. A. (1991). What makes a portfolio a portfolio? *Educational Leadership*, 48 (5), 60-63.

Pekrun, R.; Frenzel, A.; Gfötz, T. & Perry, R. P. (2007). The control-value theory of achievement emotions. An integrative approach to emotions in education. In P.A. Schutz & R. Pekrun (eds.), *Emotions in education*. San Diego, pp. 13–36.

Origins of Achievement Emotions: The Impact of Individual and Class-level Ability

Reinhard Pekrun, University of Munich, Germany; Kou Murakou, Tokyo University, Japan; Anne Christiane Frenzel, Universität Augsburg, Germany; Thomas Goetz, Faculty for Humanities, Germany

The present research tested a theoretical model describing the effects of individual and class-level ability on students' achievement emotions. The model is based on propositions from Pekrun's (2006) control-value theory of achievement emotions and Marsh's (1987) Big-Fish-Little-Pond Effect model of self-concept of ability. Data from one cross-sectional and two longitudinal studies on students' development in mathematics were used (Study 1: N = 1,610, grades 5 to 10; Study 2: N = 1,759, grade 5 to 6; Study 3: N = 4,353, grade 9 to 10). In line with hypotheses, individual mathematical ability was a positive predictor of students' enjoyment and pride in mathematics, and a negative predictor of their anger, anxiety, shame, and hopelessness in mathematics, across all three studies. In contrast, class-level mathematical ability had negative contextual effects on enjoyment and pride, and positive contextual effects on anger, anxiety, shame, and hopelessness, in all three studies. Self-concept of ability in mathematics was a mediator for the effects of both individual and class-level ability. Overall, these findings document the importance of objective and self-perceived ability for the development of students' emotions. Suggestions for future research and implications for educational practice will be discussed.

Traditionally, students' achievement emotions have been neglected by educational research, with just a few notable exceptions (test anxiety research, Zeidner, 1998; attributional studies, Zeidner, 1998). During the past ten years, however, there has been an increase in the number of studies. This research has shown that achievement emotions are of fundamental importance for students' motivation, development, and educational achievement (Schutz & Pekrun, 2007).

Given the relevance of achievement emotions, it is important to acquire information on their antecedents, so that recommendations can be derived for how academic contexts can be shaped in emotionally adaptive ways. Individual abilities are one especially promising set of antecedents, as abilities shape self-perceived competence underlying the development of students' emotions. In addition, the abilities of others may also be critically important. Specifically, social comparison and the group level of ability in reference groups have been shown to influence competence appraisals, suggesting that others' abilities can influence individual achievement emotions as well.

Empirical research addressing these possible linkages is largely lacking to date (except Goetz et al., 2004; Zeidner & Schleyer, 1998). The present research was designed to address these gaps in the achievement emotion and self-concept literatures and, therefore, to facilitate the integration of two important research traditions. Specifically, we sought to examine the joint and mediated impact of individual ability, class-level ability, and self-concept of ability on students' achievement emotions.

Theoretical Framework

The conceptual framework used brings together propositions from Pekrun's (2006) control-value theory of achievement emotions and Marsh's (1987) Big-Fish-Little-Pond Effect (BFLPE) model of self-concept. The control-value theory posits that achievement emotions depend on the perceived controllability of important achievement activities and their outcomes. Since appraisals of control over achievement depend on perceived ability, factors influencing perceived ability should influence students' achievement emotions. Specifically, we posit the following effects.

- (1) Individual ability exerts positive effects on self-concept of ability, provided that information about ability is salient, important, and consistent. These conditions are met in schools providing students with consistent, distinct information about their performance.
- (2) Group-level ability exerts negative contextual effects on self-concept of ability (BFLPE). The strength of the BFLPE is thought to be pronounced in educational systems using normative grading that is based on local class norms rather than regional or state norms, thus conveying ability information pertaining to the immediate reference group (Zell & Alicke, 2010).
- (3) Self-concept of ability positively influences students' enjoyment and pride, and negative influences their anger, anxiety, shame, and hopelessness.

(4) By implication, individual ability positively influences enjoyment and pride, and negatively influences anger, anxiety, shame, and hopelessness. In contrast, class-level ability negatively influences enjoyment and pride, and positively influences anger, anxiety, shame, and hopelessness. All these effects of ability are thought to be mediated by self-concept of ability.

Aims of the Present Studies

Data from three studies targeting students' emotions in mathematics were used to examine the hypothesized effects. Subject-specific emotions were assessed since achievement emotions tend to be organized in domain-specific ways (Goetz et al., 2007). Emotions assessed included students' enjoyment, pride, anger, anxiety, shame, and hopelessness in mathematics.

Method: Study designs and samples

Study 1 was cross-sectional and assessed students' mathematical ability and emotions within one session (N = 1,610 German high school students [48% female] from 69 classrooms [grades 5 to 10]). Study 2 was based on the longitudinal Project for the Analysis of Learning and Achievement in Mathematics (PALMA; Pekrun et al., 2007; N = 1,759 students, 50% female, from 78 classrooms). Mathematical ability and self-concept of ability were assessed in grade 5 and emotions were assessed in grade 6. Study 3 used the longitudinal PISA-I-Plus investigation (Prenzel et al., 2006; N = 4,353 [57% female] from 194 classrooms). Mathematical ability and self-concept of ability were assessed in grade 9, and emotions in grade 10. All three samples represented a wide range of students in terms of ability, socio-economic background, and school type.

Method: Measures

In all three studies, emotions were assessed using the Achievement Emotions Questionnaire-Mathematics (AEQ-M; Pekrun et al., in press; Alphas > .80 for all scales in all studies). Mathematics ability was assessed using mathematics achievement tests and test scores were derived from IRT scaling (PALMA Mathematics Achievement Test, Studies 1 and 2; PISA mathematics test, Study 3). Self-concept of ability in mathematics was measured using the PALMA and PISA self-concept scales (all Alphas > .80).

Method: Data analysis

Multi-level modelling (MPlus) was used to analyze the data, with students at level 1 and classrooms at level 2. Student-level ability scores were group-mean centered. Multilevel mediation analysis was used to examine indirect effects (Preacher, Zyphur, & Zhang, 2010), and parametric bootstrapping was used to test the significance of these effects. Results and Discussion

In all three studies, individual ability was a positive predictor of enjoyment and pride, and a negative predictor of anger, anxiety, shame, and hopelessness. In contrast, across all three studies, the contextual effects of class ability on enjoyment and pride were negative, and the contextual effects of class ability on anger, anxiety, shame, and hopelessness were positive.

These findings confirm the importance of ability as an antecedent of students' achievement emotions and corroborate that the effects of individual ability and the ability level of the classroom bear opposite signs.

Furthermore, individual ability had positive effects on students' self-concept of ability in mathematics, whereas class-level ability had a negative contextual effect on self-concept, in line with previous research on the BFLPE on self-concept. Self-concept of ability, in turn, was a positive predictor of enjoyment and pride, and a negative predictor of anger, anxiety, shame, and hopelessness. Finally, multi-level mediation analysis documented indirect effects of individual ability on emotion, as well as indirect contextual effects of class ability on emotion, that were mediated by self-concept, thus supporting our mediational hypotheses.

In sum, the findings document the important role of both individual and group-level ability for the development of students' achievement emotions. Furthermore, they show that self-concept of ability mediates the impact of ability on emotions. Suggestions for future research and implications for educational practice will be discussed.

School success and school alienation of boys and girls at secondary schools: The role of the teacher

Andreas Hadjar, University of Luxembourg, Faculty of Language and Literature, Humanities, Arts and Educational Sciences (FLSHASE), Luxembourg; Stefanie Gysin, School of Education, Bern, Switzerland

This presentation aims at an explanation of school success of male and female school students. Taking into account the current debates on failing boys, a gender perspective will be employed. Analyses will center around school

alienation as a main emotional and motivational predictor of school success. Dealing with the question, how school alienation and a lack of interest can be explained, it will be focused on the role of the teacher - on teaching style and gender as an ascriptive teacher characteristic. Quantitative as well as qualitative results of a Swiss study on school success will be presented. The research design of this study includes a questionnaire survey of 872 male and female school students in grade 8 at Swiss secondary schools, group discussions with gender-homogeneous groups of 8 graders as well as video observations of German and Math lectures.

This presentation aims at an explanation of school success of male and female school students. Taking into account the current debates on failing boys – male school students receive lower school marks and attend less often university-bound school tracks than girls –, a gender perspective will be employed. This paper combines different theoretical as well as methodological approaches to explain school success. Analyses will center on school alienation as a main emotional and motivational predictor of school success. Regarding a quantitative measurement, school alienation is specified as a second-order construct that consists of three first-order factors: negative attitudes towards school, lack of task orientation and lack of intrinsic motivation.

Quantitative as well as qualitative results of a Swiss study on school success – research project „Lazy boys and ambitious girls?“ (School of Teacher Education Bern, University of Bern) – will be presented. The research design of this study includes a questionnaire survey of 872 male and female school students (14 to 15-year-olds) at Swiss secondary schools, group discussions with gender-homogeneous groups of school students and video observations of German and Mathematics lectures.

Dealing with the question, how school alienation and a lack of school success can be explained, it will be focused on peers, teachers, parents, and on students' behaviour (deviance). Peer groups may be understood in terms of social capital since peer groups can provide support (e.g. regarding school tasks) on the one hand. On the other hand, peer groups also have a motivation function – since they define whether or not learning activities are desired or not, and members of peer groups receive approval by sticking to the notion of the peer group regarding school. Teachers may be also seen as a social capital, since they provide support and motivate school students. Concerning the questionnaire survey, the perception of the school students, if the teacher deploys a rather authoritative style (including interest in school students, support, etc.) is measured. During group discussions, school students also mentioned teacher characteristics that may influence school students' well-being at school. What also needs to be recognized is influences of social origin, i.e. parental educational levels, cultural activities of the family, authoritative support of the parents. School deviance, e.g. destroying things, intimidating teachers, beating other school students, is assumed to be one of the mediators between school alienation and school success, and will therefore be included into the analyses. Deviance is on the one hand sanctioned by the teachers and on the other hand distracts school students from learning.

Quantitative results show that school alienation is the main predictor of school success. School alienation is higher among school students who are part of peer groups that are characterised by rather negative attitudes towards school. Authoritative teacher support reduces school alienation and therefore supports school success. School alienation goes along with a higher deviance which leads – interestingly only among boys – to a lower school success. Taking into account that boys' peer groups have more negative views on school, that boys are more alienated from school and therefore more deviant than girls, their lower school success becomes plausible.

As indicated in the quantitative results, an authoritative teacher support may reduce school alienation among boys and girls. Qualitative results reveal even more characteristics of school teachers that support students' well being and reduce school alienation (from the perspective of the school students): A teacher should employ a balanced style between the dimensions "demanding" and "casual". They should be able to gain the students' respect, but the teacher-student relation should also have informal aspects. For school students, teaching methods are more important than the subjects of teaching. School students want to participate actively. They want to have opportunities of self-managed learning and they prefer team work and teaching styles that allow them to exchange ideas.

SYMPOSIUM

Challenges of developing academic futures... possibly careers... in a changing world

Chairperson: Lynn McAlpine, University of Oxford, United Kingdom

Organiser: Lynn McAlpine, University of Oxford, United Kingdom

Discussant: Dai Hounsell, University of Edinburgh, United Kingdom

Wherever one looks in higher education, global competitiveness and public oversight are fundamentally altering the context and practices of academic work. Such changes have contributed to a view of academia as a place with no time

to reflect. As well, individuals can no longer assume that if they want a permanent academic position this is easily achievable. In this context, what are the challenges facing doctoral students, post-docs and pre-tenure academics? Answers to this question have profound pedagogical and policy implications. If individuals do not see a way to address the present challenges they perceive in academic work, they may choose not to remain in academia. Thus, the potential impact on higher education of their experiences in all three roles (doctoral student, post-doc and pre-tenure academic) could be significant for years to come – both through lost or inappropriate interactions with future generations of students and lost or unfulfilled research contributions over a career. Papers from Canada, Finland and the UK describe the challenges experienced by doctoral students, post-docs, and/or pre-tenure academics imagining and constructing their careers. Each paper examines at least one of the three roles within the relevant policy context and proposes policy and pedagogical implications. The aim is to generate an international perspective on the ways in which the challenges of doctoral, post-doctoral, and pre-tenure experience are similar and different. the extent to which different policy contexts may influence those constructing academic careers. the pedagogical and policy implications for all those attending the session

Perceptions of the thesis work and being a PhD student

Jenni Stubb, Helsinki University, Finland; Kirsti Lonka, University of Helsinki, Finland; Kirsi Pyhälto, Helsinki University, Finland

Previous studies suggest that there is variation in how researchers perceive the research work (Brew 2001; Åkerlind 2008). However, such investigations have focused on the perceptions of established researchers, and only little is known about the ideas of young academics. This study focuses on investigating how doctoral students perceive research and themselves as researchers. The data were collected with semi-structured interviews that were analysed in a phenomenography-inspired way. The participants were 37 students from a research intensive university in Finland from three disciplines: medicine, natural sciences, and behavioral sciences. Results showed that PhD students' ideas of doing research and being a researcher varied in terms of whether it was seen as 1) fulfilling duties and expectations, 2) acquiring personal qualifications and merits, 3) learning and personal development, or 4) enabling a change in the discipline. The perceptions in each category varied in terms of how atomistic vs. holistic, product vs. process-oriented, and person-center vs. community-centered they were. These four 'profiles' were not exclusive: often students reported conceptions that overlapped: there were at least two different kinds of ways of seeing research work and of being a researcher. The perceptions were not discipline-related, but instead, all of the four ways of seeing research were present in each of the three domains of study. It is important to acknowledge and understand these different ways of perceiving research work as they can serve as the frame of reference for learning and promoting academic expertise.

Researchers have varying ideas about doing research and being a researcher (Åkerlind 2008). Brew (2001) suggested that perceptions of doing research vary, for instance, based on whether researchers emphasize the product or the process of doing research, and whether they see it as work following certain specific phases or, in contrast, as a more cyclic process. The main focus has been exploring those members of academia who have already established their membership in the scholarly community. Thus, little is known about the perceptions that young academics, such as PhD students, have. However, understanding these perceptions in part serves as a key to understanding the process of becoming a scholar (Pearson and Brew 2002). The present study focuses on investigating the ways in which doctoral students understand the thesis work and how they perceive themselves as researchers. This study is a part of a larger national research project on PhD education in Finland (Pyhälto, Stubb, & Lonka, 2009).

Participants.

The participants were 37 PhD students (men= 5, women= 33) from a research intensive university in Finland. The participants represented three disciplines: medicine, natural sciences, and behavioral sciences. The research contexts were chosen based on their high-quality academic achievements and the large number of doctoral students. These cases were considered representative of research intensive units and well-organized doctoral education. The participants were in different phases of their PhD process: some had just started their PhD studies while others were more advanced. A few of the participants had just graduated. The majority of the students were working full-time with their thesis.

Data collection.

The semi-structured interviews were designed to study doctoral students' perceptions of their thesis process and of themselves in the process. The questions concerned the circumstances in which the students had started their PhD project, their motivation, perceptions about doing a PhD, and their experiences of supervision. The interview focused both retrospectively on previous experiences of the PhD process as well as the present situation. Each interview lasted approximately one hour.

Analysis.

A phenomenography-inspired analysis was adopted to study the variation in the perceptions that students had about doing research and being a researcher. In the first phase, all the text segments that described students' ideas about doing research and being a researcher were coded into hermeneutic categories. Then, four different ways of perceiving the research work and being a researcher were identified. The categories were: fulfilling duties and expectations, acquiring personal qualifications and merits, learning and personal development, and enabling a change in the discipline. The perceptions in each category varied in terms of how: (a) atomistic vs. holistic, (b) product vs. process-oriented, and (c) person-centered vs. community-centered they were. More specifically, they varied from each other in terms of how the following were experienced: the reason for doing a PhD, the nature of research work, and the intended outcome. The first two categories were more atomistic and product as well as person oriented while the other two were more holistic, process-focused and both person and community-oriented. Results. First, students describing research as fulfilling duties and expectations reported doing a PhD because it was defined as being part of their job description and they saw research as a series of different tasks that were done in order to identify a question and then to answer it. The outcome was defined as something concrete: a thesis or an article, for example. Second, those emphasizing acquiring personal qualifications and merits reported that the PhD was done in order to be more qualified or competent. Essential to doing research was the possibility of finding something new and making a scientific breakthrough. The prospective outcome was described as establishing one's own position in the field. Third, students who emphasized learning and personal development described a PhD project as a possibility to focus on questions of their own interest. Doing a PhD was reported as pursuing the development of one's own thinking and understanding. Fourth, typical for students' descriptions that emphasized enabling a change in the discipline was that doing a PhD was considered as making a contribution. These students emphasized the importance of questions that were relevant to the disciplines and the community. Striving for something that would benefit the whole community or the domain was considered important.

These four 'profiles' were not exclusive: often students reported conceptions that reflected a variety of ways to perceive research. The perceptions were not domain specific. For instance, in some cases descriptions of PhD students in medicine resembled more those of PhD students in natural sciences than those of their own colleagues. Further, it seemed that from these profiles, there emerged two different ways of describing oneself as a researcher: (a) me as an academic worker/employee and (b) me as a researcher. For seeing oneself as an academic worker, it was often more typical to consider research as fulfilling duties and expectations or acquiring personal qualifications and merits. For seeing oneself as a researcher, it was more typical to consider research as source of learning and personal development, or enabling a change in the discipline.

Discussion.

Results show that students have varying perceptions about doing research. It is important to understand the different kinds of ways of perceiving the research work identified in the present study. Such views may be considered as the frame of reference of the PhD students, affecting the ways of acquiring academic expertise. This poses a challenge for how to foster construction of coherent academic identities that form the basis for PhD students' future academic careers.

Åkerlind, G. S. (2008). An academic perspective on research and being a researcher: an integration of the literature. *Studies in Higher Education*, 33(1), 17–31.

Brew, A. (2001). Conceptions of research: a phenomenographic study. *Studies in Higher Education*, 26(3), 271–285.

Pearson, M. & Brew, A. (2002). Research training and supervisor development. *Studies in Higher Education*, 27(2), 135–150.

Pyhältö, K., Stubb, J., & Lonka, K. (2009). Developing scholarly communities as learning environments for doctoral students. *International Journal for Academic Development*, 14(3), 221–232.

Establishing oneself as an academic: Experiences of PhDs, post-docs and pre-tenure academics

Cheryl Amundsen, Simon Fraser University, Canada; Lynn McAlpine, University of Oxford, United Kingdom

The goal of our research program is to contribute to a better understanding and conceptualization of early career academic experience (doctoral student, post-doc, pre-tenure academic) in today's increasingly pressured academic landscape. We propose the notion of an 'identity-trajectory' emphasizing the integration of past-present-future in the experience of academic work. An identity-trajectory, which integrates the personal with the academic, emphasizes learning processes (including intentions and emotions) that emerge from a multitude of contexts, both past and present. In this paper, we use the identity-trajectory to examine the experiences of twenty-eight early career academics in the Life Sciences, an under-explored disciplinary area. We found similarities and differences between

the experiences of doctoral students, post-docs and pre-tenure academics as concerns, for example, perceived support for their feelings of being academic and establishing themselves as an academic, and dilemmas in reconciling academic and personal values. These findings add to those from the first phase of our research in Education.

The goal of our research program is to contribute to a better conceptualization of early career academic experience (doctoral student, post-doc, pre-tenure academic) in today's increasingly pressured academic landscape. Our research is situated in and motivated by the well-documented changes in higher education internationally and the impact of these changes on academic work (e.g., Enders, 2007). These changes can have profound implications for doctoral students who pursue an academic career, and new appointees trying to establish themselves; these individuals are "the first to suffer from the stress that has befallen this system" (Laudel & Glaser, 2008, p. 388). Having completed the first phase of our research in the field of Education (e.g., Amundsen & McAlpine, 2009), we have begun the second phase, extending our work into the Life Sciences, an under-explored disciplinary area. This paper presents our first analysis of these data, focusing on the day-to-day experiences of participants over one year with a focus on their perceptions, actions and emotions in seeking to establish themselves as an academic. Conceptual framework Phase one of our program gave rise to the notion of an 'identity-trajectory' emphasizing the integration of past-present-future in the experience of academic work (McAlpine et al, 2010). In phase two, we are extending and refining this framework. Overall, identity-trajectory, which integrates the personal with the academic, emphasizes learning processes (including intentions and emotions) that emerge from a multitude of contexts, both past and present. These are generally informal learning experiences, emerging not just through doing work but also importantly from reflecting on work—learning that Clandinin & Connelly (1990) have called personal practical knowledge, or what Schön (1983) has called knowing-in-practice. Reflection on one's trajectory may provide a way to draw together the past and present to inform new intentions and directions. Focusing on the intentionality of individuals through time provides a counter discourse to policy arguments, which tend to privilege the expectations and regulation of different institutional roles.

Methodology

Data from 15 doctoral students, 6 post-docs, and 7 pre-tenure academics from the Life Sciences at two different universities in Canada, form the basis for the analysis in this paper. For each participant, three types of data were collected over a one-year period: 3-4 activity/experience logs, a pre-interview questionnaire and one interview, which drew on the previously collected protocols. From these data, case summaries (data displays) were constructed for each individual, followed by analysis looking across participants that used a priori codes (from our identity-trajectory framework) and emerging codes (Huberman & Miles, 2002).

Findings

We could locate the work of doctoral students, post-docs and pre-tenure academics in the identity-trajectory framework. The majority of participants were working with considerable intentionality while experiencing challenges (as well as pleasures). For instance, doctoral students were aware of the lack of academic positions that would be available to them; yet, they continued to seek to teach (as well as publish) knowing both would be essential if they were to be competitive positions available. Post-docs felt like 'newcomers' in the first year of their appointments; by the beginning of the second year they were suddenly 'experienced' in eyes of others and having to think about where they would go next. Doctoral students noted departmental activities and structures that supported their feeling of being an academic, whereas post-docs commented on not feeling they had similar kinds of supports. Participants in all roles expressed concern over what they perceived as an unbalanced work-life relationship. For instance, both PhDs and post-docs commented on the challenges of being or hoping to be parents while progressing their careers, and the pre-tenure academics reported dilemmas in reconciling their preferred research environment with the positions available and their family responsibilities. As has been reported elsewhere (e.g., Hakala, 2009), this may reflect the laboratory/research team structure with a tight research agenda to which, regardless of role, one can and is expected to contribute.

Theoretical and educational significance of the research

No previous research that we know of has bridged the roles of doctoral candidate, post-doc and new appointee longitudinally and addressed the day-to-day experience of intention and emotion on academic identity construction. Through the identity-trajectory framework, we hope to offer a means for individuals to reflect on their experiences and consider ways in which they might be more intentional in addressing their futures. We want to effect practice as well as theory development and future research. To facilitate this, we have employed an action research methodology, which extends beyond other interpretive traditions of research to direct action in generating plans, projects, policies that follow from research evidence. In the first phase, our findings were the basis for new activities/processes and recommendations at the department, faculty and institutional levels (Amundsen & McAlpine, in press). We continue in this tradition with phase two of our work.

- Amundsen, C., & McAlpine, L. (in press). Chapter 12: Moving from evidence to action. In L. McAlpine and C. Amundsen (Eds.) *Doctoral Education: Research Based Strategies for Doctoral Students, Supervisors and Administrators*. Amsterdam: Springer.
- Amundsen, C., & McAlpine, L. (2009). Learning supervision: Trial by fire? *Innovations in Education and Teaching International*, 46(3), 331-342.
- Clandinin, J., & Connelly, M. (1990). Narrative, experience and the study of curriculum. *Cambridge Journal of Education*, 20(2), 241-253.
- Enders, J. (2007). The academic profession. *International Handbook of Higher Education*, 18, 5-21. Amsterdam, Springer.
- Hakala, J. (2009). Socialization of junior researchers in new academic research environments: Two case studies from Finland. *Studies in Higher Education*, 35(5), 501-516.
- Huberman, M., & Miles, M. (2002). *The Qualitative Researcher's Companion*. Thousand Oaks, CA: Sage Publications.
- Laudel, G., & Glaser, J. (2008). From apprentice to colleague: The metamorphosis of early career researchers. *Higher Education*, 55, 387-406.
- McAlpine, L., Amundsen, C., & Jazvac-Martek, M. (2010). Living and imagining academic careers. In L. McAlpine & G. Akerlind (Eds.). *Becoming an Academic: International Perspectives*. London: Palgrave Macmillan.
- Schön, D. A. (1983). *The Reflective Practitioner*. New York, NY: Basic Books.

"It's just been a huge learning experience" – how new supervisors learn to do doctoral supervision

Gill Turner, University of Oxford, United Kingdom

Despite lacking tenure, research staff and pre-tenure academics undertake doctoral supervision, often assuming substantial responsibility for the progress of their students. Those early career academics who are new to doctoral supervision recount it as being hard work, receive minimal training, and practice it as a solitary pursuit. Relying heavily on their own time as a doctoral student and lacking an initial awareness of how the wider context would impact on them in this role, their development as doctoral supervisors comes mostly through on the job experience. We report here on a UK-based study of new doctoral supervisors from a range of disciplines and, amidst the challenge of undertaking doctoral supervision with little or no training, show how their learning about doing doctoral supervision is influenced by their own experience as a doctoral student, co-supervision, and the supervisor-supervisee relationship. We highlight some of the challenges that are involved in learning supervision and suggest these findings raise questions about how to better equip and support new doctoral supervisors.

Aims

Most existing literature on doctoral supervision focuses on experienced supervisors. These studies evidence such themes as supervisory models, orientations and styles, the supervisor-student relationship, supervision pedagogy, and doctoral supervision as professional work. Only recently has research focused on early career academics as new supervisors (Sambrook et al, 2008; Amundsen and McAlpine, 2009; Turner, SRHE 2010, accepted). These show new supervisors find supervision hard work; draw heavily on their own time as a doctoral student; develop supervisory expertise on the job with minimal training and support; practice supervision as a solitary pursuit; and are uninformed about how the wider context will impact them. How they learn about doing supervision is relatively underexplored. Here we report a study on ECAs who are new to doctoral supervision. Having previously recounted some of the issues involved as they undertake this new role, we now contribute to the literature aspects on how they learn about doing supervision with a view to exploring how this knowledge might address the challenges they encounter.

Methodology

ECAs with less than six years research supervision experience and currently supervising at least one doctoral student were recruited from one UK research-intensive university, from lists of individuals who had attended introductory supervision seminars and via academics with graduate training responsibilities. Eleven new supervisors volunteered from a range of disciplines. Each participant completed a pre-interview questionnaire providing background information on their experience as research supervisors before being interviewed. The interviews were transcribed and a thematic analysis carried out.

Findings

Learning to be a doctoral supervisor All participants said they had received little or no training. Of these, 6 had attended introductory seminars on supervising doctoral students at the university. As an overview of the supervisory process these seminars had some merit, e.g. providing insights into doctoral supervision from the student's point of view and clarifying what is in place to help supervisors address problems with students. However, there was a perception that no general consensus seemed to exist about what good practice is for doctoral supervision and participants reported relying on their "own experiences of being a doctoral student" and even that "the best way

[training] would be to gather experiences and then develop something on the basis of that". In light of these comments we highlight how these new doctoral supervisors learned supervision by drawing on their own experience as a doctoral student, from co-supervision, and from their relationship with their own supervisees.

Own experience as a doctoral student

As in other studies, we found these new supervisors drew heavily on their time as a doctoral student, assuming what worked for them would work for their supervisees. We also saw they realised this experience did not fully prepare them as doctoral supervisors: their style did not suit all supervisees; they were ignorant of how to fit it into their other responsibilities; they were unaware of how the wider context would impact on them. Whilst adjusting their assumptions and practice, many of these new supervisors displayed a naiveté about how well their experience as a doctoral student had equipped them for their role as doctoral supervisor.

Co-supervision

Eight of these new supervisors were in co-supervisory relationships. Despite being in non-tenured positions all assumed the main supervisory responsibility for their students, e.g. directing the student's work, arranging resources and training, organising supervisory meetings. Co-supervision seemed beneficial with new supervisors drawing on co-supervisory relationships to: determine a united approach to a supervisory problem; be affirmed in their actions on behalf of their student; assure the quality of work; bring different perspectives, ideas and expertise. However, these co-supervisory interactions were principally directed at progressing the student's thesis and were rarely concerned with the new supervisor's development as a doctoral supervisor.

Own supervisees

The new supervisor's relationship with their supervisee was the foremost challenge to their notion that their time as a doctoral student was adequate preparation for being a supervisor i.e. they realised that what worked for them did not work necessarily for their students. Yet, this same relationship was also one from which they learned much about doing doctoral supervision. They discovered: not all students responded to the same approach; students' reasons for undertaking doctoral study varied and supervisors had to accommodate this range; competing demands from different students at the same time had to be dealt with; there was a balance to be found between supporting a supervisee and encouraging their independence.

Significance

We report here ways in which, through experience, new supervisors learn how to do doctoral supervision and tackle some of the challenges they encounter. We found new supervisors realising their time as a doctoral student was an inadequate model for their own supervisory style: firstly, their experience was only one way of doing supervision; secondly, their experience provided them only with the student's perspective of the role whilst that of the supervisor's had remained invisible. We saw co-supervision used to progress the student's thesis but not as a forum for deliberating their own supervisory development; learning from a co-supervisory relationship tended to be a by-product of co-supervisory interactions. The supervisor-supervisee relationship was important in learning to do doctoral supervision. It challenged taken-for-granted assumptions about supervision and doctoral education whilst, at the same time, stimulating and providing answers. Whilst literature on ECAs new to doctoral supervision indicates that they are poorly prepared for the role, these findings provide some insights into how they address their predicament. They also raise questions about how to better equip and support new doctoral supervisors, given that existing training and support structures appear inadequate.

Amundsen, C. & McAlpine, L. 2009 'Learning supervision': trial by fire. *Innovations in Education and Teaching International*, 46 (3), pp. 331-342

Sambrook, S., Stewart, J. & Roberts, C. 2008 Doctoral supervision... a view from above, below and the middle! *Journal of Further and Higher Education*, 32 (1), pp.71-84

Turner, G. 2010 "I didn't really appreciate how hard work it would be!" – New supervisors' experiences of doctoral supervision. SRHE 2010, proposal accepted

SYMPOSIUM

Help seeking in technology-enriched learning situations

Chairperson: Minna Puustinen, Université de Poitiers & CNRS, France, France

Organiser: Minna Puustinen, Université de Poitiers & CNRS, France, France

Nathalie Huet, University of Toulouse, France

Discussant: Stuart Karabenick, University of Michigan, United States

The rapid transition of our societies towards more globalism and networking has profoundly modified student help-seeking opportunities. Seeking and obtaining help whenever necessary is possible for anyone connected to Internet and other remote communication devices. Within this context, the aim of this symposium is to present recent research on student help seeking in technology-enriched learning situations, by proposing three papers that examine the topic from different theoretical and methodological perspectives. From the theoretical point of view, the papers included in this symposium analyze student help seeking in technology-enriched learning situations in relation to existing research on task complexity (Schworm & Wuerfl), achievement goal theories (Huet et al.), and student-teacher interaction patterns (Puustinen et al.). Methodologically, the papers analyze students' help-seeking intentions but also their actual help-seeking behavior in technology-enriched learning situations using both experimental and natural data. The approaches adopted by the three papers are innovative, and the phenomena studied are currently un- or underexplored in the literature: the adaptive role of executive help seeking in learning (Schworm & Wuerfl), the help-seeking intentions vs. the actual help seeking (Huet et al.), and ineffective helping interactions between teachers and students (Puustinen et al.).

Help design in web-based learning environments: The influence of task-complexity on need for help

Silke Schworm, University of Regensburg, Germany; Magdalena Wuerfl, Institute of Educational Sciences, University of Regensburg, Germany

The present study deals with the influence of task complexity to learners' need for help during the task processing. Forty-eight students took part in the study. They worked with a computer-based learning environment on "Mental disorders in adolescents" and had to solve tasks of increasing complexity. After each task the participants had to choose from twelve alternatives which source of help they would have used to support their task solution. Help sources were distinguishable as instrumental (learning oriented) help and executive (performance oriented) help. Results show that task complexity influences the choice of instrumental help sources, but not that of executive help sources. On the comprehension and application level, instrumental help was preferred to executive help. For tasks on knowledge level, however, executive help was considered to be as useful as instrumental help. Subjects with high prior knowledge thereby considered the offered help less useful than subjects with low prior knowledge.

Intentions and actual use of help in a CBLE: The role of achievement goals and perceptions of help
Computer supported Learning Environments, Motivation, Self regulation

Nathalie Huet, University of Toulouse, France

Caroline Dupeyrat, Universite Toulouse 2, France

Franck Amadieu, CLLE-LTC (University of Toulouse), France

Jean-Christophe Sakdavong, University of Toulouse, CLLE-LTC CNRS, France

Prior research revealed that learners' help-seeking is often not appropriate. According to some authors (e.g., Karabenick, 1998), achievement goals and perceptions of help-seeking (perceived threat and costs/benefits) influence help-seeking. In the present study, the relationships between achievement goals, perceptions of help, and both help-seeking intentions and behaviours were explored in a computer-based learning environment on word processing. 65 undergraduate students were invited to learn how to create word processor style sheets on an Interactive Learning Environment and to perform exercises. After each exercise, the system detected the correctness of the procedure and if wrong, a feedback was provided. Students could choose one help among various types (e.g., screencast course) or reject it. Achievement goals (mastery, performance-approach and performance-avoidance goals), intentions, and perceptions of using help were assessed by questionnaire. Actual use of help was recorded. The main results indicated that mastery goals were positively associated to the intention of using help and negatively associated with the intention of avoiding help; both performance goals were positively associated to the intention of avoiding help but did not correlate with intentions of using help. However, in the actual learning situation, achievement goals were not related with the actual use of help.

Learning in computer-based learning environments requires that learners regulate their own learning. Self-regulation of learning includes seeking for help if learning tasks are not mastered successfully (e.g., Puustinen, 1998). Yet, prior research revealed that learners' help-seeking is often not appropriate (Aleven et al., 2003). One factor that can influence help-seeking is achievement goal orientation: intentions or purpose of the learner to achieve an academic

task. Traditionally two major classes of goals have been distinguished (e.g., Dweck & Leggett, 1988): mastery goals, in which the aim is to develop competence, and performance goals, in which the aim is to demonstrate competence relative to others by gaining favorable judgments (performance approach goals) or by avoiding unfavorable judgments of one's competence (performance avoidance goals).

In academic classroom environments, most studies showed that achievement goals influence help-seeking intentions (e.g. Cheong, Pajares, & Oberman, 2004). Students with high mastery goals showed a low help-seeking avoidance intention. Contradictory results were found concerning the role of performance-approach goals on learner avoidance of help-seeking intentions: sometimes they were unrelated, negatively related or positively related to avoidance of help-seeking intentions.

In computer-based learning environments, it was found that performance goals were negatively correlated with the actual use of help (Huet et al., in press). For mastery goals, results were contradictory: in one study, they were not associated with the actual use of help, in another they were negatively associated to the actual use of help.

Another factor that influences the use of help are the perceptions of (or attitudes towards) the use of help in the sense of perceived threat on self-esteem or autonomy and benefits of help-seeking (Karabenick, 1998). Studies showed that help-seeking can be considered by learners as a threat to their self-esteem because they perceive the seeking of help as a sign of their incompetence to resolve the problem by their own means. Consequently, they do not seek help because they want to continue projecting an impression of competence and to avoid other people's negative judgments. Studies indicated that the more learners perceive help-seeking as a threat to their self-esteem and especially on competency, the more they avoid seeking help (e.g., Karabenick 2003). Help-seeking can also be perceived negatively for another reason: learners can consider help-seeking as a dependent behavior that conflicts with their personal need for autonomy or independent mastery need and self-reliance. In other words, they do not seek help because they want to achieve the task without external help. Finally, the more learners report perceiving the benefits of help-seeking, the less they avoid help-seeking (e.g., Cheong et al., 2004).

The aim of the present research was to examine the relationships between achievement goals, perceptions of help and both intentions and actual use of help in an interactive learning environment.

Method

Participants were sixty-five human science students enrolled in a French university. Achievement goals were assessed with the P.A.L.S. Items assessing perceptions of help-seeking (perceived benefits, perceived threats to self-esteem, perceived threats on competency, and perceived threats to autonomy) were adapted from several questionnaires (e.g., Karabenick, 2003). Intentions of using help were assessed by an adaptation of the questionnaire used by Cheong and al. (2004).

After completing the questionnaires, the participants learned how to apply and create word processor style sheets from a multi-agent Interactive Learning Environment (ILE). Afterwards, they performed exercises requiring the use of style sheets on texts. After the exercise tasks, the multi-agent system, which detected the correctness of the procedure, provided a feedback in case of failure. The student could choose (or not) one type of help among various types of instrumental help (e.g., screencast course, screencast procedure...). In case of a wrong answer detected by the multi-agent system, the system offered to the learner the opportunity to use help or not. Then, whether the answer was right or wrong, another exercise similar to the previous one (i.e. requiring the same solving procedure) was proposed without the possibility of using help.

Results

The main results indicated that mastery goals were positively associated to intentions of using help ($r = .53$; p

In spite of these relations between achievements goals and intentions to use help, analyses conducted on the actual use of help did not highlight any relation between achievement goals and the use of help. However, the perception of help as a threat on competency influenced positively the intention of avoiding help ($r = .56$, p

The implications of these results for learning and help-seeking in computer-based learning environments will be discussed. Studies are needed which further examine the actual use of the help.

References

- Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help-seeking and help design in interactive learning environments. *Review of Educational Research*, 73, 277-320.
- Cheong, Y. F., Pajares, F., & Oberman, P. (2004). Motivation and academic help-seeking in high school computer science. *Computer Science Education*, 14, 3-19.
- Dweck, C.S., & Leggett, E. L. (1988). A social cognitive approach to motivation and personality. *Psychological Review*, 95, 256-273.
- Huet, N., Escribe, C., Dupeyrat, C., Sakdavong, J.C. (in press). The influence of achievement goals and perceptions of on-line help on its actual use in an Interactive Learning Environment. *Computers in Human Behavior*.
- Karabenick, S. A. (1998). Help seeking as a strategic resource. In S. A. Karabenick (Ed.), *Strategic help seeking: Implications for learning and teaching* (pp. 1-11). Mahwah, NJ: Erlbaum.
- Karabenick, S. A. (2003). Seeking help in large college classes: A person-centered approach. *Contemporary Educational Psychology*, 28, 37-58.

Puustinen, M. (1998). Help-seeking behavior in a problem-solving situation: Development of self-regulation. *European Journal of Psychology of Education*, 13, 271-282.

Seeking help on an online homework-help forum: An analysis of the student-teacher interaction
Computer supported Learning Environments, Self regulation, Social interaction

Minna Puustinen, Universite de Poitiers & CNRS, France, France

Olga Volckaert-Legrier, University of Toulouse, France

Michael Baker, CNRS - Telecom ParisTech, France

We analyzed the dynamics of student-teacher interactions in a written help-seeking situation taking place on an online homework-help forum. We used natural data, i.e. the archives of a French forum offering secondary school students individualized help in mathematics. We were particularly interested in cases in which the initial student-teacher interaction had failed, i.e. the student returned to the forum after having received the teacher's answer. Our data consisted of 54 written exchanges between 16-to-18-year old secondary school students and secondary school mathematics teachers. We conducted a qualitative analysis of the messages and then made an inductive pattern recognition analysis using the MEPA (Multiple Episode Protocol Analysis) software. The results revealed that 85% of the teachers' initial answers contained at least partial suggestions of procedure. In those cases, the students' messages gained in precision after the teachers' answers: their initial messages typically lacked details concerning e.g. their difficulties, whereas the messages typed after the teachers' suggestions contained more targeted information regarding their difficulties, the work already conducted, etc. The results further revealed that in 15% of the cases, the teachers' initial answers were exclusively composed of reminders of the forum rules and/or requests for precision; in those cases, the students were obliged to answer the teachers' remarks or questions in order to obtain any suggestions from the teachers.

Puustinen, M., Volckaert-Legrier, O., Coquin, D., & Bernicot, J. (2009). An analysis of students' spontaneous computer-mediated help seeking: A step toward the design of ecologically valid supporting tools. *Computers & Education*, 53, 1040-1047.

H 12 01 September 2011 09:00 - 10:00 Room Streatham Court Lecture Theatre B

SYMPOSIUM

New Modes of Assessment

Beyond assessment: analyzing student participation in the judgment process

Keywords: Assessment methods, Assessment of Competence, Higher education

Sig's: Assessment and Evaluation

Chairperson: David Carless, University of Hong Kong, Hong Kong

Organiser: David Carless, University of Hong Kong, Hong Kong

Discussant: Dominique Sluijsmans, HAN University of Applied Sciences, Netherlands

Aims Student involvement in assessment through peer- and self-assessment is viewed as a key aspect within 'new modes of assessment'. The rationale includes going beyond assessment as being something done to the student, in the direction of developing a shared ownership of assessment tasks, criteria and judgments. The aim of the symposium is to explore the topic of student participation in assessment processes through three empirical papers from different geographical sites. The first paper uses data from Australian universities to probe the development of student judgment through self-evaluation of their performance on their graded assignments. The second paper draws on a wide range of data from Spanish and Latin American universities, and outlines an agenda for enhancing student participation in assessment. The third paper, a case study of an award-winning teacher at the University of Hong Kong, illustrates how students use feedback from peers and the teacher to develop judgment of the quality of their own performance. Educational relevance In sum, the papers suggest that involving students actively in the assessment process is central to the improvement of learning outcomes, whilst unpacking some of the challenges for implementation of participative assessment. The discussion gives rise to a number of issues: What are the most

effective ways of promoting student participation in assessment? What kinds of students are most likely to benefit from active participation in assessment? How can institutional commitment and support for participative assessment be facilitated?

The development of student judgement: the role of practice in grade prediction

Assessment methods, Assessment of Competence, Higher education

David Boud, University of Technology, Sydney, Australia

A key feature of sustainable assessment is that students are enabled to make progressively effective judgements about their work within the subject domain of a course. Conventionally, this is not explicitly assessed, but it is assumed that students who satisfy normal assessment requirements meet this outcome. This paper explores one way of promoting and getting evidence about the development of judgment making through students making judgements about their performance with respect to criteria for assessment tasks throughout an undergraduate degree program. It examines the question of whether extended practice in self-assessment over time helps students develop the capacity to make better judgements about their work. It uses data collected as part of a pedagogic intervention about the assessment of graduate attributes to analyse convergence between student ratings of their performance on specific tasks and the marks allocated by tutors within a course module and across modules and semesters, and to identify whether some categories of student, for example high achievers, benefit more from such practices. The significance of the paper is that it uses authentic high-stakes assessment data from throughout an undergraduate course to examine ways in which grade prediction strategies can contribute to the calibration of student judgement and thus sustainable assessment.

Aims The development of student self-assessment capacities plays an important role in student participation in assessment. There have been studies of student self-assessment over many years and considerable advocacy for the effectiveness of practices in which students review their own work (e.g. Dochy et al. 1999). It has been well argued that students need to develop the capacity to make judgements about their own work if they are to be effective learners both as students and following graduation. The role of skills of self-judgement are central to the notion of sustainable assessment, that is 'assessment that meets the needs of the present without compromising the ability of students to meet their own future learning needs' (Boud, 2000, p. 151). The development of the ability to make judgements about their own work develops through practice over time, and the capacity to make good judgements does not necessarily transfer across knowledge domains. We suggest that learners' judgements need to be calibrated against the judgements of others who have a more sophisticated understanding of the type of work being assessed in order to promote the skill and for students to become aware that their judgments have improved. Through such a process of scaffolding, students can move progressively towards the kinds of quasi-independent judgements about self-performance needed for effective lifelong learning (Boud and Falchikov 2007). In this paper, the ability of students in predicting their grade for elements of an assessed task is taken as a surrogate for student self-judgement. This paper extends the base of previous empirical investigation to examine the following research questions: Does continued practice in grade prediction lead to convergence between teacher-generated grades and student-generated grades, over assessment tasks, over subject modules and over time? Does accuracy in grade prediction vary by student performance? In so doing it aims to illuminate the question of whether such practices assist students to calibrate their own judgements. **Methodology** The paper uses data from a pedagogical innovation obtained as part of the normal assessment practices in an undergraduate degree. The form and nature of the data used was constrained by the need for it to be used primarily both for high stakes assessment processes that influenced the progression of students and to provide feedback to students on their performance in self-assessment, rather than for the purposes of research. We used the full set of student assessment data in a set of linked modules conducted over three years of a Bachelors degree between 2008 and 2010. It was obtained through the medium of ReView. ReView is an online criteria-based assessment system that allows students to grade themselves on criteria for each assessment task in a subject module (as well as to provide an overall grade). This is completed before tutors' grades and feedback are available to them in ReView. Analysis has been undertaken of discrepancies between student and tutor marks for each assessment task for subjects over four separate semesters with a view to exploring changes within subjects and over time. It was hypothesised that as students practise making their own judgements, followed by their viewing of tutor's judgements, there would (a) be a convergence of marks for each iteration of assessment within a module, and (b) be an initial divergence at the beginning of each new subject which reduces in size over time. **Findings** Findings are consistent with the outcomes of a preliminary study undertaken by the authors in an undergraduate degree in another university. Initial analysis indicates the following: 1. Within each module there is convergence in discrepancies between student and tutor marks from the first assessed task to the final task. 2. Over modules (and thus over time), there is increased convergence between student and tutor marks. The gap between student and tutor marks lessens in the first assessed task in each subsequent module and plateaus. 3. In accordance with many findings on student self-marking, strong students (as defined by tutor marks) underestimate performance and weak

students overestimate performance. However, the degree of over- or underestimation diminishes over modules.4. The greatest learning benefit appears to accrue to mid-range students. Their absolute performance and performance in grade prediction increases at a greater rate than that of strong or weak students. Significance The study shows that students become more accurate in judging their own performance with extended practice over two or more modules using normal assessment tasks. Student satisfaction with the exercise was very high. In our original preliminary study, for example, significant numbers of students persisted in using the system even when it was not required and were not reminded to use it by tutors. The study does not, however, show that the improvement in self-judgement is due to the grade prediction exercise per se. It is particularly challenging to obtain independent measures of such improvements as the very act of assessment provides practice in the skill being measured. One of the most interesting findings of the study is the effect on mid-range students. High performing students are most likely to have developed skills of judging their own work—this is one of the features that make them high performing in the first place—and there is relatively little improvement. Low performing students start with poor self-judging skills, and show a modest improvement through practice. However, mid-range students seem to benefit most from the intervention. The paper concludes with a discussion of the use of such measures in promoting self-judgement and how this particular practice of sustainable assessment can be incorporated into the university curriculum. Boud, D. (2000). Sustainable assessment: rethinking assessment for the learning society. *Studies in Continuing Education*, 22, 2, 151-167. Boud, D. and Falchikov, N. (2007). Developing assessment for informing judgement. In Boud, D. & Falchikov, N. (Eds.) *Rethinking Assessment for Higher Education: Learning for the Longer Term*. London: Routledge, 181-197. ISBN10: 0-415-39778-2, ISBN10: 0-415-39779-2, ISBN10: 0-203-96430-2, ISBN13: 978-0-415-3778-0, ISBN13: 978-0-415-3779-7, ISBN13: 978-0-203-96430-9 Dochy, F., M. Segers, M. and Sluijsmans, D. (1999). The use of self-, peer and co-assessment in higher education: A review, *Studies in Higher Education*, 24, 3, 331-350.

Between reality and desire: active participation of students in assessment in the digital age
Assessment methods, Assessment of Competence, Higher education

Gregorio Rodriguez Gomez, FACULTAD DE CC DE LA EDUCACION, Spain

Implementing assessment for learning at universities requires an essential condition: the active participation of students in the assessment process via the development of informed judgments about quality learning. As highlighted by various authors this participation may be carried out through strategies like self, peer and co-assessment. This paper focuses attention on the difficulties that faculties face in implementing these strategies. Although there are a wide range of difficulties in this matter we reflect mainly on two notions: previous conceptions of university teachers and students; and the relevant characteristics of information technology and communication (ITC). Those reflections about the limitations encountered regarding participative assessment are based upon the results of several educational research projects lead by EVALfor Research Group in recent years, using as main research methods document analysis, in-depth semi-structured interviews and surveys to teachers and students from Spanish and Latin American universities. The findings demonstrate that an active involvement of students through strategies such as self, peer and co-assessment is not widespread. Moreover, in many cases the use of information technologies does not seem to facilitate such participation. Implications indicate: the importance of implementing institutional strategies to support student participation in assessment; formative processes for both teachers and students to facilitate their training regarding participative assessment; and developing technological tools which allow and promote the active participation of students in the assessment processes.

Aims In recent times, EVALfor research group has focused its activity around the participation of students in the assessment for learning process, conducting several research projects: SISTEVAL, EvalPART, EvalCOMIX, EvalHIDA and Re-Evalúa. The main objective of the paper is to present the main results of those projects and their implications for teaching and institutional policies. SISTEVAL project (Ibarra, 2007, Ibarra and Rodríguez, 2010) aimed to analyse, describe and portray the current assessment systems (a set of criteria, standards and procedures) specified by the universities in their regulations and specific legislation, as well as those specified by the faculties and departments in their norms, guides or teaching programs. EvalPART Project (Rodríguez et al., 2010) was designed to analyse the perspective of university teachers and students about the participation of the latter in assessment; and EvalCOMIX (Ibarra, 2008) and EvalHIDA (Rodríguez, 2009) research projects were focused on the role of technologies in the assessment process. Finally, Re-Evalúa project is aimed to probe the results obtained through the incorporation of "e-learning oriented e-assessment" in the development of teaching capacities in university teachers and basic competences in graduate students. In this paper selected results of this project are presented, in particular those that are focused in the analysis of the assessment activity of university teachers (Quesada, 2010). Methodologies SISTEVAL project consisted of two main tasks: 1) a documentary analysis of the existing regulations (statutes, norms, guides, etc.) in nine Spanish universities participating in the project and 2) a documentary analysis of 582 subject programs. EvalPART project was based on two surveys with the participation of 3,459 students and 424 university

teachers from two Spanish universities and five Latin American universities based in Colombia, Costa Rica, Ecuador, Honduras and Guatemala. Eleven case studies were conducted in EvalCOMIX and EvalHIDA. Re-Evalúa project includes surveys and in-depth semi-structured interviews. The following research questions guided these investigations:

RQ 1 What is the dominant discourse on assessment in universities?

RQ 2 What possibilities and limitations have tools such as forums, wikis and blogs in participative assessment processes?

RQ 3 What is the teachers' perspective on students' participation in assessment?

RQ 4 What is the students' perspective on participation in assessment?

Findings One of the main conclusions drawn from SISTEVAL project was that the discourse of assessment could be characterized as "traditional". The data showed that students are not considered prominent in the assessment process; instead, they are seen as the object to be assessed, graded and classified. EvalPART project highlighted the limitations that tools, such as forums, wikis or blogs present regarding participative assessment process, mainly the practical difficulties of analyzing the quality of students' contributions. On the basis of EvalPART project results we can conclude: a) generally there is an agreement between students and university teachers on the importance of students' participation in the assessment process; b) there are differences between the opinion of teachers and students about the implementation of assessment practices; and c) there is an agreement of both students and teachers that peer and co-assessment are not frequently practiced. The results of Re-Evalúa project are focused on the tasks that university teachers perform in higher education regarding students' participation. Results are obtained from a self-report inventory completed by 145 university teachers about their assessment activity regarding students' participation. From this survey, the tasks considered most important by respondents are "Reach a consensus with students about the assessment object (determine what to assess)" and "Promote students' participation through self-assessment (assessment of the student/group of students about their own tasks and activities)". The tasks that are perceived as least important: "Agree with students the marking procedure" and "Promote students' participation in the assessment design". Regarding the competence to carry out those tasks, teachers consider themselves least prepared to "Promote students participation through co-assessment" and "Promote students' participation in the assessment design".

Significance The significance of this review lies in its contribution to the reality of students' participation in assessment in Higher Education in the settings studied. Active student participation is an essential condition of assessment for learning, but regarding the results obtained in these research studies we will need to: a) Adjust university assessment regulation and norms so that they are aligned with the advances produced about assessment for learning. b) Promote the training of university teachers to increase their educational knowledge to put in practice assessment strategies as learning activities. c) Promote and facilitate the training of students so that they can be supported to develop informed judgments about quality learning in their discipline. d) Develop technological tools to facilitate the active participation of students in the assessment process. In brief, in the universities under discussion it is necessary to develop an alternative assessment culture. The progressive incorporation of strategies that encourage students' participation at university as self, peer and co-assessment will make a significant contribution to this paradigm shift. In the same vein is framed our contribution in Re-Evalúa project, in which we are training university teachers offering them technological tools, such as EvalCOMIX (Ibarra et al., 2010), that facilitate the participation in assessment. With the collaboration in national and international groups we hope that assessment practices can be progressively further developed.

REFERENCES Ibarra Sáiz, M. S. (Dir.) (2007). Proyecto SISTEVAL. Recursos para el establecimiento de un sistema de evaluación del aprendizaje universitario basado en criterios, normas y procedimientos públicos y coherentes. Cádiz: Universidad de Cádiz. Ibarra Sáiz, M.S. & Rodríguez Gómez, G. (2010). Aproximación al discurso dominante sobre la evaluación del aprendizaje en la universidad. *Revista de Educación*, (351), 385-407. Ibarra Sáiz, M. et al. (2010). EvalCOMIX en Moodle: Un medio para favorecer la participación de los estudiantes en la e-Evaluación. *Revista de Educación a Distancia*. Rodríguez Gómez, G. (Dir.) (2009). EvalHIDA: Evaluación de Competencias con Herramientas de Interacción Dialógica Asíncronas (foros, blogs y wikis). Cádiz: Universidad de Cádiz. Rodríguez Gómez, G. et al. (2010a). The participation of university students in assessment. *Proceedings of the European Conference on Educational Research*. ECER 2010 Helsinki. Rodríguez Gómez, G. et al. (2010b). Re-Evalúa: Comprobando el impacto de la e-Evaluación orientada al e-Aprendizaje en la universidad. In M.E. Prieto Méndez, J.M. Doderó Beardo, y D.O. Villegas Sáenz, *Recursos Digitales para la Educación y la Cultura. Actas CcITA-Volumen SPDECE*. Cádiz: Universidad de Cádiz y Universidad Tecnológica Metropolitana de México.

Sustainable feedback and the development of student self-evaluative capacities
Assessment methods, Assessment of Competence, Higher education

David Carless, University of Hong Kong, Hong Kong

This paper explores the notion of sustainable feedback: defined as feedback which informs the current task, whilst supporting students' abilities to develop their capacities to self-evaluate their performance independently of the teacher. The position taken is that only when students are developing increasingly sophisticated self-evaluative capacities are they in a position to use feedback productively. The research method involves classroom observations

and semi-structured interviews with a purposively selected award-winning teacher in the Faculty of Business in a research-intensive university. Student participants are also interviewed so as to gauge their insights into the teaching and learning process. The findings focus on selected classroom activities congruent with a framework of sustainable feedback. Students were generally positive about the classroom climate and the ways in which the teacher created classroom rapport which facilitated student participation. Related to this, trusting relationships between the teacher and the students, and between the students themselves supported practices of sustainable feedback. The significance of the paper lies in its contribution to re-conceptualizations of feedback as dialogic and interactive. Feedback is sustainable when it supports students to develop their ongoing capacities independently of the teacher. Implications for practice indicate the importance of teachers and students exploring the nature of quality work within the discipline.

Aims This paper highlights the student role in feedback processes as an important component of student participation in assessment. It builds on the notion of sustainable feedback (Carless et al., 2011; Hounsell, 2007) which prioritizes students' engagement with feedback so as to enhance their own self-evaluative capacities. This notion is a response to the multiple challenges of conventional feedback practices which are perceived by students as difficult to understand; lacking specific advice on how to improve; or difficult to act upon. Many of these problems are accentuated by the terseness and finality of one-way written comments within modularized systems. The notion of sustainable feedback is defined as feedback which informs the current task whilst supporting students' abilities to develop their judgment to self-evaluate their performance independently of the teacher. Central to sustainable feedback is dialogic feedback involving interactive exchanges in which interpretations are shared, meanings negotiated and expectations clarified. Dialogic approaches guide students on what is good performance by facilitating discussions of quality in relation to specific assessment tasks. The main objective of the paper is to probe the implementation of practices congruent with a framework of sustainable feedback. Through this exploration, the paper contributes to new ways of thinking about assessment and feedback.

Methodology The paper is based on a case study of an award-winning teacher in the Faculty of Business in a research-intensive university in Hong Kong. The objectives of the case study are to explore the strategies and underpinning rationale for sustainable feedback of the teacher. The first stage of the research process involved in-depth interviews with ten award-winning teachers in the university. The case of the teacher in the Faculty of Business was selected on the basis of the capacities of the teacher to implement practices congruent with a framework of sustainable feedback. The following research questions guide the investigation: RQ1 What sustainable feedback practices are observable in the practice of an award-winning teacher in the Faculty of Business? RQ2 What is the teachers' rationale for the practices which he adopted? RQ3 How are the students responding to the practices adopted? Two research methods are used: classroom observation and semi-structured interviews. Classroom observations are of 5 two-hour sessions taught by the teacher across two courses. The observation of selected classes is purposive on the basis of likely occurrence of practices congruent with the framework for sustainable feedback. Detailed field notes are collected. To obtain deeper understanding of the teacher's rationale for his teaching and feedback practices, three in-depth semi-structured interviews are carried out, before the course, during the course and at the end of the course. Individual interviews with 10 selected student participants provide their perspective of relevant classroom processes. Data were analyzed inductively using standard qualitative data analysis procedures, including coding, categorizing and respondent validation.

Findings The findings explore selected classroom activities which involved students in their assessment and had potential for developing their self-evaluative judgments. Oral presentations were part of the assessment for the course and were seen by the teacher as being a critical tool for a successful business career. A telling example was the use of video to record student oral presentations. Immediately after the presentation the teacher replayed short extracts and invited presenters to reflect on their performance. Interactive discussions ensued in which class participants engaged in reflections on the presentations. Through these processes, students were engaged in extending their appreciation of quality business presentations. Interviews with students revealed that trust was an important dimension facilitating and/or inhibiting student involvement and the development of self-evaluative capacities. Students noted that the teacher was able to construct an atmosphere in which students were encouraged to voice at length their opinions and that these contributions were perceived as being responded to and valued. Student confidence was more mixed, however, in relation to the ability of their peers to provide insightful critique of presentations. Concerns were also expressed about the time-consuming nature of these classroom activities which reduced the content coverage in the course.

Significance The significance of the study lies firstly in its contribution to the re-conceptualization of feedback in the direction of more dialogic less uni-directional orientation. Feedback is sustainable when it supports students to develop their ongoing capacities independently of the teacher. This notion prioritizes the student role in using productively the (inevitably) limited feedback which they receive. Trust is a factor which impacts on the implementation of sustainable feedback practices. A number of dimensions emerge: feedback requires lecturers and students to enter into a relationship of trust in which the former try to provide helpful comments that the latter attempt to use; peer feedback requires learners to place faith in others as they open up their performance to critique. The notion of trust is under-explored in relation to participative assessment and merits further attention. Finally, the study carries implications for the practice of

participative assessment. It is suggested that teachers should strive to conduct activities which illustrate the nature and characteristics of quality work within their discipline. Related to this, teachers and students may explore together good learning strategies within the discipline and how they might be further developed. References Carless, D., Salter, D., Yang, M., & Lam, J. (2011) Developing sustainable feedback practices, *Studies in Higher Education*, 36, 5 Hounsell, D. 2007. Towards more sustainable feedback to students. In *Rethinking assessment in higher education*, ed. D. Boud and N. Falchikov. London: Routledge.

H 13 01 September 2011 09:00 - 10:00 Room Peter Chalk Centre Newman B

SYMPOSIUM

Writing

The relationship between oral and written language

Keywords: Writing

Sig's: Writing

Chairperson: Sarah Critten, Oxford Brookes University, United Kingdom

Organiser: Sarah Critten, Oxford Brookes University, United Kingdom

Discussant: Barbara Arfe, Facolta di Scienze della Formazione, Italy

This symposium will share recent research elucidating the relationship between oral and written language to inform writing instruction in English and French. Writing a composition is a complex task drawing on a range of cognitive, motor and social skills; a task that many children and adolescents struggle with, particularly when linguistic difficulties are present (Graham & Harris, 2009). The symposium will begin with a longitudinal examination of the links between specific linguistic abilities and components of written text in a group of typically developing 7-9 year old children from the UK. The second paper will broaden the focus and discuss constraints for writing in children aged 9-10 years (also from the UK) with Specific Language Impairment (SLI) comparing their spelling attainment and nature of spelling errors in word and text level tasks to chronological age and language age matched controls. The final paper will also examine writing difficulties in children with language impairments but in a cross-cultural English-French comparison. An examination of the constraints on written text production is an essential step in developing and testing theoretical models of writing and in developing evidence based practice to help those with writing difficulties.

The Importance of Oral Language Skills for Component Writing Skills in 7-9 Year Old Children

Writing

Chloe Bate, University of Sheffield, United Kingdom

This presentation examines the relative importance of different oral language skills for component writing skills, in mainstream UK school children aged 7-9 years. Fifty-four monolingual children were tested at the end of Years 3 and 4 completing a written narrative task and standardised language, literacy and non-verbal cognition tasks. Written narratives were analysed using six components, derived from the UK National Curriculum: phonics and spelling; handwriting; sentence structure; punctuation; text structure and organisation; and composition and effect. Multiple regression analyses showed spelling and phonological processing were highly significant contributors and accounted for the most unique variance to all six writing components. Expressive language and vocabulary contributed highly significantly to the sentence structure, punctuation and composition and effect components. Results confirm the influence of spelling and phonological processing constraints on writing performance at this age while highlighting the importance of developing syntactic complexity orally to develop children's sentence structure, punctuation and composition skills in writing. The role of these oral language skills will be considered in relation to developmental writing models and the longitudinal data will add to our understanding of how particular oral language skills may support writing development within an educational setting

Background: Within any mainstream classroom, there will be a number of children with a range of language and literacy difficulties. Studies involving children with language impairments (e.g. Dockrell et al, 2007, Scott & Windsor, 2000) have highlighted the constraints of oral language difficulties upon written language. However, few studies have explored ways in which components of the oral language system can enhance or limit the production of written text (Dockrell and Connelly, 2009). Oral language is crucial for written language development: text generation involves turning ideas into units of language (Berninger et al., 1995), yet it is not specified as central in developmental writing models (Dockrell and Connelly, 2009) and it is still not clear how it impacts on different aspects of the writing process

(Connelly & Barnett, 2009). Indeed, little research has looked at explicit links between oral language and writing (Shanahan, 2006).

Aims: This presentation aims to explore the relationship between children's oral and written language skills. More specifically, it aims to examine the relative importance of different linguistic skills to component writing skills, in mainstream school children between the ages of 7 and 9.

Methodology: Fifty-four monolingual English-speaking children (F = 26, M = 28), in three mainstream UK schools with similar low socio-economic profiles were recruited and assessed at the end of year 3 (aged 7-8 years, mean age 8;4) and were assessed again at the end of year 4 (aged 8-9 years, mean age 9;4). The children completed a written narrative task, based on a picture prompt, as well as measures of phonological awareness, non-word repetition, expressive language (word structure, formulated sentences and recalling sentences subtests), receptive vocabulary, oral narrative, reading, spelling and non-verbal ability. Written narratives were analysed according to six different components, based on the UK National Curriculum assessment areas for writing: phonics and spelling; handwriting; sentence structure; punctuation; text structure and organisation; and composition and effect.

Because of the large number of independent variables and relatively small number of participants, a principal components analysis was carried out to group variables together that load on the same factor. This produced four factors: spelling and phonological processing (spelling, phonological awareness, non-word repetition); expressive language and vocabulary (the three expressive language subtests and receptive vocabulary); oral narrative (mean length utterance and content scores from the oral narrative measure); and non-verbal cognition (matrices and pattern construction subtests).

Findings: At the end of year 3 concurrent multiple regression analyses showed that these four factors together accounted for 70% of the total writing outcome. Spelling and phonological processing were highly significant contributors and accounted for the most unique variance to all six writing components. Expressive language and vocabulary contributed highly significantly to the sentence structure, punctuation and composition and effect components. Oral narrative contributed significant, unique variance to the punctuation and composition and effect components. Concurrent data from the end of year 4 will be presented, and the developmental role of linguistic skills in different component writing skills examined.

Theoretical and Educational Significance: Results from the end of year 3 concur with a developmental approach that lower level skills (e.g. spelling and phonological processing) impact on writing earlier (grades 1-3, aged 6-9 years), whereas language constraints may have more impact later (e.g. Abbott & Berninger, 1993). They also partly concur with a capacity approach, that automaticity in these lower level skills is needed before working memory capacity can be freed up for higher level compositional demands such as idea generation (e.g. Kellogg, 1996), highlighting the need for the embedding of these skills early on. However, the results also highlight the importance of developing syntactic complexity orally at this age (as measured by the expressive language sub-tests) to develop children's sentence structure, punctuation and composition skills in writing. These findings have implications not only for the role of oral language in relation to developmental models of writing, but also for teaching practice. The longitudinal data will illuminate how the relationships between oral and written language change over time. This will add to our understanding of how particular oral language skills may support writing development.

Writing development in children with language difficulties and the influence of spelling skill

Vince Connelly, Oxford Brookes University, United Kingdom; Sarah Critten, Oxford Brookes University, United Kingdom; Julie Dockrell, Institute of Education, United Kingdom; Kirsty Walter, Oxford Brookes University, United Kingdom

Children with specific language impairment (SLI) struggle with learning to write throughout schooling. They produce texts that are shorter with more spelling and grammatical mistakes in their writing. This study considers the relationship between the writing, spelling and oral language skills of children with SLI at age 10 and children of the same age and also children with the same language ability. It was found that type and amount of spelling mistakes were closely tied to compositional quality in writing across the groups. A detailed error classification of spelling mistakes revealed a subtle pattern of difference across groups. The children with SLI were producing more errors that were not developmentally appropriate and that differed from both their same age peers and, more interestingly, the language matched children. It was also found that children with SLI produced more non-phonologically based errors for derivational forms than either sets of control groups. The results are considered in relation to current developmental models of writing. The development of fluent spelling is critical for young writers and can significantly

constrain writing development in a number of ways. Spelling interventions need to be devised to the needs of the child and not just to their gross developmental level.

Aims:

Literacy development includes both learning to read and learning to write. Considerable advances have been made in understanding the cognitive processes underlying reading development, and this has led to effective interventions. In contrast, our understanding of the cognitive processes underpinning writing development is less advanced. Many children struggle with the production of written text especially those with language difficulties, who may be 'the most under identified and under deserved group at present' in schools. Unfortunately writing difficulties persist as an area of significant weakness for these children throughout their school careers and continues even when oral language narratives become age appropriate. There is little research into connections between writing and oral language and the ways in which language encoding processes support written text production especially beyond the single word level (Connelly & Dockrell 2009). As such, many models which purport to explain the writing difficulties of children with language difficulties are underspecified and the evidence base required for effective interventions is missing. There are powerful reasons to predict that oral language underpins the processes of text generation and that difficulties with oral language will constrain the development of written text production. Specific relationships between oral language competence and the production of written text have been reported both for children with continuing and those with resolved language problems, leading to the hypothesis that written language can be conceptualized as a window into residual language problems. Phonological processes impact directly on children's spelling while spelling is a prerequisite to extended text generation.

This study considers the relationship between the writing, spelling and oral language skills of a cohort of children with specific language impairment at age 10 and two cohorts of children; typically developing children of the same age and children with the same language ability.

Methodology.

Sample 1 consisted of 23 children with poor language skills (aged 10.5 years) matched with 23 children of the same chronological age (10.5 yrs) and 23 younger children (7.9 yrs) with the same language level. Children individually completed a range of measures including standardised writing and spelling tasks. The emphasis here was to examine spelling errors and links to competence in overall written text.

Sample 2 consisted of 34 children with poor language skills (aged 10.1 years) matched with 34 children of the same chronological age (10.1 yrs) and 34 younger children (8.2 yrs) with the same language level. Children individually completed a range of measures including standardised writing and spelling tasks with a particular focus on morphology. The children's use of both inflectional and derivational morphology was assessed in both the written and oral domains. Children also completed a number of tasks on a digital tablet that can be analyzed to determine differences in writing speed and other measures.

Findings

The children with language impairment showed no difference in overall spelling ability on a stand alone standardized spelling task compared to their language match controls but, as expected, they were significantly poorer than children of the same chronological age. In Sample1 we examined spelling within written composition and found that the children with language difficulties were producing the same proportion of spelling errors as their language matched peers and made significantly more mistakes than peers of the same age. However, a detailed classification revealed a more subtle pattern of errors. The children with language difficulties were producing more errors that were not developmentally appropriate and that differed from both their same age peers and, more interestingly, the language matched children. Using a scoring scheme developed from Silliman et al (2006) it was found that the children with language difficulties were significantly less accurate at producing correct letters and combining appropriate letter clusters when compared to the intended target words. Type and amount of spelling mistakes were closely tied to compositional quality in writing across the groups in Sample 1.

Sample 2 results focused in on the use of morphology in spelling. Here it was found that children with language difficulties were comparable to children of the same language age when it came to producing inflections in spelling. However, it was found that children with language difficulties produced more non-phonologically based errors for derivational forms than either sets of control groups. This mirrors similar findings in the oral domain for this population.

Theoretical and educational significance.

Children with language difficulties are particularly at risk for writing problems and the results are considered in relation to current developmental models of writing.

The children with language difficulties in our study were having great difficulty learning to write and the general writing support in schools was not sufficient to meet their needs. Two dimensions, vocabulary and spelling, that are both amenable to direct instruction (Hammill, 2004; Jitendra, Edwards, Sacks & Jacobson, 2004), accounted for a significant proportion of the variance in the children's written outputs. The development of fluent spelling is critical for young writers and can significantly constrain writing development in a number of ways.

Clear links between oral language competence, written spelling competence and overall writing quality were confirmed for children with language difficulties and importantly also with the control groups. The children with language difficulties had problems with the morphological aspects of spelling and in some cases this was worse than would be expected given their gross level of language ability.

Studies that aim to improve the writing of children with learning difficulties typically focus on the process of writing itself, including strategies related to such activities as planning, organizing, and revising (Graham, in press). These processes are linked to teaching children how to write. Our data suggest that for children with language difficulties addressing what to write and how to spell also continue to be important. Spelling interventions need to be devised to the needs of the child and not just to their developmental level as our error analysis illustrates subtle differences between groups that were seemingly matched.

Spoken and Written Narratives in French and English Speaking Children with Language Impairment

Judy Reilly, San Diego State University, United States; Jun O'Hara, San Diego State University, United States; Josie Bernicot, Universite de Poitiers-CNRS, France; Joel Uze, CRTL-Centre Hospitalier H.Laborit, Poitiers, France; Beverley Wulfeck, San Diego State University, United States; Mark Appelbaum, University of California, United States; Thierry Olive, Universite de Poitiers-CNRS, France; Monik Favart, Universite de Poitiers-CNRS, France

Children with Language Impairment (LI) show significant delays in spoken language development. The few studies on writing note continued problems with morphology; these are primarily English. In contrast to the impoverished and irregular morphology of English, French morphology is rich; but often silent, posing challenges for writing. Here, we focus on spoken and written narratives of American and French children and adolescents with LI and their controls (TD), addressing three issues: 1) Whether early problems with morphology persist and manifest in writing; 2) How performance differs in French and English; and 3) The role of complex syntax in narratives. Participants produced both spoken and written texts which were coded for measures of both Linguistic and Narrative structure. Despite morphological differences in English and French, LI groups displayed similar overall profiles: significantly more morphological errors than controls, and in the older groups comparable use of complex syntax to TD. For the LI groups, frequent use of complex subordinators, provides a coherent organizational structure for their texts. The juxtaposition of morphological and spelling errors to overall text coherence show an uneven developmental profile, common to both English and French adolescents with Language Impairment.

Aims:

Children with Language Impairment (LI) show significant delays in language development, but have apparently normal cognitive abilities. In spoken language, children with LI have difficulties in phonology, morphology and complex syntax. The few studies examining written discourse note continued problems with morphology; however, these studies are primarily with English speaking children. In contrast to the somewhat impoverished and irregular morphology of English, French morphology is rich; moreover, verb morphology, especially in -er verbs is silent, posing additional challenges for writing. Here, we compare spoken and written narratives of American (from California) and French (from Poitou-Charentes) children and adolescents with LI. Our research addresses the following questions: 1) Do early problems with morphology persist in both oral and written narratives? Is the profile comparable in the two languages and the two modalities (spoken/written)? 2) What is the role of complex syntax in narratives? And how does this manifest in children with LI in these two languages and modalities?

Method:

To address these questions, we have collected oral and written narratives from 16 French and 32 American children with LI (ages 7;00-16;00) and age/gender matched typically developing (TD) controls (32 French; 60 American). Children were asked to, "Tell about a time when you were mad or sad." After telling the story, they were asked to write about the same events. On completion of the written story, children could revise; then they re-read the texts aloud. Spoken narratives were transcribed using CHAT from CHILDES and Mirror transcripts were made for written stories. Both oral and written stories were coded for: 1) Language structure: length in propositions; type and frequency of morphological errors; frequency and types of complex syntax; 2) Narrative structure: setting, initiating

event, problem and resolution; quality of the setting (inclusion of place, time, situation); and written stories were also coded for Spelling: frequency and types of orthographic errors.

Results:

With respect to morphological errors, the challenge of the complex French written morphology is evident in the higher proportion of errors for all French speakers compared to their English speaking counterparts. However, the TD French group improves significantly with age whereas the LI group continues to make grammatical errors well into adolescence similar to their English speaking LI peers. For complex syntax, both the English and French children with LI in the younger groups (ages 7?11 years) used both fewer types and fewer tokens than controls. However, in the older groups (ages 12?16) both English and French LI groups used complex sentences with comparable diversity to the TD group. With respect to spelling, both groups of LI (English and French speaking), make more errors than their typically developing peers. Moreover, both the English and French TD and LI groups make fewer errors in adolescence. Interestingly in a qualitative study we found that whereas the errors in English from the LI group are word internal, such as, "uling" for ugly, the errors in French from the LI group also reflect problems with segmentation, as in, "Ses téê" for c' était, or "mavoler" for m'a voléê.

Theoretical and educational significance:

In sum, for the children and adolescents with Language Impairment, their persistent problems appear to be local, that is, predominantly in the morphology and spelling. More globally, the frequent use of complex subordinators that explicitly signal the relation between elements, provides a coherent organizational structure for their texts. The juxtaposition of local morphological and spelling errors and overall text coherence shows an interesting and uneven developmental profile that is reflected in both the English and French adolescents with Language Impairment. These findings have clear implications for designing interventions and educational policy regarding the importance of morphological knowledge in spelling instruction.

SYMPOSIUM

Philosophy with Children as Democratic Citizenship Education

Chairperson: Wiel Veugelers, University of Amsterdam, Netherlands

Organiser: Wiel Veugelers, University of Amsterdam, Netherlands

Discussant: Vivienne Baumfield, University of Glasgow, United Kingdom

In many schools programmes of Philosophy with Children have been introduced. These programmes focus on pedagogical goals as 'acquire argumentative competences', 'developing children's capacities as responsible citizens' and 'developing democratic skills and attitudes' and they include 'dialogical-reflective activities'. In this symposium three research groups will present their work. The research of Di Masi and Santi is on the 'Children Municipal Council' as 'a community of philosophical inquiry'. They focus on the capacity to judge moral arguments, the relationship between philosophical discussion and ability to understand and verbalize the emotions, and the ability to choose the arguments constructed on the others' idea.

Cassidy and Christie present a study on the 'Community of Philosophical Inquiry' approach. This approach emphasizes the quality of the philosophical dialogue, because 'one needs to challenge assumptions within one's life and the wider world.' The paper reports on the changes taking place in the children's ability to make informed choices and decisions and to articulate informed ethical views of complex issues.

Bartels, Onstenk and Veugelers present their research on 'Philosophy for Democracy'. The research involves questions and instruments on the different levels of the curriculum: abstract goals, curriculum material, operationalisation by the teachers, practice of the teachers, and experiences and effects on students. The first analysis shows that the programme is a democratic practice and that the children develop reasoning and dialogical skills.

The papers and the discussion adress the questions: what does the research say about effects of the programme, which elements of the programme contribute to these effects and in which way the programme prepares children for democratic citizenship.

Learning Democratic Thinking: Philosophy for Children as Citizen

Diego Di Masi, University of Padua, Italy

Marina Santi, University of Padua, Italy

This presentation presents the first results of wider research project aimed to develop a curriculum for citizenship to promote the competencies for an authentic participation, through the improvement of "community of philosophical inquiry" in school and town. The research follows the current debate that declined the word democracy in terms of

right to participate in deliberative process. If democracy means to participate in a public deliberation (Crocker, 2006; Sen, 2002), the democratic education turns around the development of those competences and capabilities (Sen, 1998) that enable such deliberation. In this approach democratic education is, first of all, to support participation opportunities to acquire argumentative competences (Audigier, 2005, Santi 2006).

The research is guided by the idea that the dialogical-reflective activities in "community of philosophical inquiry" based on constant practices of argumentation, negotiation and shared deliberation, improve the acquisition of the procedural citizenship's skills (Audigier, 2005). In the research the experiences of Municipal Councils has been conjugated with the P4C tradition and its world-wide scientific results in order to offer a possible educational design based on concrete practice of participation in democracy. Following the Philosophy for Children (P4C) programme, the Municipal Council of Children and the elected members' classroom had been converted in a "community of philosophical inquiry" to propose dialogical-reflective activities based on constant practice of argumentation, negotiation and shared deliberation, to improve the acquisition of those attitudes and skills useful in deliberative dialogue (Walton, 1996; Gregory, 2007). The inquiry approach becomes a methodology to improve the "complex thinking" (critical, creative, and care) and to improve the competences needed to participate in the present and future of democratic process (Lipman, 2003; Santi, 2006).

The project represents an implementation of Art. 12 of the UN Convention on the Rights of the Child and an educational design that takes in account the European Project "Education to Democratic Citizenship" framework. In according with the idea that the children is an agent, a subject able to act with others in order to construct his reality and chance his word, an Education to Citizenship programme have to foster moral and cognitive competences, supporting the opportunities, like as the Children Municipal Council, to develop the children's autonomy. The Children Municipal Council could be considered as a model of participatory democracy, in which children voices could be formed, expressed and taken into account to reach a consensus, participating to deliberative processes based on democracy of thinking and doing. At the same time the Municipal Council of Children can be interpreted as an activity to develop in the children involved their argumentative skills.

In the research the experiences of Municipal Councils has been conjugated with the P4C tradition and its world-wide scientific results in order to offer a possible educational design based on concrete practice of participation in democracy. Following the Philosophy for Children (P4C) programme, the Municipal Council of Children and the elected members' classroom had been converted in a "community of philosophical inquiry" to propose dialogical-reflective activities based on constant practice of argumentation, negotiation and shared deliberation, to improve the acquisition of those attitudes and skills useful in deliberative dialogue (Walton, 1996; Gregory, 2007). The inquiry approach becomes a methodology to improve the "complex thinking" (critical, creative, and care) and to improve the competences and dispositions needed to participate in the present and future of democratic process (Lipman, 2003; Santi, 2006).

The main research hypothesis is that "community of philosophical inquiry" as method and context which fosters argumentative thinking and its reflective and judgement dimensions, could be useful to develop the competences needed for meaningful and active participation of children in the Municipal Council and in the democratic life.

The aim is to transform the Council in a learning community and to support this experience through coordinated educational actions which start in the elected members' school and classroom context and activities. In this way school and town became a real enlarged "citizenship community" in which competences and dispositions to participate in the present and future of democracy are scaffolded and the charge and responsibility for thinking and reasoning are shared and distributed (Brown & Campione, 1996; Resnick, Levine & Teasley, 1990; Salomon, 1996). According to Kline (1998), when children have the opportunity to initiate and evaluate arguments, hear others make and examine arguments, and participate equally in resolving disputes, children improve their argument skills. P4C community of inquiry in the classrooms and Session in Municipal Council are both opportunities and contexts in which to apply and develop these skills.

The paper presented deals with these objectives: Develop in the children involved in the research, fundamental procedural skills implied for the realization of a democratic participation, such as the argumentative ones (Santi, 2006; Audigier, 2005). Promote the development of "caring thinking" (Lipman, 2003) fostering moral judgment (in its affective and cognitive dimensions) through the philosophical dialogue in the community of inquiry.

Method

Setting and subjects: The project regards a Children Municipal Council of a town situated in North-East Italy. The Council involves 40 children elected by peers from their school, distributed along the 6 educational district of the city. The project involves the classrooms of the 40 children elected (around 450 subjects, from 5th to 8th grade – 9 to 13

years old): in each classroom (22 classes) the P4C Program is implementing (1 hour/week, during 9 months, under the supervision of a CoI facilitator, expert trainers in Philosophy for Children), using specific materials created for the project, which follow the structure proposed in the P4C Curriculum.

Data collection and analysis: the research has the aim to evaluate the impact of the P4C program on the children elected, while they participate in deliberative processes during the activities of Municipal Council. To test the main research hypothesis a mixed method (quantitative and qualitative) is adopted using various instruments. In this presentation will presents the quatitative results.

1. Moral Judgement Test (Lind, 1979) to analyze how the philosophical discussion affects the capacity to judge moral arguments.
2. SAR (Baiocco, Giannini, Laghi, 2005) to study the relationship between philosophical discussion and ability to understand and verbalize the emotions.
3. Best Reasoning Test (Kunh, 2006; Santi and Giolo, 2008) to measures the ability to choose the arguments constructed on the others' idea.

Results and Discussion:

A first part of the data collection is already analysed (pre-interviews and pre-test on argumentation competences) and the first results show as the philosophical dialogue improve the consistency in moral judgement, the level of empathy and the capacity to develop a argumentative strategy based on the valorisation of others'ideas for the "commitment" in dialogue.

Brown, A. L., Palincsar, A.S., (1989) Guided cooperative learning and individual knowledge acquisition. Resnick L.B. (Ed.), *Knowing, learning and istruction: Essay in honor of Robert Glaser*, NJ: Erlbaum.

Crocker, D. (2006), *Sen and Deliberative Democracy*, in Kaufman, A. (a cura di) *Capabilities Equity: Basic Issue and Problem*, Routledge, New York

Dewey, J. (2004), *Democrazia e Educazione*, Sansoni, Milano

Di Masi, D. (2010), *Educare alla cittadinanza dialogando: il ruolo del curriculum implicito*, Magma, Vol 8 n±2

Ennis, R.H. (1962), A concept of critical thinking. *Harvard Educational Review*, 32, 81-111

Gregory, M. (2007), A Framework for Facilitating Classroom Dialogue.' *Teaching Philosophy* 30, 59-84

Lind, G. (2008), The meaning and the measurement of Moral Judgment Competence, in Fasko, Daniel &

Lipman, M., (2003), *Educare al pensiero*, tr. it., Vita e Pensiero, Milano

Losito, B. (2009), *La costruzione delle competenze di cittadinanza a scuola: non basta una materia*, Cadmo, anno XVII, 1

Resnick L.B., Levine J., Teasley S.D. (eds.) (1991), *Perspectives on socially shared cognition*, Washington DC: American Psychological Association.

Salomon G. (Ed.) (1993) *Distributed Cognitions. Psychological and educational considerations*, Cambridge: Cambridge University Press.

Santi, M. (2006), *Ragionare con il discorso*, Liguori, Napoli

Santi, M., (2007), *Democrazia e ricerca: l'internalizzazione di regole collaborative entro la "comunità di discorso" filosofica*. Atti del V Congresso Scientifico della SIRD, pp. 241-256.

Community of Philosophical Inquiry: Citizenship in the Classroom.

Claire Cassidy, University of Strathclyde, United Kingdom; Donald Christie, University of Strathclyde, United Kingdom

The context for the study was the current curriculum reform in Scotland (Curriculum for Excellence) which demands that teachers enable children to become 'Responsible Citizens'. This paper reports a study which aimed to evaluate the use of Community of Philosophical Inquiry (CoPI) as a pedagogical tool to enhance citizenship attributes in Scottish children in a range of educational settings. Before and after an extended series of CoPI sessions, the children were presented with dilemmas designed to elicit responses which indicated their ability to make informed choices and decisions and to articulate informed, ethical views of complex issues. The sessions were facilitated by the class teachers who were trained in CoPI. Changes in these teachers' understandings of citizenship and pedagogy over the course of the study were also examined. The implications both for education for citizenship and the potential of Philosophy with Children to contribute to an enhanced school curriculum will be discussed.

The reformed school curriculum in Scotland (Curriculum for Excellence, Scottish Executive, 2004) calls upon teachers to encourage children and young people to become 'Responsible Citizens'. This entails children being able to: develop knowledge and understanding of the world and Scotland's place in it; understand different beliefs and cultures; make informed choices and decisions; evaluate environmental, scientific and technological issues; develop informed, ethical views of complex issues. The present paper reports how McCall's Community of Philosophical Inquiry (McCall, 1991) is being used to achieve these goals in a range of educational contexts.

There is a strong body of evidence in support of the educational value of doing Philosophy with Children (PwC) (e.g. Lipman, 2003; Garc a-Mori  n, Rebello & Colom, 2005; Cassidy, 2007; Daniel, 2008; McCall, 1991, 2009). The use of PwC is growing globally and variations and developments of Lipman's original practice have emerged. Garc a-Mori  n, et al. (2005) carried out a meta-analysis of over one hundred international empirical studies and concluded that doing philosophy with children had a positive impact on children's learning and, in particular, on their development of higher order thinking skills, an essential pre-requisite for critical citizenship (McCall, 1991; Gregory, 2008). The present study explores the value of PwC in relationship to education for citizenship specifically.

Aim

The principle aim of the present study was to evaluate the effectiveness of the Community of Philosophical Inquiry (CoPI) approach in developing children's capacities as responsible citizens. The study also was designed to explore teachers' understandings of citizenship and the pedagogy associated with the CoPI approach.

Methodology

The study involved eight teachers as co-researchers. All the teachers had received training in CoPI through a university postgraduate certificate course and worked across a range of educational sectors. Children were presented with a series of age-appropriate vignettes containing dilemmas designed to assess the children's ability to make informed choices and decisions and to develop informed, ethical views of complex issues. These vignettes were presented by the teachers as part of normal classroom activity both before and after a series of CoPI sessions that took place throughout the course of an academic year. The children responded to the vignettes individually and then in groups on both occasions. Teachers were encouraged to involve their children in at least two CoPI sessions per month throughout the year. A sample of CoPI sessions were recorded and transcribed for analysis. After completing the final vignette activity a sample of children were interviewed in order to elicit their reflections on their own learning and the degree to which they felt they had developed self-efficacy, personal agency and the capability to engage as a citizen.

McCall's Community of Philosophical Inquiry (CoPI) differs from other PwC practices in that its structure is consistent and does not vary according to the age or composition of the group participating. The facilitator presents a stimulus in response to which participants generate questions. The facilitator selects the question to initiate the dialogue (Cassidy, forthcoming). The structure of CoPI demands that participants make connections with previous contributions by agreeing or disagreeing with previous speakers while also providing reasons for that agreement or disagreement before expanding with their own contribution. The emphasis is on the quality of the philosophical dialogue as opposed to the need to reach a conclusion or consensus, thus allowing further consideration of the topic beyond the time of a single CoPI session while also promoting the notion that one needs to question continually and challenge ideas and assumptions within one's life and the wider world (Cassidy, 2007; McCall, 2009). The inclusiveness of the structure aims to engender respect for others' views, an appreciation of ideas and meanings as well as the need to be reflective in one's life. Thus, by equipping children and young people with the tools with which to engage critically with the world around them, CoPI aims to empower children to become more active, participative and political individuals (Cassidy, 2007, 2008).

Teachers were asked to define citizenship both at the beginning and the end of the study. The teachers also maintained reflective logs throughout the year in which they recorded critical incidents (e.g. Tripp, 1993) which highlighted aspects of citizenship behaviour on the part of the children. This revealed the ways in which teachers' understanding of the concept of citizenship evolved over the course of the year.

Findings

The paper will report on the changes taking place in the children's ability to make informed choices and decisions and to articulate informed, ethical views of complex issues as reflected in their responses to the dilemmas presented before and after engaging in regular sessions of CoPI. The changes in teachers' understandings of citizenship and pedagogy associated with CoPI will also be discussed together with illuminative examples from the children's dialogues recorded during CoPI sessions. Implications both for education for citizenship and the potential of PwC to contribute to an enhanced school curriculum will be discussed.

Cassidy, C. (2007). *Thinking Children*. London: Continuum.

Cassidy, C. (2008). Philosophical citizens – a contradiction in terms? *Critical & Creative Thinking*, 16 (2), 5-21.

Daniel, M-F. (2008). Learning to philosophize: positive impacts and conditions for implementation. A synthesis of 10 years of research (1995 – 2005). *Thinking* 18 (4), 36 – 48.

Garc a-Mori n, F., Rebello, I. & Colom, R. (2005). Evaluating Philosophy for Children: a meta-analysis. *Thinking* 17 (4), 14 – 22.

Gregory, M. (2008) Philosophy in schools: ideals, challenges and opportunities. *Critical and Creative Thinking*. Vol. 16 (1), 8-15.

Lipman, M. (2003). *Thinking in Education* (2nd edition). New York: Cambridge University Press.

McCall, C. (1991). *Stevenosn Lectures on Citizenship*. Glasgow: Glasgow University Press.

McCall, C. (2009). *Transforming Thinking*. London: Routledge.

Scottish Executive (2004). *A Curriculum for Excellence*. Edinburgh: Scottish Executive.

Tripp, D. (1993). *Critical Incidents in Teaching: Developing Professional Judgement*. London: Routledge.

Philosophy for democracy

Rob Bartels, Hogeschool INHOLLAND, Netherlands; Wiel Veugelers, University of Amsterdam, Netherlands; Jeroen Onstenk, INHOLLAND Professional University, Netherlands

Philosophy for Democracy is a research project which aims to examine whether, in what way and to what extent Philosophy with Children contributes to the development of democratic skills and attitudes. The research outline is based on the curriculum theory as conceptualized by Goodlad who divides the curriculum into six levels. We used Goodlad's theory to research the development and implementation of a programme for philosophy of education. The first two levels, the ideal and the formal curriculum, consist of a study on P4C theory and on the learning material that has been developed. The second two levels, the interpreted and the operational curriculum, concern the teachers: how do they interpret Philosophy with Children, and what do they do in practice? The last two levels, the experienced and the effected curriculum, concern the children: what do they do in the Philosophy sessions, and what learning processes can be identified to contribute to democratic development? Philosophy for Democracy has been carried out in four Dutch primary schools where Philosophy is a regular practice. Through interviews, observations, registrations and analyses of philosophical inquiries, and questionnaires, we have collected the required data. The first findings of the study show that Philosophy with Children is a democratic practice and that children develop relevant reasoning and dialogical skills.

Philosophy for Democracy is a research project which aims to examine whether, in what way and to what extent Philosophy with Children contributes to the development of democratic skills and attitudes. It has been carried out in four primary schools in the Netherlands. Philosophy with Children, in the way we now find this in most European countries, has its origins in the work of the American philosopher Matthew Lipman. Lipman developed a theory, a methodology and a curriculum for Philosophy with Children. He explicitly places Philosophy with Children in the perspective of the democratic society. A democratic society like ours, Lipman argues, must do everything in its power to educate its citizens to become reasonable individuals. (Lipman, 1991). In a democratic society it is not sufficient for individuals to be rational in nature, i.e. for them to be able to argue in a mechanical and strict manner, as they also need to be capable of adapting to one another's thinking skills and abilities. Nor is it enough for individuals to be knowledgeable in a range of fields if they are not capable of applying this knowledge in the correct way. In a world that is constantly changing, a world that is increasingly multicultural, it is important to ensure that individuals develop into people with an advanced ability to judge. Two of the main goals of Philosophy with Children are: developing thinking skills and judiciousness of children, and the development of the dialogue (Sasseville, 2003).

Aims

Philosophy with Children can have an important contribution to Citizenship Education. To achieve this, a Philosophy programme for the primary school was developed in the Netherlands under the name of 'Filosoferen doe je zo' (Philosophising is done like this) (Bartels & Rossum van, 009). The main objective of the programme is the development of democratic skills and attitudes. The programme aims to contribute to the development of competencies, which are important for democratic citizenship. Philosophy with Children can be a democratic practice, a learning environment at school where children can practice democracy. Philosophy with Children is based on principles such as: children are equal, they consult and engage in dialogue with each other, they form an opinion on the basis of arguments and by themselves and differences of opinion are appreciated. The objectives and principles of Philosophy with Children are ambitious. Can these can have these pretensions be realised? Can we - in the practice of philosophising with children - perceive that children indeed acquire democratic citizenship competences?

Methodology

The research outline is based on the curriculum theory of Goodlad (1979) and others (Akker van den, 2003). The assumption of this theory is that a curriculum is active on – and can be analysed in – six levels. The first two levels, the ideal and the formal curriculum, consist of a study on P4C theory, the Lipman at pproach in particular, and of the

material that is used in the classroom. In this case the recently developed programme 'Filosoferen doe je zo' (Philosophising is done like this). The main objective of this programme is to develop democratic skills and attitudes. The second two levels, the interpreted and the operational curriculum, concern the teachers: how do they interpret Philosophy with Children, what are their objectives? How do they see their role? And on the operational level the question is: what do they do in practice?

The research has been carried out in four Dutch schools, which have been practising philosophy for several years, and which have worked with the programme on a regular basis. 300 children have participated in the study. With different methods we collected data on the distinguished levels. We used questionnaires and interviews to identify teachers' interpretation of Philosophy with Children. Furthermore, sixteen sessions of Philosophical Inquiry were observed, recorded and fully transcribed for an iterative process of content analyses. This was done not only to record the pedagogical actions of the teacher, but also to observe the actions of the children. The last two levels, the experienced and the effected curriculum, concern the children: what do they do in the Philosophy sessions, and what learning processes can be identified that contribute to democratic development? In addition to the recordings of the sessions, the participating children evaluated the inquiry afterwards. The research was finalised with an overall questionnaire for the children to evaluate the effects of philosophising.

Findings and relevance

Until recently, little systematic and empirical research has been carried out on the practice of Philosophy with Children in the framework of children's moral and social development. There is recent research in Scotland in which the development of thinking skills and those of the dialogue during philosophising, as well as the acquisition of social skills, was studied (Trickey, 2007). In Flanders and the Netherlands studies have been 'carried out', in which the effects of philosophising on the social climate in the classroom were investigated (Anthone, 2005; Bartels, 2007). The results of these studies gave strong indications that philosophising with children can contribute to democratic citizenship education. The research project Philosophy for Democracy builds on these former studies. The first findings in the present phase of the study (October 2010) show that Philosophy with Children is a democratic practice and that children develop relevant reasoning and dialogical skills. At the time of the symposium most of the data will have been analysed and can be presented. The paper will provide a understanding of the place Philosophy with Children can have in citizenship education.

Akker, van der J. (2003). Curriculum perspectives: an introduction. In Akker, van der J. , Kuiper, W., & Hameyer, U (Eds.), Curriculum Landscapes and trends (1 - 10). Dordrecht: Kluwer.

Anthone, R. (2005). Verborgen gedachten (Hidden thoughts). Brussel: Initia.

Bartels, R. (2007). Kinderen leren filosoferen (Children learn to philosophise). Utrecht: Agiel.

Bartels, R., & Rossum van, M. (2009). Filosoferen doe je zo (Philosophising is done like this). Budel: Damon.

Goodlad, J. I. (1979). Curriculum Inquiry. New York: McGraw-Hill Book Company.

Lipman, M. (1991). Thinking in education. Cambridge: Cambridge University Press.

Sasseville, M. (2003). Filosofie voor kinderen (Philosophy for Children). Alkmaar: Centrum voor Kinderfilosofie.

Trickey, S. (2007). An evaluation of the 'thinking through philosophy' programme. Clackmannanshire: School Council.

SYMPOSIUM

Deconstructing knowledge construction: Multiple perspectives on identifying knowledge elements

Chairperson: Shulamit Kapon, University of California Berkeley, United States

Organiser: Shulamit Kapon, University of California Berkeley, United States

Mariana Levin, Michigan State University, United States

Discussant: Ferenc Marton, Goteborg University, Sweden

Learning takes place in a wide-variety of contexts and is mediated by many factors. The nature of that which changes as people learn—the organization of individual knowledge systems—remains of fundamental interest. Many researchers take a complex systems approach to conceptualizing the nature of individual knowledge. However, within this general perspective, researchers have different approaches and methodologies for describing the nature and form of the component parts of knowledge systems and how they interrelate.

The goals of this session are to (1) examine a range of methodological approaches to studying the construction of knowledge in the context of mathematics and science education, (2) to highlight differences, and (3) to try to provide a synthetic picture of the current understanding about knowledge constructs and their relation to learning. Presenters will elaborate their perspectives on what knowledge elements are and how they identify them in empirical data. Related questions include: What exactly is changing as knowledge is constructed? How does examining the

structure/content of knowledge at the level of elements help us get a better understanding of particular classes of learning processes and difficulties?

The session brings together researchers from three different research perspectives (Grounded Theory, Abstraction in Context, and Knowledge in Pieces) across multiple disciplines (mathematics, physics, and chemistry) with long-standing interest in developing tools to understand processes of knowledge construction. The discussant will add an additional perspective, drawing out points of contact and divergence between the approaches taken in the symposium and phenomenographical approaches.

The place of 'grounded' approaches to modelling the learner's cognitive resources and structure

Keith Taber, University of Cambridge, UK, United Kingdom; Mariana Levin, Michigan State University, United States

Grounded Theory, GT, was said to offer a 'scientific' approach to social research, moving from open-ended enquiry to tested theory. Yet, because of the characteristics of GT, there are very few genuine GT studies. However, GT approaches can inform research when understood to refer to a research programme rather than individual studies. This issue is of particular importance in research into aspects of learning that seek to model knowledge elements, conceptual structures, learning pathways and the like. There is a tension here between studies on individuals or small samples of participants – that can seldom be assumed to represent wider populations – and the desire to build up models that have generality. Our understanding of the grain-size, stability and interlinking of knowledge elements, is not currently well advanced. At this stage what is indicated are sufficiently in-depth studies of individual learners to allow us to build tentative models ground in the data (by an inductive analytical approach) to inform further work. Such exploratory studies will inevitably interpret and report data in somewhat idiosyncratic ways. However, within the research programme, such models can be tested by 'theoretical sampling' - across learner groups, contexts, etc. - to develop generally applicable models.

This presentation will consider methodological approaches for modelling knowledge structures, and conceptual learning in science. In particular, the rationale for employing in-depth case studies, with grounded perspectives on analysis in a 'scientific' field looking to develop general models to inform teaching, will be examined. Grounded Theory (Glaser & Strauss, 1967; Taber, 2000), GT, was said to offer a 'scientific' approach to social research, moving from open-ended enquiry to tested theory. Yet, because of the characteristics of GT (e.g. open-ended design, commitment to continuing 'theoretical sampling' until 'saturation' is reached), there are very few genuine GT studies. However, GT approaches can inform research when understood to refer to a research programme rather than individual studies.

An important feature of research is consistency between (i) the ontology assumed as part of the conceptual framework; (ii) the epistemological assumptions about what it is possible to find out; (iii) the specific focus or research questions deriving a study; and (iv) the methodology applied to collecting and analyzing data.

It is common to dichotomise research approaches according to various paradigmatic descriptors - positivist-interpretive, quantitative-qualitative; nomothetic-idiographic, for example, (Gilbert & Watts, 1983; Taber, 2007) - although some of these distinctions are questionable. As natural science is widely considered to have entered a post-positivist phase (NRC, 2002; Taber, 2009), it is acknowledged to inevitably involve interpretation - even though objectively is maintained as an aspiration and ideal. Similarly, the distinction between so-called quantitative and qualitative research seems mislabelled (being primarily about the inclusion of statistical hypothesis testing rather than quantification). Many researchers have rejected the notion that these descriptors represent incommensurable paradigms, which individual researchers must adopt as a 'paradigm for life'. Sometimes this rejection may be associated with notions of 'pragmatism', and the adoption of so-called 'mixed methods' research (Johnson & Onwuegbuzie, 2004). However, if this leads to a spirit 'anything goes', this can easily lead to a loss of the coherence characteristic of rigorous research.

This issue is of particular importance in research into aspects of learning that seek to model knowledge elements, conceptual structures, learning pathways and the like. There is a tension here between studies on individuals or small samples of participants – that can seldom be assumed to represent wider populations – and the desire to build up models that have generality. This tension is not a new phenomenon: it is reflected in Piaget's programme to build models of the epistemic subject (Piaget, 1972).

A better way to dichotomise research is in terms of exploratory and confirmatory studies (Biddle & Anderson, 1986). At different stages in a research programme, different ontological and epistemological commitments will be appropriate, according to the status of (and level of empirical support for) constructs, theories and models (Lakatos, 1970). Exploratory studies acknowledge that we still have very tenuous understanding of a phenomenon and seek to

build theory. Confirmatory research comes later, once exploratory research is able to offer well-motivated models for testing. A key feature of exploratory work is that it does not seek to test specific models or theories, or even adopt in advance particular concepts and constructs to make sense of data. In other words, it takes a grounded approach. That said, it is recognised that there is a limit to which an analyst can ever approach data with a totally open-mind. Indeed, the extent to which it is desirable to attempt to exclude the influence of existing theoretical ideas from a GT analysis is contended in the literature of GT methodology itself (Glaser, 1978; Glaser & Strauss, 1967; Strauss & Corbin, 1998).

The argument then is that our understanding of the grain-size and stability and structural interlinking of knowledge elements, and even of the extent to which such characteristics will be homogenous within an individual mind, is not currently well advanced (Taber, 2008). Certainly in science education this is reflected in the wide range of terms used in research to describe conjectured and reported knowledge elements. Much of this literature is very vague about exactly what the nature of the reported entities (misconceptions, alternative conceptions, intuitive theories) are, and so offers a limited basis for building up a solid understanding – for example to inform further research (Taber, 2009, Forthcoming). At this stage of the research programme (Taber, 2009), what is indicated is sufficiently in-depth studies of individual learners to allow us to build tentative models to inform further work. Clearly once such research is far enough advanced, the methodological pendulum will swing to indicate different forms of research that are able to test out the generality of such models in broader populations, and beyond the atypical, intense elicitation context of much case-study research.

This programmatic perspective will be illustrated with examples from research into students' understanding of basic chemical ideas. Here, features of student thinking identified in in-depth interviews have been followed-up through work using instruments more suitable for survey work, and in different educational contexts. Additionally, ideas about the grain-size and location within the cognitive system of particular conceptual resources deriving from physics education research have been used to interrogate data from chemistry education.

A genuine research programme will rely upon detailed investigation of thinking, across contexts, across time, that will allow us to identify what exactly knowledge elements are, how they change, how they link etc. Such exploratory studies that seek to build models ground in the data (by an inductive analytical approach) will inevitably interpret and report data in somewhat idiosyncratic ways (compare, for example, Caravita & Hallden, 1994; diSessa, 1993; Harrison & Treagust, 2000; Petri & Niedderer, 1998). Given the inevitability of individual analysts and teams being influenced by their own prior training and reading, this should be welcomed, as providing a suitably diverse set of models for further testing. Only when models from such exploratory studies have been selected and developed through considerable further testing against new data (the 'theoretical sampling' of GT) by different research groups might they become suitable as the basis for general claims about human knowledge and learning.

Abstraction as construction and partial construction of knowledge

Tommy Dreyfus, Tel Aviv University, Israel; Rina Hershkowitz, Weizmann Institute of Science, Israel; Gila Ron, Tel Aviv University, Israel

Abstraction in Context, or AiC, is a theoretical and methodological approach for investigating the constructing of knowledge. The development of the approach was led by the need for analysing and interpreting data that pointed to constructing of mathematical knowledge by means of mathematical thinking.

The main characteristics of the approach are:

- Abstraction is considered as a process of emergence and consolidation of knowledge constructs that are new to the learner, within the mathematics itself and by mathematical means.
- Processes of abstraction are investigated by longitudinal fine-grained observations, their analyses and interpretation.
- The above analyses and interpretation make theoretical as well as methodological use of a model of three nested observable epistemic actions, the RBC-model.
- The emergence of Partially Correct Constructs, or PaCCs - constructs that only partially match corresponding intended knowledge elements, is an important and natural process typically occurring during processes of abstraction.
- The RBC-model is appropriate to describe and analyse the emergence of PaCCs.
- The study of PaCCs is based on a priori content analysis of intended constructs, and this content analysis is often refined by the study of the emergence of PaCCs.

Abstraction in Context or AiC (Hershkowitz, Schwarz & Dreyfus, 2001; Schwarz, Dreyfus & Hershkowitz, 2009) is an empirically based approach to abstraction in mathematics education motivated by our need to give theoretical expression to the specific characteristics of our data. These data point to learners' constructing of knowledge by

means of mathematical thinking in contexts differing by their mathematical content and task type, social setting, and available tools.

Accordingly, we consider abstraction as a process of emergence of knowledge by "vertical mathematization" (Treffers & Goffree, 1985), specifically the emergence of new (to the learner) mathematical constructs within mathematics itself and by mathematical means. This view of abstraction follows van Oers (2001) in negating the role of decontextualization in abstraction, and embraces Davydov's dialectic approach (1990) in that it proceeds from an initial unrefined first form to a final coherent construct in a dialectic two-way relationship between the concrete and the abstract.

Activity theory (Leont'ev, 1981) proposes an adequate framework for processes that are fundamentally cognitive while taking into account their mathematical, historical, social and learning contexts. According to activity theory, outcomes of previous activities naturally turn to artefacts in further ones, a feature which is crucial to trace the genesis and the development of abstraction through a succession of activities. The kinds of actions we found to be relevant to abstraction are epistemic actions – actions that pertain to the knowing of the participants and are observable by researchers.

In our model, the epistemic actions serve as theoretical framework as well as methodological tool (Hershkowitz, 2009). The actions and the ways in which they are nested represent the process of abstraction. We found three epistemic actions useful for our purposes. Recognizing takes place when the learner recognizes that a specific previous knowledge construct is relevant to the problem he or she is dealing with. Building-with is an action comprising the combination of recognized constructs (whence R-actions are usually nested in B-actions), in order to achieve a localized goal, such as a justification or the solution of a problem. Constructing consists of building-with previous constructs (whence B- and R-actions are nested in C-actions) to produce a new construct, for example by assembling and integrating previous constructs by vertical mathematization.

Every epistemic action carried out by a learner is an action on one or several specific constructs within a given learning context. B-actions and C-actions act on previously known constructs; C-actions result in new (to the learner) constructs whereas B-actions do not. Constructing refers to the first time the new construct is expressed by the learner, possibly without full awareness.

While constructs are not observable, epistemic actions that refer to these constructs are expressed by the learner's utterances and behaviour and hence observable. In our micro-analysis, we consider the epistemic actions and the constructs they refer to. In this sense the RBC-model serves as a methodological tool. For example, epistemic actions can serve as tracers of active and emergent constructs.

Our a priori analysis of the learning design aims at identifying the intended constructs toward which the learning is purposely designed, and which we call (knowledge) elements. Elements can be mathematical concepts, methods, strategies, and so on. They are agreed upon notions underlying the learning context; they are not absolute but relative to an instructional activity. Our analysis of transcripts of learning events then focuses on identifying specific learner actions as R, B or C-actions on this learner's constructs that reflect these elements. Comparing intentions of the design with learner constructs may lead to modifications of our a priori list of elements, for example to the inclusion of alternative constructs.

Unsurprisingly, learners' emerging knowledge constructs do not necessarily fit the designer's intentions. We use the notion partially correct construct or PaCC for a construct that only partially matches a corresponding intended knowledge element. Here the elements intended by the design are used as the whole with respect to which a learner's constructs may be partial. Learners with PaCCs may show behaviour that is misleading or inconsistent, as our research demonstrates (Ron, Dreyfus & Hershkowitz, 2006, 2010).

Using the epistemic actions as tracers, the RBC model allows us to identify not only the existence of PaCCs but also their emergence and their nature. We distinguish between two categories, structural PaCCs and contextual PaCCs. In structural PaCCs the fit between the building blocks (or their connections) of the learner's construct and those of the element is partial. We found evidence of three types of structural PaCCs: missing-element PaCCs, incompatible-element PaCCs and disconnected-element PaCCs. In contextual PaCCs the partiality of the fit between the learner's construct and the element lies in the learners' (lack of) sensitivity to the boundaries of the context in which the construct is appropriate and necessary. We found evidence of two types of contextual PaCCs: narrow-context PaCCs and wide-context PaCCs.

In addition to identifying general types of PaCCs, as well as individual learners' PaCCs that can help understanding their behavior, the study of PaCCs also contributes to the refinement of the content analysis, by pointing to fine-grained constituent elements that may be absent from some learners' constructs.

Several characteristics of AiC are essential to the study of PaCCs. The study of PaCCs starts from a priori content analysis, while the researcher who traces the learning process, using the RBC actions as tracers, focuses on the learners' emerging constructs and their expression in the constructing of new knowledge, rather than on the content domain elements. This combination, together with the dynamically nested nature of the RBC model, enables tracing a construct, and identifying cases in which a learner's construction of an idea precedes the construction of its constituent elements, as well as various types of partial fit between intended knowledge elements and learner constructs.

Developing methodological principles for validating accounts of knowledge in use and in development

Shulamit Kapon, University of California Berkeley, United States; Mariana Levin, Michigan State University, United States; Andrea diSessa, University of California, Berkeley, United States

In this paper, we discuss methodological issues involved in studying the organization of individual knowledge systems using the Knowledge in Pieces epistemological perspective (diSessa, 1993). Knowledge in Pieces (KiP) is a powerful and evolving heuristic framework for describing knowledge in use and in development. Knowledge in Pieces models conceptual competence as a complex system comprised of many and diverse types of knowledge elements (Smith, diSessa, & Roschelle, 1994). To make progress on the program of understanding learners' knowledge systems and how they evolve, a goal of empirical work is to identify relevant forms of knowledge elements and learning mechanisms. In this paper, we discuss knowledge analysis (diSessa, 1993; Sherin, 2001), a methodological approach that is complementary to KiP. An inherent difficulty of knowledge analysis (KA) is that the researcher has no direct access to the learners' knowledge system. As such, knowledge analysis is a highly interpretive enterprise. In this presentation, we will discuss three specific types of knowledge elements described in different studies of student reasoning about physics and mathematics: p-prims, explanatory primitives, and variation schemes. For each of the knowledge elements discussed, we will give (1) a definition and explicit standards of what counts as the particular knowledge element in the analysis (2) explicit indication of how the knowledge element is implicated in the process of learning or conceptual change and (3) a matching between the data and the attributed knowledge element.

Introduction

Determining what individuals know and how this changes as they learn is an important and difficult question inextricably linked to one's epistemological perspective. In this paper, we discuss methodological issues involved in studying the organization of individual knowledge systems using the Knowledge in Pieces epistemological perspective (diSessa, 1993).

Theoretical perspective

Knowledge in Pieces (KiP) is a powerful and evolving heuristic framework for describing knowledge in use and in development. KiP grew out of the constructivist tradition of Piaget in which reasoning is conceptualized as a process of interpreting phenomena through existing knowledge structures. Thus, a major focus of research from this perspective involves modeling reasoning processes by explicitly identifying knowledge structures and mechanisms by which they are reorganized.

Knowledge in Pieces models conceptual competence as a complex system comprised of many and diverse types of knowledge elements (Smith, diSessa, & Roschelle, 1994). Naive knowledge systems are comprised of many, loosely-coupled knowledge elements whose activation and use is highly context-sensitive. The development of expertise largely involves the progressive systematization and re-organization of the naive knowledge system. Two constructivist principles that deeply inform Knowledge in Pieces include the principles of continuity and functionality. The continuity principle implies that more advanced understandings should be psychologically and epistemologically continuous with prior understandings. The functionality principle proposes a potentially productive role for students' prior knowledge in the development of expertise. In empirically studying how learners' knowledge systems function, often new knowledge ontologies and learning mechanisms must be identified to account for observed phenomena.

Methodological approach

The methodology discussed in this paper is knowledge analysis (diSessa, 1993; Sherin, 2001). In the analysis of empirical data for the purpose of developing theory about how knowledge systems function and evolve, knowledge analysis aims for joint accountability to both the content and the form of knowledge. The focus on content and form, as well as on the development of principles by which such accounts can be validated, distinguishes knowledge analysis

from other related approaches to conceptual analysis. An early point of reference on knowledge analysis is diSessa, 1993, in which a moderately large system of knowledge elements and their functions are explicitly described along with a set of methodological principles and heuristics for identifying them.

Methodological challenges

An inherent difficulty of knowledge analysis (KA) is that the researcher has no direct access to the learners' knowledge system. As such, knowledge analysis is a highly interpretive enterprise. To guard against capricious attributions of knowledge elements that are not psychologically meaningful, the identification of knowledge elements in empirical analyses should fulfill certain criteria. We will discuss criteria employed in identifying and validating three types of knowledge elements: p-prims, explanatory primitives, and variation schemes. Although each is formulated in a different study and in a different context, their empirical recognition and validation share interesting features.

Examples

The first and prototypical example we discuss is phenomenological primitives - p-prims (diSessa, 1993). The construct of p-prims was formulated to account for an empirically observed phenomenon regarding the explanations that individuals would generate concerning everyday phenomena (e.g. a ball toss). Subjects' explanations appeared to be highly context-sensitive and implicated many basic abstractions of the explainer's experience with the physical world.

The second type of knowledge element that we discuss, explanatory primitives, emerged from an analysis that sought to understand some striking variability in how students made sense of an instructional analogical sequence in physics (Kapon, 2010; Kapon & diSessa, in press). The explanatory primitive model proved to be productive in explaining differences in individuals' reactions to, and shifts in judgments about an instructional analogical sequence. In addition, the model accounts for individuals' patterns of reasoning in the target domain that are not explained by Structure Mapping Theory (Gentner, 1983).

The third type of knowledge element, variation schemes, was instrumental in deconstructing the process by which a pre-algebra student constructed a deterministic and essentially algebraic strategy for solving algebra word problems of an underlying linear structure (Levin, 2009). The approach of identifying specific knowledge elements (variation schemes) that were used, refined, and coordinated during the process of strategy construction gives a knowledge-based account for the process by which novel strategies are developed. This kind of account provides an alternative to the approach taken in the standard literature on strategy development (e.g. Siegler, 2006).

For each of the knowledge elements discussed, we will give (1) a definition and explicit standards of what counts as the particular knowledge element in the analysis (2) explicit indication of how the knowledge element is implicated in the process of learning or conceptual change and (3) a matching between the data and the attributed knowledge element. The attached diagram (Figure 1) summarizes the principles employed to validate the particular knowledge elements used in each of the analyses.

diSessa, A. A. (1993). Toward an Epistemology of Physics. *Cognition and Instruction*, 10(2&3), 105-225.

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science*, 7(2), 155-170.

Kapon, S. (2010). A knowledge-based account for analogical reasoning. Paper presented at the 7th biennial meeting of the European Association for Research on Learning and Instruction, Special Interest Group on Conceptual Change, Leuven, Belgium.

Kapon, S., & diSessa, A. A. (in press). Instructional explanations as an interface - the role of explanatory primitives. In M. Sabella, C. Singh & S. Rebello (Eds.), *Physics Education Research Conference Proceedings*. Portland OR: American Institute of Physics

Levin, M. (2009). A conceptual change lens on the emergence of a novel strategy during mathematical problem solving. In Swars, S. L., Stinson, D. W., & Lemons-Smith, S. (Eds.) *Proceedings of the 31st annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Atlanta, GA: Georgia State University.

Sherin, B. L. (2001). How students understand physics equations. *Cognition and Instruction*, 19(4), 479-541.

Siegler, R. S. (2006). Microgenetic analyses of learning. In W. Damon & R. M. Lerner (Series Eds.) & D. Kuhn & R. S. Siegler (Vol. Eds.), *Handbook of child psychology: Volume 2: Cognition, perception, and language* (6th ed., pp. 464-510). Hoboken, NJ: Wiley

Smith, J. P., diSessa, A. A., & Roschelle, J. (1994). Misconceptions reconceived: A constructivist analysis of knowledge in transition. *Journal of the Learning Sciences*, 3(2), 115-163

SYMPOSIUM

Impact of school inspection

Chairperson: Hans Anand Pant, Humboldt Universitaet zu Berlin, Germany
Organiser: Holger Gaertner, Freie Universitaet Berlin, Germany
Discussant: Hans Anand Pant, Humboldt Universitaet zu Berlin, Germany

There remains a strong trend towards introducing school inspections as a new component of education systems. SICI (The Standing International Conference of Inspectorates), the umbrella organisation for regional and national school inspectorates, counted 29 members (and rising) from Europe in 2010. This is due to the double function of school inspections: as a means of stimulating school improvement as well as generating steering data about the quality of schools. Despite this trend towards introducing school inspections in ever more countries, research on school inspections remains sparse and is quite heavily focussed on results from England. This symposium therefore presents new empirical approaches from Germany, the Netherlands and Switzerland to address questions about the effectiveness of school inspections. Such a comparison promises insights into the influence of contextual conditions on the effectiveness of school inspections. It also seeks to stimulate further discussion about the conceptual design of school inspections, so as to increase the likelihood of positive effects arising from these organisational diagnoses. Evidence-based governance through school inspection.

Expectations of different stakeholders

Vera Husfeldt, University of applied science north west switzerl, Switzerland; Carsten Quesel, University of Applied Sciences North-Western Switzerland, Switzerland

Since the late 1990s, school governance in Switzerland has been redesigned according to the logic of new public management. The function of leadership has been strengthened in order to create a locus for strong and flexible decision-making within schools. At the same time, the status of school inspection has been enhanced: evaluation reports are now a cornerstone of education monitoring; they are to be a useful tool for cooperative school improvement and are to provide substantial information for holding school leaders accountable for the performance of their institutions. Meanwhile, the demand to observe professional standards and scientific evidence in school management competes with traditional forms of lay participation: traditionally, the governance of public schools in Switzerland has been an important task of the local citizenry. It is debatable whether the long-established local school boards can be successfully integrated into a reformed public sector guided by the principles of evidence-based management. In a case study of the canton Argovia, we investigate how teachers, principals and members of local school boards assess the effectiveness of inspections. Using qualitative and quantitative research, we identify conflicting expectations, linked to claims of professional autonomy, managerial expediency and democratic control.

Objectives

As in many other countries, the history of school inspection in Switzerland can be traced back to the 19th century. Since the late 20th century, however, the aims and means of school inspection have come under scrutiny. The implementation of new public management reforms has enlarged the scope of supervisory tasks: now, school inspection considers not only compliance with applicable laws and the proper fulfilment of duties, but the quality of schooling as well. School inspection in the canton Argovia assesses the state of school leadership and professional cooperation as well as school and classroom climate and reports severe deficiencies to the Ministry of Education, which is obliged to intervene with measures of additional control and support. Implemented on the cantonal level, school inspection is intended to facilitate self-monitoring and self-determined school development on the local level. Thus, the policy of school inspection primarily targets hard and soft factors of the organisational setting, inducing an indirect effect on teacher performance and student learning. The evaluation report is devised as a diagnosis for the school and the authorities; the scope is limited to recommendations and does not trigger rewards, sanctions or other measures. This limitation was established in order to emphasize the developmental benefits of school inspection: As a device for learning organizations, the feedback shall be positioned as far away as possible from the 'shadow of hierarchy'. However, a total detachment of school inspection from governmental control is not intended: the shadow of hierarchy is conspicuous in the case of grave deficiencies – and the cantonal authorities may ask not only whether the principal is responsible for the failure, but whether the local school board is as well. Our study investigates how the attitudes of teachers, principals and school board members are influenced by this shadow of hierarchy.

Research design

Our research is based on a multi-dimensional model of school inspection as a political and pedagogical tool: school inspection provides data for (1) legitimation, (2) accountability, (3) school improvement and (4) scientific research. According to this model, different points of view have to be taken into account in order to assess the effectiveness of school inspection. Our research seeks to clarify how the expectations of teachers, principals and school board members are shaped by experiences in the course of public sector reforms in recent times.

Our research design includes qualitative and quantitative methods: from June to August 2010, group discussions with teachers, principals and school board members were conducted in order to formulate a typology of mindsets in an exploratory way. The questions were focused on

- the reform of Swiss school governance in the last decade
- the cantonal policy of school inspection
- opportunities and threats of evidence-based governance
- the informative value of school inspection for different stakeholders
- the relationship between inspection and accountability
- the relationship between inspection and political support
- local problems and perspectives of school development
- intentions and side effects of inspection.

Hardly any of the respondents present themselves as ardent believers in new public management, many articulate an attitude of change-orientated pragmatism and of sceptical loyalty, and more than a few argue that new managerial autonomy creates pseudo-autonomy and that school inspection may contribute to the bureaucratization of schooling. Scepticism is more present in the discourse of teachers and school board members, while principals accentuate their role as change agents while arguing for the benefits of professional external feedback.

In November 2010, this typology will be checked and validated by an online survey which includes samples of teachers, principals and school board members of 48 municipalities. Based on the first findings from the group discussions we expect that principals will show a strong determination to incorporate the new governance model in their schools and to use the results from school inspection with respect to the different functional domains. In particular, they might find it difficult to reconcile the accountability function and the development function. With regard to the teachers, we expect a strong tendency to protect the classroom as a pedagogical shelter, leading to ambiguities concerning the demand for more transparency. Therefore, they tend to have more critical attitudes towards school inspection. The qualitative data indicate that the school board members accept the logic of new public management but fear the decline of traditional lay participation due to the argument that bodies of deliberating citizens cannot meet the challenges of accountability.

For our study we chose to focus on the canton of Argonia, since it is a canton with a highly developed school inspection and with a strong tradition of lay participation in the field of school governance. The design of both the qualitative and the quantitative research draws on comparative approaches: one part of the respondents had already experienced the new type of inspection, the other part was to be inspected in the following years.

Theoretical and educational significance of the research

As in many other European countries, the reform of school inspection in Switzerland follows the line of policies which are intended to create a new balance between autonomy and efficiency. School inspections are considered to be a key feature in a system of multi-level governance which is shaped not only top-down by directives but by negotiations between stakeholders and interest groups. Our study clarifies the mindsets of stakeholders that play an active part in schooling and in the process of school inspection: the expectations of these stakeholders have to be taken into account in order to avoid constellations of resentment and antagonism in the course, and in the aftermath, of inspection. Beyond that, one must analyse which criteria need to be met for school governance in a highly professionalised democracy.

Strategic responses of schools to multiple measures in the Dutch accountability system

Melanie Ehren, University of Twente, Netherlands

School inspections are expected to have a great impact on what students learn and how they learn. The standards inspectorates use to assess educational quality and teaching and learning in schools during inspection visits, the sanctions for failing schools and the rewards for well-functioning schools stimulate and pressure schools to meet nationally defined targets and objectives. As a result, school inspections may lead to unintended negative consequences for teaching and learning in schools. This study analyses how the Dutch (risk-based) school inspections may lead to strategic behaviour in Dutch primary schools. We studied two types of strategic responses of schools: cheating on tests and reshaping of the test pool. The results of our study indicate that 5.5 percent of the schools do not comply with the guidelines for administering the test. One third of the schools also exclude one or more students from the test. These types of behaviour, however, do not appear to be related to specific measures in the Dutch school inspections or prior performance of schools on these measures.

Objectives or purposes

Available studies into effects and negative consequences of school inspections give a very mixed view of the type of changes in schools that result from school inspections and the causes of these changes in schools. A number of studies point out that strategic responses are particularly likely when accountability systems (such as school inspections) base important high-stakes decisions on a single measure of a limited number of aspects of teaching and learning. Several scholars (particularly in the US) therefore express the need for multiple accountability measures to hold schools accountable for broader goals (Koretz, 2003; Ladd, 2007). Multiple measures include measures of cognitive (student achievement) and non-cognitive outcomes (e.g. attendance, drop-out rates), or other direct measures of educational practices (school inspections/quality reviews) (Koretz, 2003). The Dutch Inspectorate of Education includes both measures of student achievement (test scores of students) and inspections of educational practices in the evaluation of schools. The objective of this study was to learn how these multiple measures may cause or prevent strategic responses of schools, particularly cheating on tests and reshaping of the test pool to improve the school's performance on the standards of student achievement.

Methodology

Until 2007, the Dutch Inspectorate of Education used measures of both cognitive student outcomes (test scores) as well as measures of educational practices (inspection visits) to monitor schools. After 2007, the inspection methodology changed, and measures of cognitive outcomes became central in holding schools to account. We expected an increase in strategic responses in schools as a result of this change. Strategic responses of schools before and after the change in inspection methodology were compared using a t-test and an analysis of variance.

The extent to which schools reshape their test pool was measured in all primary schools in the Netherlands from 2004 to 2009. School records, testing records and schools' responses on the annual inspection questionnaires were used to study the extent to which schools reshape their test pool both before and after the change in inspection methodology in 2007. We analysed which students are exempted from the Cito test in Grade 8, whether schools retain pupils in Grade 7 (prior to test taking) or refer students to special primary education or to (advanced) special education before Grade 8.

The extent to which schools cheat on tests was measured through observation of teachers during administration of the national Cito test (which is used to evaluate student achievement of schools). School inspectors visited 257 primary schools (3.7% of all primary schools) unannounced during the day the Cito test was scheduled to be administered to students in Grade 8, and observed whether the test was administered according to the guidelines of the testing company.

Findings

The results of our study indicate that 5.5 percent of the schools do not comply with the guidelines on administration of the test. The teachers in these schools allowed students to use scrap paper while making the test; they clarified test questions or prompted students with the correct answer. Some teachers also gave instruction to students just before administration of the test (after having read the test items) or put up explanations of spelling problems on the black board. One of the schools also administered the test one day before the official test administration day.

Our results also indicate that schools reshape their test pool to some extent, particularly by taking students out of the test pool who will be referred to regular secondary education with special learning support. Over the years of our study, at least one student does not participate in the Cito test in one out of every three to four schools. On average, in each primary school three to five percent of the students do not participate in the Cito test in Grade 8. The percentage of schools with students that do not take the Cito test also grows steadily over the years, but seems to stabilize after 2006. This may be related to a change in the testing guidelines. From 2007 onwards, schools were required to include in the test all students who would be referred to the learning support trajectory in secondary education. The introduction of risk-based school inspections in 2007 (which emphasized the cognitive outcomes of schools in the overall inspection methodology) may have counterbalanced a potential decrease resulting from this additional requirement.

Even though we found some instances of the strategic use of data, this type of behaviour does not appear to be related to the measures in the Dutch accountability system. We found no significant difference in the extent to which schools reshape their test pool before and after the introduction of risk-based school inspections; there is also no difference in strategic data use in schools that perform above and below the inspection threshold.

Theoretical and educational significance of the research

Across Europe, school inspections are instated to provide checks and balances to the decentralization of national policies and increases in autonomy of schools, and to provide national mechanisms of quality assurance to ensure high quality teaching for all. Growing evidence indicates that school inspections can be a key feature of school improvement. More recent studies, however, also point to unintended consequences such as excessive bureaucracy and teaching to the test. Good measures and methods of school inspections are therefore crucial in promoting quality within schools.

De Wolf, Inge F. and Janssens, Frans J. G. (2007). Effects and side effects of inspections and accountability in education: an overview of empirical studies. *Oxford Review of Education*, 33(3), p. 379 — 396.

Koretz, D.M. (2003). Using Multiple Measures to Address Perverse Incentives and Score Inflation. *Educational Measurement*, 22(2), 18-26.

Koretz, D.M., McCaffrey, D.F. and Hamilton, L.S. (2001). Towards a Framework for Validating Gains under High-Stakes Conditions. CRESST/Harvard Graduate School of Education: CSE Technical Report 551

Ladd, H.F. (2007). Holding Schools Accountable Revisited. 2007 Spencer Foundation Lecture in Education Policy and Management.

The impact of school inspection on school improvement – a quasi-experimental field study

Holger Gaertner, Freie Universitaet Berlin, Germany; Sebastian Wurster, Humboldt Universitaet zu Berlin, Germany

This study examines the impact of school inspections on the development of various aspects of school quality. During the phasing-in of school inspections in the federal states of Berlin and Brandenburg both inspected and uninspected schools were examined. School improvement was surveyed over a period of one year from the perspective of school principals and teachers. The main finding is that perceptions of school quality were highly stable, irrespective of the introduction of school inspections. The results show school inspections had a comparatively low impact on the aspects of school quality measured here. Some findings suggest that the main effect of school inspections concerns preparations for inspection. This would have implications for the way in which inspection processes are currently designed.

Aims

In contrast to previous studies the following uses a control group design to examine the effect of school inspection. A number of empirical studies, mostly from England and the Netherlands, deal with the question of the effect of school inspections on school and instruction improvement processes. One recent summary of the state of research is de Wolf and Janssens (2007). The following findings on the effect of school inspections are already known: studies on satisfaction suggest that the majority of school principals of inspected schools are satisfied with the inspection of their own school. Studies on behavioural effects normally confine themselves to statements about which measures will be introduced in future in response to the results of the inspection. Studies on student performance yield an uneven picture. While English studies tend to point out the negative effects of inspection on student performance, a Dutch study recently reported a positive effect in relation to student performance (Luginbuhl, Webbink & de Wolf, 2007). In their synthesis, de Wolf and Janssens (2007) conclude that previous research approaches are not robust enough. Research designs previously used are not in fact suited to deriving statements about causal relationships. For this reason experimental or quasi-experimental studies should be used more often to clarify such questions. This study does that.

This study took the implementation phase of school inspections in two federal states in Germany, Berlin and Brandenburg, as an opportunity to investigate the effects of school inspections. Inspections in Berlin and Brandenburg take place as follows. Schools receive a systematic, full inspection. School visits include observation of lessons, interviews, questionnaires and the study of school documents. Based on the findings of the inspection report, schools are then requested to define objectives to enhance their quality (action plan). These objectives are defined by the school and by the responsible school supervision authority. The next school inspection takes place after approximately five years, or after two years for schools below standard. Even when a school is underperforming significantly, the inspectorate itself has no legal authority to take direct action.

Methodology

The survey included school principals and teachers from schools that had not yet been inspected, so as to compare the improvement of these schools with those that had already been inspected within the years before. This was done by surveying the schools again after one year (first survey: October 2008; second survey: October 2009). The make-up of the schools was as follows (the sample size for both surveys is indicated in brackets):

Experimental Group 1: Schools that were inspected two years before the first survey (N=56 Principals (P); N=167 Teachers (T))

Experimental Group 2: Schools that were inspected a year before the first survey (N=94 P; N=279 T)

Experimental Group 3: Schools that were inspected within the survey period (N=102 P; N= 321 T)

Control Group: Schools that were not inspected either before or during the survey period, but will be inspected in future (N=59 P; N=173 T)

Response rates for the survey range between 13.7% and 30.2% according to the group surveyed. An analysis of non-participants revealed no differences between the schools taking part and those not taking part with respect to either student performance or their evaluation by inspectors.

The 15 dependent variables represented aspects of school quality that accord with the quality framework used by both federal states (teacher and student satisfaction; burnout of teachers; classroom management; participation of parents and teachers; cooperation with partners; leadership; organisation; professional development; co-operation among staff; monitoring of instruction and student achievement; school-self-evaluation; quality management). Independent variables are federal state (Berlin/Brandenburg), perspective (principals/teachers) and school group (experimental group 1 / 2 / 3 / control group).

Findings

A multivariate variance analysis, controlling for pre-test values, revealed significant effects for federal state ($F(15/610) = 4.04$; $\eta^2 = .09$), perspective ($F(15/610) = 5.14$; $\eta^2 = .11$), and school group ($F(45/1836) = 2.24$; $\eta^2 = .05$), as well as a significant three-way interaction between these factors ($F(45/1836) = 1.49$; $\eta^2 = .03$). This means that while there were significant changes over the survey period, these were perceived differently depending on the federal state and perspective. Changes of differing degrees were also observed for each of the school groups, although with low effect size. Considering the influence of the independent variables separately yields the following results:

Federal states: In both federal states, only few changes were statistically significant: in Brandenburg 9 of 120 – still less than in Berlin (15 of 120), though the inspection process in both states is comparable.

Perspective: Changes are perceived differently by school principals and teachers. For example, in Berlin, among principals it is those in the control group who see most changes, whereas among teachers, it is those who were inspected in the survey period who see most changes.

School group: The results show no systematic differences between the development of the inspected schools (experimental groups 1 - 3) and the control group. While there was not one significant change in the control group in Brandenburg, the control group in Berlin stood out as having the most changes (4 positive changes from the perspective of the principals).

Theoretical and educational significance

Taken together, the results suggest that school inspections have comparatively little influence on the variables measured here. The results suggest a high degree of stability for the aspects of school quality measured here, irrespective of the implementation of school inspections. However, the Berlin results suggest that the initial hypothesis (i.e. that the effect of a school inspection would be most noticeable after an inspection) may be incorrect. Instead, these results can be interpreted as indicating preparatory activities: that is, most effects occurred prior to an inspection.

If this hypothesis is confirmed by other studies, this would have implications for the way inspection processes are designed in future. For example, Baden-Württemberg already gives schools one or two years' advance notice of an inspection, so that they can (with support) specifically prepare themselves. This approach would strengthen the tendency towards specific preparations, and contrasts markedly with the notion of announcing inspections at short notice.

De Wolf, I. F. & Janssens, J. G. (2007). Effects and side effects of inspections and accountability in educations: an overview of empirical studies. *Oxford Review of Education*, 33(3), 379-396.

Luginbuhl, R., Webbink, D. & de Wolf, I. (2007). Do school inspections improve primary school performance? The Hague, NL: CPB.

SYMPOSIUM

Differential effects of preschool education: Examples from England, Germany and Belgium

Chairperson: Pamela Sammons, University of Oxford, United Kingdom

Organiser: Yvonne Anders, University of Bamberg, Germany

Discussant: david reynolds, University of Southampton, United Kingdom

There is growing empirical evidence that high quality preschool education may have beneficial effects on young children's cognitive and non-cognitive development. But when looking at the body of research concerning the impact of preschool programs, there is less clear evidence concerning their differential effects on children's development. Can universal preschool programs protect children from the impact of developmental risks the same way Early Interventions can? Which groups of children benefit most from high quality preschool programs? Which pedagogical approaches serve best to promote young children's cognitive and non-cognitive development? This symposium seeks to draw light on these questions through three papers on large-scale longitudinal studies conducted in England, Germany and Belgium. The British study illustrates how high quality universal preschool has the potential to serve as an intervention to promote children's cognitive and social skills within normal populations. Results of a longitudinal secondary analysis are reported that examined the psychological development of preschoolers between the ages of 3 to 5 years. The German study focuses on the language development of young children while they move through preschool. This paper investigates the differential effects of various measures of preschool experience depending on children's migration background and their language competencies when they begin preschool. Finally, the Belgium study explores the impact of alternative schools on children's non-cognitive development and compares these results with children from traditional schools. Furthermore, the possibility of differential effects regarding students' social status and functional risk, are examined.

Can pre-school protect cognitive and social development? Variation by center quality and duration

James Hall, University of Oxford, United Kingdom; Kathy Sylva, University of Oxford, United Kingdom; Pamela Sammons, University of Oxford, United Kingdom; Edward Melhuish, Birkbeck, University of London, United Kingdom; Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Brenda Taggart, Institute of Education, University of London, United Kingdom

Aims:

Although it is well known that targeted Early Interventions can protect the development of young children from the impact of developmental risks, there remains less clear evidence concerning universal programs of pre-school.

Methodology: A longitudinal secondary analysis was conducted that examined the psychological development of 2,862 English pre-schoolers between the ages of 3 to 5 years.

Findings:

At age 5, instances of significantly protected development were more strongly evidenced when examining: 1) cognitive rather than social development, 2) child-level rather than family-level risks, and 3) the quality of the processes taking place within pre-schools rather than just the structures. For pre-schools that featured only high quality structures, any partial protection of development was limited to instances of longer duration of child-attendance.

Theoretical and educational significance:

That higher quality programs of universal pre-school have the potential to partially combat the effects of risks including social inequalities. Thus, programs of universal pre-school have the potential to serve as a type of intervention within normal populations by offering a form of primary prevention.

Aims:

This paper summarizes the results of a large-scale study that aimed to determine if the quality of pre-school programs (particularly high quality rather than low) could protect the cognitive and social development of a broadly representative sample of young English children. Aimed at addressing the limitations of previous research, this longitudinal secondary analysis adopted a broad remit with an examination of:

- (1) The cognitive and social skills of young children between 3-5 years
- (2) Child- (ecological) level and family-level risks
- (3) The quality of pre-school processes and structures
- (4) The varying lengths/duration that young children attended their pre-schools.

Methodology:

A reanalysis was conducted of the (anonymized) longitudinal data collected by the Effective Provision of Pre-School Education project (EPPE). This was a longitudinal English study that began in 1997 with the aim of investigating the effects of pre-school education and care on the development of young children between the ages of 3 and 7. Five geographical regions that were representative of England were sampled (covering urban, rural and sub-urban areas) and from these, 141 pre-schools were randomly selected. The qualities of the processes and structures within these 141 programs of universal pre-school were then assessed and the development of a random sample of children was

measured (after informed consent was obtained from parents). The final sample for this analysis consisted of 2,862 pre-school attendees.

Applying the terminology of 'developmental psychopathology', the young pre-school attending children had 21 recorded potential risks to their cognitive (measured via British Ability Scales; BAS) and social abilities (measured via Adaptive Social Behavior Inventory; ASBI) measured alongside their developmental skills when they were, on average, 38 months of age. Development was then measured again when these children were, on average, 58 months. Further to the aims of this study, a single global/overall measure (Early Childhood Environmental Rating Scale-Revised; ECERS-R) of the quality of the pre-schools that these children attended was assessed alongside 5 indicators of the quality of processes and 7 indicators assessing structures. To properly assess the impacts of the qualities of pre-school, the EPPE project also measured the duration that each child had attended their pre-school.

The 5 measures of process quality included the overall score from the Early Childhood Environmental Rating Scale-Extension, (ECERS-E) and the four subscales of Caregiver Interaction Scale, (CIS; Positive Relationships; Punitive Relationships; Permissive Relationships; and Detached Relationships). The 7 measures of structural quality included:

- Manager:
 1. Highest Academic Qualification
 2. Highest Childcare Qualification
- Staff:
 3. Mean Age
 4. Mean Highest Academic Qualification
 5. Mean Highest Childcare Qualification
- 6. Number of Staff
- 7. Number of Children

This study divided potential risks according to ecological levels that were either closely (proximal) or distantly (distal) related to the children. Seven of the measured risks in this study were hypothesized to be proximal to the child whilst fourteen were judged to be more distal and thereby more proximal to the family. Each of these two sets of risks (7 child-level, 14 family-level) were then hypothesised to have impacts on development that were best measured with all individual risks being considered in combination with one another (via Formative Confirmatory Factor Analysis; CFA).

The 21 recoded potential risks were composed as follows: 7 risks pertinent to the child included: Male child gender; English spoken as additional language; Birth weight; Number of siblings; Birth order; Ethnic Minority Background; Any Parent/Carer reported developmental salient event.

The 14 risks pertinent to the family included: Family salary; Mother's occupational status; Partner's occupational status; Highest status in the family; Mother's qualifications; Partner's qualifications; Mother working status; Partner working status; Whether either parent worked; Whether the child had a two parent family; Mother's age; Partner's age; Number of non-parental carers; Home Learning Environment.

Findings:

Figure 1 presents a stylized representation of the SEM that were specified to examine the relationships between latent combined risks, the development of children's cognitive and social abilities, and the quality and duration of children's attendance at pre-school. A series of analyses were conducted in which each measure of quality was independently examined to determine whether it could significantly moderate the effects of each of the combined risks as they impacted each measure of development that was assessed at entry to school (General Cognitive Ability, self regulation, antisocial/worried behavior). In addition, duration of attendance at pre-school was also tested alongside each measure of quality, both as an additional moderator of risks but also as a moderator of any of quality effects. As a result, when testing the hypotheses of risk-moderation, three multiplicative statistical interaction terms were used: 1) quality x risk; 2) duration x risk; and 3) (quality x duration) x risk.

The results of the analyses summarized in Figure 1 showed there to be many more instances of significantly protected cognitive (46% incidence) rather than social/behavioral development (15%). Further, perhaps the most important protective finding was that the global/overall quality of pre-school (incorporating assessments of both structures and processes) had the potential to protect the General Cognitive Abilities of young children from the significant impacts of family-level risk.

Theoretical and educational significance:

Given that the combined family-level risk measured in these analyses was broadly analogous to socioeconomic status, the findings of this study suggest that the attendance of young children at higher quality programs of universal pre-school has the potential to partially combat the effects of inequalities (including social) in a manner similar to Early Interventions such as the High/Scope Perry Pre-school Project (although not necessarily to the same extent). Moreover, it therefore becomes possible to conclude that programs of universal pre-school have the potential to serve as a type of intervention within normal populations by offering a form of primary prevention.

Internal and external influences on children's language development during preschool

Susanne Ebert, University Bamberg, Germany; Sabine Weinert, University of Bamberg, Germany; Kathrin Lockl, University of Bamberg, Germany; Yvonne Anders, University of Bamberg, Germany; Katharina Kluczniok, Otto-Friedrich-University of Bamberg, Germany; Hans Guenther Rossbach, University of Bamberg, Germany

International studies have pointed out significant disparities in educationally relevant competencies related to social background variables for German children. It is assumed that language - as a means supporting children's knowledge acquisition - plays an important role for the emergence of these disparities. Therefore the aim of the present study is to investigate language development and its predictors in the preschool years in groups with different verbal competencies at the beginning of preschool. In particular we ask, whether there are differential effects of various measures of preschool experience on language growth. The study draws on 547 children from 97 preschools followed from beginning of preschool until grade four of elementary school. The present investigation focuses on children's receptive vocabulary (PPVT) development using latent growth curve models. As predictors children's phonological working memory skills as well as indicators of preschool and home environment were included. Multiple group analyses differentiating between children with more or less advanced language competencies at first time of measurement were conducted to compare the effects of the various predictors. Results show strong impacts of phonological working memory on vocabulary development in all groups. However, we identified also differential effects, especially on the growth of vocabulary over preschool years. For example for children with background of migration growth in vocabulary is influenced by aspects of structural quality of kindergarten (e.g. children with background of migration-to-class size ratio). The results will be discussed with respect to their developmental and educational consequences.

Aims

Among other findings, international large-scale surveys like PISA or PIRLS have pointed out significant disparities in educationally relevant competencies related to social background variables for German children. In particular, severe disadvantages of children with a background of migration were found concerning their competence development and educational careers in the Germany (e.g. Baumert & Schýmer, 2001; Bos et al., 2003). Up to 40% of children with a background of migration have severe difficulties in German language when they start school. Therefore it is likely that these deficits hinder their successful start into the German school system (e.g. Mengerling, 2005; Schßler et al., 2004). However, also in the group of native German speaking children social disparities in language development in preschool years can be found and may explain later problems in school (Weinert et al., 2010). Language as a means to support children's acquisition of knowledge in various domains presumably plays an important role for the emergence of these disparities. Therefore we ask how and what factors influence language development in the preschool years in groups with different (German) verbal competencies at the beginning of preschool. In particular we ask, whether there are differential effects of various measures of preschool experience on language growth.

Methodology

The reported data are part of the more comprehensive longitudinal project BiKS (Bildungsprozesse, Kompetenzentwicklung und Selektionsentscheidungen im Vor- und Grundschulalter / Educational processes, competence development and selection decisions in pre- and elementary school age). In BiKS two longitudinal studies are conducted, whereas the present study is part of the study BiKS-3-10. In this study 547 children from 97 preschools are followed from beginning of preschool until end of grade four in elementary school. At first time of measurement children were about 3;8 years old.

The present investigation focuses on children's vocabulary development using latent growth curve models. Children were tested with a German Research Version of the Peabody Picture Vocabulary Test (PPVT) at three measurement points, separated by testing intervals of one year.

As predictors of children's vocabulary development various child characteristics, indicators of the preschool environment as well as variables concerning the child's home environment were included.

Multiple group analyses were conducted to compare the effects of the various predictors for (a) children with background of migration and children with no background of migration and (b) children with good German language competencies (grammar as well as vocabulary) at the first time of measurement and children who did not that good. For (b) only children without background of migration were considered.

As it is known that children's phonological working memory is a relevant predictor of children's language development we ask whether these child competencies have a different impact on children's vocabulary development. Furthermore we wanted to know whether there are differences in additional effects of preschool learning environment for the various groups. Therefore we looked at process quality, especially concerning literacy stimulation (as measured by ECERS-E), as well as structural quality (e.g. child-staff-ratio, class size). In addition family background variables (migration background, HISEI and mother's education) and a scale measuring the quality of the home environment in terms of promoting literacy skills (based on information from questionnaires, interviews and observations) as control variables were considered.

Findings

The results show that the average vocabulary grows significantly and steadily over the preschool years. Concerning our research question we identified different effects of various covariates for starting level and growth for children with and without background of migration as well as for children without background of migration but high vs. low language competencies at first time of measurement. Although there seems to be a strong impact of phonological working memory skills on vocabulary development for all investigated groups, an effect on growth shows up only for native German speaking children with worse language competencies at first time of measurement.

First analyses also demonstrate effects of structural quality of kindergarten on vocabulary growth for children with background of migration. Children with background of migration seem to profit from smaller class sizes as well as less children with background of migration in their class. There is an interrelation between children's language competencies on the one hand and support programs in kindergarten on the other showing that language problems are well noticed by the preschools. However, these programs as well as kindergarten quality as measured in this study do not seem to have significant impact on the growth of vocabulary.

Theoretical & educational significance

Summing up child's phonological memory skills, indicators of the preschool environment as well as variables concerning the child's home environment have an effect on children's language development in preschool year. However, effects can be different in accordance to children's language competencies at beginning of preschool. These results point to the importance of fostering language development in accordance to children's competencies. Further implication of results will be discussed with respect to their developmental and educational consequences.

The impact of alternative schools on children's early non-cognitive development

Jerissa de Bilde, University of Leuven, Belgium; Bieke De Fraine, K.U.Leuven, Belgium; Jan Van Damme, K.U.Leuven, Belgium

Alternative schools are often said to put more emphasis on supporting children's natural inclination to learn and promoting children's well-being. Surprisingly, the claims of these alternative schools have seldom been the subject of study. Present research aims at examining the impact of alternative schools on children's non-cognitive development and compares these results with children from traditional schools. Furthermore, the possibility of differential effects regarding students' social status and functional risk, are examined. Results revealed that, without controlling for student background characteristics, children from Freinet school have a higher teacher-rated school enjoyment and independent participation. However, these effects disappear after taking into account student background characteristics. Finally, the gap between at-risk and not-at-risk children is generally smaller in Freinet or Waldorf schools compared to traditional schools.

Aims.

Flemish (Belgium) schools are free to develop their own teaching methods, and there is a considerably amount of schools with alternative pedagogical beliefs. These alternative schools are often said to have an atmosphere that promotes well-being and motivation, more than is the case in traditional schools. Two of these alternative pedagogical methods are discussed in this paper: Freinet education and Waldorf education.

Schools modeled on the pedagogy of French educator Célestin Freinet (Acker, 2007) see the child's interest and natural curiosity as a starting point for learning and attempt to use real experiences of children as authentic opportunities for learning. Children are encouraged to learn by cooperatively making products or providing services. In Freinet schools, students are familiarized with democratic self-government to take responsibility for themselves and

for their community. Today, Freinet schools exist mostly in France, Belgium and Germany, often as alternative schools within the public school system. Waldorf schools, also known as Steiner schools, are based on the educational ideas of the philosopher Rudolf Steiner. Waldorf education is currently practiced in kindergartens and schools in 60 countries and is thus, together with Montessori education, the predominant form of alternative education around the globe. Waldorf schools emphasize that school should be a place where children can grow up in peace and harmony. Typical Waldorf education is the late onset of formal teaching (starting at age seven), offering structure and routines and offering artistic activities (Nicol, 2007).

Surprisingly, the claims of these alternative schools have seldom been the subject of study. Studies comparing traditional schools to alternative schools are very rare. The current paper intends to make such a comparison. Three questions are central in this research:

- First, what are the gross differences between traditional and alternative schools with regard to children's growth in school enjoyment and independent participation from kindergarten till third grade? (gross effect)
- Second, what are the differences between traditional and alternative schools with regard to children's non-cognitive development after controlling for student intake characteristics (e.g. gender, age, SES, initial achievement)? (controlled effects)
- Third, do the effects of pedagogical method differ between at-risk and not-at-risk students (differential effect)?

Methodology.

The study is based on data from the SiBO project (Maes, Ghesqui re, Onghena, & Van Damme, 2002), a longitudinal study in Flanders (Belgium) involving a cohort of about 6000 pupils followed through primary school. It provides us with teacher rated information about children's school enjoyment and independent participation in kindergarten, first, second and third grade (4 fixed measurement occasions).

We applied three level growth curve models (measurements within pupils within schools; Snijders & Bosker, 1999). Five series of analyses were executed. First, we modeled the development of school enjoyment and independent participation during these early years using quadratic functions. Second, interaction terms with a) Freinet schools and b) Waldorf schools were entered into the model, providing information about the gross effect of a method on the growth in school enjoyment and independent participation. Third, student predictors age, gender, SES, and initial language and arithmetic achievement were added into the model to create a corrected measure of the effect. Fourth, interaction terms with the at-risk variables SES and initial language achievement were entered, providing an answer to the question whether the effects are different for at-risk and not-at-risk children. In the fifth and last step, several simple slope analyses (Aiken & West, 1993) were conducted.

Findings.

The results suggest that gross differences between schools in children's enjoyment and independent functioning can be found. In general, children from Freinet schools have higher ratings in enjoyment and independent functioning. Children from Waldorf schools tend to score lower on enjoyment and independent functioning, although these differences are not significant due to the small sample size.

Second, it was examined whether these differences would change after taking into account pupil characteristics (gender, age, SES and initial achievement). First, after controlling for differences between schools in child intake characteristics, the positive effect of Freinet schools on children's enjoyment dropped to non-significance. Moreover, children from Freinet and Waldorf schools were rated as less independent in their school functioning, compared to their peers in traditional schools. This findings suggest that the positive effects of Freinet schools are due to the high amount of children with a high SES, children with high initial achievement, in their school and that intake characteristics.

Third, in traditional schools the gap between at-risk and not at-risk children with regard to SES and initial language achievement, is usually slightly increased. Although no significant differences were found in the slopes of Freinet and Waldorf schools, these schools tend to diminish, or even reverse, the gap. These results suggest, that alternative education may play a role in the promotion of at-risk children.

Theoretical and educational significance.

This study covers a field of educational effectiveness research that remains understudied, namely the effectiveness of alternative compared to traditional schools. The results could shed light on the effects of school's pedagogical approach on children's non-cognitive functioning and contribute to the field of educational effectiveness research.

Acker, V. (2007). The French educator Célestin Freinet (1896-1966): An inquiry into how his ideas shaped education. Lanham, MD: Rowman & Littlefield Publishers.

Maes, F., Ghesquière, P., Onghena, P., & Van Damme, J. (2002). Longitudinaal onderzoek in de basisonderwijs: Van doelstellingen tot onderzoeksopzet [Longitudinal research in primary education: from objectives to the design of the research] (LOA report No. 1). Steunpunt Loopbanen doorheen onderwijs en arbeidsmarkt, Cel 'Schoolloopbanen in het basisonderwijs (SiBO).

Nicol, J. (2007). Bringing the Steiner Waldorf Approach to your early years practice. London, UK: David Fulton Publishers.

Snijders, T. A. B.; & Bosker, R. J. (1999). Multilevel analysis an introduction to basic and advanced multilevel modeling. Thousand Oaks, CA. London, UK: SAGE.

SYMPOSIUM

Understanding emotional dynamics in collaboration and learning

Chairperson: Michael Baker, CNRS - Telecom ParisTech, France

Organiser: Sanna Jarvela, University of Oulu, Finland

Michael Baker, CNRS - Telecom ParisTech, France

Discussant: Charles Crook, LSRI, United Kingdom

Collaborative learning takes place as a result of group work on solving problems designed to promote learning, or more precisely as a result of collaboration. Such a coordinated, synchronous activity requires communicative interaction, in order to share and agree on ideas, strategies and solutions. When group of people collaborate emotional reactions can emerge endangering the emotional balance and optimal conditions for collaboration. While the impact of social dynamics on student learning can be partly inferred from the study of communicative interactions, understanding the development of emotional experiences related to social dynamics is still a challenge. The purpose of this symposium is to bring together researchers who have different empirical approaches to understanding emotional dynamics in collaboration and learning. The three papers will complement our understanding about emotional dynamics in collaboration. Baker, Andriessen and Pardijs focus on the nature of the collaborative working relationship between students, the regulation of tension and relaxation in collaborative interactions, and its interdependence with respect to progression of the learning task. Schwartz and Goldberg present a case study to inquire the role of emotions in learning a hot historical issue in argumentative activities. Järvenoja and Järvelä paper stresses a need for regulation of emotions to ensure a favorable affective atmosphere for collaboration. Their empirical study show that regulation of emotion can be scaffolded by increasing students' awareness of their situational emotions and by prompting them to plan their regulatory aptitude purposefully.

A developmental perspective on collaborative working relations and learning

Michael Baker, CNRS - Telecom ParisTech, France; Jerry Andriessen, Wise & Munro, Netherlands; Mirjam Pardijs, Wise and Munroe Learning Research, Netherlands

Students who work in groups in educational situations have to not only try to solve the problem that is set to them in order to learn, they also have to work on each others' problem solving, regulate their collaboration, and also maintain their interpersonal relationship. Within the framework of the "social turn" in human, social and educational sciences, that gives primacy to the social nature of human encounters, in this paper we focus on the nature of the collaborative working relationship between students, and its interdependence with respect to progression of the learning task. Building on previous work on the regulation of tension and relaxation in collaborative interactions (Andriessen, Baker & van der Puil, 2010), we adopt a developmental perspective, providing rich interpretations, or "thick descriptions", of a series of six working sessions, during which a group of three students designed a student area for a town. The students' interpersonal relationship was revealed as sufficiently resilient to be able to absorb or dissipate various tensions arising from the task, each other, and group-external aspects (such as the teacher's monitoring). We conclude that development is not only a matter of change, but also of actively remaining the same — in this case, as a group — in the face of an evolving task context.

In the continuation of the "cognitive revolution" of the end of the previous millenium, and the separation of reason from emotion (itself over two millenia old: Aristotle, c. 330 B.C.), the dominant vision of collaborative learning was that of knowledge co-construction. More recently, the emergence of what has been termed the "social turn" in human and social sciences (e.g. Foucault, 2001; Latour, 2010), and educational sciences in particular (Vygotsky, 1930/1978), has led to a view of collaborative learning situations as primarily social encounters, and secondarily, as joint attempts to solve problems and learn together. The common approach of constituting "friendship" groups in collaborative learning situations bears witness to the fact that in these cases, students have to solve at least three 'tasks' * i.e. solving a school problem, working together on that problem, and creating or maintaining a satisfactory "collaborative working relation" (Andriessen, Baker & van der Puil, 2010).

In the research presented in this paper, our aim is to extend previous work (op. cit.) that studied the collaborative relation in terms of the relation between the interplay of tension and its relaxation and deepening of a pedagogical debate, in a single interaction. Our approach was to develop a set of categories for the qualitative analysis of different dimensions of students' interactions. Tension and relaxation relate to the interactive circulation of affect. For example, making counter-arguments raises tension, and even more so if they are stated in an aggressive, ironic or sarcastic way. Tension can be relaxed, for example, by playful laughter, or by simply conceding, and showing consideration for others' views and feelings. We found that the pattern of tension rising and relaxation (by argumentation) was related to the depth of the argumentation, albeit in an indirect way. Tension-raising contributions by one party resulted in the other party producing new arguments and deepening previous ones, which resulted in the first party raising the tension by rejecting these arguments. Relaxation was produced by (sudden) changes of topic, especially going off-task. Our conclusion was that there is a relationship between the socio-emotional and the socio-cognitive aspects of collaboration, and in order to understand collaborative working relationships we have to look more closely at the patterns of tension and relaxation during collaborative interaction.

Here, we adopt a developmental perspective, studying how the collaborative working relationship changes and remains the same throughout a series of interactions between members of a single group of students. The students were engaged in an open-ended design task, specifically (on their own choice) that of designing a student area of a town. Given the innovative and exploratory nature of this research, we have not limited our approach by the pre-specification of a determinate set of analytical categories, for the design task, the collaborative working relation and the flux of tension-relaxation. Rather, we provide rich interpretations (Baker, 2010), or "thick descriptions" (Ryle, 1968; Geertz, 1973) of the students' activity, with a view to furthering theoretical insights into relations between cognitive, socio-relational and affective dimensions of interaction.

Across six working sessions of the students, we analysed the progression of the design task, from brainstorming general ideas, establishing constraints, genuinely collaborating to draw the town area plan, interacting with the teacher to explain their work, and concluding it. We related this progression to the flux of tension and relaxation in the group, and to off-task talk (about football) that served to cement the relationship. Overall, we found that the students' collaborative working relationship was remarkably stable across the various working sessions. When tensions did arise from the task (frustration with lack of advancement), from subtask allocation, or even from the teacher's probing questions, the students were able to quickly absorb this, and displayed group solidarity when faced with the teacher. It is an axiom of small group research (Arrow, McGrath & Berdahl, 2000) that there is a tradeoff between working on the task and working on the relation: when the relation is problematic or nascent, work on it will detract from work on the task. More prosaically, it might be thought that groups of good friends will tend to concentrate on 'having fun together' rather than on achieving the task. However, in this study we saw that a strong interpersonal relationship, and group identity and solidarity, enabled the relaxation of tensions, that will inevitably arise, and thus enabled the group to function effectively. Finally, from a developmental perspective, educational systems tend to emphasise the need for (positive) change, i.e. learning. But development also involves the active process of remaining the same (Hviid, 2010) remaining oneself, and preserving the group, in a changing task context and a changing world. This is what we have exemplified in the present study.

Aristotle (1926/c. 330 B.C.). *Art of Rhetoric*. Trans. J.H. Freese, Loeb Classical Library. Cambridge Mass.: Harvard University Press.

Arrow, H., McGrath, J.E. & Berdahl, J.L. (2000). *Small groups as complex systems: formation, coordination, development and adaptation*. Thousand Oaks: Sage.

Baker, M. (2010). Approaches to understanding students' dialogues: articulating multiple modes of interpretation. Keynote speaker lecture, EARLI SIG 17 "Qualitative and Quantitative Approaches to Learning and Instruction"; meeting on "Methodology in Research on Learning", Friedrich-Schiller-University of Jena, 2-3 September 2010

Foucault, M. (2001). *Dits et écrits II (1976-1988)*. Paris: Gallimard.

Geertz, C. (1973). Thick description: Toward an interpretive theory of culture. In C. Geertz (Ed.), *The interpretation of cultures*, pp. 3–30. New York: Basic Books.

Hviid, P. (to appear). Investigations of "remaining the same" as an active process in developing as a person. *Proceedings of ISCAR 2011*, Rome.

Latour, B. (2010). Coming out as a philosopher. *Social Studies of Science*, 40: 599-608.

Ryle, G. (1968). The thinking of thoughts. What is Le Penseur doing? Reprinted from 'University Lectures', no.18, 1968, by permission of the University of Saskatchewan. http://lucy.ukc.ac.uk/CSACSIA/Vol11/Papers/ryle_1.html

Vygotsky, L.S. (1930/1978). *Mind in society: the development of higher psychological processes*. Cambridge Mass.: Harvard University Press.

A case study to inquire the role of emotions in learning a hot historical issue in argumentative act

Baruch Schwarz, Hebrew University, Israel; Tsafrir Goldberg, University of Haifa, Israel

We report on the analysis of a series of activities designed to trigger productive argumentation in a history class. Students wrote an argumentative essay on a hot issue, read conflicting sources on this issue, evaluated the sources with the teacher, participated in a small group discussion to elaborate their views on the issue, and wrote again individual essays. We focus on one group of students to show that while their reasoning was very often biased, the interaction between students with different views on the hot issue led them to boost three historical disciplinary practices: (1) historical empathy, (2) the use of evidence in argumentation, and (3) evaluation of reliability. Theoretical considerations on the role of emotions in learning hot issues in history will be elaborated.

There is hardly a discipline in which emotional states are more pronounced than history. However, in spite of the centrality of emotion in history learning, this issue has been hardly studied. Researchers have recognized the impact of collective memories on individuals to show that students' attribution of significance to past events is mediated by family and ethnic collective memories (Seixas, 1994), by students' racial and social background (Epstein, 1998), or by media conveying a collective memory (Wineburg, Mosborg, & Porat, 2001). Also, educational research has paid growing attention to two practices that are quite prone to social and emotional influences: (1) the ways students evaluate and interpret historical evidence (Lee, 2005; Wineburg & Schneider, 2010); the learning with multiple historical sources (Hynd, 1999; Rouet, Britt, Mason, & Perfetti, 1996). The various biases that may rise in historical reasoning do not augur, a priori, occasions for learning gains in rich social interactions involving students with different views since the social interactions risk exacerbating these biases.

In a first study (Goldberg, Schwarz & Porat, 2008), we investigated the effect of the vitality of historical issues in collective memory on students' history learning processes and products. Sixty four 12th grade students of different ethnic background participated in two historical problem-solving learning tasks based on argumentative design (critical evaluation of sources and unguided group discussions). Vitality impinged on narrative and argumentative change, and on the relation of historical source evaluation with narrative change. An interaction was found between issue vitality and ethnicity in source evaluation: more vital collective memory narratives were more resistant to change and more prone to ethnic identity bias.

This first study suggests that collective memory and collective identity bias learning. However, a closer analysis of learning in the context of a vital collective memory issue, revealed effects for design and identity (Goldberg, Schwarz & Porat, in press). Even on the backdrop of a consensual collective memory narrative, argumentative condition produced improvement in the argumentative level of writing and promoted narrative change. Surprisingly, no evidence of confirmation bias was found in students' evaluation of sources and in final narratives. However, identity did seem to have strong impact, as the narratives of students from different ethnicities differed in the frequency, direction and degree of changes. Narrative change apparently bolstered in-group image. Argumentative design seemed to facilitate adoption of new perspectives, while social identity needs seemed to motivate it. In other words, emotional factors which could be thought as detrimental to historical learning seemed to boost it.

In the presentation, we will delve into interactions instead of relying solely on interpretations based on inferential statistics. We explore how emotions were intertwined in learning of an ethnicity relevant historical issue, heating up, but also promoting reasoning processes. The historical disciplinary practices to which we shall refer in our analysis to show the beneficial effects of emotions are (1) historical empathy, (2) the use of evidence in argumentation, and (3) evaluation of reliability. Historical empathy refers to the ability to put oneself in "the other's shoes", and to reconstruct historical agency in terms of mentality, context and intentionality. Empathy, or perspective taking, is one of the highly advocated and operationally under defined concepts in history education (Barton & Levstik, 2004).

Evidence use refers to reasoning on the basis of evidence. At its lowest level, evidence use is not deemed necessary to back historical claims. Higher up is the reference to generalized collective memory images. A more proficient use of evidence would be citation of a historical source relevant to the claim made. In the full disciplinary level a learner combines sources on the basis of relevance to claim and of evidence reliability. However, a learner may ignore the reliability of evidence, unintentionally or for a deliberate rhetoric reason (Rouet et al, 1998).

Evidence reliability evaluation is a dialectical process in which the learner determines in what way and to what degree the information contained in a source may be biased or flawed. At its lowest level all evidence is taken as true with no reference to reliability or bias. At higher levels, evidence reliability is evaluated through content and style cues, corroboration and contextualization ((Lee, Ashby & Dickinson, 1995; Wineburg & Fournier, 1994).

We will show that socially charged issues, and the "hot" cognition accompanying them, while fueled by biases, actually fostered cherished practices as evidence evaluation and perspective taking through one in-depth analysis of an unguided small group discussion on a "hot" issue. Students' "hot cognition" led from an egocentric to an "other oriented" or universal approach. Such a development could be seen as somewhat parallel to the courses of development outlined by Piaget, Erikson and Kohlberg, in the cognitive and moral realms. We will show that discussants progressed from solipsistic unsupported claims to reasoned argument addressing peer's challenge. They progressed from ignoring historical agents' consciousness to explaining it on the basis of historical context and human feelings' universality. We will show the complexity of the picture both practically and theoretically. Discussants' argumentative moves were fueled by ego and social belonging needs, not just by universal principles. They moved from universal to contextual explanations to individualized personal testimony based reasoning. We will suggest that although for most cognitive developmental theories the direction is from the individualized egocentric, to contextual and then to the universal reasoning, learners abandoned universalistic assumptions in favor of more contextual and even more individualized mental reconstruction.

Goldberg, T., Schwarz, B. B. & Porat, D. (2008). Living and dormant collective memories as contexts of history learning. *Learning & Instruction*, 18(3), 223-237.

Goldberg, T., Schwarz, B. B., & Porat, D. (in press). Changes in narrative and argumentative writing by students discussing 'hot' historical issues. To appear in *Cognition and Instruction*.

Individuals' Situational Emotions and Regulation of Emotions in Collaborative Learning

Hanna Jarvenoja, University of Oulu, Finland; Sanna Jarvela, University of Oulu, Finland; Jonna Malmberg, University of Oulu, Finland

Successful collaboration involves regulation of emotions to ensure a favorable affective atmosphere for collaboration, but there is not much research on how these processes can be supported. Our hypothesis is that regulation of emotions can be scaffolded with emotion awareness tools. That is why the aim of this study is to investigate 1) How students' situational emotions can be characterized?, 2) How students plan their anticipated emotion regulation?, and 3) How students' anticipated and realized emotion regulation correspond with each others?

Participants included 14 adult graduate students working in teams in three collaborative learning phases over an 8-week period. The data is composed of the students' "emotion awareness tool" responses, which the students use to indicate their situational affective state and to plan anticipated emotion regulation as well as the students' "Adaptive Instrument for Regulation of Emotions" responses which they used to reflect realized regulation of emotions. The results show that students' reports on anticipated emotion regulation changed to be more strategic and realistic after using the Emotion Awareness tool. Also the students' anticipated and realized regulation converged. Especially estimations of the use of "positive" regulation of emotions increased along with estimations of the use of "social" regulation of emotions decreased and corresponded better with evaluations of realized regulation. The results suggest that the students utilized the Emotion Awareness tool as a strategic emotion regulation tool.

INTRODUCTION

The importance of optimum motivational and emotional conditions for collaboration is widely acknowledged (Järvelä, Volet, & Järvenoja, 2011). However, when group of people collaborate emotional reactions can emerge endangering the emotional balance and optimal conditions for collaboration. This means that successful collaboration involves regulation of emotions to ensure a favorable affective atmosphere for collaboration.

Although studies have shown the importance of motivation and emotion regulation in learning, there is not much research on how these processes can be supported (Boekaerts & Corno, 2005). Research has shown that cognitive regulation processes can be promoted with computer-based regulation tools (Winne & Hadwin, 2009). These types of tools can also be useful for supporting motivation and emotion regulation, given that they provide possibilities for example to increase students' awareness of these processes and can provide feedback and visualise their activities.

AIM

Our hypothesis is that regulation of emotions can be scaffolded with emotion awareness tools that (A) Increase students' awareness of their situational emotions, (B) Guide students' to explicate the reasons for their emotions, and (C) Prompt students' to think and plan strategically their regulation of emotions. To investigate the hypothesis the specific research questions are

1) How students' situational emotions can be characterized?,

- 2) How students plan their anticipated emotion regulation?, and
- 3) How students' anticipated and realized emotion regulation correspond with each others?

PARTICIPANT AND METHODS

Participants included 14 adult graduate students working in collaborative teams of 3 to 4 over an 8-week period that included three face-to-face meetings, and three virtual solo and collaborative learning periods. Collaborative tasks were constructed to be challenging and require multiple student perspectives. The nStudy (Winne & Hadwin, 2009) software was used for collaborative planning and work, as well as for collaboration between team members.

The data of this paper focus on virtual collaborative learning periods. Every time students logged in to the nStudy learning environment they were advised to fill in an EmA-sheet. This "emotion awareness tool" (EmA) was used to increase students' awareness of how their emotional state affect on their studying and prompt students to regulate their emotions if needed. The questions in the sheet were 1) How are you feeling right now (neg-pos), 2) Why? (open question), and 3) How do you aim to control your emotional state? (open question).

ANALYSIS

Analysis proceeded by first characterizing students situational emotions (RQ 1). Students' feelings during collaborative learning phase and the reasons for the situational affective states were decoded. The reasons for affective state were coded into three categories; studying or course, other aspects of life, and un/balance between studying and life. The reliability of the coding was checked by another coder, and inter-coder reliability was calculated (Cohens Kappa 0,87). Next in the analysis students' plans for anticipated emotion regulation (RQ 2) were coded from EmA data according to the focus or aim of students' descriptions for the open question. The coding included four different categories presented in Table 1. Again, the reliability of the coding was checked by another coder, and inter-coder reliability was calculated (Cohens Kappa 0,67).

Finally, students' anticipated emotion regulation from EmA data were contrasted with their evaluations of realized emotion regulation reported with AIRE (RQ 3). The emotion regulation reports from each three collaborative learning phase were compared with each other using the categorization presented in Table 1.

RESULTS

Regarding to the first research question the results show that all together students felt positive during the collaborative working even though they reported emotions throughout the scale from negative (8%) to positive (63%). The experienced emotions were related to categories studying and course (33%), other aspects of life (49%) and un/balance between studying and life (18%).

Regarding to the second research question the results indicate that students reported plans for anticipated emotion regulation increased after the first collaborative learning phase; 48% of the codings in category nothing and 42% of the codings in category emphasizing social were given during the first learning phase. Codings in neutral –category remain almost the same throughout the three phases. Conversely 42% of the codings in to the category increasing positive were given during the last learning phase.

CONCLUSION

The results of the study showed that the students' awareness of their situational affective state increased when they used EmA-tool regularly. Furthermore, the results suggested that the students can employ the EmA-tool for their regulatory purposes and that they can learn to plan realistically how to regulate emotion during learning. All together the results indicate that regulation of emotion can be scaffolded by increasing students' awareness of their situational emotions and by prompting them to plan their regulatory aptitude purposefully.

SYMPOSIUM

What, when, where? How extracurricular activities foster learning and social development

Chairperson: Natalie Fischer, German Institute for International Educational Research, Germany

Organiser: Natalie Fischer, German Institute for International Educational Research, Germany

Discussant: Falk Radisch, Bergische Universitat Wuppertal, Germany

Effects of participating in extracurricular activities on several cognitive and non-cognitive outcomes have so far been analyzed primarily in the USA. European results are rarely quoted in literature. Moreover research in the field has predominantly been outcome-oriented so far. Only recently researchers started to examine questions of quality and dosage of extracurricular activities. The studies presented in this symposium focus on conditions and characteristics of after-school programs that are relevant for their effectiveness on learning and social and motivational development. Longitudinal data from three different countries (i.e. Australia, USA, Germany), assessed with different

methodologies, are presented. The studies are innovative by examining moderators and mediators of the effects of extracurricular activities. Different measures of experiences in activities and student-perceived quality of the programs are used. Student engagement, challenge, adult support and autonomy in the activities are amongst the included predictors and mediators. Influences of dosage are examined as well. In summary, results show that quality of experiences is an important factor in predicting academic and non-cognitive outcomes of adolescents. Results concerning dosage assessed as quantity of participation are inconsistent. Participation profiles as another measure of dosage seem to be predictive of academic success. The symposium can add to international research by clarifying processes and mechanisms underlying the effects of extracurricular participation.

Quality and dosage of extracurricular activities: Effects on motivational and social development

Natalie Fischer, German Institute for International Educational Research, Germany; Hans Peter Kuhn, University of Kassel, Department of Education, Germany; Ivo Zuechner, Deutsches Institut für Internationale Pädagogische Forschung (DIPF), Germany; Desiree Theis, Deutsches Institut für Internationale Pädagogische Forschung, Germany

The "Study on the Development of all-day Schools" (StEG) evaluates effects of the introduction of all-day-schools in Germany using a multi-perspective and multi-criterial longitudinal design. All-day schools offer extracurricular activities which include academic and non-academic enrichment. The evaluation of quality and individual effects of the school-based extracurricular activities is one main focus of StEG. Based on results of international studies in the field it is assumed that extracurricular participation in German all-day schools leads to improved motivation as well as reduced misconduct in school. Student perceived process quality of the activity and dosage are examined as mediators of these effects. This paper is based on data of about 9.000 students in 370 schools. They were assessed three times from grade 5 to 9 (age: 10 to 14 years). Hypotheses are tested using hierarchical linear modelling and structural equation modelling. Results show that extracurricular participation is related to a decrease of misconduct in school. Duration of participation is crucial for a positive development. Student perceived process quality and relatedness in the activities affect the development of motivational and social outcomes. Altogether, quality features of the activities seem to be more important than attendance intensity.

Introduction

In Germany, school is traditionally associated with the academic curriculum. Typically leisure activities are offered by out-of-school organizations. Due to the results of PISA 2000, the introduction and enhancement of the so-called "all-day schools" have been major topics in educational debates in Germany. The conversion and equipment of schools are financially supported by the federal investment program "Future of Education and Care". The "Study on the Development of all-day Schools" (StEG) was designed to evaluate effects of this program and is funded by the German Federal Ministry of Education and Research.

To be considered an all-day school, a school has to offer supervision for at least seven hours a day, three days a week. Although their pedagogical concepts are very heterogeneous, all German all-day schools provide extracurricular activities which mostly include academic and non-academic enrichment. The evaluation of quality and individual effects of the school-based extracurricular activities is one main focus of StEG. In Germany this is a new field of research but there is a large body of US-Studies about the effects of extracurricular activity participation on several cognitive and non-cognitive outcomes. The aim of this paper is to link the German results from StEG to international research in the field.

Theoretical and Empirical Background

At the beginning of this century research on extracurricular participation was mostly product-oriented. Recently researchers started to examine questions of process quality, student's experiences and dosage of extracurricular activities. In summary, empirical results showed that extracurricular participation in all-day schools can have a positive influence on social learning and the development of school grades and motivation (cf. Durlak et al., 2010; Feldman & Matjasko, 2005). But what are the processes leading to these effects? Existing models of after-school program effectiveness often include either process-quality or dosage. To measure dosage Fiester et al. (2005) differentiated between „absolute attendance", which means joining an activity compared to not participating, „attendance intensity", which covers the amount of time per week/ month etc. and „duration", which refers to the length of participation over time. Another measure of dosage concerns "breadth of activities" or participation profile (cf. Barber et al., 2005). Concerning program quality up to now there are some hints of certain features linked with positive outcomes. Mahoney and Stattin (2000) found that a structured environment in adult-supervised programs leads to a decrease of antisocial behavior compared to participating in low-structure activities. Besides structure, adult supervision is an important indicator of program quality (cf. Vandell et al., 2007). Based on self-determination-theory (Ryan and Deci, 2000), it can be assumed that extracurricular activities predict a positive development because of their high potential in addressing students basic needs (Barber et al. 2005; Fischer et al. 2009). Miller (2003) described

features of effective programs including supportive relationships, opportunities for skill-building and structure. Comparing the influence of quality versus dosage Shernoff (2010) argued that the quality of experiences in after-school programs is more important than dosage for academic outcomes. Contrary, first analyses of the first two measurements of StEG showed that duration of participation was linked to academic outcomes, whereas student perceived quality could predict motivation (Fischer et al. 2009).

Research questions

This paper examines two questions: a) Does extracurricular participation in German all-day schools lead to improved motivation and performance as well as reduced misconduct in school? b) Can the effects be mediated by student-perceived process quality of the activity as well as by attendance duration and intensity?

Method

StEG is a multi-perspective and multi-criterial longitudinal study. The target groups (i.e. the schools' principals, teachers, other pedagogical staff, parents and students) filled out questionnaires at three measurement points (2005, 2007 and 2009). Analyses for this paper are based on data of about 9.000 students from grade 5 to 9 (age: 10 to 14 years) in 370 schools. All day schools differ in student level of obligation. At most schools participation in extracurricular activities is available but not mandatory. So students in all-day-schools who did not participate in extracurricular activities are included in the analyses as control group. Hypotheses are tested using hierarchical linear modelling and structural equation modelling (growth curves).

Results and implications

Results show that participation in extracurricular activities influences social behavior. Duration of participation (but not intensity) is crucial for a positive development. Student perceived process quality and relatedness in the activities affect the development of non-cognitive outcomes (and GPA). Altogether, quality features of the activities seem to be more important than attendance intensity. This leads to implications for extracurricular arrangements in all day schools.

Predicting Social Competence and Academic Performance with Engagement in After School Programs

David Shernoff, Northern Illinois University, United States

Using Experience Sampling Method (ESM), this study examined two questions related to outcomes associated with after-school programming. First, does the quality of experience in after-school programs mediate the effect of program participation on social competence and academic performance? Second, among program participants, is the difference in quality of experience when in programs versus other settings after school related to higher social competence and academic performance? Middle school students (N = 196) attending eight programs in three Midwestern states reported a total of 4,970 randomly sampled experiences in and out of after-school programs during one week in the fall and spring of the 2001-2002 academic year. Engagement during after-school hours partially mediated the relationship between participation in after-school programs and social competence. In addition, relative perceptions of engagement, challenge, and importance when in after-school programs compared to elsewhere after school predicted higher English and math grades. Results suggest that the quality of experiences in after-school programs may be a more important factor than quantity of experiences (i.e., dosage) in predicting positive academic outcomes.

The goal of the proposed study is to examine how middle-school students' experiences and perceptions in after-school programs are related to social competency and academic performance. Research suggests that adolescents report a higher quality of experience in structured after-school programs, including greater engagement and more positive emotions, than in less structured and supervised activities after school (Authors, 2005). Research also links participation in after-school programs and extracurricular activities to the development of social competence (Durlak & Weissberg, 2007; Fredricks & Eccles, 2006a, 2006b; Larson & Brown, 2007) and higher academic achievement (Darling, 2005; Durlak & Weissberg, 2007; Fredricks & Eccles, 2006b; Mahoney, Lord, & Carryl, 2005). Few studies, however, have examined whether engagement and related experiential factors in after-school programs help account for positive social and academic outcomes. Using flow theory (Csikszentmihalyi, 1990) as a theoretical base suggesting that optimal experiences combining high concentration and enjoyment can lead to skill development (Csikszentmihalyi, Rathunde, & Whalen, 1993), two hypotheses were examined testing the role that the quality of experiences after school played in the development of middle school students' social competence and academic performance. The first hypothesis tested a mediation model: Does the quality of students' experiences after school mediate the effect of program participation on social and academic outcomes? The second hypothesis tested a differential benefits model: Among after-school program participants, does quality of experience in -programs relative

to that encountered elsewhere after school (e.g., home or in public) predict greater benefits in social and academic outcomes?

Method.

Data were collected in eight after-school programs in two medium sized cities and one small town in three Midwestern states. All of the programs were based in middle schools. The sample consisted of middle school youth ($N = 191$). Fifty-two percent were male, 60% were children of color, and 47% reported an annual household income of less than \$40,000. One-hundred-sixty students were program participants who reported participating in an after-school program at least once during the study, and 31 were program nonparticipants who did not participate in any organized program. Students' experiences and emotions were measured with the Experience Sampling Method (or ESM; see Hektner, Schmidt, & Csikszentmihalyi, 2007) over the 2000 – 2001 school year. To carry out the ESM, participants were provided with digital wristwatches that were programmed to emit 35 signals over two 7-day periods (approximately 5 signals per day) – one in fall (wave 1) and one in spring (wave 2). When signaled, students recorded their location, activity, social partners, subjective experiences, and emotions (e.g., challenge, importance, engagement, etc.) into self-report logbooks which were collected, monitored, and checked by field staff each day. The Social Competence Scale was completed at baseline (beginning of fall 2001 semester), and at follow up (end of spring 2002 semester) for the outcome measure. It yielded a measure of social competence of satisfactory reliability ($\alpha = 0.79$), factorial validity, and internal consistency. Academic performance was operationalized as English and math grades received at the end of the academic year, with self-reported grades at the beginning of the year utilized as the baseline measure. Analyses and results. The sample responded, on average, to 33 of the 35 signals (94% response rate). Self-reports ($N = 4,970$) occurring after school on weekdays, between the time school was dismissed and 6 p.m., were selected for analysis in the study. A variety of experiential variables (e.g., engagement, challenge, skills, positive affect) were significantly correlated with two measures of program participation (program status and dosage), and with social competence. Based on these correlations, plausible models were identified for further testing of mediation in four steps according to the seminal work of Baron and Kenny (1986) and Frazier, Tix, & Barron (2004). First, engagement was tested as potentially mediating the effect of program status (i.e., program participant vs. nonparticipant) on social competence. All four conditions tested in the four steps were satisfied, supporting partial mediation after controlling for background characteristics (i.e., gender, ethnicity, and socioeconomic status). Secondly, flow (i.e., mean of challenge, skills, and positive affect) was tested as a mediator of dosage (percentage of time spent in after-school programs) on social competence.

While the direct effect of dosage on social competence was not significant, the indirect effect of dosage on flow, and flow on social competence, was significant after controlling for background characteristics. However, mediation was not significant in either mediation model after additionally controlling for the baseline measure of social competence. To test the differential benefits hypothesis, a series of General Linear Models (GLMs) were conducted predicting outcome variables with mean differences in each experiential variable when in programs versus elsewhere after school. Higher levels of challenge and importance in programs (versus elsewhere after school) predicted both higher English and math grades, and higher negative affect predicted higher English grades, after controlling for background and baseline characteristics. In addition, engagement in programs predicted higher English and math grades after controlling for background characteristics but not baseline measures.

Discussion and implications.

Engagement and flow after school predicted higher social competence, an effect found to account for a significant portion of the positive association between program participation and social competence. This finding is consistent with Larson's (2000) conception of positive youth development: when youth combine concentrated focus with positive emotions in the task at hand, a combination represented in the engagement and flow constructs, conditions are optimal for developing social competencies such as teamwork and conflict resolution. These conditions are reported most frequently in structured, voluntary programs such as school-based after-school programs.

Results testing differential benefits of program participation among participants suggested that relative perceptions of environmental challenge and meaningfulness during after-school programs may be especially related gains in academic achievement. This finding supports perspectives of situational challenge and relevance as integral to flow-producing, authentic engagement and achievement (Csikszentmihalyi, 1990; Newmann, 1992). Especially considering the lack of significant associations between dosage and academic outcomes, results suggest that relative quality of experience in programs may be stronger and more positive predictor of academic performance than the quantity of experience in programs.

Profiles of activity participation and academic engagement - the impact of positive adult leaders

This paper examines the role of patterns of extracurricular activity participation, positive adult leadership, and social class in academic engagement of Australian adolescents. The sample included 1,504 adolescents (56% female). Students from Year 8 ($n = 924$) and Year 10 ($n = 579$) participated in the study, with the mean age of participants being 13.8 years ($SD = 1.02$ years, range 12-16 years). Participants in lower SES schools had the least auspicious participation profiles, being overrepresented among those with no activities, or playing only sports. Students from high SES schools were more likely to combine sports with other types of activities such as debate or band. Positive adult experiences in both sport and non-sport activities significantly predicted academic self concept, school attachment, and university aspirations. There was a significant cross-level interaction between positive adult leader in non-sport activities and school SES in the models predicting academic self concept and school attachment. Specifically, the association between positive adult leader in non-sport activities and both academic self concept and school attachment was stronger for youth from lower SES schools. Coordinated efforts are needed to increase the range of available activities for youth, particularly in under-resourced areas.

Going to school involves much more than the formal academic curriculum. The broader school environment can offer a range of opportunities for students to find their niche and invest in endeavors such as sports, music, or student leadership activities. School-sponsored activities such as sports and performing arts are important contexts that can support or undermine academic developmental goals and link students to the larger society of the school. However, recent reviews have observed that the scientific research base pertaining to activity participation is limited. There has been far less research on the developmentally facilitative processes in constructive leisure activities than on those in other contexts such as family and school. Nevertheless, it is becoming clear that structured organised activities are important, with mounting evidence that activity participation facilitates healthy development. There has been a recent call for researchers to consider the patterns or profiles of participation, that is, ways that students combine multiple activities. For example, some students play on a sport team or two, while others spend their time in academic clubs, and still others participate in a combination of different activities. One mechanism through which these participation patterns of activities can influence positive development is through interpersonal supports. Structured extracurricular activities provide adolescents with access to caring non-familial adults. Coaches and club advisors often invest a great deal of time and attention in these young people. With the right adults, such contact is likely to have positive effects on development particularly during adolescence. This paper addresses this link. The moderating effect of socioeconomic status on the outcomes associated with activity participation has received surprisingly little attention. A consistent criticism of the majority of studies investigating adolescent activity participation is that they are based primarily on middle-class youth. However, the findings of studies that have assessed the role of socioeconomic status suggest that the benefits of extracurricular activity participation are particularly prominent for adolescents from more disadvantaged backgrounds. Our paper considers SES as a moderator of the impact of the adult leader on academic engagement.

Method

Participants were recruited from 26 high schools, selected to represent the four metropolitan school districts ($n = 14$) and five of the regional school districts ($n = 12$) across Western Australia. The questionnaire took approximately 40 minutes to complete, and was administered either via laptop computers connected to a wireless intranet, or in an equivalent paper and pencil format. The sample included 1,504 adolescents (56% female). Students from Year 8 ($n = 924$) and Year 10 ($n = 579$) participated in the study, with the mean age of participants being 13.8 years (range 12-16 years).

Measures.

Participants were provided with a list of 30 sports (e.g., basketball, netball, swimming) and 24 non-sport structured extracurricular activities (e.g., band, school council, drama club), and were asked to check off all their extracurricular activities. Participation types were then divided into 4 categories: those who did not participate in any structured extracurricular activities (no participation), those who participated only in sports (sports only), those who participated in only non-sport structured activities (activities only) and those who participated in at least one sport and one non-sport structured activity (mixed). Participants also responded to a series of questions concerning their experiences with the adult leader in the sport and/or non-sport they spent the most time in (positive adult-leader; 4 items, sport $\alpha = .85$, non-sport activity $\alpha = .91$). The survey also included scales measuring academic self-concept (3 items; $\alpha = .79$) school attachment (5 items; $\alpha = .73$), and university aspirations. To assess socio-economic status (SES), school-level data were obtained from the Department of Education and Training in Western Australia which computes the Index of Community Socio-Educational Advantage (ICSEA) for each school in Western Australia. From their ICSEA scores, each school was given a rank of 1-26, with 1 representing the lowest ICSEA school in the sample, and 26 representing the highest ICSEA school.

Results

Chi-squared analyses revealed that participation category was distributed significantly differently by SES group ($\chi^2(6, 1486) = 123.45, p < .001$). Given the hierarchically nested structure of the data and our hypotheses concerning the main and interactive effects of SES (a group-level variable) on individual-level relationships, a multilevel analytic strategy was appropriate. The analyses were conducted with the Mplus 5.21 program. In order to test the links between individual characteristics (activity participation, positive adult leadership), group characteristics (school SES), and interactions and academic engagement, a series of 2 Level models were estimated. The within-person associations were modelled at Level 1. Gender and year at school were included as covariates. The between-person variable, school SES, was modelled at Level 2. Cross-level interactions were also investigated. Positive adult experiences in sport and non-sport activities significantly predicted academic self concept, school attachment, and university aspirations. There was a significant cross-level interaction between positive adult leader in non-sport activities and school SES in the models predicting academic self concept and school attachment. Specifically, the association between positive adult leader in non-sport activities and both academic self concept and school attachment was stronger for youth from lower SES schools.

Discussion and Implications The past 2 decades have seen a growth of interest in the extracurriculum. Much of the research on extracurricular activities has been concerned with the outcomes or effects of participation. Although we now have a good understanding of the benefits of activity participation, less is known about the mechanisms responsible for these effects. Our results suggest that having a more positive adult leader in one's activity is one promising explanation. However, despite good opportunities for many youth, those in disadvantaged communities have quite limited access, especially to non-sport activities. In tight economic times, school budgets have been cut, and teachers are under pressure to focus on achievement rather than non-academic activities. Coordinated efforts are needed to increase the range of available activities for youth, particularly in under-resourced areas.

SYMPOSIUM

Multimedia Goes to School: Studying Learning from Text and Pictures Beyond the Lab

Chairperson: Katharina Scheiter, Knowledge Media Research Center, Germany

Organiser: Katharina Scheiter, Knowledge Media Research Center, Germany

Jennifer Cromley, Temple University, United States

Discussant: Roger Azevedo, McGill University, Canada

In the last years, various suggestions have been derived from tightly controlled laboratory experiments on how to create effective multimedia instruction (i.e., instruction involving verbal and visual representations like diagrams or animations). For practical reasons, these experiments are often limited to rather homogeneous subject samples, short instructional messages, system-controlled instruction, a narrow range of materials of little personal relevance to learners, and learning outcome assessments immediately after learning. Nevertheless, the derived design principles are claimed to also provide useful guidance for the design of multimedia lessons to be used in real-life learning situations. The aim of this symposium is to challenge this idea of a simple transfer from the lab to the field. Results from the contributions show that first under real-life learning conditions (e.g., longer instructional units, learner control, delayed assessment) well-established multimedia design effects cannot be confirmed or even reverse (Contributions 1 & 2). Second, multimedia design effects obtained in the field are relatively small and may easily be overridden by more influential factors such as learners' individual characteristics (e.g., motivation, preexisting cognitive abilities; Contributions 2 & 3). Third, as a consequence, a successful approach towards improving multimedia effectiveness under these conditions may be to focus on fostering learners' abilities in handling the materials (e.g., by training them how to study diagrams) rather than on optimizing only the materials' design (Contribution 3). These findings therefore imply that the generalizability of lab research needs to be empirically proven; moreover, they suggest new avenues for supporting multimedia learning.

Long-term modality effects of multimedia learning in children and adults

Eliane Segers, Behavioural Science Institute, Netherlands; Gesa van den Broek, Radboud Universiteit Nijmegen, Netherlands; Ludo Verhoeven, Radboud Universiteit Nijmegen, Netherlands

In this presentation, I will describe three studies that investigated modality effects in multimedia learning in children and adults. In all three studies, both quantity and quality of learning were assessed. In a first study with 128 fifth-graders, we compared four learning conditions (written text, written text & pictures, oral text, oral text & pictures) in a learner-paced learning situation. Modality effects were found directly after the intervention, but reversed for the quality of learning one week later. In a second study with 80 children in sixth grade, we found a reversed modality effect for quantity of learning directly after the intervention, and again a reversed modality effect on the long-term measurement. In a third study with 86 adults, this reversed modality effect at long-term was again replicated. In this

third study, we took study-time and modality of the questions into account, but these were not of influence on the modality effect. It was found that the participants in the two conditions spent the same amount of time studying, but those who received on-screen text went through the slides faster and repeated more slides than those who studied spoken narrations. Such study behaviors were not correlated with performance. In the discussion, I will relate the three studies to the ongoing research on multimedia learning and challenge the design principles that suggest oral text accompanied by pictures is the optimal learning situation. The effect does not seem to hold in more realistic school situations.

Instructional materials that combine verbal information, such as on-screen text or spoken narrations, with pictures or animations, have become more and more relevant for education since multimedia computers are increasingly available to students and teachers. However, a learner's capacity for cognitive processing is limited and designers of multimedia instructions must take into account the load that is imposed on the learner's cognitive system (Verhoeven, Schnotz, & Paas, 2009). As a result, design principles for multimedia materials have been investigated extensively (see Mayer, 2009). One important conclusion from previous studies is that learners better simultaneously process pictures and spoken narrations than pictures and on-screen text (see Ginns, 2005). This effect is known as the modality effect. According to the cognitive theory of multimedia learning (CTML) (Mayer, 2009), explanations lie in early levels of processing of sensory information in working memory. A second type of explanations of modality effects is based on the idea that it is easier for learners to divide their (visual) attention between pictures and spoken narrations than between pictures and printed text. This split-attention hypothesis became prominent when evidence accumulated that modality effects, though often found with system-paced presentations, seemed to disappear or reverse when learners controlled the presentation rate of the information (for a review, see Ginns, 2005).

Both the CTML and the Split-Attention hypothesis focus at early processing stages and make relatively few predictions about later meaningful processing of the materials. Differences between visual-only and audio-visual materials are explained in terms of the amount of information that a learner can process simultaneously, either the amount of visual and auditory input that the working memory can take up at one moment in time, or the amount of visual and auditory information that learners can look at or pay attention to at one moment in time. The implicit assumption behind these accounts is that materials, which allow the learners to process more information at the same time, are also more likely to later engage learners in meaningful cognitive processing of this information.

However, text modality does not only influence early sensory processes, but also the way in which learners can deal with the information (e.g. spoken text is "fleeting", and printed text typically remains visible on the screen). Consequently, learners can decide at which point in the printed text they want to start reading, can quickly scan the text to find out if it includes a specific piece of information, and can selectively re-read difficult parts of the text. It is therefore interesting to study long-term modality effects. The focus of this paper lies on the practical importance of modality effects. We believe that, in order to formulate multimedia design principles, there must be sufficient evidence for the generalizability and the permanence of text modality effects.

Study 1 was a within-subject experiment with elementary school children (N=128 fifth-graders), testing modality effects in a self-paced learning situation. Children read or heard four texts each, of 190–240 words, either or not accompanied by pictures. The children showed standard modality effects immediately after learning, but after one week, the effects disappeared for retention measures (i.e., the amount of information that the children could reproduce), and even reversed for transfer measures (i.e., the degree to which the children were able to apply the acquired knowledge to solve new problems): Postponed transfer scores were better for the visual-only than for the audio-visual materials. Study 2 used the Mayer material on the formation of lightning, and replicated this postponed reversed modality effect for transfer measures in a between-subject experiment after a delay of just one day with 80 sixth-grade children.

In both studies, the performance of the participants in the audio-visual and the visual-only condition changed differently over time. Performance in the audio-visual group decreased from the immediate to the delayed test. With regard to performance development in the visual-only condition, we found no change in the retention performance and an improvement on the transfer scores from the first to the second testing occasion in study 1. In study 2, we found a decline in retention performance, but again an improvement on transfer scores.

In study 3, with 86 adults, participants had more extensive study material. It consisted of 128 slides (2695 words) about physical processes in Magnetic Resonance Imaging. No modality effects were found directly after learning, but reversed modality effects appeared one day later when the participants who studied the visual-only presentation performed better than the participants who studied the audio-visual presentation. This effect did not depend on the modality of the questions, as it was found for oral and written retention questions and for oral, but not written,

transfer questions. We also found that the questions were consistently more difficult when presented in the oral form than in the written form. The students in the two experimental conditions both spent about half an hour studying, but the participants who received on-screen text went through the materials faster and repeated the slides more often than the participants who studied spoken narrations. These study behaviors were, however, not related to performance outcomes.

We can conclude that with respect to long-term outcomes, learner-paced multimedia presentations with pictures and on-screen text are superior to presentations with pictures and spoken narrations. This finding is in line with the claim that the presentation rate of multimedia instructions constitutes a boundary condition of modality effects (Mayer, 2009).

Ginns, P. (2005). Meta-analysis of the modality effect. *Learning and Instruction*, 15, 313–331.

Mayer, R.E. (2009). *Multimedia learning* (2nd ed.). New York: Cambridge University Press.

Verhoeven, L., Schnotz, W., & Paas, F. (2009). Cognitive load in interactive knowledge construction. *Learning and Instruction*, 19, 369–375.

The relative importance of learner characteristics and instructional design in multimedia learning

Katharina Scheiter, Knowledge Media Research Center, Germany; Anne Schueler, Knowledge Media Research Center, Germany; Peter Gerjets, University of Tuebingen, Germany

The goals of the study were to test whether well-established multimedia design principles that have been derived from experimental studies conducted under strictly controlled laboratory conditions hold also in real-life learning situations as has been suggested. In particular, we investigated whether under more realistic conditions additional variables such as motivation or cognitive abilities come into play that may override the effects of improved multimedia design. Moreover, we were interested specifically in the relative contribution of reading comprehension skills to multimedia learning. In the study, 125 pupils from grades 9 and 10 of a German Gymnasium learned about cell reproduction during their regular Biology lessons in one of six conditions that resulted from cross-varying multimedia (text only vs. text plus visualizations) and text modality (spoken vs. written vs. spoken and written). Various learner characteristics were assessed prior to learning. A recall and a transfer test served as dependent variables. The results from several regression analyses support the assumption that under realistic learning conditions multimedia design manipulations become less important (in that there was no modality or redundancy effect and a limited multimedia effect only) than individual learner characteristics (e.g., motivation, representational abilities). The relevance of the latter was particularly evident when looking at performance measures that imposed higher cognitive demands such as transfer tasks or delayed tests. Moreover, the results suggest that text comprehension is highly important in learning irrespective of whether the text is accompanied by visualizations or not. Consequences for multimedia design theories will be discussed at the conference.

In the last years, various multimedia design principles have evolved from experimental studies conducted under strictly controlled laboratory conditions (Mayer, 2009). These principles are claimed to also provide useful guidance for the design of multimedia lessons to be used in real-life learning situations. So far only a few studies have investigated their applicability in real-life classrooms; however, they speak against a simple transfer from the lab to the field (e.g., De Westelinck, Valcke, De Craene & Kirschner, 2005; Tabbers, Martens & van Merriënboer, 2004). One reason may be that under more realistic conditions additional variables come into play that override the effects of improved multimedia design. For instance, motivation may be required to remain engaged during longer instructional sessions that may also build upon cognitive prerequisites to a larger extent than self-contained lab materials do. Moreover, because the content is taken from the regular curriculum and students have made prior experiences with similar contents, they bring specific attitudes towards the domain into the learning situation (e.g., domain-specific self-efficacy beliefs). In the current field study the relative importance of multimedia design manipulations compared to individual learner characteristics was investigated. Moreover, we were interested specifically in the relative contribution of reading comprehension skills as compared to skills related to the integration of verbal and pictorial information as well as related to handling computer-based materials in general (i.e., digital literacy). Given that the processing of multimedia materials has been shown to be largely text-driven (Hegarty & Just, 1993), reading comprehension was expected to be particularly influential in multimedia learning.

Method

In the study, 125 pupils from grades 9 and 10 of a German Gymnasium learned about cell reproduction during their regular Biology lessons. They had not received any prior instruction on this topic. Within each class, the pupils were randomly assigned to one of six conditions that resulted from cross-varying multimedia (text only vs. text plus visualizations) and text modality (spoken vs. written vs. spoken and written). Thereby the study allowed investigating

the multimedia principle, the modality principle, and the redundancy principle (Mayer, 2009). The learning environment comprised ca. 2,200 words that were either in written form or were spoken by a female voice. Depending on condition, the instructional explanations were or were not accompanied by static as well as animated visualizations that depicted cell structures and the process of cell reproduction.

With respect to learner characteristics, established measures assessed the pupils' biological literacy, their motivational orientation towards Biology (i.e., self concept, self-efficacy expectations, intrinsic motivation, extrinsic motivation, as well as pleasure and interest in science) as well as towards the task, reading speed and reading comprehension, digital literacy, and their ability to integrate text and pictures (self-constructed measure). Learning outcomes were assessed with a recall and transfer test that addressed students' memory for the presented information as well as their ability to draw inferences. Both tests were administered immediately and one week after the instructional lesson.

Results

A factor analysis of the learner characteristics data yielded three factors (explained variance: 56.43%). The first factor represented concepts addressing students' motivation towards Biology (domain-specific motivation). The second factor comprised concepts related to the ability to extract information from external representations and to use digital tools (representational abilities). The third factor represented more general motivational aspects as well as domain-specific prior knowledge (general motivation / scientific literacy).

The learners' factor scores, the two independent variables as well as the interaction terms were used as predictors in a regression to analyze recall and transfer performance; all reported results were significant at $p < .05$.

Both, the presence of visualizations as well as representational abilities contributed positively to immediate recall performance. Moreover, two interactions showed that adding visualizations aided learning especially if they were accompanied by spoken text and if learners possessed a high level of domain-specific motivation.

Immediate transfer performance was better the higher learners loaded on any of the three learner characteristics factors. Moreover, similar to recall performance, adding visualizations aided transfer performance only in the case of spoken text.

Multimedia design manipulations had no impact on either delayed recall or transfer performance, where either only domain-specific motivation served as a predictor (for recall) or a combination of domain-specific motivation and general motivation / scientific literacy (for transfer).

To test whether representational abilities related to either traditional media (i.e., reading speed, text comprehension) or to more advanced media (i.e., digital literacy, text-picture integration ability) are more influential for learning, the respective concepts were introduced separately as predictors together with the instructional design variables in a regression. This analysis revealed the overarching importance of text comprehension ability, which was the only significant predictor for delayed recall as well as immediate and delayed transfer. Immediate recall performance improved as a function of text comprehension as well as when visualizations were present.

Discussion

The results support the assumption that under realistic learning conditions multimedia design manipulations become less important - in that there was no modality or redundancy effect and a limited multimedia effect only - than individual learner characteristics. The relevance of the latter was particularly evident when looking at performance measures that imposed higher cognitive demands either because the knowledge had to be maintained over a longer time period or because inferences were required. Moreover, the results suggest that text comprehension is highly important in learning irrespective of whether the text is accompanied by visualizations or not. Therefore, multimedia cannot be used as a way of circumventing low text comprehension.

De Westelinck, K., Valcke, M., De Craene, B., & Kirschner, P. (2005). Multimedia learning in social sciences: Limitations of external graphical representations. *Computers in Human Behavior*, 21, 555-573.

Hegarty, M., & Just, M. A. (1993). Constructing mental models of machines from text and diagrams. *Journal of Memory and Language*, 32, 717-742.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press.

Tabbers, H. K., Martens, R. L., & van Merriënboer, J. J. G. (2004). Multimedia instructions and cognitive load theory: Effects of modality and cueing. *British Journal of Educational Psychology*, 74, 71-81.

Can laboratory research on multimedia comprehension be implemented in 10th grade biology classes?

Jennifer Cromley, Temple University, United States; Bradley Bergey, Temple University, United States; Shannon Fitzhugh, Temple University, United States; Theodore Wills, Temple University, United States; Nora Newcombe, Temple University, United States; Thomas Shipley, Temple University, United States

In an attempt to improve student comprehension of multimedia in situ, we created two workbooks for high school biology students—Coordinating Text and Diagrams (CTD) and Self-explanation in diagrams (SelfExpl)—and compared

effects to teaching Conventions of Diagrams (COD) in two studies ($N = 100$ and $N = 113$). Teachers delivered their usual instruction, pausing for about 7 min for students to complete a worksheet in pairs, followed by whole-class discussion of about 3 min ($M = 1$ worksheet/class meeting). Each workbook was implemented over a 5-6 week period covering 3-4 chapters and 21-34 worksheets, with daily researcher checks for fidelity of implementation. Results showed equal, significant, growth in biology diagram scores from pre- to posttest for COD and CTD ($d = .29$ and $.44$). Biology topic knowledge at pretest and Embedded Figures (spatial ability) scores at T1 predicted the rate of growth in diagrammatic reasoning (biology), but there were no interactions with condition. By contrast, only the Self-explanation treatment showed significant effects only on a transfer measure in another domain, and there was a condition \times MRT (spatial ability) interaction favoring high-spatial students in the Self-explanation treatment. Results suggest that, with these younger students studied in situ, 1) diagram skills can be improved with little disruption of normal classroom routines, 2) diagram skills may be more domain-specific than the literature has recognized to date, 3) different measures of spatial ability relate differentially to diagram skills in different domains, and 4) there are relatively complex individual difference \times treatment interactions.

Most research on students' comprehension of multimedia has been conducted in laboratories, with undergraduate psychology majors as participants. As part of a program of applied research, we have been creating a series of classroom interventions in reasoning with diagrams and text. In the current paper, we report on an evaluation of two workbooks we created for high-school biology students—Coordinating Text and Diagrams (CTD) and Self-explanation in diagrams (SelfExpl).

People often have difficulty understanding diagrams (Hannus & Hyona, 1999; Mayer, 2005). In the context of high-school biology, diagrams illustrate key concepts and are ubiquitous in textbooks. Despite their prevalence and importance, students often ignore large portions of diagrams (Cromley, Snyder-Hogan, & Luciw-Dubas, 2010). When students do attend to diagrams, the meanings of diagrammatic conventions (e.g., arrows, color use, labels) are often misunderstood (Hegarty & Sims, 1994; Heiser & Tversky, 2006).

While understanding diagrammatic conventions is necessary for deep understanding, the act of making sense of diagrams requires students to make inferences as they try to relate diagrammatic representations with the concepts represented and with prior knowledge. The cognitive complexity of such tasks may be particularly challenging for students at different developmental stages (Ainsworth, 2006) and abilities (Mayer, 2005; Sweller, 2005). One promising approach for helping students understand diagrams is self-explanation (Chi, de Leeuw, Chiu, & Lavancher, 1994). While the body of research on multimedia learning continues to grow, only a small proportion of these are experimental intervention studies (e.g., Seufert, 2003).

The purpose of this study is to experimentally compare the effectiveness of two classroom interventions on students' ability to answer near transfer (uninstructed biology diagrams) and far transfer (geology diagrams) measures of diagrammatic reasoning. Because neither type of instruction has been previously implemented with high school students, we were not able to predict whether the CTD instruction might be more effective because it would not be too difficult for the students, or whether the SelfExpl instruction might be more effective because it was designed to foster high-level processing.

Method

Across two studies, participants were $N = 100$ and $N = 113$ ninth-grade (i.e., 14-year-old) students in intact biology classes at a medium-achieving school in a small city in the Eastern United States.

Materials

We created Self-Expl and CTD workbooks to accompany 3-4 chapters (21-34 worksheets) in the students' own textbook, and compared each to previously-developed COD workbooks. Each workbook included images of every diagram in the relevant chapters, together with explanations and a series of targeted questions, which students answered in writing. In the COD workbook, the uses of various conventions were explained, and students answered questions identifying and explaining conventions in figures from their own textbooks. In the CTD workbook, students were shown that they should look at diagrams whenever a figure reference was given or a part in a diagram was explained; they then practiced these skills on figures from their own textbook. In the SelfExpl workbook, self-explanation was modeled, and students were asked self-explanation questions.

Measures

Students completed researcher-developed measures of biology and geology (transfer domain) knowledge and biology and geology diagram reasoning, and the Mental Rotations Test (spatial ability) during one regular class meeting. Both diagram reasoning measures were given again at posttest.

Procedure

Teachers received a 2-hr training explaining how to integrate the workbooks, scaffold students as they completed workbooks, and lead a class-wide discussion. Teachers delivered their usual instruction over 5-6 weeks, pausing for about 7 min for students to complete a worksheet in pairs, followed by whole-class discussion of about 3 min. After obtaining parental informed consent and student assent, students were pretested, received the intervention, and were posttested.

Results

Results showed equal, significant, growth in biology diagram scores from pre- to posttest for COD and CTD ($N = 100$; from 10.02 at pretest to 10.98 at posttest and from 11.25 to 12.96, $d = .29$ and $.44$, respectively). Biology topic knowledge at pretest and Embedded Figures (spatial ability) scores at T1 predicted the rate of growth in diagrammatic reasoning (biology), but there were no interactions with condition.

By contrast, in our second study ($N = 113$), only the Self-explanation treatment showed effects and only on the geology (transfer domain) measure; COD was 3.26 at pretest to 3.55 at posttest, but SelfExpl students increased from 2.49 to 3.18 ($d = .40$). We found a condition \times MRT (spatial ability) interaction favoring high-spatial students in the Self-explanation treatment.

Discussion

Results suggest the following conclusions regarding teaching diagram skills in situ to younger students than have usually been studied:

- 1) diagram skills can be improved with little disruption of normal classroom routines.
- 2) diagram skills may be more domain-specific than the literature has recognized to date: results differed for (instructed) biology diagrams and (non-instructed) geology diagrams, and only growth in biology diagram scores depended in topic knowledge at pretest.
- 3) different measures of spatial ability relate differentially to diagram skills in different domains
- 4) there are relatively complex individual difference \times treatment interactions.

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and Instruction*, 16, 183-198.

Chi, M. T. H., Leeuw, N., Chiu, M., & Lavancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science*, 18, 439-477.

Cromley, J. G., Snyder-Hogan, L. E., & Luciw-Dubas, U. A. (2010). Cognitive activities in complex science text and diagrams. *Contemporary Educational Psychology*, 35, 59-74.

Hannus, M., & Hyona, J. (1999). Utilization of illustrations during learning of science textbook passages among low- and high-ability children. *Contemporary Educational Psychology*, 24, 95-123.

Heiser, J., & Tversky, B. (2006). Arrows in comprehending and producing mechanical diagrams. *Cognitive Science*, 30, 581-592.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 31-48). Cambridge: Cambridge University Press.

Seufert, T. (2003). Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13(2), 227-237.

Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 19-30). Cambridge: Cambridge University Press.

SYMPOSIUM

The impact of genre on reading processes, critical thinking and epistemological beliefs in science

Chairperson: Isabel Braun, University of Freiburg, Germany

Organiser: Isabel Braun, University of Freiburg, Germany

Matthias Nuckles, University of Freiburg, Germany

Discussant: Clark Chinn, Rutgers University, United States

Science communications and popularizations differ from research articles in their communicative function and socio-cultural context, content and surface features (e.g. source information, structure, rhetoric), with function and context being reflected in content and surface features. Articles in popular science magazines, for example, are characterized by a rhetoric that attributes certainty to the scientific evidence presented whereas the distinct rhetoric of research articles suggests ambiguity and complexity. Furthermore, the standard structure of the research article gives way to an engaging storyline when an original publication is popularized. Scientists process science communications and popularizations in a different way than research articles and other scientific genres. In distinguishing between these

genres, they rely on the distinctiveness of textual characteristics and their knowledge of text genres. Hence, genre informs scientists' reading practices. With students, however, the role of genre remains largely unexplored: How do students distinguish among genres? (Strömsö & Bråten) Do students pay attention to surface features indicating the genre of scientific texts? (Braun & Nyckles; Strömsö & Bråten) Do genres differ in their effects on students' reasoning about scientific texts, critical thinking skills and epistemological beliefs? (Braun & Nyckles; Norris, Phillips & Yarden; Strömsö & Bråten) How can texts written in a scientific genre be modified so as to facilitate student learning? (Braun & Nyckles; Norris et al.) These are the central questions the symposium will address. The unifying aim of those involved in the symposium is to clarify the impact of genre on students' reading processes and learning outcomes in science.

Sourcing and judgment of trustworthiness when reading scientific texts representing different genres

Helge Stromso, University of Oslo, Norway; Ivar Braten, University of Oslo, Norway

Sourcing refers to readers' attention to and use of source information while reading different kinds of documents. In this study we hypothesized that students' sourcing activity would vary with different documents representing different genres. We also assumed that students' sourcing activity would be related to how much they trusted the documents that they read. A group of undergraduates ($n = 51$) were instructed to think aloud while reading two different documents about the possible relationship between cell phone use and health risks. The first document was a public information text from a national agency, while the second document was a newspaper article. After having read both documents, participants were asked to judge their trustworthiness. Analyses of think-aloud protocols indicated that students were paying significantly more attention to source information when reading the public information text than when reading the newspaper article. The public information text was also judged to be significantly more trustworthy than the newspaper article. Results also showed that students' level of sourcing while reading the public information text was positively related to their trust in that document. Their level of sourcing while reading the newspaper article was negatively related to their trust in that article, but positively related to their trust in the public information text. The results from the present study indicate that students' on-line attention to differences in genres, as indicated by source information, is related to how they judge different documents' trustworthiness.

Aims

In the present study, we set out to explore whether undergraduates' sourcing activities would vary according to the genre of the document. Next, we investigated whether on-line sourcing was related to students' judgments of the documents' trustworthiness. Theoretical framework Sourcing refers to readers' attention to and use of source information while reading different kinds of documents. Such skills are of importance to readers' understanding and evaluation of documents concerning scientific issues (Strömsö, Bråten, & Britt, 2010). With source information being central indications of a document's genre, students' sourcing activity may enable them to contextualize the content of a document and thereby facilitate comprehension. An important premise for readers' possibilities to take advantage of source information in text processing is that they actually pay attention to such information. However, even readers at university level may ignore vital source information while reading and evaluating media reports on scientific research (Goldman & Bisanz, 2002; Kopran, Bisanz, Bisanz, & Henderson, 1997; Stadler & Bromme, 2007). Students' lack of source awareness could affect their understanding of the documents' content, and is possibly also related to how trustworthy students judge a document to be (Bråten, Strömsö, & Britt, 2009). In the present study, we also hypothesized that sourcing activity could be related to the document's genre, with an informational document from a public agency expected to elicit more sourcing than a newspaper article. The public agency document will probably represent a less familiar genre to the readers. In addition, we wanted to explore whether on-line sourcing was related to students trust in the documents.

Methodology

Fifty-one undergraduates read two documents presenting different views on cell phones and health risks while thinking aloud. Verbalizations were coded as representing different forms of attention to source information, including both explicit and implicit source verbalizations. Explicit verbalizations of source information would typically be references to the publication's or author's name, while implicit verbalizations could be pronouns (e.g. he, this, that) referring to source information. The first document was a 444-word public information text from the National Radiation protection Agency, and the second document was a 395-word newspaper article. Participants were informed that they could read the documents in any order they preferred. After having read both documents, participants were asked to judge their trustworthiness. Results Think-aloud protocols were segmented and coded according to whether and how participants referred to source information while reading the documents. Preliminary analyses, using Wilcoxon Signed Ranks test, indicated that students paid significantly more attention to source information while reading the public information document than while reading the newspaper article, $z = -2.53$, $p =$

.011. There was also a significant difference in students' ratings of the two documents' trustworthiness, $z = -5.54$, $p = .001$, $p = .30$, $p = -.33$. **Conclusions** The results from the present study indicate that students' on-line attention to source information varies according to what kind of document they read. Specifically, students may pay less attention to source information when they read an article from a well known newspaper in a well known format than when they read a more unfamiliar document type, although they represent related genres (Goldman & Bisanz, 2002). It was also found that students' on-line sourcing was related to the perceived trustworthiness of the documents. Trust in the public information document was positively related to students' on-line sourcing while they read both documents, while trust in the newspaper article was negatively related to students on-line sourcing while they read that article. These results indicate that the relationship between perceived trustworthiness and sourcing activity is dependent on the nature of the document. As the results are of a correlational nature, we suggest that more experimental studies should be carried out to examine whether on-line sourcing affects students' trust in the documents they read. With the specificity of genres possibly being less apparent in the wealth of digital documents on the web, we believe that students need to be even more aware of source information in order to contextualize and understand many documents and that educators should facilitate such awareness.

Bråten, I., Strömsö, H.I., & Britt, M.A. (2009). Trust matters: Examining the role of source evaluation in students' construction of meaning within and across multiple texts. *Reading Research Quarterly*, 44, 6-28.

Goldman, S.R., & Bisanz, G.L. (2002). Toward a functional analysis of scientific genres: Implications for understanding and learning processes. In J. Otero, J.A. León, & A.C. Graesser (eds.), *The psychology of science text comprehension* (pp 19-50). Mahwah, NJ: Erlbaum.

Kopran, C.A., Bisanz, G.L., Bisanz, J., & Henderson, J.M. (1997). Assessing literacy in science: Evaluation of scientific news briefs. *Science Education*, 81, 515-532.

Stadler, M., & Bromme, R. (2007). Dealing with multiple documents on the WWW: The role of metacognition in the formation of documents models. *International Journal of Computer Supported Collaborative Learning*, 2, 191-210.

Strömsö, H.I., Bråten, I., & Britt, M.A. (2010). Reading multiple texts about climate change: The relationship between memory for sources and text comprehension. *Learning and Instruction*, 20, 192-204.

Students' interpretations of two scientific text genres: A tale of two countries

Stephen Norris, University of Alberta, Canada

Linda Phillips, University of Alberta, Canada

Anat Yarden, Weizmann Institute of Science, Israel

This paper reviews the results of two related studies, one conducted in Israel and the other in Canada, on the effects of Adapted Primary Literature (APL) on students' interpretations of scientific text. APL comprises articles written for high school students. It is based upon Primary Scientific Literature (PSL) and maintains its original structure by including introduction, methods, results, discussion, and conclusion sections, and by preserving the argumentative genre. Baram-Tsabari and Yarden compared the use of APL and Secondary Literature (SL) with two groups of high school biology students and found that the students using APL showed greater scientific inquiry and critical thinking skills in their interpretations of the text than did the students using SL. In addition, students comprehended the SL better and expressed more negative attitudes towards APL. Subsequently, Norris, Stelnicki, and De Vries conducted a similar study with two groups of high school mathematics students. They found a comparable effect on critical thinking in the interpretations of the APL group with an effect size almost identical to that found in the Baram-Tsabari and Yarden study. They also found APL to be more difficult to interpret than SL, but did not find differences in students' attitudes towards the two types of text. It appears from these studies that the use of APL might be an effective means to provoke students' critical thinking during the course of reading scientific text, as well as to present them with a more authentic scientific reading experience than afforded by SL and school textbooks.

Theoretical framework

This paper reviews the results of two related studies, one conducted in Israel and the other in Canada, on the effects of Adapted Primary Literature (APL) on students' interpretations of scientific text. Conceptually, APL is different from both Primary Scientific Literature (PSL) and Secondary Literature (SL) (Yarden, 2009). PSL comprises articles that appear in scientific journals written for scientists, while SL comprises articles that appear in the popular media written for non-scientific readers. The genre of PSL is mainly argumentative, while the genre of SL is a combination of narrative and expository. APL comprises articles written for high school students. It is based upon PSL and maintains its original structure by including introduction, methods, results, discussion, and conclusion sections, and by preserving the argumentative genre (Yarden, Brill & Falk, 2001). The rationale for using APL is that it introduces students to more authentic scientific texts than appears in SL and in their school textbooks and thus has an increased potential to teach students how to reason scientifically and to read the scientific genre (Yarden, 2009). In both studies

it was hypothesized that students would comprehend SL better than APL, because of their greater familiarity with the SL form, whereas students reading APL would gain greater insight into scientific inquiry and scientific thinking.

Study 1 – Methodology and Results

We shall describe two experimental studies and compare their results. In the first study, Baram-Tsabari and Yarden compared the use of APL and SL with two groups of 10th, 11th, and 12th grade high school biology students in Israel (N = 272). The students went to both urban and suburban schools, and were enrolled in a high school biology course. The PSL had appeared in Nature Biotechnology and reported an empirical study that designed a polyvalent inhibitor of anthrax toxin. The PSL was written in English, whereas the APL and SL adaptations were written in Hebrew, which was the language of instruction in the schools. After initial instruction in the underlying biological concepts given to all students, the APL and SL texts were assigned randomly to students to read and to answer a series of questionnaires. The questionnaires were validated by a team of six experts and measured comprehension, attitudes towards the texts, and scientific inquiry including critical thinking about the texts. It was found that the students reading the APL showed greater scientific inquiry and critical thinking skills in their interpretations of the text than did the students using SL

Study 2 – Methodology and Results

Subsequently, Norris, Stelnicki, and De Vries conducted a similar study with two groups of 12th grade mathematics students in Alberta, Canada (N = 211). The students were enrolled in an introductory calculus course, and were attending urban schools. The APL and the SL were based upon a PSL that appeared in the Proceedings of the Royal Society of London B and provided an epidemiological model for the spread of the West Nile virus. The study was a theoretical exercise in mathematical modelling. Both the APL and the SL were written in English. As in the Israeli study, after the basic mathematical modelling concepts were taught to all students, the APL and SL were assigned randomly to students to read and to respond to questionnaires. The questionnaires were either taken exactly from the Israeli study, or modified to accommodate the differences in content. The results showed a similar effect on critical thinking in the interpretations of the APL group compared to the SL group (p d, .34 v. .38 for critical thinking; .44 v. .39 for comprehension). The results also showed APL to be more difficult to interpret than SL, as was found in Israel (p ConclusionsIt appears from these studies that the use of APL might be an effective means to provoke students' critical thinking during the course of reading scientific text, as well as to present them with a more authentic scientific reading experience than afforded by SL and school textbooks. The findings from both studies highlight the contribution of APL in encouraging critical thinking and demonstrate that the structure of scientific texts can be useful in prompting students to think critically. In each study, exposure to different types of texts for portraying the same content was the treatment difference between the experimental and control groups. The content instruction in each study was identical for both groups and was not designed to assist with interpreting the texts. The findings are particularly encouraging given the difference between the Canadian and Israeli contexts. There were differences in the grade levels of the students, in the language of instruction, in the scientific content and nature of the scientific studies, in the urban and suburban composition of the schools, and in the school subject in which the students were registered. Despite these differences, the findings were largely the same. This is why we conclude that the results seem to suggest that exposure to texts that resemble canonical scientific form can provoke students to use critical thinking skills they already possess and that this result can occur across different cultures, languages, student ages, science topics, and other contextual differences. Nevertheless, although the studies mutually confirm the major findings on the size of comprehension and critical thinking effects, there are other results regarding student attitudes that appear might be influenced by context. A possible next step in this line of inquiry is to employ instruction that aims to teach students about the APL genre so that they are able more effectively to interpret it. It would be interesting to learn whether such instruction had positive effects on students' attitudes towards APL and on their ability to think critically about it.

Yarden, A. (2009). Guest Editorial - Reading Scientific Texts: Adapting Primary Literature for Promoting Scientific Literacy. *Research in Science Education*, 39(3), 307-311.

Yarden, A., Brill, G., & Falk, H. (2001). Primary literature as a basis for a high-school biology curriculum. *Journal of Biological Education*, 35(4), 190-195.

How the rhetoric of science can improve beliefs about knowledge construction

Isabel Braun, University of Freiburg, Germany; Matthias Nuckles, University of Freiburg, Germany

Scholarly journals, popular magazines and textbooks have their own ways of "telling science" and, hence, differ in their portrayal of the nature of science (NOS). As their rhetoric conveys a more adequate epistemology of science, research articles may provide more effective support for the development of students' understanding of the NOS than popular and instructional genres. To test this hypothesis we had 81 high school juniors read one of four versions of a

biology text: (1) an original publication from a scholarly journal, (2) a text adapted from the original publication so as to represent adapted primary literature (APL), (3) an article from a popular science magazine, (4) a chapter from a biology textbook. We administered questionnaires to assess students' understanding of the NOS, epistemological reasoning and genre knowledge. Half of the participants were prompted to think aloud during reading. Analyses of the post-test data showed that students improved significantly in their beliefs about the argumentative nature of knowledge construction after reading in the scientific genre (APL or original publication) but not after reading in the popular and instructional genres. We observed a general lack of knowledge about the scientific genre and low engagement in epistemological reasoning during reading. Our results seem promising as they show that the "rhetoric of science" can improve students' understanding of the NOS. However, as the potential of research articles was only partially realized, we suggest extending the notion of APL to include modifications of deep-level text characteristics, prompting epistemological reasoning or providing genre instruction.

Aims

The aim of the research we will be presenting in the symposium is twofold: First, we investigated the effects of discourse genres differing in their rhetoric and underlying epistemological assumptions on students' understanding of the nature of science (NOS). Second, we aim at refining the APL approach (Yarden, Brill & Falk, 2001) to more fully realize the potential of research articles for science instruction. Background Cognitive models of text comprehension assert that reader characteristics and text characteristics form complex interactions when students learn from text. The effects of surface-level text characteristics on students' understanding are well understood. However, research on features that mark a text as belonging to a particular genre and reflect both conventions and shared understandings of a discourse community remains limited. In the case of scientific, popular and instructional genres this lack of research is striking as they convey different epistemological assumptions through rhetorical features and structure, i.e. the way they present and unfold arguments. For example, popularizations of research articles furnish scientific evidence with a degree of certainty not found in the original accounts (e.g., Fahnestock, 1986). A similar "rhetoric of conclusions" (McComas, Almazroa & Clough, 1998), which contrasts the "rhetoric of science" (Har   , 1990) characteristic of the research article, can be found in high school science textbooks (e.g., Penney, Norris, Phillips & Clark, 2003). As the rhetoric of scientific genres implies a more adequate epistemology of science we assume that research articles provide more effective support for the development of students' understanding of the NOS than popular and instructional genres. Empirical evidence lending support to our hypothesis comes from research on the effects of refutational texts on epistemological beliefs (Kienhues, Bromme & Stahl, 2008) and research on adapted primary literature (APL) (see paper by Norris, Phillips & Yarden, this proposal). APL refers to research articles which are modified so as to be comprehensible and accessible to high school students.

Method

In a randomized experiment, we had high school juniors (n=81) read one of four versions of a biology text: (1) an original publication from *Animal Cognition*, (2) a text adapted from the original publication so as to represent APL, (3) an article from a popular science magazine that reported on the original publication, (4) a chapter from a biology textbook. Questionnaires were administered before and after the learning phase to assess students' understanding of the NOS, epistemological reasoning and knowledge of key concepts addressed in the texts. Half of the students of each condition were prompted to think aloud during reading. After completing the reading activity, students were asked to indicate which genre they thought their text had been written in (multiple-choice item).

Results

Students who read texts written in the scientific genre (original publication or APL) improved in their understanding of the NOS whereas students in the popular and instructional genre conditions showed less adequate understandings of the NOS after the treatment. Planned contrasts following MANOVA ($F[21,219]=1.78$, pp Students' responses to the epistemological reasoning questionnaire (free-response items) were analyzed for implicit references to the NOS. Despite a low number of implicit references in all of the four conditions (as indicated by preliminary analyses), more references were observed in the APL condition ($M=2.70$, $SD=1.38$) than in the popular genre condition ($M=2.40$, $SD=.99$), the instructional genre condition ($M=2.29$, $SD=1.10$) and in the remaining scientific genre condition (original publication), $M=2.47$, $SD=.90$. However, analysis of variance did not yield a significant result. An inspection of the think-aloud protocols corroborated the overall result obtained with the epistemological reasoning questionnaire: Across conditions, very few students engaged in any reasoning about issues related to the NOS. More detailed results will be presented at the conference. Out of 76 students who indicated the genre of the text they had read, 47 were unable to identify the correct genre (observed/expected per genre: $\chi^2[4, n=76]=45010.53$, p

Conclusions

The results from our present study indicate that discourse genres featuring a "rhetoric of science" facilitate the development of an adequate understanding of the NOS whereas popular and instructional genres and their "rhetoric

of conclusions" do not. The beneficial effects of texts written in the scientific genre were limited, however, to a single aspect of the NOS. Given the findings from our study, three approaches might prove successful in increasing the effectiveness of reading texts written in scientific genres.

First, we suggest that the notion of APL be extended to include modifications of deep-level text characteristics. In particular, the epistemological assumptions encoded in rhetorical features should be elaborated and the salience of the overall line of argument (running from the introduction to the discussion section) should be increased. This might allow students access to the implicit epistemology of the research article which appears to have been limited in our study as we did not observe differences between APL and the original publication.

Second, prompting epistemological reasoning during reading seems necessary as we found hardly any evidence of epistemic processing in the think-aloud protocols and students' awareness of the NOS at post-test appeared low across conditions. This will be the approach taken in our second study, which we plan to conduct in the fall. In a 2x2 design, students will read APL or an article from a popular science magazine. Half of the students will be prompted to engage in epistemological reasoning. Third, students might benefit from explicit genre instruction before reading APL (cf. paper by Norris et al., this proposal) as the high number of incorrect genre categorizations we identified points toward deficiencies in students' knowledge of scientific genres. Taken together, our results seem promising but they show that students cannot gain a complete understanding of the NOS through reading in the scientific genre only even when the research article has been adapted to their level of prior knowledge. Hence, the approach of adapting research articles has to be refined or complemented by instructional support in order to realize its full potential for learning from text in science.

SYMPOSIUM

Social Interaction in Learning and Instruction

Chairperson: Gaye Williams, Deakin University, Australia

Organiser: David Clarke, University of Melbourne, Australia

Discussant: Helen Melander, Uppsala University, Sweden

The theme of this symposium is "coherence," which includes curricular links between different pieces of knowledge, narrative links between different ideas or events within a lesson or between lessons, and connections between pedagogical incidents, performatively realised by the classroom participants (the teacher or the students). The analyses were conducted within the Learner's Perspective Study, in which sequences of lessons were recorded, using a multi-camera approach supplemented by post-lesson video-stimulated interviews (see Clarke, 2006), in mathematics classrooms around the world. In this symposium, we consider two forms of coherence that were performatively realized in mathematics classrooms in Hong Kong, Melbourne and San Diego:

? Coherence of knowledge: The structural coherence inherent in mathematical knowledge was performed as a narrative constructed by the teacher (and possibly by the students) to link old knowledge (what the students have learned) to new knowledge (what the students are intended to learn).

? Pedagogical coherence: Consistent pedagogical strategies were used by the teacher in the lessons analysed, such that sociomathematical norms were well-established in the classroom and understood by all participants.

The combination of coherence of knowledge and pedagogical coherence can be portrayed as a form of classroom narrative, in which the logic and connectedness of the instruction reflect the connectedness of the mathematical concepts in a form of curricular storyline that is perceived as coherent by the students. It is not sufficient to argue for a coherence evident to the researcher, if no similar coherence was perceived by the participants.

The performative realization of coherence in one San Diego classroom: Scaffolding student mathematic

Carmel Mesiti, International Centre of Classroom Research, Australia; David Clarke, University of Melbourne, Australia

This study examined the management of instructional transitions in a year 8 mathematics class in San Diego (USA) with a view to revealing strategies used by the teacher to assist the students in making connections between these various activities and the conceptual content and associated mathematical practices that were the focus of each activity. The hypothesis underlying this research was that these transitions, from one type of instructional activity to another, facilitate or inhibit connection between mathematical concepts and activities. Ardoin, Martend and Wolfe (1999) reported that efficient transitions can lead to an increase in academic learning time and thus student achievement. We are investigating the notion of coherence in relation to the teacher's active construction of meaningful connections in the management of these transitions.

Our analysis of a San Diego classroom has helped to identify ten different categories of dialogue that are present in the moments identified as instructional transitions. These categories are not restricted to the organisational domain and indeed some statements are intended to make more explicit the cognitive connection from one type of task to another. Our analysis suggests that the transitions are integrated so well that the students appear to engage with the sequence of tasks as a seamless progression. Further analysis addresses whether this progression equates to productive conceptual connections and thereby to coherence of knowledge construction and mathematical practice by students. Student post-lesson interview data suggest a connection between such classroom coherence and the coherence of student-constructed mathematical narratives.

The connection of instructional activity to learning outcome remains an abiding challenge for classroom research. In this study, use was made of data generated by the research design employed in the Learner's Perspective Study (LPS) (Clarke, 2006) to study lesson sequences in geographically and culturally diverse classroom settings, where multi-camera video documentation of classroom practice was supplemented by post-lesson video-stimulated interviews with teacher and students. The study of mathematical talk by Clarke, Xu and Wan (in press,) suggested that student fluency with spoken mathematics provided a learning outcome capable of distinguishing one classroom from another in a fruitful and theoretically interesting way. Based on this analysis, it was the students of LPS San Diego classroom 2 that employed the most mathematical terms overall in their post-lesson interviews. In particular, in discussing the mathematical content and their learning, the students in this classroom made more frequent use of mathematical terms not actually employed in the particular lesson under discussion, thereby demonstrating a compelling form of connected knowing. This consistent use by students of both mathematical terms central to the lesson and other mathematical terms encountered in earlier lessons or other contexts can be interpreted as suggesting a form of interconnected mathematical knowledge or conceptual coherence arising from the instructional practices of the classroom.

This argument suggested that a case study of San Diego classroom 2 should be conducted with a particular focus on the teacher's strategies and success in developing this connected mathematical knowing among the students. In particular, it was hypothesised that this demonstrable connectedness might be associated with the teacher's actions during instructional transitions during the lesson sequence. On that basis, the teacher's management of instructional transitions was taken as an appropriate analytical entry point.

We identified the transitions as the moments between the periods of expected student engagement in academic activities, when the teacher actively seeks to direct students' attention and engagement with a discussion or task. The lesson transcript, with specific attention to the teacher dialogue, was used to categorise teacher attempts at connecting one task to another from two points of view: organisationally and conceptually.

Our analysis suggests that the transitions in this classroom were not always efficient, yet the engagement rate of students was still quite high. This is in conflict with Brophy (1988) who has previously reported that student engagement rates require, in addition to other elements, that transitions between academic activities are brief and orderly. From a related perspective, Stevenson and Stigler (1992) found that more time was spent in transition between instructional activities in American classrooms with respect to their Chinese and Japanese counterparts, and they suggested that this may have consequences for the instructional environment. In fact, the San Diego classroom that provided the focus of this study can be characterized by the manner in which the teacher seized every opportunity to create a teaching moment. As a consequence, what might appear to be a lengthy transition becomes an academic activity in its own right.

Our analysis of San Diego classroom 2 has identified ten different categories of dialogue that are present in the moments identified as instructional transitions. These categories are not restricted to the organisational domain and indeed some statements are intended to make more explicit the cognitive connection from one type of task to another. Our analysis suggests that the transitions are integrated so well that the students appear to engage with the sequence of tasks as a seamless progression. Further analysis addresses whether this progression equates to productive conceptual connections and thereby to coherence of knowledge construction and mathematical practice by students.

Our results suggest that analyses of classroom discursive practice that address both conceptual and pedagogical coherence offer new insights into the constitution of accomplished teaching practice in mathematics classrooms by shifting emphasis from connecting instructional task types to testable student performances to a more subtle and sophisticated reading in which students participate in the development of coherent mathematical narratives. The development of these narratives being facilitated by the teacher's management of the transitions between instructional activities, thereby scaffolding student construction of coherent mathematical narratives related to the

lesson's content, in which the student's mathematical vocabulary is inevitably invoked. The facility with mathematical language and the integration of diverse mathematical terms into student reconstructive accounts of lesson content, documented previously by Clarke, Xu and Wan (in press) would be entirely consistent with this hypothesis.

Seeking coherence in mathematics teaching: An example in Hong Kong lessons

Ida Ah Chee Mok, The University of Hong Kong, China

Many educators agree that coherence is important to support students to realize and appreciate the rich relationship between concepts and skills. By analysing a sequence of ten Hong Kong 8th Grade lessons on the topic of equations, this presentation reports how coherence could be established between lessons and within lessons. There are two research questions. First, how is new knowledge linked to old knowledge? That is, how links between knowledge in the past, knowledge in a different part of the lesson, knowledge in different lessons in the sequence of lessons or knowledge developed outside that classroom could be established in the teaching. Second, what are the pedagogical strategies that create a pedagogical coherence throughout the teaching?

The data used in the analysis is taken from the Hong Kong data set (the lesson data and the teacher interviews) in the Learner's Perspective study. In the analysis, coherence was identified in terms of similarity in content and pedagogy. Applying a Grounded Theory approach in the analysis, I present the storyline of "coherence" in terms of three categories that include: the curricular links between different subtopics within a topic; the narrative links between different ideas or events within a lesson or between lessons, and the consistent pedagogical features found in the teacher's pedagogical beliefs.

Understanding in mathematics is about the realization of the relationship between concepts and skills. Such a relationship is not a matter of socially emergent causal connections nor of random association, because the structure embedded in mathematical knowledge is often hierarchically or logically structured. For this reason, many educators agree that coherence is important to support students to realize and appreciate the rich relationship between concepts and skills. By the analysis of a sequence of 10 Hong Kong 8th Grade lessons on the topic of equations, this presentation describes how coherence could be established between lessons and within lessons. There are two research questions. First, how is new knowledge linked to old knowledge? That is, how links could be established in the teaching between knowledge in the past, knowledge in different parts of the lesson, and knowledge in different lessons in the sequence of lessons. What are the instructional strategies that create a pedagogical coherence throughout the teaching?

The data utilized in this analysis are taken from the Hong Kong data set in the Learner's Perspective study. The data set included: the video of the lessons; transcripts with English translation; lesson materials which included the textbook pages, the students' work, the teacher's handouts and powerpoint files; the transcripts of the teacher's interviews.

In the analysis, coherence was identified in terms of similarity in content or pedagogy. In the analysis, the framework by Chen and Li (2009) for instructional coherence was adapted. The possible relationship between segments in the lessons are classified into categories: (1) the segments had similar mathematical ideas; (2) the segment was dependent procedurally on an earlier segment; (3) the segment extended an earlier segment procedurally or conceptually in terms of level of complexity. At the same time, a Grounded Theory approach was used to allow synthesis and extension of theory.

In the paper, I present the storyline of "coherence" in terms of three categories that include: the curricular links between different subtopics within a topic; the narrative links between different ideas or events within a lesson or between lessons; and the consistent pedagogical features found in the teacher's pedagogical beliefs.

The first kind of coherence comes from the connection between the sub-topics under the topic of simultaneous equations. The sequence began with the meaning of simultaneous equations in two unknowns, followed by the method of substitution and the method of elimination, the graphical method, and finally word problems. The coherence is inherent in the relationship between the sub-topics that in turns supports the understanding of the topic and is embedded in the design of the curriculum.

The second kind of coherence is found within the lesson. In the analysis of the lessons, the word "narrative" was used. The narratives describe a sequence of connected events or episodes in the lesson, which are useful in creating coherence in the flow of teaching and in the presentation of knowledge during the lesson, which can appear in different functional form in the lessons. For example, in a lesson the teacher respectively used a review, a word problem and a worksheet to create a context in which he connected different objects together. In the review of an

earlier topic that took place at the beginning of the lesson, the teacher used the concept “a linear equation in one unknown and its solution” with which the students were familiar to remind the students of the meaning of unknown and degree; concepts that are canonical for building equations with more unknowns and higher degrees. Using the chicken-and-rabbit problem as a context the teacher created a context linking three methods of solving the problems that included both the old knowledge (linear equation of one unknown) and the new knowledge (simultaneous equations in two unknowns). A worksheet provided an exercise that let the students to explore the meaning of solutions first in the case of a single equation followed by the case of a system of two equations.

The third kind of coherence refers to the pedagogical consistency embedded in the teacher’s belief. Embedded in his actions and decision-making in his lessons, the teacher often took into pedagogical consideration the development of some generic aspects besides the explanation of the content. These were: building the new knowledge from the old, building confidence and treasuring each student’s contribution.

Chen, X. & Li, Y. (2009). Instructional coherence in Chinese mathematics classroom – A case study of lessons on fraction division. *International Journal of Science and Mathematics Education*. Published online: 01 October 2009.

Should Areas of Parallelograms Be Taught Before Areas of Triangles? Is that the question?

Gaye Williams, Deakin University, Australia

In Victoria, Australia, curriculum documents do not prescribe the order of curriculum sequencing within a year level, and although broad guidelines on approaches to implementing the curriculum are provided, teachers in some schools are given considerable autonomy in sequencing and implementing the curriculum. This paper reports the activity of a teacher (Mrs Milano) who used such autonomy to develop a more coherent approach to the topic of ‘Areas of Triangles and Parallelograms’. It stimulates thinking about differences in pedagogical understandings developed by teachers who have responsibility for developing topic coherence, and teachers required to follow a prescribed curriculum that could vary in level of detail prescribed: order of sub-topic sequencing, tasks to be used, and / or how these tasks are implemented.

This study raises questions about whether teachers develop deeper pedagogical understandings when they struggle and work out ideas for themselves, or whether deeper pedagogical understandings develop through study of research literature. Mrs Milano’s experience suggests that studying research literature is not sufficient, on its own, to develop deep pedagogical understandings although this knowledge may have been important to her reflection process. Maybe the question should be “Is there an optimal balance between learning from experts and experimenting and reflecting to deepen pedagogical understandings? And, “What support structures could be developed to enhance such processes?” This case suggests we should have faith in teachers’ ability to develop topic coherence, and provide appropriate support structures to enable those teachers interested in doing so to develop curriculum coherence.

Coherence, for the purpose of this study, relates to the quality of student outcomes associated with a learning sequence. Coherence was considered to be present when students had opportunity to develop a deep and connected understanding of a mathematical topic. In Victoria, Australia, curriculum documents do not prescribe the order of curriculum sequencing within a year level, and although broad guidelines on approaches to implementing the curriculum are provided, teachers in some schools are given considerable autonomy in sequencing and implementing the curriculum.

This case reports the activity of a teacher (Mrs Milano) who used such autonomy to develop a more coherent approach to the topic of ‘Areas of Triangles and Parallelograms’. It stimulates thinking about differences in pedagogical understandings developed by teachers who have responsibility for developing topic coherence, and teachers required to follow a prescribed curriculum that could vary in level of detail prescribed: order of sub-topic sequencing, tasks to be used, and / or how these tasks are implemented. Mrs Milano progressively developed greater coherence for these topics by reflecting on difficulties students experienced, and what could help student learning in the future.

Mrs Milano had taught for more than five years and continued with postgraduate studies through that time. She has thus been exposed to research on the deeper understandings students develop when they build on their own ideas. Mrs Milano was described by many of her students as caring, easy to understand, willing to explain ideas, and available to speak to students and student pairs during student explorations. These students identified three ways in particular in which Mrs Milano assisted them: answering their mathematical questions; seeking out reticent students to be sure they understood; and affirming students’ mathematical pathways. Mrs Milano intentionally provided both ‘emotional and cognitive security’ for class members with actions including ‘telling’ and ‘affirming’. Such activity at

first appeared inconsistent with Mrs Milano's expressed goals of encouraging students to build ideas. During the research period, it became clear that in this topic at least, Milano interpreted 'students building ideas' to mean letting students develop ideas associated with a pathway she had pre-planned. Thus, Mrs Milano was identifying, and affirming ideas that progressed this direction, and gently deflecting ideas that did not. At the end of the sequence, Mrs Milano was concerned that the students had not developed the deep understanding she had expected: ability to recognise the relevant height of a triangle no matter its orientation.

After the lesson sequence, Mrs Milano's initially queried the order in which she had sequenced the subtopics because a student in another class she taught had just suggested using the area of a parallelogram to help find the area of a triangle. Mrs Milano had deflected this same suggestion during the lesson sequence because students had not learnt the formula for finding areas of parallelograms. Mrs Milano now realised it was not necessarily a change to topic sequencing that would enhance student learning: there were other possibilities. By retaining the sequence of lessons, and having faith in student ability to select and pursue their own mathematical directions, she now considered students could gain a more connected understanding. Mrs Milano's activity was increasing topic coherence.

There are parallels between exploratory student activity leading to deeper understanding of mathematics, and autonomous teacher activity leading to deeper pedagogical understandings. There are also parallels between the role of the teacher as listener and questioner eliciting further mathematical thinking from their students, and the role of the researcher as listener and questioner as the teacher reflected on pedagogical possibilities. This study raises questions about whether teachers develop deeper pedagogical understandings when they struggle and work out ideas for themselves, or whether deeper pedagogical understandings develop through study of research literature. Mrs Milano's experience suggests that studying research literature is not sufficient, on its own, to develop deep pedagogical understandings although this knowledge may have been important to her reflection process. Maybe the question should be "Is there an optimal balance between learning from experts and experimenting and reflecting to deepen pedagogical understandings? And, "What support structures could be developed to enhance such processes?" It could be productive to interrogate Japanese Lesson Study to identify whether, and if so how, it combines these different processes for developing pedagogical expertise. This case suggests we should have faith in teachers' ability to develop topic coherence, and provide appropriate support structures to enable those teachers interested in doing so to develop curriculum coherence.

SYMPOSIUM

Discussing complex "real world" issues at school: A space of dialogical tensions

Chairperson: Nathalie Muller-Mirza, Institut de Psychologie, Universite de Lausanne, Switzerland

Organiser: Michele Grossen, University of Lausanne, Switzerland

Discussant: Ed Elbers, Utrecht University, Netherlands

Over the last years, school curricula have given more and more importance to subject matters that deal with complex social issues and are closely related to the students' everyday experience. One general pedagogical purpose is to contribute to the development of responsible individuals and, eventually, of accountable citizens. However, the proximity of such topics with everyday experiences and highly polemical social discourses is challenging. Discussing "real world" issues may be extremely emotional and threaten the students' and teachers' identities. It may also be a source of misunderstanding between the school expectations and the students' experience, knowledge, opinions, etc., as well as between the school, the students and their families. Drawing on a socio-cultural and dialogical framework, this symposium aims at identifying the specificities of educational situations dealing with complex social issues and to understand how the teachers and the students make sense of them: What are the goals of these situations from the actors' perspective? How are "real world" issues discussed? In which communicative format and with what difficulties and misunderstandings? What mediational means can bring about change in student's commitment? More specifically, the aim is to examine the various dialogical tensions that arise when "real world" issues are discussed within the classroom. These research questions are examined through the analysis of actual teaching-learning practices dealing with topics that are of special relevance in the contemporary world and pertain to citizenship education: intercultural communication and racism, violence prevention through peer mediation, socio-scientific issues such as climatic change and environmental sustainability.

Access points to knowing: Arguing and learning about "real world" issues in the school context

Asa Makitalo, University of Gothenburg, Sweden

The aim of the reported project was to scrutinize how students approach socioscientific issues in a school context. In Sweden, the institutional response to the media development is that learning is more frequently organised in terms of extended projects where students work on real world dilemmas in groups using the internet, textbooks and other

resources. The extensive use of internet and other textual resources creates a learning context characterised by heteroglossia, which implies that the range of available voices and genres, potentially useful to frame an issue, are increasing. This implies that the "issues" students are working on must be transformed and framed in a specific discourse which makes local sense, i.e. it must be made relevant to the school setting and the task at hand. Three cases of such 5-7 week long project work arrangements were documented using video- and audio recordings and analyses of participants' interaction was conducted from a sociocultural and dialogical perspective. The results show the discursive complexity and argumentative challenges for both students and teachers as real world concerns and a set of different genres are brought into the school setting.

Taking a sociocultural and dialogical perspective on learning as the point of departure (Bakhtin, 1986; Rommetveit, 1992) the interest in the reported project was to study current attempts to organize teaching and learning activities in school. In particular, we studied activities arranged with the view to develop the communicative and literacy skills necessary to exert agency as citizens in a complex world mediated through digital media.

In Sweden, the institutional response to the media development is that learning is more frequently organised in terms of extended projects where students work on socioscientific issues and real world dilemmas in groups using the internet, textbooks and other resources. This kind of arrangement means that the complexity of what is to be learnt in school is increasing (Mäkitalo, Jakobsson & Säljö, 2009). The extensive use of internet and other textual resources creates a learning context characterised by heteroglossia, which implies that the range of available voices and genres, potentially useful to frame an issue, are increasing. As the different genres available on the internet 'hits' the classroom it becomes "populated -- overpopulated with the intentions of others" (Bakhtin, 1986, p. 294). Students are accordingly expected to learn how to come to an informed opinion from a myriad of possible ones. This implies that the "issues" students are working on must be framed in a specific discourse which makes local sense, i.e. it must be made relevant to the school setting and the task at hand. The aim of the project was to scrutinize how students approach such complex tasks.

The data consists of three cases of 5-7 week long project work arrangements on a) energy and sustainable development, b) genetically modified organisms, c) globalisation and international economy. These projects were initiated by teachers for 15-17 year old students (one class in secondary and two in upper secondary schools). The three data corpuses consists of video- and audio recordings of authentic classroom work, of students' interaction in groups as well as their interaction with teachers. The main research question was: How do students transform information from the Internet into knowing relevant in school?

In terms of results we can conclude that the students took on epistemic responsibility with regard to the accuracy of the information they retrieved from the Internet. However, gathering information was not sufficient to solve their tasks. In order to meet the local institutional expectations they also needed to address the issue of what was relevant when producing knowing. We could see the following pattern across cases:

First, students took an evaluative stance and the information from the Internet was sorted into what was considered "negative" or "positive" facts. This evaluative engagement was grounded either in a normative classroom discourse and/or in personal values. However, this evaluative stance was only a first step in organizing their work in a set of activities, which anticipated and responded to the upcoming assessment arranged by the teachers. In these settings the debate format was commonly used to report on their work.

Second, as both the positive and negative information were to be accounted for, an argumentative format was needed, which fitted the aim of the project work arrangement. The way the students approached the task was accordingly heavily influenced by the debate format. The retrieved information was arranged into descriptions, which took a narrative form i.e. the negative and positive facts were arranged according to time and a set of events. The set of events were then connected in ways that allowed students to argue that the real world issue (global warming, poverty or cloning) were either a consequence of human action or had natural or causal effects.

Third, when framing the complex issues the students used different communicative genres and social languages. Economic and scientific discourses were commonly used to frame the issues but also moral and political discourses were brought into the classroom. The students moved between these discourses without explicitly noticing that the premises for the arguments changed. Neither did the teachers make such shifts noticable. Teachers however supported the students when moving between general claims and specific examples in their argumentation.

From a sociocultural and dialogical perspective it is concluded that learning the relevant discourses in contemporary society is a demanding process in which students and teachers need to find relevant and comprehensible access

points into very complex issues. To appropriate the normatively preferred discourse at school is a challenging task in the new media ecology. "Expropriating it, forcing it to submit to one's own intentions and accents, is a difficult and complicated process." (Bakhtin, 1986, p. 294).

Bakhtin, M. M., Holquist, M., & Emerson, C. (1986). *Speech genres and other late essays*. Austin, TX: University of Texas Press.

Jakobsson, A., Mäkitalo, Å., & Säljö, R. (2009). Conceptions of knowledge in research on students' understanding of the greenhouse effect: Methodological positions and their consequences for representations of knowing. *Science Education*, 1-18.

Mäkitalo, Å., Jakobsson, A., & Säljö, R. (2009). Learning to reason in the context of socioscientific problems. Exploring the demands on students in 'new' classroom activities. In K. Kumpulainen, C. Hmelo-Silver & M. Cesar (Eds.), *Investigating classroom interaction. Methodologies in action*. (pp. 7-26). Rotterdam: Sense Publishers.

Rommetveit, R. (1992). Outlines of a dialogically based social-cognitive approach to human cognition and communication. In A. Heen-Wold (Ed.), *The dialogical alternative: Towards a theory of language and mind* (pp. 19-44). Oslo: Scandinavian University Press.

Åberg, M., Mäkitalo, Å., & Säljö, R. (2010). Knowing and arguing in a panel debate. Speaker roles and responsivity to others. In K. Littleton & C. Howe (Eds.), *Educational dialogues: Understanding and promoting productive interaction* (pp. 13-31). London: Routledge.

Learning to care for the environment through mediated experiences in natural places

Peter David Renshaw, The University of Queensland, Australia; Ron Tooth, University of Queensland, Australia

This paper takes a sociocultural perspective to investigate primary-school students' learning of a sense of civic responsibility for environmental sustainability. The site of the investigation is outdoors at an environmental education centre but the students' experience of the natural environment is mediated by specific tools and social scaffolds including: ocular devices such as magnifying glasses, cameras and recorders; narratives and story-telling related to real and fictional characters related to the place; and by thought experiments such as imagining the past and reflecting on possible futures for the natural environment. Data collection included observations of and interviews with students and teachers, and recording of teacher-student discussions and inquiry circles. Data analysis revealed changes in students' knowledge of the environment and growth in personal qualities such as confidence and attentiveness. Of particular interest were changes in their values and relationships to others and to place. Students reported changes in their sense of civic responsibility for family, peers at school and for future generations regarding sustaining the natural environment. The paper highlights the key role of mediational means such as narrative and deep listening in natural places to bring about significant change in students' civic commitments to ensure environmental sustainability.

This paper examines students' learning for environmental sustainability beyond the classroom where detachment and abstraction are privileged, to the affordances of the outdoors where engagement with nature is privileged along with the associated emotions and responses of the body to nature (Wattchow Burke & Cutter-Mackenzie, 2008). There is tension between the abstraction and detachment typical of classroom learning and the civic and personal commitments associated with learning to care for the environment in a natural setting. For example, Tooth found that experiences in natural places could provoke a heightened responsiveness and motivation for students to change their behaviour regarding environmental sustainability.

This paper builds on this earlier research by taking a sociocultural perspective to investigate primary-school students' learning during an excursion to a natural setting. Our focus in this paper is on their sense of civic responsibility regarding environmental sustainability and their subsequent commitments to try to change the behaviour of family members at home and peers at school. The site of the investigation is outdoors at an environmental education centre but the students' experience of the natural environment is mediated by specific sociocultural tools such as: ocular devices including magnifying glasses, cameras and recorders; narratives and story-telling related to real and fiction characters related to the natural place; and thought experiments such as imagining the past and reflecting on possible futures for the environment (Tooth, Wager, & Proellocks 1988). During the excursion the students are guided by teachers to participate in: (i) first-hand experience of a natural setting where deep listening to nature and close observation of small events in nature are scaffolded by the teacher; (ii) collecting, categorising and returning plants, insects and other animals; (iii) using scientific vocabulary and forms of argument to back up their suggestions regarding sustaining the natural environment; (iv) entering an imaginary space where they adopt the identity of characters in a drama involving the natural environment; (v) within the drama resolving a dilemma created for them as characters in the story. These activities are subsequently reviewed and revisited by teachers and students during the weeks that follow the excursion.

The research project involved students and teachers from nine classes (year 1 to year 7) drawn from different primary schools (N>200 students) in Brisbane, Australia. Across the year (2010) data was collected on a range of measures (prior and following the excursion) of student knowledge, values and changes in their sense of civic responsibility and commitments to environmental sustainability. Data collection methods included observations of and interviews with students and teachers, video- and audio-recording of teacher-student discussions and inquiry circles. For this paper we drawn upon data collected during: (i) the inquiry circle where students responded individually to the question, What changed for you as a result of going to the environmental education centre? (ii) in-depth small group interviews where a researcher asked the students to reflect on the changes that had occurred for them as a result of participating in the excursion.

In categorising their responses we searched the whole corpus of responses for consistent foci and themes expressed by students as the key changes that had occurred. We abstracted three key foci – (i) changes in self; (ii) changes in ones relationship to others and place; (iii) changes in learning at school. The changes to self were in terms of their personal qualities such as confidence and enthusiasm and an emerging new identity. The changes to their relationship with others were concerned especially with their sense of agency to influence others and do things to protect the environment, as well as in the realisation that even children have the power and responsibility to act for others and to protect the environment. The changes with regard to school learning were concerned primarily with more positive engagement and realising the relevance of school learning more. These changes were explicitly linked by some students to their realisation of the importance of direct experience of natural places for longer lasting and deeper change to occur.

We were surprised by the depth and eloquence of some responses from students. For example, one student (year 6 female) expressed herself as follows:

Before I did this program I just saw myself as someone who is passionate about nature and, yeah, someone who cares about wildlife but after I'd done this program I see myself as a wildlife warrior and I feel more confident in myself and I've become more alert and observant with my surroundings and it has given me a new confidence to go out and see the environment, instead of - just sitting and think oh I like the environment, I like nature, but not actually doing anything about what's happening.

In reflecting on the data from the project, we consider the affordances of different kinds of learning experiencing for transformational rather than simply incremental changes in students' thinking and civic sense of responsibility.

Tooth, R. (1995). Environmental History through Story. In Red Gold: Environmental History Through Story. Brisbane: Pullenvale Environmental Education Centre.

Tooth, R., (2007) Growing a Sense of Place: Storythread and the Transformation of a School. Doctoral Thesis, The University of Queensland, Brisbane.

Tooth, R., Wager, L., & Proellocks, T. (1988). Story, Setting and Drama - A new look at Environmental Education. Australian Journal of Environmental Education, 4, 31-34.

Wattchow, B., Burke, G., Cutter-Mackenzie, A. (2008). Environment, place and social ecology in educational practice. Changing Climates: Education for Sustainable Futures. Melbourne: Monash University.

Dialogical tensions and learning processes in intercultural education and interpersonal communicatio

Nathalie Muller-Mirza, Institut de Psychologie, Universite de Lausanne, Switzerland; Michele Grossen, University of Lausanne, Switzerland; Julien Grand, University of Lausanne, Switzerland

Drawing upon a socio-cultural and dialogical framework, we assume that a teaching-learning situation is a place of dialogical tensions between the here and now of the teaching situation and the there and then of situations outside school. Our aim is to identify the dialogical tensions at work in pedagogical situations dealing with real world issues and to examine the conditions in which they enable secondarisation, that is, the transformation of everyday experience into a form of conceptualised knowledge. How do teachers and students make sense of these pedagogical situations? What difficulties and misunderstandings do they face? What semiotic tools do they elaborate to enable secondarisation?

Teacher-students interactions and interviews with the teachers were collected in two contexts: intercultural education lessons and sensitisation course concerning interpersonal communication. The analysis of the results showed misunderstandings that referred to various dialogical tensions: (1) tensions between objects, values and norms that are valorised by the school and those that are valorised outside school; (2) tensions between various discursive genres; (3) tensions between various semiotic tools that can be used to elaborate a personal experience.

The significance of these studies is twofold: on a theoretical level, they shed light on the relationships between identity, learning processes and semiotic tools; on an educational level, they show that the introduction of real world issues in school has to go beyond the mere expression of personal emotions and values in order to foster the development of self-reflection.

Drawing upon a socio-cultural and dialogical framework (Marková, Linell, Grossen & Salazar Orvig, 2007; Muller Mirza & Perret-Clermont, 2009), we assume that a teaching-learning situation at school is a place of dialogical tensions in which the "here and now" of classroom interactions meets various "there and then" referring to the participants' (the students' as well as the teacher's) personal and social life outside school. From this standpoint, a teaching-learning situation is in permanent dialogical tension with other situations (Grossen, Zittoun & Ros, in press). It involves the person as a participant in various "communities of practice" (Lave, 1993) and, therefore, is related to the person's identity.

In this paper, we shall focus upon pedagogical situations in which these dialogical tensions may be particularly intense: those dealing with delicate social issues that are explicitly related to the students' everyday experiences, emotions and shared social representations. How do the students make sense of these situations and deal with these dialogical tensions? Our hypothesis is that such issues may raise highly emotional reactions, threaten the person's identity and hinder a secondarisation process (Bautier & Goigaux, 2004), that is, a transformation of everyday experience into a form of conceptualised knowledge that places the personal experience within a broader framework and takes it as an object of reflection. In other words, our aim is to examine the conditions in which pedagogical situations dealing with "real world" issues lead the students to take a reflexive stance on their own experience and identities.

We shall present some results taken from two studies. The first concerned intercultural education, and the second interpersonal communication. Despite their differences, these two pedagogical situations had at least three points in common: (1) they required the students to draw upon their personal experiences, feelings and everyday behaviour in order to participate in the pedagogical situation; (2) the issues at stake referred to various bodies of knowledge or competence (for example, social and intercultural psychology, communication sciences, etc.) that were not based upon explicit learning theories or pedagogical methods; (3) they were explicitly related to personal and social values and, therefore, differed from usual curricular subject matters.

Six teachers, who were interested in using intercultural pedagogical material provided by a pedagogical centre of intercultural education and sustainable development, and 105 students aged 4 to 16 from 6 classrooms of primary and secondary schools, participated in the first study. The pedagogical material concerned the relationship to "Otherness" and/or migration. Classroom observations were made and pre- and post-interviews were carried out before and after these observations. The data were audio- and video-taped. The second study was part of a larger research project concerning peer-mediation in a lower secondary school (12-16 years old). One part of the complex training programme set up by this school was a "sensitisation course" that introduced the students to interpersonal communication and, more specifically, to peer-mediation. This course was given in four half-day sessions in which students worked in small groups moderated by two teachers. Two groups were observed and audio-taped during the four sessions.

The method of analysis consisted of analysing the dialogue between the teachers and the students in order to identify: (a) the misunderstandings, divergences or gaps between the teachers' pedagogical goals and the students' interpretation of the situation and task, as we assume that misunderstandings and gaps shed light on the implicit expectations of these pedagogical situations; (b) the place given by the teachers to the expression of personal experience, values and emotions; (c) the intermingling between the present dialogue between the teacher and the students, and the distant dialogues with other situations and third parties.

The results of our analyses enabled us to identify a series of divergences or misunderstandings that can be seen as the expression of various dialogical tensions: (1) tensions between objects, values and norms that are valorised by the school and those that are valorised in peer and social groups outside school ; (2) tensions between various discursive genres (academic genre vs. everyday conversation); (3) tensions between various semiotic tools that can be used to elaborate a personal experience.

The significance of these results is twofold: on a theoretical level, they shed light on the relationships between identity, learning processes and semiotic tools; on an educational level, they show that the introduction of 'real world' issues in school has to go beyond the mere expression of personal emotions and values in order to foster the development of self-reflection.

Bautier, E., & Goigoux, R. (2004). Difficultés d'apprentissage, processus de secondarisation et pratiques enseignantes: une hypothèse relationnelle. *Revue Française de Pédagogie*, 148, 89-100

Grossen, M., Zittoun, T., & Ros, J. (in press). Boundary crossing events and potential appropriation space in philosophy, literature and general knowledge. In E. Hjärne, G. van der Aalsvoort & G. de Abreu (Eds.), *Learning, social interaction and diversity – exploring school practices*.

Lave, J. (1993). Situating learning in communities of practice. In L. Resnick, J. M. Levine & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 63-82). Washington, DC: American Psychological Association.

Marková, I., Linell, P., Grossen, M., & Salazar Orvig, A. (2007). *Dialogue in focus groups: Exploring socially shared knowledge*. London: Equinox.

Muller Mirza, N., & Perret-Clermont, A.-N. (Eds.). (2009). *Argumentation and education: Theoretical foundations and practices*. New York: Springer.

SYMPOSIUM

Measurement and cognitive structure of digital literacy skills

Chairperson: Johannes Naumann, German Institute for International Educational Research, Germany

Organiser: Johannes Naumann, German Institute for International Educational Research, Germany

Frank Goldhammer, DIPF - German Institute for International Educational Research, Germany

Discussant: Jean-Francois Rouet, Université de Poitiers, France

This symposium aims at exploring digital literacy skills both from a measurement and a cognitive perspective. Under digital literacy skills we subsume skills in accessing, integrating, and evaluating information, using information and communication technologies (ICT). We address this issue from three angles: First, we look at individual differences in the skills of using the ICTs to access and evaluate information, and new approaches to measure these skills taking into account efficiency of task engagement. Second, we look at students' skill in understanding digital reading materials, which can be assumed distinct from their skill in print reading, and also can be assumed to partly rest upon the skills discussed previously. We introduce a large scale assessment of these skills carried out in PISA 2009, the Electronic Reading Assessment (ERA) and show how success in ERA tasks depends on students' access of information, and the interaction of access processes with access demands. Third, we complement the large scale assessment perspective including cross-sectional data by an experimental psychology perspective towards strategies in accessing digital information. This study seeks at disentangling different cognitive strategies in hypertext selection. By these means, this symposium, besides its substantive aims, also seeks to bring together methodological perspectives and traditions in research on digital literacy (psychometric measurement/process analysis; large scale assessment/experiment) that often remain distinct, to complement each other in giving a comprehensive picture of students' digital literacy.

Measuring individual differences in ICT literacy: Accessing and Evaluating Information

Yvonne Pfaff, German Institute for International Educational Research, Germany; Frank Goldhammer, DIPF - German Institute for International Educational Research, Germany

The computer and the Internet have become essential and omnipresent parts of our daily life. Thus, computer-related skills are considered as an important condition for successful problem-solving in educational and workplace settings. A multi-faceted construct of Information and Communication Technology literacy (ICT literacy) is needed to address the competent, responsible and critical handling of information- and communication technology. This study focuses on the theoretical and empirical fundamentals of two major facets of ICT literacy, namely accessing information and evaluating information. The ICT literacy facet 'access' is defined as the skill and speed to use basic interaction functions of graphical user interfaces of computers to access, collect, and provide information. 'Evaluate' refers to the cognitive skill to efficiently make judgements about the quality of online-information using structural and message features of a website. We look at new approaches to measure these skills taking into account not only accuracy, but also efficiency of task engagement. The psychometric properties of the two scales are investigated as well as their validity following a nomological network approach.

During the past decades the competent and critical handling of information- and communication technology (Information and Communication Technology, or ICT literacy), has become a crucial skill in many educational areas. In the 21st century, no study programs, either vocational or academic, can be accomplished without basic ICT skills. Individuals lacking ICT skills will be left behind both in educational as well as in professional contexts. Moreover, the computer itself has become an important means of instruction, and to-be-learned materials are being delivered through the computer as hypertext, hypermedia, or simulations. This study focuses on the theoretical and empirical fundamentals of two major facets of ICT literacy, namely basic computer skills that enable to access electronic information and evaluation skills that allow to judge information retrieved from the Internet with respect to credibility. We define the competence of 'access' as the skill and speed to use basic interaction functions of graphical

user interfaces of computers to access, collect, and provide information (see Goldhammer, Naumann, & Pfaff, in preparation). We conceptualize the competence of 'evaluate' as the skill to efficiently judge the reliability and credibility of online-information, using structural and message features of a website (cf. Hong, 2006). Message features are defined according to five criteria originally developed for print-media, but being applicable also to the credibility of online-information. These are accuracy, authority, objectivity, currency, and coverage (see Alexander & Tate, 1999). Structural features are specifically related to the composition of websites and include domain names, the presence of site maps, online privacy policies, third-party seals of endorsement, and advertisements. A website is regarded to be a credible source of information on the basis of message-features primarily. Based on the assumption that structural features are predictive for message features, however, structural features can serve as valid heuristic cues to efficiently judge the quality and reliability of a website. Regarding measurement of digital skills, tests are often designed as knowledge tests, using multiple-choice-questions and short answer formats (e.g. Richter, Naumann & Groeben, 2001). Such atesting approach cannot provide an authentic interactive task as computer simulations can do. Thus, one major goal of this study was to design, scale and validate computer-based measures which indicate 'access' and 'evaluate' by means of interactive simulations of computer environments, allowing to estimate a person's efficiency and speed in task completion in addition to their accuracy.

The 'access' scale proposed here consists of 25 interactive items assessing the skill to operate mouse and keyboard, to open, save, delete and change texts and to handle menu bars, hyperlinks, scrollbars and hotkeys etc. The items include simulated environments representing standard programs, i.e., word processing, web browser and email client. For all items, response accuracy and response times are collected. The scale 'evaluate' comprises 24 interactive items simulating web-environments assessing the skill to efficiently judge online-information with respect to credibility. Online-information is presented in the form of link lists provided by a search engine, and forum entries. The informational context varies across items and includes health, craft, school and sports. Eight items consist of link lists, where the links cannot be clicked on. In this case the test taker needs to use structural features, and is not able to fully evaluate message features. Another eight items consist of link lists, where the links can be clicked on and the corresponding websites can be explored. Here the test taker can use both structural and message features. The last set of eight items comprises forum entries where the test taker needs to make a judgment on message features alone, and cannot rely on cue information provided by structural features. Again, for all items response accuracy and speed are collected.

A sample of 400 students in grade 9 from all educational tracks and 200 students in grade 12 completed the ICT scales 'evaluate' and 'access' as well as further computer-based tests for validation. We will present results pertaining to the measurement models for 'access' and 'evaluate'. In line with previous findings (Goldhammer et al., in preparation), for 'access', data proved unidimensional for each accuracy and speed, i.e., responses and response times were accounted for by one skill factor and one speed factor. Also in line with previous research as well as assumptions made in item development, 'access' item parameters were predicted by the number of steps required for task completion. For 'evaluate', two skill dimensions were identified, relating to whether structural or message features of a website had to be taken into account. The same pattern held for speed in the completion of 'evaluate' tasks. Analyses of 'evaluate' item characteristics predicting 'evaluate' item difficulties are currently under way. First results indicate that in line with item development rationales, the amount of information that has to be considered is predictive of item difficulty. Also, items that allow for the attendance to both structural and message features are harder if message and structural features in the to-be considered websites point to different directions in terms of reliability. In sum, the 'access' and 'evaluate' scales appear to provide a reliable measure of persons' ability and speed with respect to these two dimensions of ICT literacy.

To further investigate the construct validity of 'evaluate' and 'access' scales, the respective skill and speed dimensions will be embedded in a nomological network, including their relation to practical computer knowledge, general cognitive ability, attentional speed, word recognition, and computer usage.

Alexander, J.E. & Tate, M.A. (1999). *Web wisdom: How to evaluate and create information quality on the Web*. Hillsdale, NJ: Erlbaum.

Goldhammer, F., Naumann, J., & Pfaff, Y. (in preparation). *Basic Computer Skills: Conceptualization and psychometric characteristics of an interactive scale*.

Hong, T. (2006). The influence of structural and message features on website credibility. *Journal of the American Society for Information Science and Technology*, 57, 114-127.

Richter, T., Naumann, J., & Groeben, N. (2001). The Computer Literacy Inventory (INCOBI): An Instrument for the Assessment of Computer Literacy and Attitudes toward the Computer in University Students of the Humanities and the Social Sciences. *Psychologie in Erziehung und Unterricht*, 48, 1-13.

Introducing the PISA 2009 Electronic Reading Assessment and explaining performance by process data

Johannes Naumann, German Institute for International Educational Research, Germany; Tom Lumley, Australian Council for Educational Research, Australia; Juliette Mendelovits, Australian Council for Educational Research, Australia

In the 2009 cycle of PISA, for the first time, an assessment of students' skill in reading and understanding digital texts was carried out, the Electronic Reading Assessment (ERA). In PISA 2009, the ERA option was an international option that was chosen by 19 countries and involved 24,000 students. In the present paper, we introduce the ERA framework, and present results speaking to both commonalities of electronic and print reading skill, and distinctive features of electronic reading. Results from the ERA indicate that while print reading and electronic reading share a substantial proportion of their variance, their latent correlation is also clearly different from one, indicating the presence of unique variance in electronic reading that print reading skill cannot account for. One factor specific to electronic reading is the use of navigation strategies in information access. Logistic regressions of success in responding to electronic reading tasks on navigation behaviour, navigation demands, and the interaction of navigation behaviour and navigation demands revealed an impact of navigation on the probability of succeeding in electronic reading tasks especially for tasks with high navigation demands. These relations prevailed when print reading skill on the student level was controlled for.

In the 21st century, a still increasing amount of students' reading activities is directed at electronic sources such as websites, e-mails, blogs or microblogs, or online discussion forums. On the one hand, the demands put on a reader when engaging with electronic reading materials are closely related to the comprehension of printed text, since all the basic processes of text comprehension, from word recognition to forming macropropositions, are the same in the printed and electronic medium. On the other hand, a number of reading processes take on a specific shape, and require specific knowledge and skills, when electronic reading materials are encountered (Rouet, 2006).

Referring to characteristics of the aspects of reading, as distinguished by the PISA 2009 assessment framework (OECD, 2009), first, accessing information in the electronic medium usually requires navigation of the text material, which includes the use of devices such as hyperlinks, menus, search boxes, etc. Second, integration of information from multiple documents is crucial in reading electronic sources, as most electronic documents come as hypertexts, which are intrinsically multiple documents. Because readers typically have more freedom in constructing hypertexts than they do when reading in the print medium, strategies for managing the reading process are likely to assume even greater importance in electronic reading than in print reading (e.g. Naumann, Richter, Christmann & Groeben, 2008). Third, the evaluation of electronic sources delivered via the internet requires the use of specific cues such as information contained in a website.

Given the distinctive features of electronic documents, and their distinctive processing requirements, a reading assessment not incorporating electronic texts will under-represent the domain of reading, and fail to measure an important part of students' reading skills. For these reasons, in the current cycle of PISA, a measure of students' skills in reading electronic texts was employed in addition to the PISA print reading assessment. In the present paper, we (1) introduce the PISA 2009 Electronic Reading Assessment (ERA), and discuss a selection of its basic outcomes (OECD, forthcoming), with a focus on the relationship between reading performance in the print and electronic environments; and (2) take the opportunity provided by a computer-delivered reading test to describe and investigate processes of information access in reading tasks. We use information provided through log files of students' navigation to determine the goal-directedness of their navigation behaviour to predict task success.

The Electronic Reading Assessment was an international option in PISA 2009, taken by 19 countries, involving a total of approximately 24,000 students. The ERA used a total of 29 computer-delivered reading tasks, covering a range of types of reading materials currently found on the Internet, encompassing both authored (e.g. Websites) and message-based (e.g. blogs, e-mails) texts. The 29 tasks were distributed across nine units, with each student responding to two-thirds of the tasks.

To investigate the relation of reading skill in the print and electronic medium, in a first step, ERA scores were regressed on print reading scores. Results indicate that, as expected, print reading and electronic reading share a major part of their variance. At the same time, however, their latent correlation was clearly different from one, indicating that parts of the variance in electronic reading are specific and cannot be accounted for by print reading skill. Therefore, in a second step, behavioural data was taken into account to depict students' navigation strategies as one factor specifically affecting electronic reading outcomes. For these analyses, a two-level logistic regression model was employed, with tasks being nested in students. Consideration of a task level was required as electronic reading tasks differ considerably from one another in the navigation demands posed by each task. Indices of navigational

behaviour such as the number of visits to task-relevant pages, however, will be more or less predictive of task performance conditional on task demands. Thus, on the task level, the log odds of task success were regressed on navigation behaviour (number of task-relevant page visits), navigation demands, and the interaction of navigation behaviour and navigation demands. In line with what was expected, goal-oriented navigation, as indicated by the number of visits to task-relevant pages, was positively predictive of the probability of succeeding in a task. This was, however, conditional on task characteristics: A positive relation of task success probability with number of task-relevant page visits was found only for tasks requiring a high degree of navigation both quantitatively (number of page visits required) and qualitatively (number of different navigational devices required to respond successfully to the task). Emphasizing the specific importance of navigation processes in electronic reading, these results held when print reading skill on the student level was controlled for. This means, in other words, that navigation predicts comprehension in electronic reading over and above print reading skill.

All in all, the analyses and results presented in this paper highlight both commonalities and distinctive features of print and electronic reading. On the student level, while already a substantial proportion of variance in electronic reading performance can be explained by print reading skill, their latent correlation is also clearly different from one. Analyses on the task level point to the importance of goal directed navigation in responding to electronic reading tasks. Taken together, these results imply that in future reading assessments, electronic reading tasks should be included to achieve a full coverage of the domain. From a methodological perspective, the task level analyses provided here also illustrate the potential that lies in process data that become increasingly available also in large scale assessment settings such as PISA, as computer-based assessment procedures become more common.

Naumann, J., Richter, T., Christmann, U., & Groeben, N. (2008). Working memory capacity and reading skill moderate the effectiveness of strategy training in learning from hypertext. *Learning and Individual Differences*, 18, 197-213.
OECD (2009). PISA 2009 assessment framework. Key competencies in reading, mathematics, and science. Paris: OECD.
OECD (forthcoming, June 2011). Volume 6 of the PISA International Report: Students on line - reading and making use of digital information. Paris: OECD.
Rouet, J.-F. (2006). *The skills of document use*. Mahwah, NJ: Erlbaum.

Hyperlink Selection strategies in a Wikipedia reading task: Literal versus semantic matching

LADISLAO SALMERON, UNIVERSITY OF VALENCIA, Spain; Pilar Garcia-Carrion, Universidad de Valencia, Spain; Raquel Cerdan, Faculty of Psychology. University of Valencia, Spain; Johannes Naumann, German Institute for International Educational Research, Germany

Current models of hyperlink navigation propose that students assess the semantically process hyperlinks before deciding to proceed. The matching heuristic model challenges this view, suggesting that as an alternative mechanism students may select links based on a matching heuristic: they may follow a link if it contains similar words as those included in their study goal (i.e. a particular question), independently of the semantic relevance of it. We studied students' selection of links in a task-oriented Wikipedia reading scenario. Results provide evidence favoring the predictions of the matching heuristic model, assuming a literal matching heuristic is used in addition to semantic matching. In addition, comprehension skill modulated the use of the matching heuristic. Proficient readers were more able to discard irrelevant semantic matches initially, and more able to recover the correct route after having selected an incorrect link.

Current models of hyperlink selection such as SNIF-ACT (Fu & Pirolli, 2007) propose that hyperlink selections are generally made on the basis of a semantic match between the person's goal and the link. Evidence for these models comes mostly from fact searching tasks (i.e. selecting a page to buy a flight ticket), with university students. An alternative strategy in contrast might rely not on a semantic, but a literal match between the question and the wording of a link, independently of the semantic relationship between them (Cerdán, Gilabert & Vidal-Abarca, in press). For example, imagine that while learning about the French Revolution, a reader encounters a question such as "Why did peasants benefit from the popular revolts during the French Revolution, after they took the Novelty castles around France?" A Wikipedia document may include two embedded links: "Live conditions in the country-side after the Revolution" and "The Novelty castles in France". Although only the first link would include relevant information to answer the question, some students may decide first to select the second link because it includes a positive word matching with parts of the question. Especially younger or less able students may be inclined to use this matching strategy (Rouet et al., in press). The aim of the present experiment was to investigate whether students in fact use a simple literal matching strategy to a substantial degree when selecting hyperlinks when both semantic and literal matching strategies can be applied, and lead to different choices. We used a Wikipedia reading task to investigate this issue. Fifty-five eight-grade students from a private school participated in the experiment (mean age 14.2 years).

Participants' task was to navigate through a Wikipedia document about 'The French Revolution' to answer a series of questions. The main document was an adapted version of an on-line document developed by a professional teacher, and distributed by the Spanish Minister of Education. The main document was composed of 1559 words, and was organized in three main sections (Causes, development and consequences of the Revolution), and 10 subsections. Eight sections included 3 embedded hyperlinks to additional 24 Wikipedia documents. A total of 12 retrieve and interpret questions were used. After being presented with a question (e.g. "Why did the King defeat the new revolutionary laws emerged in the National Assembly after the Storming of the Bastille?"), participants were told to go to a specific subsection of the main Wikipedia document to answer that question. In each subsection there were three links: (1) a relevant hyperlink that was signaled in the question. In one condition, this link was explicit in that it had a literal overlap with the question (e.g. "New revolutionary laws"). In a second condition, this link was a paraphrase of the question wording (e.g. "Novel legal order"). In both conditions, (2) an irrelevant-signaled link that was always explicitly signaled in the question (e.g. "Storming of the Bastille") was included that pointed to a document with irrelevant information for that question, and (3) an irrelevant and non signaled link with a wording that had no literal overlap with the question.

We performed two sets of analyses: first we explored students' initial hyperlink selection, and second we checked how students' comprehension skills related to hyperlink selection. With regard to students' initial selections, an ANOVA with type of hyperlink (relevant and irrelevant) and matching condition (explicit and paraphrase), showed an effect of type of hyperlink ($F(1,50)=19.37$, $p=.001$, $\eta^2=.28$). Participants accessed the relevant link more often ($M=30.63$; $SD=22.69$) than the irrelevant-signaled link ($M=19.44$; $SD=19.01$). This main effect of link relevance was however qualified by whether the relevant link also included a semantic match to the question, or a paraphrase, $F(1,50)=16.36$, $p=.001$. In addition, we regressed link selection (initial and rectification) on reading skill in both matching conditions. In the explicit condition, comprehension skill was not related to initial relevant link selection, $r(53)=.13$, $p=.32$, but proficient readers selected it more often after an initially incorrect selection, $r(32)=.32$, $p=.06$. In the paraphrase condition, proficient readers selected initially the relevant link more often, $r(53)=.50$, $p=.001$. Our results concur with a matching heuristic model. Although students clearly identified the relevant hyperlinks when there was a literal match in addition, they were equally inclined to select either a relevant or irrelevant hyperlink if the question included a word-match to the irrelevant link only. These results suggest that students may find it difficult to decide which link to select when the relevant one for a specific task requires a semantic conversion and there is simultaneously a competing link that shares superficial features with the original task. In such cases, the simple overlapping of words between the task and a specific link may be equally salient than performing a more demanding semantic analysis, at least for younger students. Data from the reading skill analyses go in the same direction. When the task was semantically demanding (paraphrase), proficient readers were able to discard the irrelevant match. In addition, they were able to recover the correct link route. Less proficient readers, in contrast, more heavily relied on literal matching even in the presence of a semantically plausible alternative when this alternative did not provide a semantic match. In further analyses we will explore the influence of individual differences and navigation behavior in students' performance.

Cerdán, R., Gilabert, R., & Vidal-Abarca, E. (in press). Estrategias de selección de información en tareas de contestación a preguntas. *Infancia y Aprendizaje*.

Rouet, J.-F., Ros, C., Goumi, A., Macedo-Rouet, M. & Dinet, J. (in press). The influence of surface and deep cues on primary and secondary school students' assessment of relevance in Web menus. *Learning and Instruction*.

SYMPOSIUM

Teacher learning in the context of educational innovation

Chairperson: Kurt Reusser, University of Zurich, Switzerland

Organiser: Jan Vermunt, Utrecht University, Netherlands

Monika Waldis, University of Applied Sciences, Switzerland

Discussant: Paul Conway, University College Cork, Ireland

Claims that teacher education programs have improved teaching very little and rest on a shallow knowledge base (e.g. Morris & Hiebert, 2009) have sparked controversy. Acknowledging diversity of opinion, we take the view that expanding our knowledge base about teacher learning in different learning environments and educational contexts does contribute to our understanding of processes and factors that influence teacher professional development. The aim of this symposia is to bring researchers from three different countries together who have been engaged in the study of teacher learning in a variety of contexts. These contexts include (1) the introduction of a national innovation programme in secondary education in the Netherlands, aimed at introducing more active and self-regulated pupil learning (SRL) in the classroom, (2) a quasi-experimental study to investigate the implementation and effects of collaborative pre-lesson conferences on assisting student teachers in practica in Switzerland and on the advancement

of student learning and (3) a professional development program in Teaching and Learning Mathematics in the USA, investigating the efficiency of learning materials developed for teacher learning including videocases and analyzes of teaching materials.

PAPER PRESENTATIONS will include the underlying theoretical notions of the research and intervention models chosen and display empirical data on effected teacher learning activities and learning outcomes. Preconditions for teacher learning in the context of educational innovation will be discussed.

Teacher professional learning in a time of educational change: a model

Jan Vermunt, Utrecht University, Netherlands; Theo Wubbels, Utrecht University, Netherlands; Mieke Brekelmans, University of Utrecht, Netherlands

This longitudinal study was aimed at increasing our understanding of how teachers learn. The central question was: What learning activities do teachers employ in different types of learning environments and what are the relations between these learning activities, type of learning environment, personal and contextual factors, and changes in their beliefs and teaching practices? More specifically, this study was aimed at testing a model of interrelations between these variables. During one year 94 teachers reported a learning experience every six weeks. Moreover, they completed a questionnaire on their beliefs about and their interpretations of the innovation twice. Personal factors included learning motivation, learning conception, professional identity and personality traits. Contextual variables included type of learning environment, dominant beliefs at the school, and perceptions of organizational climate. Teacher practices were measured in terms of student perceptions. Interrelations between variables in the model were tested. Results showed, among other things, that learning activities were associated significantly with all measures of learning outcomes. Moreover, personal factors were more important than contextual factors for explaining teachers beliefs and practices. However, for explaining learning outcomes and activities, contextual factors seemed to be more important. Especially type of learning environment turned out to matter. It is concluded that teachers respond to educational change with ways of learning. From the viewpoint of adopting innovative teaching methods, some of these approaches are more favourable than others. Implications for a scientific knowledge base needed to explain and foster teacher professional learning are discussed.

Aims

This longitudinal study was aimed at increasing our understanding of how teachers learn. The central question of this research project was: What learning activities do teachers employ in different types of learning environments and what are the relations between these learning activities, type of learning environment, personal and contextual factors, and changes in their beliefs and teaching practices? More specifically, this study was aimed at testing a model of interrelations between these variables. The context of the research project was a national innovation in Dutch secondary education aimed at fostering students' active and self-regulated learning, implying a fundamental change in the pedagogical role of the teacher.

Methodology

The study was characterised by a longitudinal design. During one year 94 teachers reported a learning experience every six school weeks by email. Moreover, they completed a questionnaire on their beliefs regarding the innovation and their interpretations of the innovation twice, at the beginning and end of the research year. Personal factors and contextual factors were measured twice with existing and newly developed questionnaires. Personal factors included learning motivation, learning conception, professional identity and personality traits. Contextual variables included type of learning environment (informal workplace learning, collaborative project groups, reciprocal peer coaching), dominant beliefs at the school, and perceptions of organizational climate and workplace conditions. Students of the teachers completed a questionnaire on their teacher's classroom practices twice.

The learning experiences were content-analysed in terms of learning activities and learning outcomes. Relations between personal and contextual variables and teacher beliefs, practices, and learning process and outcome variables were computed via regression analyses and related techniques.

Findings

Six main categories of learning activities were identified: experimenting, considering one's own practice, getting ideas from others, experiencing friction, struggling with behavioural tendencies, and avoiding learning, the first two being reported most frequently. Reported learning outcomes referred to changes in knowledge and beliefs, emotions, practices, and intentions for practice, with changes in knowledge and beliefs being reported most frequently and changes in teaching practices being reported rarely. Learning activities were associated significantly with all measures of learning outcomes.

Teachers turn out to learn predominantly through experimenting, but there are large differences between teachers in the extent to which they do these experiments, and conduct other learning activities, in a more meaning-oriented or performance oriented way. In the first instance they work at the development of their personal theory-of-practice, in the second they generate more isolated knowledge elements.

Analyses pertaining to the testing of the model are still in progress. Preliminary findings show, for example, that perceived workplace conditions are related to teachers' attitudes towards and interpretations of active and self-regulated student learning. Personal factors show to be more important than contextual factors for explaining teachers beliefs and practices. However, for explaining learning outcomes and activities, contextual factors seem to be more important. Especially type of learning environment turns out to matter, which is significantly associated with teachers' learning activities and learning outcomes.

Theoretical and educational significance

This study contributed to scientific knowledge about the way teachers learn in a period of educational change, the learning outcomes they attain, and the personal and contextual factors that influence these learning processes and outcomes. Evidence was generated that some ways of teacher learning are better than others with regard to the learning outcomes that are attained. The study has contributed to theory building about teacher professional learning. To our knowledge this study was one of the first that tried to relate teachers ways of learning to realised learning outcomes on a fairly large scale, using both qualitative and quantitative methodology. In our view, attempts to foster teacher learning should be based on a solid scientific knowledge base about how teachers learn in more or less natural settings.

It is concluded that teachers respond to educational change with different approaches to learning. From the viewpoint of adopting innovative teaching methods, some of these approaches are more favourable than others. The discussion of the findings focuses on implications for a scientific knowledge base needed to explain and foster teacher professional learning.

Teacher learning through videocase-based professional development

Nanette Seago, WestEd, United States; Hilda Borko, University of Stanford, United States; Jennifer Jacobs, University of Colorado at Boulder, United States

The main goal of the Learning and Teaching Geometry (LTG) project is to build professional development materials that provide opportunities for teachers to expand their mathematical knowledge for teaching. In particular, the LTG materials are designed to engage teachers in learning about mathematical similarity through the use of videocases, in which specific and increasingly complex mathematical ideas are presented within the dynamics of classroom practice. Videocases allow teachers a window into both classroom practice and mathematics. They offer great potential for teachers to gain a better understanding of the relationship between pedagogical decisions and practices, students' mathematical work, and the mathematical content.

The central component of the LTG materials is the Foundation Module, which is comprised of 10 3-hour workshops, and is intended to provide teachers with a thorough grounding in key mathematical and pedagogical issues related to similarity. The Foundation Module has been developed and piloted in 5 sites throughout the U.S (with different facilitators). Data were collected on the impact of these pilots on teachers' knowledge of mathematics for teaching (specifically in the domain of geometry), using three assessment instruments. In this presentation we discuss the results, focusing on the degree and nature of teachers' learning.

Learning and Teaching Geometry project's professional development (PD) materials are aimed at supporting middle grades teachers to meet the challenges of teaching mathematical similarity. LTG is premised on the idea that using artifacts of practice within a well-structured PD program can promote mathematical knowledge for teaching (Ball & Cohen, 1999). This idea is supported by a variety of learner-centered, inquiry-based theoretical traditions, including constructivist and situative perspectives on learning (Cobb, 1994). These perspectives share the notion that engaging in challenging, problem-based, collaborative, and socially shared activities is likely to promote an expanded knowledge base (Borko, et al., 2005).

We have chosen classroom video as the primary medium for teacher learning in the LTG project because of the opportunities it provides for teachers to consider issues related to their own practice through viewing and discussing the practice of others (Seago, 2004). By viewing real classroom video footage, the materials provide insight into (1) what an emerging understanding of similarity among middle school students looks like and (2) what instructional strategies can foster students' understanding of similarity. The LTG project is creating a Foundation Module and four extension modules. Throughout each module teachers (a) explore the mathematics, (b) view, analyze and discuss videocases, (c) compare and contrast issues across cases, and (d) make links to their own instructional practice. Some

of the video cases portray student thinking about particular concepts and tasks and some cases portray pedagogical issues and their impact on students' opportunities to learn (Seago, Driscoll & Jacobs, in press).

The Foundation Module is comprised of 10 3-hour workshops, and is intended to provide teachers with a thorough grounding in key mathematical and pedagogical issues related to similarity. To date, the Foundation Module has been piloted in 5 sites throughout the U.S., in order to generate both formative and summative evaluation data. The first pilot was facilitated by the Principal Investigator and lead materials developer (the first author of this presentation). Based on data collected from this initial pilot, the module was revised and the revised version was used by facilitators in diverse locations across the country. The facilitators of the 4 later pilots were known to the LTG staff and had extensive experience facilitating similar types of mathematics professional development. Altogether, 75 teachers participated in the pilots, which totaled 30 hours of PD for each group (10 sessions x 3 hours per session).

Three instruments were used to assess impacts of the PD on teachers' knowledge of mathematics for teaching: a content assessment and two sets of embedded assessments. All of the assessment items are situated in the work of teaching geometry, and specifically mathematical similarity, and all include pre- and post-measures. The content assessment is a 25-item multiple choice test that covers properties of similarity, ratio and proportion, scaling, dilations, and transformation. The embedded assessments are tasks that exist within the Foundation Module as part of the PD; they include an open-ended mathematics task (administered during sessions 2 and 9) and a video analysis task (administered during sessions 3 and 10). In addition, data were collected on the fidelity of implementation by the 4 pilot facilitators who were not part of the materials development process. Instruments to measure fidelity of implementation include facilitator session logs, a professional development observation protocol, and a facilitator interview protocol.

In this presentation, we will discuss the results of the three pre-post assessments (the content assessment and two embedded assessments), including sample items, scoring rubrics, and differences across the pilot sites. Preliminary results suggest trends in teacher learning that are aligned with the goals of the Foundation Module. In addition, we will present data on the fidelity of implementation, focusing on the extent to which facilitators adhered to and focused on the intended mathematical and pedagogical storylines, and the philosophy of teaching and learning that undergirds the LTG materials. Finally, we will note next steps in the research and development of the LTG materials as well as implications of this work for the broader field of teacher learning.

Ball, D., & Cohen, D.K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional development. In G. Sykes & L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco: Jossey Bass.

Borko, H., Frykholm, J., Pittman, M., Eiteljorg, E., Nelson, M., Jacobs, J., Clark, K. K., & Schneider, C. (2005). Preparing teachers to foster algebraic thinking. *Zentralblatt für Didaktik der Mathematik: International Reviews on Mathematical Education*, 37(1), 43-52.

Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher*, 23(7), 13-20.

Seago, N., Driscoll, M., & Jacobs, J. (in press). Transforming middle school geometry: Professional development materials that support the teaching and learning of similarity. *Middle Grades Research Journal*.

Seago, N., Mumme, J., & Branca, N. (2004). *Learning and teaching linear functions*. Portsmouth, NH: Heinemann.

Advancing Student Teacher Learning through Collaborative Pre-Lesson Conferences

Fritz C. Staub, University of Fribourg, Switzerland; Monika Waldis, University of Applied Sciences, Switzerland

There is much evidence from student teachers that classroom-based practica are considered to be highly useful for professional learning (e.g. Hascher et al., 2004). Very little is known, however, on the effects of different ways of assisting, mentoring or coaching student teachers on the advancement of their learning (Hobson et al., 2009). In contrast to the predominant approach of assisting student teacher learning through reflection after lessons, Content-Focused-Coaching (West & Staub, 2003) is a new model that suggests a more active role for cooperating teachers or mentors. One of its pivotal features is that cooperating teachers assist student teachers through content-specific collaborative lesson planning in pre-lesson conferences. In an intervention study, 30 cooperating teachers were randomly assigned to either an innovative setting introducing them to lead collaborative pre-lesson planning conferences to assist student teachers in 7th and 8th grade mathematics classrooms or to a traditional setting. The study looks at the extent to which pre- and post-lesson conferences are implemented and at the quality of assistance as perceived by student teachers. Results provide evidence that the professional development with the innovative element lead cooperating teachers to implement content-specific collaborative pre-lesson conferences in significant ways. Considering the fact that the professional development sessions were of short duration only, this is very

promising. Further analyses will focus on effects of pre-lesson conferences on student teachers' quality of teaching as viewed by the pupils in the 30 classrooms involved in the study.

Theoretical Framework and Aims

Classroom-based practica are pivotal elements of teacher education. There is much evidence that student teachers view practica to be highly useful for their professional learning (e.g. Hascher et al., 2004). There is, however, little research on the effects of different ways of assisting, mentoring or coaching student teachers on the advancement of their learning (Hobson et al., 2009; Wolf, 2003; Zanting et al., 2003). The predominant practices strongly focus on reflecting lessons. Content-Focused-Coaching (West & Staub, 2003) is an innovative model that suggests a more active role for cooperating teachers. One of its pivotal features is that cooperating teachers assist student teachers through collaborative content-focused lesson planning in pre-lesson conferences. There is already some evidence that student teachers working with cooperating teachers who make use of pre-lesson conferences reported more learning gains and enacted lessons of higher quality than student teachers assisted in traditional ways (Futter & Staub, 2008; Kreis & Staub, submitted). However, the intervention workload in these studies was quite demanding, including up to 120 hours within 15 months. Building upon this research, the goal of the new intervention study reported in this paper is to introduce cooperating teachers in professional development sessions of a shorter format (2-3 hours only), in how to conduct productive pre-lesson conferences. Research interest focuses on the kind of assistance these teacher subsequently provide and on the question how different ways of assisting student teachers (with or without collaborative pre-conferences for lesson planning) impact student teachers' self-reported learning and their quality of teaching.

Method

Cooperating teachers are randomly assigned to one of two types of professional development offered in collaboration with three Swiss teacher colleges. In the innovative setting teachers were introduced to lead productive pre-lesson conferences, in the traditional setting the focus was on the reflection in post-lesson conferences. So far, a total of 98 dyads of cooperating teachers and student teachers participated. In this paper we focus on those 30 dyads, who documented their teaching of mathematics classes in 7th or 8th grade.

Data collection during practica took place on days when mathematics lessons had been taught. Student teachers reported by means of an on-line questionnaire on the occurrence, duration and quality of pre- and post-lesson conferences. They also provided written statements on their learning. Quality of assistance in lesson conferences was assessed with two scales: Interaction Atmosphere (4 items on a 4-point-Likert-scale, e.g. "In the pre-lesson conference our discussion took place in a friendly atmosphere"; $\alpha = .79$) and Collaborative Assistance in Lesson Planning (5 items; e.g. "In the pre-lesson conference we discussed different options of a lesson plan"; $\alpha = .71$). Student teachers were asked to indicate the degree of detail in which topics such as lesson content, learning goals, etc. were discussed in each conference (single items, 5-point Likert-scale). To adequately deal with the nested data including various numbers of entries belonging to one person, data analyses are based on hierarchical linear modelling with level 1 representing the collected online-reports and level 2 representing person's allocation to the innovative or traditional intervention group.

Once a week during practica, pupils in the mathematics classes taught by the student teachers answered a short questionnaire aiming to assess pupils' perception of aspects of quality of teaching like cognitive activation, clarity, and classroom management (Cronbach's $\alpha > .65$; rit $> .30$).

Findings

From the 30 student teachers a total of 251 online-reports were collected. On average, student teachers answered 8.5 times ($SD = 2.50$). Pre-lesson conferences were held more often in the dyads ($n = 14$) guided by a cooperating teacher who attended the professional development session with the innovative focus on collaborative pre-conferences than in dyads ($n = 16$) collaborating in traditional ways ($b = .32$, $SE = .11$, p and the use of didactical materials. For the traditional dyads, however, there is a preference to discuss aspects of classroom management (all HLM Beta-coefficients). Pupils' ratings of the quality of teaching provide an additional perspective on how the assistance of cooperating teachers affects the performance of student teachers. Preliminary analyses of the first 14 dyads show significant differences in terms of classroom management between the two intervention groups with an advantage for student teachers being assisted by cooperating teachers.

Theoretical and Educational Significance

The differences found between the dyads with innovative and traditional professional development with respect to the occurrence, duration and quality of pre- and post-lesson conferences provide evidence that the innovative professional development sessions did lead cooperating teachers to implement content-specific collaborative pre-

conferences in significant ways. This is encouraging, considering the fact that the professional development sessions were of short duration only. Further analyses looking at student teachers quality of teaching from pupils point of view and content analyses of student teachers answers to what they have learned from lesson-conferences will allow to further assess and understand the effects of collaborative lesson planning for the advancement of teacher learning.

SYMPOSIUM

Self-regulated learning at school

Chairperson: Jasmin Warwas, German Institute for International Educational Research (DIPF), Germany

Organiser: Gerhard Buettner, University of Frankfurt, Germany

Discussant: David Whitebread, University of Cambridge, United Kingdom

Self-regulation is assumed to be closely related to academic achievement. Empirical evidence shows that self-regulatory competencies are crucial in the prediction of students' academic performance. Moreover, a number of studies reveal that training on self-regulated learning enhance students' academic performance. The symposium brings together recent studies aimed at investigating several aspects of instructing self-regulation in classrooms. Otto, Olyai, Buettner & Krajewski (Frankfurt, Germany) developed an intervention in order to enhance self-regulated learning in primary students. The intervention was conducted during regular school lessons by teachers. The authors examined the effects of this self-regulated learning training, a math specific training, and a combined training (both math specific training and self-regulated learning training) on first graders' self-regulated learning. Kistner, Rakoczy, Buettner & Klieme (Frankfurt, Germany) present a study intended to identify possible influencing factors on teachers' instruction of strategies. Analysing three lessons on the Pythagorean Theorem and two lessons on word problems they investigated the significance of both didactic context and teacher beliefs for the amount and pattern of strategies that teachers instruct. The purpose of Kramarski and Weisbart's (Israel) study was to investigate the mathematical literacy (i.e., problem solving in a context) of low-achieving students who were exposed either to hypermedia with self-regulated learning support or hypermedia with no self-regulated learning support. In addition, the ability of self-regulated learning among low-achieving students in both hypermedia groups was examined. The presentations are discussed by David Whitebread (Cambridge, UK).

Effects of a teacher intervention on first graders' self-regulated learning

Barbara Otto, Institut of Psychology, Germany; Nadja Olyai, Goethe-University Frankfurt, Germany; Gerhard Buettner, University of Frankfurt, Germany; Kristin Krajewski, University of Giessen, Germany

This study examined the effects of a teacher training program on first graders' self-regulated learning (SRL). The study theoretically based on a process model of SRL. Data of 47 first grade classes of German primary schools were collected. All together, 660 students voluntarily participated in the study. The classes were randomly assigned to one of four conditions: (1) control group without training (CG); (2) math specific training (MZZ); (3) self-regulated learning training (SRL); and (4) combined training (MZZ + SRL). The teachers of the training classes were instructed in applying the eight week training program during regular school lessons. The post-test was conducted ten weeks after teacher instruction. SRL was assessed by two measures: (1) students filled in a questionnaire (25 items; $\alpha=.86$); (2) teachers rated their students' self-regulated learning behavior (13 items, $\alpha=.91$). In order to examine the effects of the training program on self-regulated learning multivariate analyses of variance were conducted. The results reveal that according to students' self-report compared to the control group SRL could significantly be enhanced by SRL training and combined training but not by MZZ training. With regard to teacher ratings of students' SRL no significant difference to the development of the control group could be found for all three training conditions. These findings lead to several theoretical and practical conclusions which will be discussed at the end of the presentation.

Objectives

Even though a large number of recent studies on self-regulated learning (SRL) show that high self-regulation is accompanied by high academic performance (e.g. Hidi & Ainley, 2008), most of these studies are purely correlative. However, single empirical studies using regression analyses also revealed that self-regulatory competencies truly are crucial in the prediction of students' academic performance (e.g. Otto, Kistner, Perels & Býttner, submitted). If self-regulatory competencies are indeed that important for students' academic achievement, it appears necessary to foster these competencies already at the beginning of students' school career in order to prevent learning difficulties. Although interventions to enhance SRL are more effective if they are conducted by researchers than by teachers (Dignath, Býttner, & Langfeldt, 2008), pure researcher interventions seem not to be practicable for different reasons (e.g. costs) in real school life. It is rather of interest to develop an effective intervention which can be conducted by primary teachers. Thus, the present empirical study addressed this imperative by developing and evaluating an appropriate intervention which is supposed to be conducted during regular school lessons by first graders' teachers in order to enhance the students' SRL.

Theory

The present study is based on a process model of SRL, which is basically consistent with the theoretical assumptions of Schmitz and Wiese (2006). According to Zimmerman (2000) the learning process is divided into three consecutive phases: The pre-action phase, the action phase, and the post-action phase. The learning process begins with the pre-action phase which refers to the preparation of the learning. The given assignment and the particular conditions in the learning environment initiate the beginning of the SRL processes by evoking certain motivational and emotional tendencies within the learner. If the learner is not intrinsically motivated or shows low self-efficacy he needs to apply self-motivating strategies. Under these affective-motivational conditions the student has to set goals for his learning. Moreover, the learner will have to plan the application of learning strategies as well as the time he will invest for finishing the task. Afterwards, the learner starts with learning (action phase). In order to complete his assignment he will apply different learning strategies. Moreover, he has to apply volitional strategies in order to avoid internal or external distraction and maintain concentration, effort, and motivation while performing academic tasks (Corno, 2001). In case the learner deviates from his planned learning behavior it is beneficial if he self-monitors his actual behavior. Finally, a learning outcome results. In the post-action phase the student has to compare his actual final result with his prior set goal (ideal result). Hereby, he also has to evaluate whether the final result can be interpreted as success or failure. Furthermore, he will also reflect how he approached the given task. As a consequence of comparing, evaluating, and reflecting, certain emotions (e.g. satisfaction) will arise depending on whether the task was successfully solved or failed. These subsequent emotions and evaluations have an impact on future learning, as they can lead to modifications in planning strategies and time or in setting goals.

Method

In order to answer the research question data of 47 first grade classes of German primary schools were collected. All together, 660 students voluntarily participated in the study. As different studies already proved interventions to foster SRL are particularly effective if self-regulatory contents are combined with the instruction of domain-specific contents (e.g. Perels, Gyrtler & Schmitz, 2005). Therefore, the classes were randomly assigned to one of four conditions: (1) control group without training (CG); (2) math specific training (MZZ); (3) self-regulated learning training (SRL); and (4) combined training (MZZ + SRL). The teachers of the three training conditions participated in a one day workshop by which they were instructed in applying the training program during regular school lessons. All three training programs were designed to be applied during eight weeks (90 min per week). The teachers of the control group did not participate in any workshop and did not receive any material. The math specific training MZZ is an effective program in order to enhance basic mathematical quantity-number competencies. Teachers of this condition received the original training program (Krajewski, Nieding & Schneider, 2007) with all materials. The SRL training based on the above mentioned process model of SRL and consisted of eight units addressing the enhancement of self-efficacy, realistic goal-setting, motivation to learn, time management, concentration, stress relief, positive dealing with mistakes, and the application of the individual reference norm. Teachers of this condition also received all required materials. Teacher of the condition with combined training (MZZ+SRL) received a selection of the original training program MZZ which was supposed to be applied during the first four weeks of the training period. Furthermore, they also received the material of a shortened version of the SRL training which was supposed to be applied during week five to eight. Data were collected with a pre-test post-test design. The first assessment took place right before teacher instruction. The post-test was conducted ten weeks after teacher instruction. SRL was assessed by two measures: (1) students filled in a questionnaire (25 items; $\alpha=.86$); (2) teachers rated their students' self-regulated learning behavior (13 items, $\alpha=.91$). Both measures based on the above mentioned process model of SRL. The students' questionnaire was newly developed whereas the teachers' instrument was basically compiled by combining existing scales.

Results

In order to examine the effects of the training program on SRL multivariate analyses of variance were conducted. The preliminary results reveal that according to students' self-report compared to the control group SRL could significantly be enhanced by SRL training and combined training but not by pure MZZ training. With regard to teacher ratings of students' SRL no significant difference to the development of the control group could be found for all three training conditions. These findings lead to several theoretical, methodical, and practical conclusions which will be discussed at the end of the presentation.

Instruction of learning strategies in classrooms: the role of didactic context and teacher beliefs

Saskia Kistner, , Germany; Katrin Rakoczy, German Institute for International Educational Res, Germany; Gerhard Buettner, University of Frankfurt, Germany; Eckhard Klieme, Deutsches Institut fur Intern. Padagogische Forschung, Germany

Instructional learning strategies is one important aspect of the consistently claimed promotion of self-regulated learning in classrooms. This study intended to identify possible influencing factors on teachers' instruction of strategies. We investigated the roles of (1) didactic context and (2) teacher beliefs for the amount and pattern of strategies that teachers instruct. 20 mathematics teachers were videotaped for 5 lessons in the ninth grade. 3 lessons on the Pythagorean Theorem (PT, introductory unit including a mathematical proof) and 2 lessons on word problems (WP, practice unit including a phase of cooperative learning) represented the two different didactic contexts. A low-inferent observation instrument was used to code the teachers' instruction of cognitive strategies (e.g., organisation), metacognitive strategies (e.g., planning), and motivational strategies (e.g., resource management). Different aspects of teacher beliefs were captured by a teacher questionnaire in the beginning of the school year. Results show differences between didactic contexts only for the instruction of planning strategies. Strategy instruction correlated highly between the two kinds of lessons, for organisation and resource management strategies as well as overall. Regarding teacher beliefs, the emphasis of an individual reference norm was related to the instruction of several kinds of strategies. Other aspects of teacher beliefs were associated more specifically with single types of strategies. Thus, teacher beliefs seem to play a role for strategy instruction, which makes them a possible starting point for enhancing the promotion of self-regulated learning.

Theoretical Background and Aim of the Study

In current research on learning and instruction there is a strong agreement that self-regulation is important for successful learning and that self-regulated learning should be promoted in schools. A central aspect of the promotion of self-regulated learning in classrooms is the instruction of learning strategies. Following Boekaerts (1999), self-regulated learning strategies can be grouped into cognitive, metacognitive, and motivational strategies. Studies that observe teachers' strategy instruction in classrooms indicate that this kind of instruction is rather rare, but also show that teachers highly differ in their amount of strategy instruction (e.g., Kistner et al., 2010). The present study aims at identifying possible influences on the amount and pattern of strategies instructed by teachers in regular classroom settings. It is assumable that didactic features of a specific lesson such as the instructional aim or the amount of cooperation are related to teachers' strategy instruction. For example, there is some evidence that the number of suggested strategies varies depending on the subject matter (Moely et al., 1992). Research on teachers' professional competence suggests that teachers' beliefs about the nature of teaching and learning influence their daily practice in classrooms. Indeed, various studies report associations between teachers' beliefs and their activities in the classroom, for example their emphasis on student autonomy (e.g., Stipek et al., 2001). Thus, teacher beliefs could also play a role for teachers' instruction of strategies.

This study investigates the roles of didactic context and teacher beliefs for the instruction of learning strategies in classrooms by addressing the following research questions: (1) Does the amount and pattern of instructed learning strategies differ according to the didactic context? and (2) Is the amount and pattern of instructed learning strategies related to teacher beliefs?

Research Methods

We analysed a subsample from the video study "Quality of Instruction, Learning, and Mathematical Understanding" (Klieme et al., 2009). Twenty teachers and their overall 538 secondary school students (grade 9) were videotaped for five mathematics lessons. A low-inferent observation instrument (Dignath & Býtner, 2010), based on Boekaerts' (1999) self-regulation model, was used to assess the instruction of specified learning strategies. Minute by minute, the instruction of cognitive strategies (elaboration, organisation), metacognitive strategies (planning, monitoring and evaluation), and motivational strategies (resource management, feedback) was coded. Interrater reliability (Cohen's Kappa) was high. The didactic context was varied by videotaping each teacher for three lessons on the Pythagorean Theorem (PT) and for two lessons on word problems (WP). The three lessons on the Theorem of Pythagoras were the beginning of an introductory unit on this topic. Here, a new mathematical concept was introduced to students and teachers were advised to carry out one proof for the Pythagorean Theorem during the videotaped lessons. The two lessons on word problems were part of a practice unit on this theme and the focus was on the application of linear equations. Teachers were advised to implement a form of cooperative learning within the two lessons. Teacher beliefs were assessed using a teacher questionnaire in the beginning of the school year. The questionnaire covered world views of the subject mathematics with the two scales "formalism" ($\alpha = .80$) and "application" ($\alpha = .66$). It included a scale that measured a constructivist view of learning and teaching mathematics ($\alpha = .78$). Furthermore it included a single item on the relevance of extrinsic motivation and a scale on assessing students according to an individual reference norm ($\alpha = .85$).

Results and Implications

Concerning the didactic context, the total number of instructed strategies did not differ between PT lessons and WP lessons ($t = -.08$, $p = .93$). This was also true for most of the specific kinds of strategies. Only for the instruction of

planning strategies, we found a significant difference between the two kinds of lessons. More planning strategies were instructed in WP lessons compared to PT lessons ($t = -2.67$, $p = .01$). We also looked at the stability of strategy instructions between the two kinds of lessons by computing correlations. For the total number of strategy instructions we found a significant correlation between PT lessons and WP lessons ($r = .50$, $p = .02$), as well as for organisation strategies ($r = .46$, $p = .03$) and resource management strategies ($r = .66$, $p = .001$). As for teacher beliefs, the scale on individual reference norms correlated significantly with the total number of instructed strategies ($r = .57$, $p = .001$) and monitoring and evaluation strategies ($r = .60$, $p = .001$). The results contribute to the understanding of teacher activities in classrooms and stress the importance of teachers' beliefs for their daily practice regarding the promotion of self-regulated learning. Thus, when we intend to foster self-regulatory skills in students, we should consider trying to shape teacher beliefs as a possible starting point.

Investigating the benefits of stimulating SRL with hypermedia

Bracha Kramarski, Bar-Ilan University, Israel

The present study investigated the benefits of stimulating self-regulated learning (SRL) in hypermedia environment for fostering students' (low and high achievers) mathematical literacy and SRL. The study compares 64 seventh-grade students who were exposed to a self-directed hypermedia either supported by SRL with IMPROVE questions (the H_SRL group) or receiving no direct SRL support (the H_NS group). We investigated mathematical literacy with: (a) authentic problem solving performance on basic, routine and complex tasks (PISA, 2003); and (b) online discussion for SRL processes (cognitive, metacognitive, motivation and social feedback). Findings indicated that the H_SRL intervention led to more significant gains than the H_NS group in mathematical literacy for students of varying ability levels (low and high-achieving students). In addition, the benefits of H_SRL persisted in online discussion feedback. These effects were particularly beneficial for the low-achieving students. This study offers potential contributions to theoretical research examining the role of SRL support in hypermedia for enhancing mathematical literacy and SRL of low-achieving students.

Introduction

The goal of the present study was to design an instructional intervention based on stimulating SRL in a self-directed hypermedia environment geared toward low-achieving students. Hypermedia is a powerful cognitive tool that provides students with dynamic, interactive nonlinear access to a wide range of links to information and online interactions. However, research has indicated that very few students (i.e., low and high achievers) are skilled at regulating their learning to optimize self-directed learning in such an environment (e.g. Azevedo & Cromley, 2004; Kramarski, in press; Kramarski & Dudai, 2009; Kramarski & Mizrachi, 2006). Hence, providing support and guidance to facilitate learning for the low-achieving students should help them access and interact with the content productively and allow them to think about the deeper concepts and structure of disciplinary relations. In our study SRL support was based on the IMPROVE self-questioning prompts, which are effective for fostering domain knowledge and self-regulatory cognitive strategies (e.g., Kramarski & Mevarech, 2003). The IMPROVE model aims to support key aspects of self-regulation by using four generic self-questioning prompts: comprehension (e.g., "What is the task/problem?"), connection (e.g., "What is the difference/similarity?" and "How do I justify my conclusion?"), strategy (e.g., "What is the strategy?" and "Why?"), and reflection (e.g., "Does the solution make sense?"; "Can the task be solved otherwise?". The purpose of the present study is twofold: (a) to investigate the mathematical literacy (i.e., problem solving in a context) of low-achieving students who were exposed either to the hypermedia with SRL support (H_SRL) or hypermedia with no SRL support (H_NS); (b) to examine the ability of SRL among low-achieving students in both hypermedia groups (H_SRL and H_NS). Mathematical literacy is determined by different task complexity, and SRL is observed in forum discussions related to online feedback. Furthermore, to achieve a more comprehensive understanding of the low-achievers' performance, we compared these outcomes to those of the high-achievers.

Method

Our study investigated 64 Israeli seventh graders attending two heterogeneous classes within one junior high school. At the outset of the study, there were no significant differences between the two groups in their prior knowledge of mathematics. The low-achieving students were selected according their scores (below the median score-55.4) on the Ministry of Education's standardized test administered in the beginning of the year. Instructional programs: H_SRL vs. H_NS group. Students from both groups were exposed to distance learning with hypermedia self-directed course (eight weeks) based on the Moodle (Modular Object-Oriented Dynamic Learning Environment) open e-learning software platform. Participants practiced varying complexity dealing with mathematical literacy. They could click onscreen links for clarifying "Terms" (e.g., variable, mean), using "Resources" (i.e., internet, guided prompts), viewing video "Lessons" (i.e., authentic classroom events of teachers' explanations and instructions), and accessing additional "Help" (e.g., worked-out examples). Finally the link to "Forum" enabled discussing solutions and providing/receiving feedback. Students in the H_SRL group received SRL support for problem solving, based on the IMPROVE self-

questioning approach (Kramarski & Mevarech, 2003). The metacognitive questions were presented and explained on the "metacognitive screen" in the link of Resources; question prompts were embedded in students' tasks. The students were encouraged to answer these questions while solving their tasks and to use them when providing explanations and peer feedback in the forum. The aim of the H_NS Group was to improve students' mathematical literacy by sharing knowledge in the forum.

Measures

Mathematical literacy. A 46-item pre/post test included items assessing procedural tasks demanding basic skills of one-step calculations, problem solving in routine tasks demanding several manipulation steps and justifications of the solution, and problem solving in complex tasks demanding high-level skills (i.e., justifications and conclusions). Cronbach alpha reliability coefficient was .81.

Online forum discussion.

Online discussion was assessed on the SRL process scheme index (low-1 to high-3; Kramarski, in press) related to cognitive (i.e., mathematical-solution accuracy, knowledge, strategy use and explanations), metacognitive (i.e., planning, monitoring and evaluation) motivational (investment of effort and interest), and social categories (interaction style as help seeking). Inter-rater reliability, calculated with Cohen's kappa coded by both raters, yielded high reliability coefficients for the feedback (cognitive- .93; metacognitive- .89; motivational and social - .92). Results of a two-way MANOVA test followed by univariate ANOVAs and Cohen's *d* effect sizes for the posttest indicated a significant interaction between groups and levels of achievement on the procedural, routine and complex tasks (p d = 1.19; 0.80, respectively for the low and high achievers), routine (d = 0.75; 0.48) and complex tasks (d = 1.38; 0.56). A MANOVA test followed by univariate ANOVAs and Cohen's *d* effect sizes for online feedback discussion criteria indicated a significant difference between the groups along the four criteria for cognitive (d = 0.61), metacognitive (d = 0.70); motivation (d = 1.9), and social feedback (d = 0.67). Furthermore, a significant interaction between groups and levels of achievement was found only on cognitive and metacognitive feedback (p d = 1.0; 0.37) and metacognitive feedback (d = 0.89; 0.61).

Discussion and Conclusions

In conclusion, making disciplinary strategies explicit in technology tools can help low-achieving students think about the steps of the solution process and monitor strategies that they need to adopt. H_SRL probably guided subjects to look for all the relevant information, to combine all types of knowledge (i.e., linguistic, mathematical and strategic) and so construct a correct mental representation of the problem. The study extends previous findings in regular learning environments regarding the effects of IMROVE support on mathematical problem solving among young (grade 3) low-achieving students (Kramarski, Weiss, & Kololshi-Minsker, 2010). The present study calls for further scrutiny of how low-achieving students' SRL in hypermedia emerges in the context of mathematical literacy.

SYMPOSIUM

Developing expertise development in the classroom: An utopia or reality?

Chairperson: Mien Segers, Maastricht University, Netherlands

Organiser: Quincy Elvira, Radboud University, Netherlands

Discussant: Jeroen Van Merriënboer, Maastricht University, Netherlands

It is argued that reconceptualization of school learning based on expertise development literature is needed (e.g. Hatano & Oura, 2003). The results of expertise development research offer valuable insights on how to design classroom learning environments in order to enhance students' expertise development. However, to date, there is no comprehensive overview of the instructional implications of expertise development research. The members of the expert panel have extensively built on the theory of expertise development from various perspectives. Their research has indicated various implications for designing (classroom) learning environments focused on fostering expertise development in different domains (e.g. medicine, management, counselling and law). The aim of this expert panel discussion is threefold; (1) to bring together current insights on the instructional/educational implications of expertise development research in terms of design principles for learning environments; (2) to further explore and debate on the design principles (3) to enhance the cross-fertilization between expertise research and studies on school learning. Particularly, the following issues and questions will be addressed by the panel: 1) How to define expertise development? 2) Can expertise development be enhanced in school settings? If yes, when to start? 3) Which learning and teaching activities are powerful to foster expertise development? 4) Which specific design principles can be formulated for the developers of learning environments and learning materials, taking into account the results of expertise development research?

Task, Learner, Context, and Time: The Interactive Elements of Competence Development

While addressing the theoretical, conceptual, and operational questions posed for panelists about expertise development and learning environments that contribute to expertise, this presentation will seek to raise several critical issues for consideration. First, what is the fundamental relation between expertise development, in particular, and learning, in general? Second, to what degree is it within the purview of secondary and tertiary education to "develop" experts? Third, what should be the academic mission of K-16 education regarding expertise development? And, what emphases and what transformations are required of academic learning environment to support students in their journeys toward expertise?

Task, Learner, Context, and Time: The Interactive Elements of Competence Development

The stated goal of this panel is to explore the features of learning environments that contribute to expertise development. This exploration will unfold around four interrelated questions:

- How do I define expertise development?
- Can expertise be fostered through formal education?
- What activities or features of the environment are likely to contribute to expertise development?
- What principles should developers of learning environments take into consideration if their intention is to foster expertise development?

In the broadest sense, expertise can be understood as a special form of learning marked by the exceptional level of performance or achievement for a given task or within a particular domain or discipline. Thus, considerations of expertise development must begin with a careful examination of learning. For instance, Alexander, Schallert, and Reynolds (2009) have argued that the topography of learning at any stage entails the continual and critical interaction between four foundational dimensions: the task (the what), learner (the who), the context (where), and time (when). Certainly, any discussion of expertise development must pay homage to these dimensions of learning, and the changes in knowledge, strategies, beliefs, and motivations associated with learning (Alexander, 1997, 2003; Alexander & the Disciplined Reading and Learning Research Laboratory, 2010).

Drawing on the topography of learning forwarded by Alexander et al. (2009), it is impossible to regard the nature of expertise development by isolating the features of the learning environment (the where) from the what, who, and when dimensions. First, there is always a "what" that is being learned; where the what represents the objects or foci of that learning system (Giussani, 1995; Spiro, Feltovich, Jacobson, & Coulson, 1992). These objects of learning can be distinguished and classified along dimensions that matter to expertise development. Second, the "where" of learning refers to the ecological context where that learning unfolds—a context that entails both the physical environment as well as the social and cultural milieu. Third, learning is inevitably influenced by the biological, cognitive, experiential (including individual and cultural experience), and affective (motivation/emotion) characteristics of the learners who populate any instructional environment. Finally, just as learning does not occur in a vacuum but unfolds in a physical and social context, there is always a temporal nature to learning. The time scale for learning can be measured in seconds or can be gauged over many years. If we are to consider expertise development then time ultimately must be considered.

Moreover, because this discussion panel has been asked to focus on learners within secondary and tertiary education, it is my contention that it is more relevant to consider the optimal combination of task, learner, context, and time that should give rise to competence within an academic setting rather than expertise (e.g., Fox, Dinsmore, & Alexander, in press). Educational systems at the secondary and tertiary levels are not expressly configured to develop experts in any academic domain. Instead, secondary and tertiary systems have been devised to lay the foundations for expertise; that is, to move students into the stage of competence in foundational domains and disciplines.

Based on the aforementioned grounding and building on over a decade of research that my colleagues and I have undertaken (Alexander, 2005; Alexander, Jetton, & Kulikowich, 1995; Fox et al., in press), I would forward the following principles to guide the development of learning environments that can move students into competence and toward expertise:

- Seek Principled Understanding
- Teach More About Less
- Allow Students to Appreciate the Complexity, Sophistication, and Uncertainty of Knowledge
- Aim for Rooted Relevance
- Incorporate an Array of Social Interaction Patterns
- Attend to Individual Strengths and Needs
- Build in Opportunities for Student Choice and the Pursuit of Individual Interest
- Explicitly Teach Domain-General and Domain-Specific Strategies

- Work toward Self-Regulation and Self-Assessment
- Appreciate that Expertise Development Comes from Effort and Sacrifice

This consideration of the optimization of competence will be informed not only by the decades of research in expertise, but also by the theoretical and empirical work in individual differences, learning, instruction, development, motivation, epistemic beliefs, higher-order thinking, and problem solving.

References

- Alexander, P. A. (1997). Mapping the multidimensional nature of domain learning: The interplay of cognitive, motivational, and strategic forces. In M. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 10, pp. 213-250). Greenwich, CT: JAI Press.
- Alexander, P. A. (2003). The development of expertise: The journey from acclimation to proficiency. *Educational Researcher*, 32(8), 10-14.
- Alexander, P. A. (2005). Teaching towards expertise. [Special Monograph on Pedagogy— Learning for teaching] *British Journal of Educational Psychology. Monograph Series II*, 3, pp. 29-45.
- Alexander, P. A., Dinsmore, D. L., Fox, E., Grossnickle, E. M., Loughlin, S. M., Maggioni, L., Parkinson, M. M., & Winters, F. I. (in press). Higher-order thinking and knowledge: Domain-general and domain-specific trends and future directions. In G. Schraw (Ed.), *Assessment of higher order thinking skills*. Charlotte, NC: Information Age Publishers.
- Alexander, P. A., & the Disciplined Reading and Learning Research Laboratory (2010). *The challenges of developing competent literacy in the 21st century*. Washington, DC: The National Academies of Science.
- Alexander, P. A., Jetton, T. L., & Kulikowich, J. M. (1995). Interrelationship of knowledge, interest, and recall: Assessing a model of domain learning. *Journal of Educational Psychology*, 87, 559-575.
- Alexander, P. A., Schallert, D. L., & Reynolds, R. E. (2009). What is learning anyway? A topographical perspective considered. *Educational Psychologist*, 44, 209-214.
- Fox, E., Dinsmore, D. L., & Alexander, P. A. (in press). Reading competence, interest, and reading goals in three gifted young adolescent readers. [Special Issue on Motivation and Giftedness] *High Ability Studies*.
- Giussani, L. (1995). *The risk of education: Discovering our ultimate destiny*. New York: Crossroad.
- Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 57-75). Cambridge, UK: Cambridge University Press.

Developing expertise in the classroom requires an understanding of cognitive AND social adaptations!

Hans Gruber, University of Regensburg, Germany

Research on expertise has delivered many arguments that domain-specific cognitive adaptations result from extended deliberate practice – in virtually every serious domain. Some findings confirm that in the classroom similar processes as in many other domains can be observed. On the other side, (conservative) political interests and some myths about the nature of teaching and learning in the classroom (e.g. "born as a teacher") make a different issue of the "domain classroom". In the panel, I will argue that there is no intrinsic distinctiveness to the domain. Nevertheless, understanding the development of expertise in the classroom requires more than understanding cognitive adaptations. A research focus should be directed towards social adaptations, for example the growth of social networks. The analysis of social adaptations has to take into account particular features of the domain and of prominent kinds of workplaces. Simultaneously taking into consideration both cognitive adaptations and social adaptations, helps to predict how subjects master critical changes or transitional periods in their professional careers. I will outline some research projects, in which such joint analyses of individual and social aspects of expertise have been conducted.

Research on expertise and expert performance has become a promising approach to investigate high level performance in many domains (Ericsson, Roring, & Nandagopal, 2007). In particular, individual cognitive components of expertise, such as memory and knowledge, are focused. There is convincing evidence that inter-individual differences in such components are acquired rather than innate (Ericsson, 1996). But although expert performance often is individual in nature, expertise is situated within a social context. Individual strength and group acknowledgment are intrinsically related: Skillful people "become" experts through translating and integrating their knowledge into popular meaning systems (Walter, 2004). Other members of the social system guide them during (and often are the driving force behind) the acquisition of expertise. In the panel, I will argue that research on expertise should take into account both processes of cognitive adaptation and processes of social adaptation during the development of complex (professional) performance.

A close look at professional learning processes reveals, that subjects have to practice a lot AND the right issues in order to develop expert level. Superior reproducible performance of experts generally emerges after extended periods of deliberate practice, which aims to develop one's performance level beyond the current level (Ericsson, Krampe, & Tesch-Römer, 1993). The improvement of specific components is addressed in order to refine the related activities. Such experience is neither mindless drilling nor joyful and is not conformable with definitions of intrinsically motivating activities. It is not trivial to decide which (parts of) components are candidates for forthcoming deliberate practice, and individuals rarely spontaneously engage in deliberate practice. Usually there are persons who define the direction of practice and who guide (and enforce) subjects during practice.

It is this description which reveals that the development of expertise is based on cognitive adaptations (within individuals), which are triggered and directed by significant other persons (Gruber, Lehtinen, Palonen, & Degner, 2008, call these persons "persons in the shadow"). Social adaptations thus play an important role in the development of expertise, because the individual has to get opportunities (and she/he has to make use of them) to grow into relevant social networks and to build up professional relations with significant "persons in the shadow".

Such persons in the shadow play a critical role in designing practice activities, setting the goals for practice, motivating (often: forcing) individuals to engage in practice, breaking down complex performance into smaller units to be practiced, etc. They bear different names in different domains: trainers, coaches, teachers, mentors, parents, etc. So far only few studies have pointed to the important role of particular social contacts for the long term development of individuals in expertise research (Mieg, 2006).

In the panel I will argue that the acknowledgment of the presence of such persons has to be an integral part of the assessment and of the prediction of future expertise development. I concede that this argument makes the definition of "expertise" even more difficult, which seems to be particularly problematic in the teaching domain (Berliner, 2001). Most current approaches to investigate teacher expertise include measures which are based on peer nomination. Such measures have been criticised (Ericsson et al., 2007). An explicit analysis of professional social networks and of those characteristics of networks, which are used as indicators for the definition of "expertise", might help to better understand different notions of "teacher expertise". It might thus contribute to raise our awareness of what we are talking about when we are talking about "expertise development in the classroom".

Berliner, D. C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35, 463-482.

Gruber, H., Lehtinen, E., Palonen, T. & Degner, S. (2008). Persons in the shadow: Assessing the social context of high abilities. *Psychology Science Quarterly*, 50, 237-258.

Ericsson, K. A. (Ed.). (1996). *The road to excellence: The acquisition of expert performance in the arts and sciences, sports, and games*. Mahwah: Erlbaum.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100, 363-406.

Ericsson, K. A., Roring, R. W., & Nandagopal, K. (2007). Giftedness and evidence for reproducibly superior performance: An account based on the expert performance framework. *High Ability Studies*, 18, 3-56.

Mieg, H. A. (2006). Social and sociological factors in the development of expertise. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 743-760). Cambridge: Cambridge University Press.

Walter, W. (2004). Experts' discourses as judicial drama or bureaucratic coordination: Family debate in the United States and Germany. In E. Kurz-Milcke & G. Gigerenzer (Eds.), *Experts in science and society* (pp. 27-46). New York: Kluwer.

Expertise development in the professions; Implications for teaching and assessment
Els Boshuizen, Open University, Netherlands

In this contribution the implications of a theory on expertise development in professional domains is worked out in terms of implications for education and instruction, and for assessment. Next this is taken one step further by extrapolation the theory and empirical findings developed in domains with a common body of knowledge, domain-specific skills, agreed upon best practices, and shared professional values, to labour markets that put more emphasis on fundamental knowledge and generic skills in graduates. This does not only apply to the standard professional domains, but also to domains –the 'new' professions– that so far do not have developed a shared body of knowledge and set of best practices. Competences to set standards and find feedback on performance seem key competences here.

Investigating expertise and expertise development from the perspective of the professions implies a specific goal, i.e. that the student develops into the direction of the standards set by the specific professional community this person is training for.

Professions set standards for the kind and level of competencies that are expected of a practitioner in that field, the body of knowledge shared by its members, or the practices performed. From that perspective, expertise is relative to the standards set for the quality of the services provided both to the clients of the profession and to the profession itself. Services to clients are medical care, contract writing, or teaching lessons; similarly, services to the profession can be improvements of care practices, guidelines for certain contracts, or evidence-based improvement of a teaching method. This means that expertise level can be defined according to set standards, but also to performance of peers. The expert in a certain field is characterised by better performance on critical tasks than his or her peers, while experts in general are better than intermediates.

From the perspective of formal education, standards set for expert levels of performance are not very informative. More interesting and informative is the answer to the question how experts came to that level. How was the trajectory that brought them so far? Which educational and instructional measures and formats can help novices and intermediates take the next step in their development toward expertise? These measures depend on the level of expertise.

In our research efforts we have taken the latter perspective using a cognitive view on knowledge and skill development; it has led to a theory of expertise development including two major processes: knowledge extension and validation and problem-oriented knowledge restructuring – consisting of knowledge encapsulation, and illness script formation and enrichment (see Boshuizen & Schmidt, 2009; Boshuizen, Van de Wiel & Schmidt, submitted). It was also found that skilful use of knowledge in practical settings requires that knowledge can be used dynamically and is automatically and readily available (Wagenaar, 2008). The role of biomedical and clinical knowledge (in the medical professions, which is comparable to the fundamental and applied sciences in other fields) turned out to have two dimensions: 1) it lays and structures the scientific grounds for development of the whole domain, and 2) through the same structure it helps students to learn and remember the less principled and less coherent knowledge of the applied sciences (Woods, et al., 2007). Intermediates and experts use this basic science knowledge in different ways: Intermediates use it to solve cases, unless they are very easy; experts hardly use biomedical knowledge, unless they deal with very complex cases.

Such findings have several implications for teaching both at the novice and the intermediate levels of expertise.

- 1) Selection of topics and subject matter to be included in a curriculum must depend on the body of knowledge shared by professionals;
- 2) Selection of the basic science knowledge should also serve the goal to improve understanding of clinical knowledge;
- 3) Tasks set for students should help them to evaluate and validate their knowledge;
- 4) Solution of misconceptions should be supported;
- 5) Students should be trained in all competences required of a beginning professional;
- 6) As the role of well-structured knowledge permeates all competences, knowledge development should come first but not in isolation from the competences;
- 7) Authentic problems should be used to guide problem-oriented knowledge reconstruction;
- 8) These problems should be chosen such that they best serve integration and validation of knowledge, support knowledge restructuring in the 'right direction', demonstrate the variations within problem themes prevalent in the field, and cover the kind and complexity of tasks of beginning professionals.

Assessment formats should match the levels of expertise reached and be in accordance with the aim of a specific curriculum part. That might mean the following:

- 1) Whole-task assessment should be the norm in an assessment programme though part-task assessment may play a role; a backwashing effect of the latter might have detrimental effects of the intended learning outcome
- 2) At the lower levels students should demonstrate the validity and extent of their knowledge in the context of authentic cases.
- 3) At higher levels students should show their competences in the context of cases that gradually become more complex both in the sense that the cases themselves become more complex and that the circumstances in which action is required become more demanding.
- 4) Task complexity can involve co-ordination, speed, timing and time-management.

All this is relatively 'easily' done when the relation between education and expertise domain is clear, which is the case in medicine, but less in law or language or mathematics.

An extra complication results from differences in the structure of labour markets in different countries and continents. Some countries and labour market expect more generic skills in graduates while other countries expect that graduates have a mix of generic and domain specific skills.

So far no good models of generic skills exist. In much literature, problem solving, social and communication and lifelong learning have been identified as important skills. However, there is no common understanding of what lifelong learning skills are. Especially in domains where no set practices and no common body of knowledge exist –the 'new' professions– lifelong learning skills should entail generating and setting standards for practice and finding sources for feedback on performance to be compared with these standards.

Boshuizen, H.P.A. et al., (submitted). Learning from multiple cases; a test for knowledge encapsulation.

Boshuizen, H. P. A., & Schmidt, H. G. (2008). The development of clinical reasoning expertise; Implications for teaching. In: J. Higgs, M. Jones, S. Loftus, & N. Christensen (Eds.), *Clinical reasoning in the health professions*, (3rd comp. rev. ed.). Oxford: Butterworth-Heinemann/Elsevier.

Woods, N. N., Brooks, L. R., & Norman, G. R. (2007). It all makes sense: Biomedical knowledge, causal connections and memory in the novice diagnostician. *Advances in Health Sciences Education*, 12, 417–426. Wagenaar, A. (2008). What and how students learn from experience. PhD thesis Maastricht University.

Building the pillars of expertise: self-regulated learning, knowledge, and high-quality performance

Margje W.J. van de Wiel, Faculty of Psychology and Neuroscience, Maastricht University, Belgium

Development of professional expertise is characterised by a developmental process that stretches over many years. Formal education lays the foundation of a person's expertise development, and should create prerequisites for successful progress in further studies and professional life. Research on expertise development has to meet the challenge of providing tools how to design a learning environment in these formal educational settings focused on that progress. Although we cannot raise experts in secondary and higher education, we can build the pillars of expertise based on guiding principles and strategies, derived from expertise development research. In this discussion panel, I will first critically examine what is meant with expertise from three dominant perspectives. Second, I will discuss the deliberate attempts at developing expertise in various domains, including the workplace. Lastly, I will answer the question whether and how learning environments can be designed that would foster expertise by formulating seven guiding principles.

To answer the question whether and how learning environments can be designed that would foster expertise development already in secondary and higher education, I will first critically examine what is meant with expertise from three dominant perspectives. From an expert-performance perspective, Ericsson (2009) characterizes expertise as the capability to demonstrate reproducible superior performance in a specific domain. The highest expertise level is obtained when individuals are able to go beyond mastery and contribute creative ideas and innovations. Although years of practice and experience are needed to become an expert, skilled performance and experience are not enough. Routine behavior and full automaticity should be counteracted by gaining high-level control of performance that allows further improvements to be made. From an adaptive expertise perspective, researchers (Hatano & Oura, 2003) argue that real expertise is characterized by flexible, innovative, and creative competencies within a domain that are used to adjust procedures to task constraints and solve new problems. This is contrasted to routine expertise, in which experts can only solve familiar problems with high speed, accuracy, and automaticity. Finally, from an expert-novice research perspective (Chi et al., 1989), expertise has been characterized by differences in performance and underlying knowledge between groups with increasing levels of experience in a domain. Experts have a large and well-developed knowledge-base, that is tuned to the tasks performed and the problems encountered, and allows fast and accurate performance in routine situations. In more complex situations, they can flexibly apply their knowledge in trying to understand the situation and decide upon further actions.

The obvious similarity in these characterizations of expertise is that they all emphasize routine, automatic versus controlled performance. For the development of expertise this means that challenging situations and tasks in which further thinking is required can contribute most to the building of knowledge and skills. According to Ericsson (2009) experience with such situations must be enhanced by specifically designing tasks to develop performance aspects that need improvement, i.e. deliberate practice. In our own research we have applied the expert-novice approach (Van de Wiel, Boshuizen, & Schmidt, 2000), but also deliberate practice theory (Van de Wiel, Szegedi, & Weggeman, 2004; Van de Wiel, Van den Bossche, Janssen, Jossberger, 2010), as we wanted to move beyond implicit learning from

experience and examine deliberate attempts at developing expertise. We investigated engagement in work-related activities that might further professional development including preparation, problem-solving, asking for feedback and advice, performance evaluation, reflection and updating activities. For both organizational consultants and physicians we found that these activities were mostly engaged in with the professional goal of high-quality performance and to a much lesser extent to improve competence. This suggests that much could be gained from managing learning opportunities in the workplace more explicitly. Therefore, we deduced from the descriptions of deliberate practice recommendations to design learning environments that promote the acquisition of expertise formulated in seven guiding principles (Van de Wiel, Van den Bossche, & Koopmans, in press):

Principle 1: Informative and immediate feedback is fundamental to refine knowledge and skills.

Principle 2: Measuring and analyzing current performance is the cornerstone to improve it.

Principle 3: Practice activities need to be specifically designed to improve performance aspects that need improvement.

Principle 4: Practice activities need to be repetitive but also allow for reflection on outcomes and processes.

Principle 5: The motivation to improve performance is prerequisite to achieve expertise.

Principle 6: Time and effort need to be invested.

Principle 7. Teachers and coaches play a crucial role in guiding individual development.

In these principles we can clearly recognize, the importance of self-regulated learning for deliberate practice as the control of learning by planning, monitoring and evaluating performance plays a key role (Van de Wiel et al., 2004; Zimmerman, 2006). Enhancing the ability of self-regulated learning, and creating work environments in which learning is facilitated, incorporated in work procedures (e.g., exchanging knowledge and experience around difficult problems), and set as a norm will foster expertise development.

In secondary and higher education we cannot raise experts, but we can build the pillars of expertise based on these principles and strategies. Thus, motivation for learning should be encouraged, self-regulated learning need to be practiced, and knowledge and understanding of a domain must be acquired that enable flexible and high-quality performance. Very important is the pursuit for further improvements if the goal is to make all professionals perform at top-level (think of your own physician).

Chi, M.T.H., Glaser R., & Farr, M.J. (1988). The nature of expertise. Hillsdale, NJ: Lawrence Erlbaum..

Ericsson, K.A. (2009). Enhancing the development of professional performance: Implications from the study of deliberate practice. In Development of professional expertise: Toward measurement of expert performance and design of optimal learning environments (pp. 405-431). New York, NY US: Cambridge University Press.

Hatano, G., & Oura, Y. (2003). Commentary: Reconceptualizing school learning using insight from expertise research. *Educational Researcher*, 32(8), 26-29.

Van de Wiel, M.W.J., Boshuizen, H.P.A., & Schmidt, H.G. (2000). Knowledge restructuring in expertise development: Evidence from pathophysiological representations of clinical cases by students and physicians. *European Journal of Cognitive Psychology*, 12(3), 323-355.

Van de Wiel, M.W.J., Szegedi, K.H.P., & Weggeman, M.C.D.P. (2004). Professional learning: Deliberate attempts at developing expertise. In H.P.A. Boshuizen, R. Bromme & H. Gruber (Eds.), *Professional Learning: Gaps and Transitions on the Way from Novice to Expert* (pp. 181-206). Dordrecht: Kluwer.

Van de Wiel, M.W.J., Van den Bossche, P., Janssen, S., & Jossberger, H. (2010). Exploring deliberate practice in medicine: How do physicians learn in the workplace? DOI: 10.1007/s10459-010-9246-3

Van de Wiel, M.W.J., Van den Bossche, P. & Koopmans, R. (in press). Deliberate practice, the high road to expertise. In Dochy, F., Gijbels, D., Segers, M., Van den Bossche, P. (eds.). *Theories of learning in the professions: Building blocks for training & development programs*. Routledge.

Zimmerman, B.J. (2006). Development and adaptation of expertise: The role of self-regulatory processes and beliefs. In K.A. Ericsson, N. Charness, P.J. Feltovich & R.R. Hoffman (Eds.), *The Cambridge Handbook of Expertise and Expert Performance* (pp. 705-722). New York, NY: Cambridge University Press.

SYMPOSIUM

Invited SIG

The role of refutational texts in achieving conceptual change

Chairperson: Wim Van Dooren, K.U. Leuven, Belgium

Organiser: Wim Van Dooren, K.U. Leuven, Belgium

Michael Schneider, ETH Zurich, Switzerland

Discussant: Clark Chinn, Rutgers University, United States

The development of instructional interventions and learning environments aimed at promoting conceptual change has been a central concern for the conceptual change community over the past years. Nevertheless, there is a general feeling that more research is needed in this domain.

This invited symposium focuses on the role that refutational texts may play in achieving conceptual change, therefore addressing not only issues related to conceptual change, but also themes that are of more general interest to the EARLI community, such as text comprehension or instructional design. Refutational texts are considered a powerful resource when a learner's inaccurate ideas about scientific phenomena need to be revised.

The three contributions in this symposium will provide a review of important research findings in this domain. Sinatra and Broughton will set the stage by reviewing multiple perspectives on the role of refutational texts in promoting conceptual change. Next, the contributions by Ariasi and Mason and by Kendeou will focus on how the underlying subprocesses that take place in processing refutational texts can be revealed by relying on eye-tracking data, reading times and thinking aloud data. The findings will not only point at the characteristics of texts that may elicit conceptual change in learners; they also contribute to our theoretical understanding of conceptual change.

Understanding the Refutation Text Effect in Conceptual Change Research: Multiple perspectives

Gale Sinatra, University of Nevada, Las Vegas, United States; Suzanne Broughton, University of Nevada, Las Vegas, United States

In this presentation, we present an overview of multiple perspectives on the role of refutational text in promoting conceptual change. Perspectives from text processing such as Kintch's Construction Integration Model, and van den Broek and colleagues Landscape Model, and Broughton and colleagues' perspective on attention allocation will be reviewed for their contributions to our understanding of the effect of text structure on processing. Perspectives from conceptual change learning such as that offered by the CRKM (Dole & Sinatra, 1998), Hynd (2001), Mason (Mason & Gava, 2005), Skopeliti and Vosnidou, (2008) and Chi (2009) will also be discussed. These perspectives will be contrasted to provide a framework for the symposium and a summation of where theory and research is to date in exploring the nature of the refutational text effect.

The inquiry movement in science education has focused interest on hands-on learning, problem-based learning, and the design of inquiry projects. As inquiry has been foregrounded in researchers' attention, text has been backgrounded. Recently, however there has been a renewal of interest in text in science classrooms (see Broughton & Sinatra, 2009). In particular, the resurgence of research on refutational text has led to a renewed interest in the potentially positive role text can play in the science classroom to promote conceptual change.

In this presentation, we will overview recent perspectives from text processing research and conceptual change research on the role of refutational text in promoting conceptual change, providing a framework for the symposium. One text processing perspective is from Kendeou, Van den Broek and their colleagues. They proposed a model of reading comprehension that may help explain the nature of the refutation text effect called the Landscape Model (see van den Broek, Young, Tzeng, & Linderholm, 1999). According to the Landscape Model, readers balance their limited attentional resources while at the same time maintain standards of coherence. Readers integrate four sources of information in each cycle of processing in working memory: the text information in the present cycle; residual text information from the previous cycle; the memory representation constructed thus far; and the reader's prior knowledge, which can include misconceptions. Van den Broek and Kendeou (2008) explained, "As the reader proceeds through the text, concepts fluctuate in activation: with each new cycle some concepts continue to be active, others decline in activation and yet others become newly reactivated" (p. 338).

The key for conceptual change according to this model is that only information that is coactivated – that is active in the same processing cycle– can be compared and integrated with the reader's developing text representation. The Landscape model predicts that the misconception must be activated at the same time as the accurate scientific information is activated for conceptual change to occur. Van den Broek and Kendeou postulated that coactivation is essential if the reader is to engage in the deeper cognitive processes needed for conceptual change.

In a related view, Kintsch's (1988) Construction Integration Model hypothesizes that reading comprehension occurs in two phases. In the construction phase a network of associations of the readers' propositions and concepts are automatically activated. In the integration phase associations that do not fit with the text's meaning are discarded. In relation to conceptual change, as learners read a refutation text they integrate their prior knowledge with the new

information in the text. This often results in the formation of a new mental model of the phenomenon under study (deLeeuw & Chi, 2003; Mikkila-Erdmann, 2002). Readers may assimilate elements of the scientific explanation into their existing mental models, distorting the scientific concepts, while at the same time adding or deleting beliefs from their existing mental model, resulting in a synthetic model (Hynd, Alvermann, & Qian, 1997; Vosniadou, 2002). Gradually, with repeated exposure to the scientific information, the synthetic model can be revised to align with the scientific explanation (Mikkila-Erdmann, 2002).

A processing perspective offered by Broughton, Sinatra, and Reynolds (2010) is that readers may devote more attentional resources to processing the refutation text segments than other comparable segments of the text if they find the information to be important or salient. In a recent study, Broughton et al. (2010) showed that readers spent less time processing the refutational text segment, a finding consistent with the literature on attention and interest showing that readers who find a text segment interesting, actually spend less time processing that text segment. Broughton et al. (2010) did not have crucial "look back" data that can only be obtained through eye-tracking. Others who have used eye tracking have shown that while readers may spend less time processing the refutational text segment, they also often look back, or make a regression, to previous text perhaps in an attempt to reconcile the discrepancy between their prior knowledge and the new text information which contradicts that knowledge.

Hynd (2001) offers yet an alternative perspective based on text structure. She claims that it is the structure of refutational texts that contributes to their effectiveness. She claims that because refutational texts are structured to concretely and explicitly tell the reader what to think and why, text content is better learned and recalled due to the concrete and explicit format.

Researchers such as Vosniadou, Chi, Sinatra, and Mason offer alternative perspectives based on conceptual change research and theory. Skopeliti and Vosniadou (2008) have explored the effectiveness of refutational text based on the type of information that is refuted in the text (categorical or non-categorical). Similarly, Chi (2009) has explored whether the type of learning failures (under-developed schemas, misconceptions, incomplete activation of relevant schema) is the key factor. Mason and her colleagues (Mason, Gava, & Boldrin, 2008) have explored how learner characteristics interact with text features to support or hinder conceptual change.

Yet another perspective comes from models of conceptual change learning. Conceptual change from refutational text may be the result of increased learner engagement with the ideas in the text (Dole & Sinatra, 1998). For example, a reader might find the refutation information to be personally relevant because the misconception in the text is similar to the conceptions held by the reader. In addition, the refutation sentence may lead the reader to thoughtfully and critically weigh the scientific explanation because it explicitly rejects their idea. A large body of research supports the notion that refutation texts may exert their effect through inducing deep engagement and critical thinking as the result of the cognitive conflict that arises when readers have the opportunity to juxtapose their misconceptions against the new information (Guzzetti et al., 1993; Hynd et al., 1997; Mason, et al., 2008).

These multiple perspectives will provide a context for the empirical studies presented in the symposium.

Eye-Movement Analysis for a Process Approach to the Refutation Text Effect

Nicola Ariasi, University of Padova, Italy, Italy; Lucia Mason, University of Padova, Italy

In academic contexts, texts are the primary medium for acquiring disciplinary knowledge. The effects of a particular text structure, the refutational, were examined in this study. A refutation text is one that acknowledges students' alternative conceptions about a topic, directly refutes them, and introduces scientific conceptions as viable alternatives. Refutation texts are considered a powerful resource for science learning, which very often implies the revision of inaccurate ideas about scientific phenomena. Using the methodology of eye movement, we have addressed the open issue of whether the refutation text effect encompasses a series of sub-processes with different time courses, which take place on different parts of the text and at different stages of the reading process. Forty undergraduates were randomly assigned to different reading conditions, according to a 2 (text: refutation, non-refutation) x 2 (topic: tides, Darwinian theory of evolution) within-subject design. As hypothesized, results show that, regardless of the topic, participants made shorter first-pass fixations while reading the refutation text. Concurrently, they made longer looks-back and looks-from the whole refutation text than the non-refutation text. In addition, readers devoted shorter first-pass fixations to the metatexts in the refutation text. At the same time, refutation metatexts were backtracked (looks-back) for longer. In addition, the information provided by scientific segments was re-fixated more while reading the metatexts in the refutation text (looks-from). Finally, refutation-text readers outperformed non-refutation text readers in learning the new scientific concepts.

Theoretical Framework and Aims

Conceptual change is shaped by the interplay of multiple factors, especially as related to the characteristics of students and instructional materials (Murphy & Mason, 2006; Sinatra & Mason, 2008). In academic contexts, the latter mainly regard written texts, as they are the primary medium for acquiring disciplinary knowledge. This study focused on the effects of a particular text structure, the refutational. A refutation text is one that acknowledges students' alternative conceptions about a topic, directly refutes them, and introduces scientific conceptions as viable alternatives (Alvermann & Hague, 1989; Hynd, 2003). Refutation text is considered powerful for science learning, which very often implies revising inaccurate ideas (Chi, 1992; Vosniadou, 1994). Research has documented that a refutation text is more effective than a standard text in learning physics (Hynd, 1998) and biology concepts (Mikkilä-Erdman, 2002), for students of elementary (Diakidoy, Kendeou, & Ioannides, 2003; Mason, Gava, & Boldrin, 2008), middle (Mason & Gava, 2007), high school (Qian & Pan, 2002), and college (Chambers & Andre, 1997). As these studies were mainly focused on the end product of refutation text reading, we adopted a process approach (Kendeou & van den Broek, 2007) to reveal what underlies the refutation text effect. Its greater effectiveness may be due to a peculiar type of global text processing (Hyßnä, Lorch, & Rinck, 2003) that it promotes. Recent studies have documented that refutation text facilitates reading the parts which challenge the reader's alternative conceptions (Broughton, Sinatra, & Reynolds, 2010) and sustains the co-activation of inaccurate and scientific conceptions (van den Broek & Kendeou, 2008). To extend current research, both theoretically and methodologically, we sought to go beyond these process data by examining eye movements, which have been proved useful in investigating the cognitive processing of text segments that are larger than a single sentence and span relatively long distances (Ariasi & Mason, 2010). In addition, eye movement analysis makes it possible to tap into the time course of cognitive processing during reading (Kaakinen, Hyßnä, & Keenan, 2003). Using this methodology, we have addressed the open issue of whether the refutation text effect encompasses a series of sub-processes with different time courses, taking place on different parts of the text and at different stages of reading. Assuming the superiority of refutation text, the following research questions guided our study: (1) What is the time course of the facilitation effect while reading the refutation text?; (2) What parts of the text are concerned with such a facilitation?; (3) Is the co-activation of inaccurate ideas and scientific conceptions actually greater during the reading of a refutation text? The related hypotheses were: (1) The effect of facilitation would take place during the initial processing of refutation text reading; (2) This facilitating effect would regard the refutation parts; (3) The refutation parts and those introducing the scientific conceptions would be co-activated more strongly, and the former would be used more as anchor points to integrate new information.

Method

Forty ($F=25$) undergraduates (age: $M=25.1$, $SD=4.7$) participated. Each participant was randomly assigned to a different reading condition according to a 2 (text: refutation, non-refutation) \times 2 (topic: tides, Darwinian theory of evolution) within-subject design. Both texts introduced four new concepts, each presented on a different page. For each concept the texts included metatexts (refutation, non-refutation) and scientific parts. Following Hyßnä and Lorch (2004), the scientific parts were further divided into three segments: introducing, medial, and end. Readers' conceptions about the topics were assessed through open-ended questions, before and after each reading. Five eye-movement measures were computed by ratio-per-character: first-pass forward, first-pass rereading, and first-pass fixation time, all reflecting the early processing of a text segment; look-back fixation time revealing the strategic behavior during reading; look-from fixation time unveiling the simultaneous processing of different text segments. These eye-movement indices were used as different levels of a variable named "processing". Data about 6,400 segment-level eye-movement durations were collected. These durations were log-transformed to control for the great inter-individual variability.

Results

Differences for prior-knowledge in the four conditions were not significant ($ps>.05$). Thus, prior-knowledge was not considered in the analyses. As assumed, the end product of reading showed that refutation text was more effective than the non-refutation, $F(1, 65)= 6.166$, $p=.016$, $n2p=.09$. To test our hypotheses, a within-subject ANOVA with text (refutation, non-refutation), topic (tides, evolution), concept (first, second, third, fourth), segment (metatext, introducing, medial, end), and processing (eye-movement measures) was performed. Log-transformed eye-movement durations represented the dependent variable. Results showed a significant text \times processing interaction, $F(4,5600)=2.976$, $p=.018$, $n2p=.12$. Participants made shorter first-pass fixations while reading the refutation text. Concurrently, they made longer looks-back and looks-from on the whole refutation text than on the non-refutation text (Figure 1). Furthermore, the text \times segment \times processing interaction was significant, $F(12,5600)=2.400$, $p=.004$, $n2p=.15$. Specifically, readers devoted shorter first-pass fixations to the metatexts in the refutation text. At the same time, refutation metatexts were backtracked (looks-back) for longer (Figure 2), and the information provided by the scientific segments was re-fixated more while reading the metatexts in the refutation text (looks-from).

In sum, as hypothesized, the facilitation effect produced by refutation text takes place during initial processing, regardless of the topic (Broughton et al., 2010). Readers are therefore able to save resources in the earliest stage of processing and invest them to re-read and integrate the new information to be learned. Additionally, inaccurate ideas and scientific conceptions are co-activated more while reading the refutation text (van den Broek & Kendeou, 2008). The former are also used more to integrate the new information.

Theoretical and Educational Significance

The study makes a scientific contribution to research by providing objective evidence that the refutation text effect takes place in different parts of the text and at different stages of reading.

From an educational point of view, the study indicates that the structure of an expository text for learning disciplinary knowledge plays an essential role. Although not all learning texts can have a refutation structure, it may be especially useful when complex phenomena must be understood by changing previous representations.

Situating conceptual change in the process of reading comprehension

Panayiota Kendeou, Neapolis University Pafos, Cyprus

Refutation texts have been found to have considerable potential for changing students' misconceptions. Most of prior research has observed such effects after reading is complete. The aim of the present study is to understand the mechanism by which refutation texts exert their influence during reading comprehension. To do so, we follow a three-pronged approach (cf. Magliano & Graesser, 1991). First, we form hypotheses with respect to readers' processing of scientific texts drawing on recent research in cognitive psychology and discourse processing. In particular, we use the conceptual framework of the Landscape model, in which many of the comprehension processes identified in cognitive research are integrated. Second, we perform simulations to test our hypotheses using the computational implementation of the Landscape Model (Tzeng, van den Broek, Kendeou, & Lee, 2005). Third, we collect empirical data using think-aloud, reading time, and eye-tracking methodologies on the reading process to compare with the computational data (Kendeou, 2010; Kendeou, Muis, & Fulton, in press; Kendeou & van den Broek, 2007; van den Broek & Kendeou, 2008).

The results show that texts that promote co-activation of misconception and correct information (i.e., refutation text) elicit fundamentally different comprehension processes in readers with misconceptions than do texts that do not promote co-activation (non-refutation text). The findings provide new insights in the underlying mechanisms that support change during reading and how situating the study of these change processes in current theories of reading comprehension can contribute to our theoretical understanding of conceptual change.

The aim of the present set of studies is to understand the mechanism by which refutation texts exert their influence during reading comprehension by situating their investigation in the context of current theories of reading comprehension. To do so, we follow a three-pronged approach (cf. Magliano & Graesser, 1991). First, we form hypotheses with respect to readers' processing of refutation texts drawing on recent research in cognitive psychology and discourse processing. In particular, we use the conceptual framework of the Landscape model, in which many of the comprehension processes identified in cognitive research are integrated. Second, we perform simulations to test our hypotheses using the computational implementation of the Landscape Model (Tzeng, van den Broek, Kendeou, & Lee, 2005). Third, in a series of studies we collect empirical data using think-aloud, reading time, and eye-tracking methodologies (Kendeou, 2010; Kendeou, Muis, & Fulton, in press; Kendeou & van den Broek, 2007; McCrudden & Kendeou, 2010; van den Broek & Kendeou, 2008).

Step 1: Forming Hypothesis within the Landscape Model Framework

The Landscape model was developed to capture the comprehension processes that take place during reading and their relation to the gradually emerging memory representation of a text. In the Landscape model, the various processes that take place at each point during reading reflect a balancing of the reader's limited attentional resources with the standard of coherence and comprehension that the reader –implicitly or explicitly– sets. As a result, as the reader proceeds through the text, concepts (propositions, informational units) fluctuate in activation: With each new cycle (e.g., sentence) some concepts continue to be active, others decline in activation, and yet others become newly (re)activated.

Step 2: Computational Simulations

In two sets of simulations we investigated the availability of information critical to comprehension during reading of refutation and non-refutation scientific texts. Two texts were used, each describing a common problem in Newtonian Mechanics. The texts were adapted from McCloskey (1982). These simulations revealed that refutation texts create optimal circumstances for co-activation of the misconceptions and correct conceptualizations (van den Broek & Kendeou, 2008).

Step 3: Empirical Evidence

The description of cognitive processes during reading comprehension and the simulations outlined above suggest that refutation texts may be effective because they create optimal circumstances for co-activation of the misconceptions and correct conceptualizations and, thereby, provide the foundation for further processing that differs fundamentally from the processing that takes place during reading of traditional, non-refutation texts. To determine whether such differences in processing indeed occur, we conducted four empirical studies on the on-line processing of refutation and non-refutation science texts by readers with and without misconceptions related to the topics of the text.

In Study 1, readers read the same texts as were used in the simulations, while performing a think-aloud task (Kendeou & van den Broek, 2007). In Study 2, readers read the refutation text or the non-refutation text on the computer, one sentence at a time in a self-paced manner (Kendeou et al., in press). In Study 3, readers read the refutation text or the non-refutation text while their eye-movements were recorded (Kendeou, 2010). In Study 4, a younger group of readers read the refutation text, and following a case-based approach, the time course of conceptual change was investigated (McCrudden & Kendeou, 2010).

The results from Study 1 showed that, for both refutation and non-refutation texts, readers with misconceptions generated more incorrect (difference in average number of inferences per text = 3.8, pp For refutation texts readers with misconceptions engaged in more conceptual change behaviors. The reading times for the sentences with the correct information (which conflicted with the prior knowledge of readers with misconceptions) in Study 2 showed that readers with misconceptions spent more time reading those sentences than did readers with no misconceptions but only when these sentences were included in a refutation text (difference = 104 ms, $p = .05$). For the non-refutation text the reading times of target sentences by readers with and without misconceptions did not differ (difference = 30 ms, $p > .05$). The results of Study 3 showed that readers made significantly more $F(1, 95) = 8.15$, $p = .005$ and longer $F(1, 95) = 10.12$, $p = .002$ forward fixations during reading the refutation sentence in the refutation than the non-refutation text. Also, readers made significantly more $F(1, 95) = 6.42$, $p = .013$ and longer $F(1, 95) = 7.28$, $p = .008$ look back fixations in explanation sentences in the non-refutation text version. These findings show that readers experience initial difficulty during reading of refutation sentences most likely due to the conflict between their misconception and the refutation (due to co-activation). This initial difficulty, though, assists readers in subsequent integration of the explanations of the misconception. Finally, in Study 4 the results of the case-based analysis showed that readers can undergo conceptual change during reading of refutation text and that these changes appear to be influenced by the degree of similarity between readers' conceptions and scientific conceptions.

Discussion

These results indicate that texts that promote co-activation of misconception and correct information (refutation text) elicit fundamentally different comprehension processes in readers with misconceptions than do texts that do not promote co-activation (non-refutation text). When reading the refutation texts, readers with misconceptions read the sentences with correct information more slowly (Study 2 & Study 3) and engaged in more conceptual change behaviors (Study 1 & Study 4) than when reading the non-refutation texts. Thus, the co-activation of misconceptions and correct information led readers with misconceptions to experience conflict (i.e., they detected the inconsistency between their prior knowledge and the textual information) and allowed them to engage in efforts to repair the conflict and create coherence. In contrast, readers with misconceptions who read text versions that do not promote co-activation did not slow down or engage in conceptual change behaviors anymore than did readers without misconceptions.

SYMPOSIUM

Invited SIG

Reflections on the interpretation of collective interactions in learning and instruction

Chairperson: Patrick Sins, Leiden University, Netherlands

Organiser: Patrick Sins, Leiden University, Netherlands

Michaela Glaeser-Zikuda, University of Jena, Germany

Discussant: Petra Grell, University of Potsdam, Germany

Although the learning sciences still lack standard methods for analyzing learning and instruction, most studies comply with a traditional approach. This approach involves that particular relevant learning processes are deconstructed into analyzable units that are coded and subsequently correlated with other relevant (outcome) variables in a nomological network. The rationales underlying the substantial preference for this approach are cultivated by respectively a positivistic and a reductionist epistemological view that can be considered problematic. Firstly, it presumes that what people explicate in questionnaires, interviews or in dialogues provides a straightforward view into the nature of their learning. However, we need to consider that there is a two-way interaction between the nature of learning and the nature of what is represented in these measures and that the mechanisms and configurations of elements involved may differ structurally. Secondly, learning is a process that can be characterized as a dynamic system where interactions between its elements emerge, unfold, accumulate and refer back. This view is incommensurate with decomposing learning into isolated units of analysis. Consequently, there is an emerging need for alternative methodological approaches toward interpreting and analyzing learning. We have gathered three distinct scholars – from Germany, France and The Netherlands – who have all confronted the same challenge. We invited each of them to present their reflections on alternative approaches for interpreting learning. Our discussant, Petra Grell, who is not affiliated with any of these research programs, will synthesize the ideas and advances in this work and leads the discussion amongst the symposium's participants.

Potentials of qualitative content analysis for research on learning and instruction

Michaela Glaeser-Zikuda, University of Jena, Germany

Conducting empirical research in the field of learning and instruction is a highly complex task. It requires first, to find the most appropriate research methods to address our theoretically framed research questions. Second, those research methods and strategies need to be identified, designed, and applied to ensure that results produce reliable and valid answers to these questions. This presentation is focusing on a specific method for analysis of qualitative data. This method, called qualitative content analysis, has been widely applied in the field of research on learning and instruction, especially in studies focusing learning strategies, instructional quality, learning motivation and emotion, teaching competencies, and school effectiveness. Based on several examples from research on students' learning strategies and emotions, and instructional quality the ways in which data can be analyzed and interpreted by qualitative content analysis is illustrated. Finally, implications for how this approach may contribute to a better and deeper understanding of learning and instruction are discussed.

Levels of analysis in the interpretation of dialogues

Patrick Sins, Leiden University, Netherlands

This contribution attempts to engender and to illustrate an alternative approach to the interpretation of dialogues in collaborative learning settings, taking into account the movements across timescales as an additional dimension to the analysis of dialogues. Based on a critical reflection of quantitative content analysis, the argument is made that in order to understand how dialogue may contribute to collaborative learning, researchers need to understand how interactions occurring at different timescales connect. Based on the works of Lemke (2000; 2001), semiotic artefacts are proposed as the carriers of information that enable us to create coherence between distal interactions. Three levels of analysis are proposed that focus on respectively: (a) trajectories of the development of interactions over time (macro level), (b) patterns in artefact-mediated interactions (meso level) and (c) the ways in which concepts articulated become materialized in semiotic artefacts (micro level).

Many authors in the field of educational research have advocated quantitative content analysis for investigating collaborative learning (cf. Chi, 1997). This approach roughly involves that researchers interpret set of codes that have been assigned to segments identified in the verbatim transcripts of verbal interactions between people who had been engaged in achieving a particular collaborative learning task. The segment constitutes the unit of analysis and may vary from small to large, e.g. a word, an utterance, an episode or a thematic unit. The basic tenet of this approach is to generate models explaining how specific configurations of processes identified in the interactions between learners affect a particular outcome measure of what has been learned. In other words, this means that the analytic focus is on relating the systemic relations between forms of interaction at the one hand and qualities of learning outcome on the other (cf. Arnseth & Ludvigsen, 2006).

What is problematic in this method is the underlying reductionist view that considers the act of speech as a process that can be decomposed into isolated units of analysis. The meaning and functions of a coded segment cannot,

however, be treated as distinct and separable from other discursive acts that have occurred in the interaction. In contrast, communicative acts are by nature responsive to each other and at the same time they project possible responses in the future (Linell, 1998). Moreover, contributions to dialogue are made coherent by being related to some issue of current relevance that may be related back to something that had been explicated somewhere in the past. Thus, in order to understand how interactions between learners may contribute to collaborative learning, we as analysts need to carefully investigate the sequential unfolding of dialogues along different timescales (Lemke, 2000).

Every discursive act occurs on some timescale (Lemke, 2001). What is articulated here and now is constrained, facilitated and afforded by the discourse that has been typically taking place on longer timescales. In addition, the kinds of interactions that can happen depend on the kinds of processes occurring on shorter timescales. This means that a particular meaningful segment in the interaction that has been assigned with a code, is not only constituted by configurations of words articulated, but they are also constrained by being themselves part of longer timescale processes, such as talking about a specific topic or theme or participating in a particular discourse genre (cf. Bakhtin, 1986). Moreover, to make sense of how concepts introduced earlier in the interaction between learners are taken up and advanced later on, we need to zoom out to include interactions occurring on other timescales. Local coherence is achieved when interactions occurring on shorter timescales are constrained by these higher level processes occurring on longer timescales in such a way that patterns consistent with the constraints become manifest. Learning is an aspect of development on a longer timescale, which means that it is essential to investigate dialogues both in relation to articulations on the shorter timescale as well as in relation to patterns and trajectories in the discourse taking place on longer timescales.

How do articulations that occur on short timescales become embedded in and contribute to discourse on longer timescales? How can we investigate interactions between processes occurring on different timescales? Lemke (2000; 2001) proposed the concepts of heterochrony and semiotic artefacts to address these questions. Heterochrony involves the exchange of knowledge between timescales through the indirect means of people interpreting and making use of semiotic artefacts during interactions. These artefacts, such as notebooks, research reports or wiki-pages materialize knowledge that can subsequently be carried across several timescales serving to create coherences between distal events (Lemke, 2001, p.21). An implication for the analysis of dialogues of this stance, is that we need to focus on the role of these artifacts in order to move between timescales to make claims about collaborative learning.

This contribution will illustrate an alternative approach to the investigation of dialogues employing three levels of analysis that correspond to idiosyncratic timescales (i.e., macro, meso and micro). The data consists of the interactions between researchers and teacher-trainers that had occurred in a one-year project that focused on the collaborative development of curricular artefacts for advancing existing teaching practices. On the macro level, trajectories and developments in the interactions between project team members over time are described as well as the extent to which artefacts are taken up in subsequent meetings is investigated. On the meso level, collaborative learning was discerned in emerging patterns in the artefact-mediated interaction taking place over several episodes. These patterns were consisted of sequences of moves in the interaction that were found to be significantly higher than may be expected on the basis of the distribution of moves. The micro level analyses focused on particular concepts that were explicated during particular moves in the project team's interactions and that had been materialized into their artefacts. The contribution concludes with contemplating how qualitative with quantitative measures can be integrated to investigate the relation between interactions and object progression taking into account differences in timescales.

References

- Arnseth, H.C. & Ludvigsen, S. (2006). Approaching institutional contexts: Systemic versus dialogic research in CSCL. *Computer-Supported Collaborative Learning*, 1, 167-185.
- Bakhtin, M. M. (1986). *Speech genres and other late essays*. (C. Emerson & M. Holquist, Eds., V. W. McGee, Trans.). Austin: University of Texas Press.
- Chi, M.T.H. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences*, 6(3), 271-315.
- Lemke, J.L. (2000). Across the scales of time: Artifacts, activities and meanings in ecosocial systems. *Mind, Culture, and Activity*, 7(4), 273-290.
- Lemke, J.L. (2001). The long and the short of it: Comments on multiple timescale studies of human activity. *The Journal of the Learning Sciences*, 10(1&2), 17-26.
- Linell, P. (1998). *Approaching Dialogue. Talk, Interaction and Contexts in Dialogical Perspectives*. Amsterdam: John Benjamins Publishing Company.

Michael Baker, CNRS - Telecom ParisTech, France

A significant area of research in the Learning Sciences involves studying collective activities in educational situations, and thus the attempt to analyse how meaning is co-created in and by communicative interactions. In this paper I want to deconstruct the very notion of such "analysis", taking as a point of departure the etymology of the term, as 'unloosening the bonds that hold together discrete elements'. My critique bears principally on difficulties involved in identifying the unit of analysis of collaboration, in ascribing univocal speaker-meanings and in studying fossilised thinking. Drawing on theoretical perspectives from sociology and anthropology (Geertz, Latour), I argue that in the human and social sciences, the relation between researcher and object of study is rather one of interpretation, i.e. an empathetic interactive encounter allowing the creation of meanings (rather than explanations). This leads on to a critique of the very paradigm of which interaction analysis is a part, from the point of view of complexity theory. In the second part of the presentation, I illustrate an approach to interpreting students' argumentation dialogues, based on articulating seven alternative perspectives. The paper concludes with remarks on the nature of dialogue as collective thinking and how it can be known scientifically.

A significant area of research in the Learning Sciences involves studying collective activities in educational situations. In the absence of perfect mutual knowledge in evolving situations, people have to communicate and to interact with each other, in order to work and learn together. It follows that the study of how meaning is co-created in and by communicative interactions is a central focus of research.

Within what has been termed the "interactions paradigm" in collaborative learning research (Dillenbourg, Baker, Blaye & O'Malley, 1996), the study of communicative interactions produced in educational situations has been conceived in terms of analysing different types of categories of interactions and correlating frequencies of categories with learning effects, as a means of identifying productive types of interactions.

I will argue that the study of communicative interactions occurring in educational situations should be conceived of as a process of articulating multiple interpretations and meanings, within a dialogue involving social actors, of which participants in those situations, and members of the relevant research community.

In the first section of this paper, my argument begins with a critical perspective on the interactions paradigm and the very notion of analysis of interactions that it incorporates. From the perspective of cognitive theories of dialogue (Allwood, Clark, Trognon), certain 'technical' problems arise with analysis of dialogue into discrete units. These include, firstly, segmentation into units, which from the very outset requires definition of the unit of analysis and the object of study. I shall argue, on methodological grounds, that the unit can not be individual thoughts expressed in dialogue (to paraphrase Edwards, 2003, dialogue is not a "window on the mind"), but can only be collective thinking, the set of elaborations of others' thoughts. This leads to the exchange being identified as the fundamental unit of collaboration and thinking. Further technical problems relate to multifunctionality (Bunt) and strategic indeterminacy (Edmondson, 1981), that should erode belief in the possibility of univocal analysis of units, however defined. Finally, on this level of technicity in interaction analysis, the very status of the corpus as a finished textual object, to be perused by the analyst, can be called into question, with respect to the idea of dialogue as a kind of processual "palimpseste" (Bouchard, 1988) that is continually overwritten. In the conclusion of this first section, I move to the level of the paradigm within which interaction analysis is situated. It involves an assumption of linearity: learning conditions engender (relate to, are correlated with, cause, etc.) specific types of interactions that in turn engender specific types of learning effects (conditions > interactions > effects). Such linearity is not tenable; and I shall explore the diverse ways in which "effects" exert influence on their "causes" (knowledge emerging from interaction transforms the nature of interaction; interaction is the locus of the transformation of the meaning of "conditions", etc.). This amounts to a view of context as interactively constituted rather than 'given', that has been magisterially elaborated by researchers such as Perret-Clermont and Grossen. At the end of this critical analysis of the interactions paradigm, I want to elaborate an alternative view, which amounts to saying that we should embrace interpretation rather than analysis; recognise that researchers, as human beings, have a privileged way of interpreting other human beings, that is different from the analysis (or separation into components) of inanimate objects such as sand and salty water. Scientific truth in this domain may well be what emerges, in a constructivist sense (Brouwer), from the scientific debate between interpretations (Latour), leading to some kind of 'thickening' of descriptions (Geertz), tending towards a limit. Validation of scientific interpretations is a matter of confronting explicit and publicly available views within a research community (pace "intercoder reliability ratings"). In a sense, this amounts to a restatement,

specifically anchored in a fundamental problem for the Learning Sciences, of the old debate between sciences of nature and sciences of the mind, between explanation and understanding (Dilthey, Weber; Naturwissenschaften vs. Geisteswissenschaften vs. Kulturwissenschaften).

In the second section of this paper, I shall try to give an illustration — albeit, a necessarily monological one — of what a dialogue between interpretations might be like, for the case of the study of students' argumentation dialogues occurring in collaborative problem solving situations in both natural and social sciences (cf. Baker 1996, 1999, 2002, 2010). Here, the dialogical proponents are not necessarily individuals (although proponents of certain theories will be referred to here), but rather interpretative viewpoints. The list is not closed; but I shall try to sketch out a general integrative vision of how students create meanings for the educational situations in which they find themselves and which they co-create, where they confront disagreements and controversies whilst confronting each other, drawing on the following viewpoints: dialectical, rhetorical, dialogical, epistemological, discursive, socio-relational, affective. What seems to be beginning to emerge from this epistemological dialogue is a vision of such educational interactions as a kind of tension-relaxation process (Andriessen, Baker & van der Puil, 2010), operating conjointly with respect to the plasticity of concepts, modes of reasoning and ways of relating to each other.

In conclusion to this critical and comparative analysis of interaction analysis and interaction interpretation, I shall try to sketch out a vision of what collective thinking in dialogue is, — or rather of dialogue as collective thinking — and to examine prospects for the elaboration of publicly expressed and evaluable, teachable, research methods for interpretation of students' dialogues.

SYMPOSIUM

Invited SIG

Education for a Global Networked Society: Online Collaborative Learning in Higher Education

Chairperson: Velda McCune, University of Glasgow, United Kingdom

Organiser: Anne Nevgi, University of Helsinki, Finland

Velda McCune, University of Glasgow, United Kingdom

Discussant: Jeroen Van Merriënboer, Maastricht University, Netherlands

This symposium aims to explore the relevance of online and blended collaborative learning as a means of educating students such that they will be able to participate effectively in a global networked society. The symposium will involve consideration of online collaboration across a range of subject areas and different international contexts. The papers which will be presented in this symposium offer both rich empirical findings and considered theoretical perspectives on students' experiences of collaboration. This provides a sound basis for discussion of how collaborative learning may contribute to students' development in ways which meet the particular demands of the 21st century.

Knowledge creating inquiry in customer projects

Hanni Muukkonen, University of Helsinki, Finland; Kari Kosonen, University of Helsinki, Finland

The study examines two higher education courses which involved students, teachers, and customers in multifaceted experiences of knowledge creation. Participants engaged in online collaborative knowledge creation within a blended learning environment. The knowledge creation approach to learning (Paavola et al., 2004; Hakkarainen et al., 2004) provides a theoretical tool to address learning and teaching organized around authentic problems and the development of shared knowledge objects, such as reports, products, and new practices. This approach directs attention to those aspects of social interaction and artifact-mediated activities which focus on the development of shared objects and the pursuit of novelty. To create an authentic mirroring of professional work practices, it appears necessary to design sufficient open-endedness and complexity for students' teamwork to generate unpredictable and both practically and epistemologically challenging situations. The investigation addresses the roles of technology-mediation, customer involvement, and guidance in developing effective knowledge creating inquiry practices.

The aim of the present study was to explore the kinds of knowledge creating inquiry processes higher education students take forward in course settings focused on complex customer projects. The pedagogical design, actual practices, and technology-use of two courses were investigated. The theoretical background of the study, the Trialogical learning approach (Paavola et al., 2004; Hakkarainen et al., 2004) places particular value on the development of various shared knowledge objects and artifacts as a central mechanism for fostering collaborative

knowledge-creation. It emphasises the interaction between collective and individual efforts on shared objects as well as pragmatic, epistemic, social, and reflective mediation (Rabardel & Bourmaud, 2003) for these processes. A virtual collaboration tool, the Knowledge Practice Environment (KPE) developed in Knowledge Practice Laboratory Project (see <http://www.knowledgepractices.info/>) was used as the virtual environment of the courses. The KPE has been designed to support collaborative knowledge creation: it provides various tools and functionalities for reflective and "object-centred" knowledge practices, such as planning and brainstorming about epistemic processes, producing texts, organising collaboration around knowledge objects as well as planning and reflecting on processes. The design of the tool is based on the design principles of the dialogical learning approach.

Two research questions are addressed: What kind of knowledge creation processes did the participants engage in during the investigated courses? How did the KPE-environment and its integrated analytical tools enable the participants to organize their work and artifacts as well as reflect on their working activities? The first setting which was investigated was the "Application development project" course organized at the Metropolia University of Applied Sciences. It aimed at promoting the learning of various professional practices featuring the development of business ideas, services and multimedia products taking place in professional practice. From the 11 teams taking part, 5 were included in the data-analysis. Representatives of 4 customer organizations were intensively involved in the process. In the second course which was investigated, "Humans, organizations and technology", students from the University of Helsinki and the Aalto University, School of Economics were organised into multidisciplinary teams. The teams worked on a project related to the psychology of economic behaviour for a customer organization, the Finnish Tax Administration.

Thirty students participated in the course, composing 6 project teams, a research team, and a coordination team. Data collected included the database materials from the KPE environment, students' answers to pre- and post course reflective questions, selected team interviews including stimulated recall of the use of the learning environment as well as teacher and customer interviews. In the first course selected teams' steering group meetings were video-recorded, as were both courses' lectures and customer feedback. A qualitative content analysis of the items created in the virtual working space of the teams was conducted to find out what kind of functions these items served. The answers to the reflective questions and interview data were analyzed. In the first course, students participated from 3 training programs, media engineering, industrial management and media and communications. The 5 multidisciplinary teams of 3-6 were observed to develop business plans, user stories, marketing strategies, prototypes, sales pitches, weekly team progress reports and software architecture to come up with an application and business in operation. During lectures students were introduced to the practices and methods used in business and application development. A proportion of the lectures were held by visiting experts coming from business settings. Working documents (templates) pre-structured with domain specific conceptualizations were provided by the teachers. The "steering group" for each team consisted of 1-2 teachers and 1-2 company representatives. They were held weekly in the first two periods, and every second week in the last period. The goal of the steering groups was to support the teams to address all relevant aspects of business planning, software development and acquiring users (and business revenue) for their application. In the second course, the project teams had members with business and psychology backgrounds. The teams worked jointly to produce research plans for the customer, including, for instance, data collection about initial attitudes towards tax-paying and interventional approaches for transforming these attitudes. Teams developed team flyers and rules, projects plans, presentations for the customer and final reports.

In their answers to the reflective questions, the vast majority of respondents described their experiences from the course in mainly positive terms pointing out that the course setting provided them with a window into real working life. The involvement of the company representatives in the first course was perceived to bring a particularly valuable perspective to the steering sessions that supplemented the teachers' guidance and positions. The working document templates mediated the participants' work on their projects, business ideas and products and the analysis of related problem spaces. The use of the KPE facilitated student teams to jointly develop their working ideas, organize related sub-tasks visually, explicate interdependencies of the produced knowledge artefacts, and to define and negotiate on roles, deadlines, milestones, and responsibilities. As the teams were relatively free to select their collaboration tools, we observed a large variation in the tools used. Although in both courses the teachers were able to follow team activities and artefacts in the KPE, nearly every second team in effect adopted other, often more familiar tools in their collaboration and only posted the necessary reports and outcomes in KPE. However, with the teams that did carry out their processes in the KPE environment, the teachers expressed that they would have valued and benefited from a similar overview of activities from all teams.

The use of these working document templates reflecting real professional practices and the company representatives' participation brought a strong cross-fertilization mechanism into the pedagogical setting of the courses. Overall, the investigated courses presented very demanding collaboration tasks for the students. They encountered epistemic and

pragmatic challenge related to the analysis and development of business ideas and applications or the research plans, and the management of workflow in teams. The outcomes were valued by the customers, suggesting potential of the knowledge creating inquiry practices in bridging between expectations of workplace practices and higher education.

Knowledge development and problem solving in practice: what students value in collaborative aspect

Samuel Edelbring, Karolinska Institutet, Sweden; Nabil Zary, Karolinska Institutet, Sweden; Lars-Ove Dahlgren, Linköping university, Sweden

The Dublin descriptors ("The joint quality initiative," 2010) emphasise sharing understanding with others. Professional work is also based on collaboration in knowledge use (Hutchins, 1995). Recently there has been increased interest in collaborative aspects of studying with computers (Koschmann, 1996). New ICT allows for more flexible use and educational practices change accordingly. We need knowledge on students' strategies regarding collaboration and to what extent we should encourage this formally in higher education. Col[®]lab[®]orating in the small group setting using computer applications is beneficial in most, but not all settings (de Leng, Muijtjens, & van der Vleuten, 2009; Lou, Abrami, & d'Apollonia, 2001). What reasons do students see for collaboration and how does collaboration contribute to student learning? We have been investigating two course contexts where students use computerised virtual patients (VPs) with the aim of understanding the functions of this technology for student learning. One context where collaborative work was designed into a clinical practice setting, another where collaboration was left to free choice in a course. Results from these studies will be presented and discussed from a collaborative learning perspective. Collaboration does not necessarily occur naturally among medical students. The relevance of collaboration in knowledge development and problem solving are identified by students when having worked in that setting. However, when given a free choice in "everyday study" the students opted for individual work. Motives for collaborative work need to be explicitly expressed and supported in course settings.

Introduction

There are political, societal and educational reasons for stimulating collaborative student work in higher education (HE). The Dublin descriptors ("The joint quality initiative," 2010) unite the different European countries in a common focus on learning outcomes in HE. For each of the three cycles within these descriptors there is an emphasis on students sharing their understanding with others with different perspectives. For example, in the 1st cycle it says: "can communicate about their understanding, skills and activities, with peers, supervisors and clients". The social dimensions of knowledge development and knowledge use in professional practice have also been pointed out (Hutchins, 1995). Work in the Computer Supported Collaborative Learning (CSCL) tradition has emphasised the social aspect of learning in educational research on the use of new technology for learning (Koschmann, 1996).

Changed practices

New technology is not only passively mediating information, but shapes our practices and the way we think (McLuhan & Fiore, 1967). We see this in society at large but also in HE. The technology we bring to education has consequences for educational practices. The formal education community is a driver in creating innovations; much of the ICT that we use has its embryonic start at universities. However, apart from innovators themselves and technology enthusiasts, the large majority of teachers seem reluctant to adopt new technology and innovations for learning until they are more commonly used. Everett Rogers (2003) describes uncertainty and perceived benefits as important to address in the integration of new practices within organisations. From Cuban's (1988) historical analysis of IT integration in schools in the USA we learn how important it is to involve teachers in the integration process of innovations. Students as well as teachers need to know "what's in it for them". A meta analysis of col[®]lab[®]orative learning when using computer applications, shows that the small group setting is beneficial for learning (Lou, Abrami, & d'Apollonia, 2001). We also need studies which clarify the benefits of new practices in ways which go beyond performance measures designed to suit previous practices. What reasons do today's students see for collaboration and how does collaboration contribute to student learning? Two empirical studies: technology resources allowing for student collaboration in medical education In medical education, as in many other disciplines, students' reasoning and elaboration around specific cases is of concern for educators. The collaborative aspect seems natural to use to bring in other perspectives into the elaboration or problem solving. However, our experience is that this collaboration does not occur naturally among students. We have been investigating two course contexts where students use computerised virtual patients (VPs) as learning tools for working with patient cases. The aims were to understand the functions of this technology for student learning. In the first context the collaborative work was designed into the course. In the other context students were left to choose whether to work individually or in collaboration. The first setting was a rheumatology clinic where medical students get early clinical experience during a stay of two weeks. A mandatory part of their stay was to work through 4 VP rheumatology cases. The 31 students were placed at the clinic in pairs and were encouraged also to work with the VPs in pairs which most of them did. When interviewed about the

VP experience, the pair-wise work, distinct from individual, but also from settings of 3 and 4 students working together, was highlighted as increasing their learning experience (Edelbring et al. submitted). Students expressed that case data was more elaborated and that they took different standpoints and argued for them in solving and managing the case when working in pairs. However, when comparing triad versus individual student computerised case work De Leng et al. (2009) found no difference between the two contexts regarding case elaboration. We intend to follow the collaborative work in this first setting more closely focusing on what happens in the interaction between students and VPs by using video observations and questions about the collaborative setting.

Research questions guiding that work are: What happens in the collaborative situation regarding knowledge development and reasoning? Is there an added value working with a peer in this activity? How do students describe that value? A case from that setting will be used to highlight these aspects. In the other setting medical students (n=247) were given VPs to work with in a clinical preparatory course. A web based login made it open to students to choose to work individually or collaboratively. Seventy-nine per cent of the respondents (161, rr=65%) chose to work individually. When asked for their preference on this 56% of the students preferred to work on their own (Edelbring et al., in preparation). The flexibility of this and many new learning tools allows for using them at any place, any time. In our investigation 65% used the tool at home, 19% at campus/hospital, 15% both at home and campus/hospital and two students (1%) at a café. The high numbers using the activity alone at home raises questions whether it is optimal use of this resource. Surely this depends on the kind of learning activity and its goal. The VP activity intends to enhance clinical reasoning and help to contextualise declarative biomedical knowledge. In case reasoning, collaboration seems, at least in pair-work, to stimulate case elaboration and enhancing the reasoning process. As future professionals students will also need to interact and collaborate not only with same discipline professionals, but also with other categories possibly taking different perspectives on their topic.

Conclusion

The relevance and benefits of collaborative aspects of knowledge development and problem solving are identified by students when having worked in that setting. However, when given a free choice in "everyday study" they opt for individual work. Motives for collaborative work need to be explicitly expressed and supported in course settings.

International Student Learning and Avatar Collaboration in an Immersive World

Howard Ramsay, University of Strathclyde, United Kingdom; Catherine Demangeot, University of Strathclyde, United Kingdom; Ray Land, University of Strathclyde, United Kingdom

This project brought together online, within the immersive world of Second Life, a small group of MBA students from 8 different locales in Europe, the Middle East and Asia (and from distinctively different cultures) to collaborate on various questions of International Marketing. The research aimed to ascertain how students and their facilitator felt about their avatar and about mediating their interaction through an avatar. Did it help or impede communication, involvement and collaboration? The facilitator was not aware of the real identity of the avatars at any point during the research. The avatars' relative genderlessness and culturelessness meant that the communication with each avatar was not affected by awareness of differences between high? and low?context cultures (Hall, 1973). A related issue was whether trust could flow through avatars in the same manner that it does between students. The virtual environment appeared to change the 'rules of engagement' between avatars, primarily as a result of the absence of body language cues, and the contextlessness and culturelessness of the avatars. The resulting findings from this project are now informing the design of a follow-up study in collaboration with the Canadian Civil Service.

Introduction

The idea of immersive learning environments is seductive for higher learning institutions whose co?producers of learning (students, academics and tutors) may be spread around the world. Such immersive worlds as Second Life offer the opportunity of bringing together, in one – virtual – world, people residing in different locales, achieving increased student interaction and enabling them to network internationally, at a very low cost. In immersive worlds students might also experiment and play, comforted by the anonymity afforded by the mediation of an avatar. This can enhance the social interaction of a virtual community, while avoiding the mainstreaming and inhibiting aspects of real learning communities. The project aimed to investigate the potential of immersive environments in bringing together students from different centres or cultures. It entailed the development of a pilot learning environment on Second Life and its deployment in two different learning situations. The research project was supported by a Teaching Research and Development Grant from the Academy of Marketing and the UK Higher Education Academy Subject Centre for Business Management Accountancy and Finance.

Principal objectives

The project's principal objectives were: To research and test the practical requirements of setting up immersive learning environments; To develop an immersive environment and customise it to the needs of two learning events; To investigate how students of a different culture react to learning in an immersive environment; To investigate how student avatars negotiate collaboration in an immersive learning environment. Theoretical background The project explored interaction in an immersive environment and the effect of being given freedom to experiment and play? While in reality people are at their desk, in front of a computer screen, telepresence, facilitated by both the interactivity and the vividness of the medium (Steuer, 1992), enables them to feel part of a remote environment. Websites can also convey social presence, or a feeling of warmth and sociability (Gefen and Straub, 2003). Therefore, immersive learning environments could be propitious to student involvement and student collaboration. Educators have also noted that virtual learning communities lead to greater collaboration and more even participation (Falloon, 2010; Hansen, 2008). This may happen through the sense of belonging to a virtual community (Peltier, Drago and Schibrowsky, 2003). Virtual worlds deprive their visitors of cues as to the reality behind the world represented on their screen, thus potentially confusing their sense of the real and the virtual (Bayne, 2008). However, the 'non?real' nature of immersive learning worlds may also facilitate learning in new ways. In particular, anonymity may prevent emotions such as shyness, self?consciousness or fear of embarrassment from inhibiting student participation. Learners can make mistakes safely (Tambone et al, 2009). For these reasons, in spite of the absence of important cues and the uncertainties associated with participation in a non?real environment, the co?production of knowledge may be made easier in an immersive world: students may feel freer to ask for help or provide help since their behaviour will not have consequences on their permanent identity.

Method

Two virtual seminars were organised, to which the University's executive offshore MBA students, residing in 8 different locales in Europe, the Middle East and Asia, were invited on a volunteer basis. Interested students contacted the technologist (they remained anonymous to the facilitator). They were matched to an avatar whose first name was the name of a Scottish town – so as to avoid revealing students' gender or ethnicity. Students were offered a short one?on?one initiation session to Second Life, during which they could test audio and navigation. A total of seven students participated in the study: three in the first seminar, four in the second. Issues investigated The research aimed to ascertain how students and facilitator feel about their avatar and mediating their interaction through an avatar ?? does it help or impede communication, involvement and collaboration? The facilitator was not aware of the real identity of the avatars at any point during the research. The avatars' relative genderlessness and culturelessness meant that the communication with each avatar was not affected by awareness of differences between high- and low-context cultures (Hall, 1973). A related issue was whether trust can flow through avatars in the same manner that it does between students. The virtual environment appeared to change the 'rules of engagement' between avatars, primarily as a result of the absence of body language cues, and the contextlessness and culturelessness of the avatars.

Conclusion

The presentation will explore the methodology in further depth and then report on the project's findings regarding students reactions to participating in this multicultural initiative. It will explore the opportunities offered by this manner of online collaboration as well as its distinct constraints. Future research could consider whether avatars in immersive environments are particularly suited to learning situations dealing with controversial topics. While several students stated that the anonymity of their avatar did not make a difference to what they said, social desirability may have affected their response. A follow up project is currently being organised in collaboration with Dalhousie University and the Canadian Civil Service to explore the matters further.

SYMPOSIUM

Invited SIG

Learning and Development in Early Childhood

Chairperson: Marja-Kristiina Lerkkanen, University of Jyväskylä, Finland

Organiser: Marja-Kristiina Lerkkanen, University of Jyväskylä, Finland

Miriam Leuchter, University of Munster, Germany

Discussant: Paul Leseman, Utrecht University, Netherlands

Number of previous studies has shown that the high quality home and pre-school environments in early years provide children's later learning and development. Drawing on the recent research in several countries using a range of methodologies, contributors of this symposium will present and discuss evidence for the importance of home environment, teacher support and classroom quality and child's own engagement with teachers, peers, and tasks in relation to child outcomes. This symposium seeks to address these questions through three papers on large-scale

early childhood studies conducted in England, Finland and US. The British study investigates whether high quality home environment at early years enhance children's later development and learning. The Finnish study focuses on the effect of classroom quality (i.e., emotional, instructional and organizational support) in preschool for children's motivation and academic and social skills development. Finally, the study from US explores preschool children's engagement with teachers, peers, and tasks in relation to language and literacy gains over time. The discussion will highlight the need for triadic perspective on child's learning and development in early childhood and why improving the quality of parenthood, classroom practices and teacher-child interaction in classroom should be a priority in early childhood.

The Effects of Parents and the Home Learning Environment on Children's Development and Learning

Iram Siraj-Blatchford, Institute of Education - University of London, United Kingdom; Pamela Sammons, University of Oxford, United Kingdom; Edward Melhuish, University of London, United Kingdom; Kathy Sylva, University of Oxford, United Kingdom; Brenda Taggart, University of London, United Kingdom; Aziza Mayo, University of London, United Kingdom

This paper examines quantitative (N = 3000+ children) and qualitative data for the Effective Provision of Preschool Education (EPPE) project during the first five years of this longitudinal study, supplemented with some in-depth case studies conducted five years later (N=50 cases) with some of the children and families with interesting learner trajectories. The early HLE as reported by parents in the pre-school period was found to exert a strong and significant net impact on intellectual development and a weaker positive impact on aspects of social behaviour at earlier time points, even when parental education, SES and income are controlled. Aspects of the HLE experienced by children as reported at age 3 continue to show significant positive effects on attainment and social behaviour at age 7 years plus, net of the influence of child and parental background influences such as family SES and mothers' qualification levels. For example, parents reading to their child, teaching/playing letters and numbers, visiting the library, and teaching songs and nursery rhymes continues to be related to better outcomes at age 6 and 7 years. Our quantitative and qualitative data show that boys and girls have significant differences in the early HLE they experience, with boys tending to have lower scores on HLE and less educational and self-regulation experiences at home. Such differences in parenting may account for gender differences in cognitive attainment and social behaviour. The results on HLE confirm that such experiences remain statistically significant predictors of later educational outcomes at age 7 years.

The Aims

Learning happens in social contexts and is often contingent and embedded in the child's earliest experiences. The contribution of parents and families is well recognised as a driver for children's development and learning, yet many studies focus on only the effects of pre-school and later stages of education. Other papers in this symposium look at the impact of pre-schools and teacher interactions. The Effective Provision of Pre-School Education (EPPE) project is the first major European longitudinal study of a national sample of young children's development between the ages of 3 and 7 years. We asked:1. What is the impact of pre-school on children's intellectual and social/behavioural development?2. Are some pre-schools more effective in promoting children's development?3. What are the characteristics of an effective pre-school setting?4. What is the impact of the home on children's development?5. Do the effects of home and pre-school continue through Key Stage 1 (age 7 years)?This paper will only focus on aim 4, the contribution of the early home learning environment (HLE).The qualitative case studies gave us information to the question of why parents choose to provide their children with a strong or weak early HLE. This makes the study unique in answering some of the what, how and why HLEs contribute or not to children's learning and whether the impact is lasting.

Methods

The impact of the early home learning environment at age 3+ on children's development to age 7Interviews were conducted with 3000+ parents when their child entered the study at 3+ (with follow-up questionnaires when the children were in school). These were used to collect detailed information about childcare histories, characteristics of children, their families and home education environments. In addition we collected teacher and psychometric child assessments and pre-school and school information. This wealth of information has enabled the research study to investigate some of the influences affecting young children that have a significant relationship with their later intellectual and social/behavioural development. These factors clustered around demographic influences, the home learning environment and patterns of childcare before entering the study. EPPE uses statistical techniques (multilevel modelling) to measure the influence of different background factors on young children's attainments at the start, middle and end of primary school. Qualitative interviews were conducted with 50 carefully sampled children and their parents when children were in secondary school to get behind some of the reasons why parents offered strong or

weak early and later HLEs and how these experiences persisted and influenced later learning. These qualitative data were analysed using NVivo software.

Findings

The EPPE research points to the importance of a young child's HLE. Although other family factors such as mother's qualification level and family SES are also highly significant, the 'Home Learning Environment' exerts a significant and independent influence on attainment at both age 3 years plus and later at the start of primary school (rising 5 and 7 years) and progress during this pre-school period. Aspects of self-reported parental involvement in activities (such as reading to their child, teaching songs and nursery rhymes, playing with letters and numbers, visiting the library, painting and drawing, etc.) remain significant positive influences which account for differences in attainment and also influence young children's cognitive progress over the pre-school and early primary period. The study also shows that the HLE index we created (measuring the extent of different activities involving the child at home) is only moderately correlated ($r = 0.3$) with family SES or mother's qualification levels. EPPE demonstrated a strong relationship between children's outcomes and parental factors but this was somewhat weaker for their social/behavioural development than for cognitive. Research has consistently indicated that there are strong associations between certain factors related to disadvantage (such as low socio-economic status or SES, low income, mother's educational levels etc.) and children's poor intellectual attainment at school. However, few large-scale research studies have been able to explore the very wide range of background factors considered in the EPPE study, especially daily activities in the home. The qualitative follow-up case studies showed that for children from low SES families who academically succeeded against the odds, these early HLE experiences were often strong, particularly for boys. Even in those cases where frequency was low due to parent's need to work long hours outside the home, need to care for relatives and limited financial resources, we found that the quality of interactions was still high, i.e. providing children with informal learning experiences that prepare them for classroom interactions and academic learning. Parents and children felt strongly that these early HLE experiences had helped them bond and had provided children with a sense of awareness of the value for school and learning at a young age. Our quantitative and qualitative data show that boys and girls have significant differences in the early HLE they experience, with boys tending to have lower scores on HLE and less educational and self-regulation experiences at home. Such differences in parenting may account for gender differences in cognitive attainment and social behaviour.

Theoretical and educational significance

What parents and carers do makes a real difference to young children's development. The EPPE project developed an index to measure the quality of the home learning environment (HLE). There are a range of activities that parents undertake (outlined above) with pre-school children that are related to a positive effect on their development. These activities could also be viewed as 'protective' factors in reducing the incidence of SEN because children whose parents engaged regularly in home learning activities were less likely to be at risk for special educational needs. Poor families/parents with few qualifications can improve their children's progress and give them a better start at school by engaging in activities at home that engage and stretch the child's mind. This has important implications for programmes in England and beyond for such programmes as Local Sure Start and Children's Centres that target areas of high social disadvantage.

The Effects of Classroom Quality on the Development of Motivation and Pre-Skills in Preschool

Anna-Maija Poikkeus, University of Jyväskylä, Finland; Marja-Kristiina Lerkkanen, University of Jyväskylä, Finland; Helena Rasku-Puttonen, University of Jyväskylä, Finland; Eija Pakarinen, University of Jyväskylä, Finland; Martti Siekkinen, University of Eastern Finland, Finland

This paper reports findings from a large scale longitudinal follow-up conducted in Finland. Preschool year data on motivation, mathematics, pre-reading, and social skills were available for approximately 1300 6-year-old children. Observation data were collected from 49 preschool classrooms using the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008). In the present analyses we report on the predictive relationships between indicators of classroom quality (i.e., emotional, instructional and organizational support) as assessed by the CLASS, and children's early motivation and skill development. The results of the multilevel modeling at the classroom level showed, first, that the higher the level of instructional support observed in a particular classroom, the less children were rated as showing task-avoidant behavior, and the lesser the level of children's task-avoidant behavior in a particular classroom, the higher were their math skills. Second, the higher the level of classroom organizational support observed in a particular classroom, the higher the children's learning motivation shared among the class members, and, further, the higher the level of learning motivation in a particular classroom, the higher were children's pre-reading skills. Finally, the higher the level of instructional support observed in the classroom, the more empathy and less disruptiveness the children displayed in that particular classroom. These predictive links suggest that

children's learning motivation is sensitive to classroom quality, and motivational factors may have a mediating role between classroom practices and skill development.

The Aims

Three domains of classroom quality, i.e., emotional support, classroom organization, and instructional support (Pianta, La Paro, & Hamre, 2008) have been differentiated as having documented links with children's developmental outcomes in early year education. High instructional quality, for instance, has been found to be associated with the children's classroom engagement (Downer, Rimm-Kaufman & Pianta, 2007), academic outcomes (Hamre & Pianta, 2005; Mashburn et al., 2008), as well as more positive interactions with teachers and peers (NICHD, 2002). Although motivational factors are known to form cumulative cycles with academic skills and school performance the effects of classroom quality have thus far rarely been examined with respect to children's motivation. Task-focused versus task-avoidant behavior and children's interest in subjects, tasks and activities are among the motivational constructs that have an important role in children's academic achievement and performance. Task motivation has been found to predict the development of math and reading skills among children (e.g. Aunola, Nurmi, Lerkkanen, & Rasku-Puttonen, 2003). The three substudies reported in the present paper aimed to add to the understanding of the effects of classroom quality as assessed by the CLASS (Pianta et al., 2008) on the preschool-age children's motivation (task-avoidance, and preschool learning motivation) and skill development (mathematics, pre-reading, and social skills). Research questions were: Study 1: To what extent do observed preschool classroom quality dimensions predict children's task-avoidant behavior and math skills in preschool? Study 2: To what extent do observed preschool classroom quality dimensions predict children's learning motivation and pre-reading skills in preschool? Study 3: To what extent do observed preschool classroom quality dimensions predict classroom differences in children's social competence?

Methods

Participants.

The children represent a whole age-cohort from three municipalities, two of them located in Central Finland and one in Eastern Finland. Children's data was available for 1,268 (613 girls, 655 boys) preschoolers ($M = 73.58$ months old, $SD = 3.40$ months). Of the altogether 137 preschool teachers, a subsample of 49 preschool teachers participated in the classroom observations.

Children's motivation.

The measure of task-avoidant behavior was based on teacher ratings (5 items rated on a 5-point scale) of the behavior of each child in their class using the Behavior Strategy Rating Scale. The measure of children's preschool learning motivation was based on the Content Interest Rating Scale for Children (7 items rated on a 5-point scale) which was individually presented to the children.

Children's skills.

Children's math skills in the preschool Fall were assessed by using a Number Sequences test, and in the preschool Spring by using a Number Concept test and an Arithmetic test. Children's pre-skills in reading were assessed in the preschool Fall by using two subtests, Initial Phoneme Identification and Letter Knowledge. Phonological awareness in the preschool Spring was assessed using the same Initial Phoneme Identification test. The teachers rated each child's social competence using the Multisource Assessment of Social Competence Scale which consists of 15 items assessed on a 4-point rating scale and provides the following four sub-scale scores: Cooperation, Empathy, Impulsivity, and Disruptiveness.

Classroom observations.

The classrooms were observed using the Classroom Assessment Scoring System (Pianta et al., 2008). The CLASS consists of ten dimensions measuring three components of classroom quality: Emotional Support (4 dimensions), Classroom Organization (3 dimensions), and Instructional Support (3 dimensions). Each dimension was rated on a 7-point scale: low (1, 2), moderate (3-5), and high (6, 7) quality. Observation was carried out in 30-minute cycles in two separate days in each classroom (total number of the cycles was 10-12 per classroom).

Analysis.

Multilevel modeling was used which enables the variance in the observed variables to be divided into variation due to differences between different classrooms (between class variation) and variation due to individual differences after taking into account class membership (within- class variation). Since the missing data proved to be missing-at-random, statistical analyses were carried out using the full-information maximum likelihood estimation (FIML), which allows all the information available to be used without imputing data. In all studies, intraclass correlation coefficients were first calculated to determine the between-classroom variation in the skill and motivation measures. After that separate

multilevel models were run for the three CLASS domains to determine whether the observed classroom quality indicators would predict classroom differences in children's motivation and skills, after controlling for factors such as maternal education, child's gender, child's age, and pre-skills.

Findings

Study 1: Instructional support in the classroom was found to be associated with children's task-avoidant behavior: the more instructional support the teacher provided in a classroom, the less task-avoidant behavior children were showing. Furthermore, the lesser the level of children's task-avoidant behavior in a particular classroom, the higher were their math skills, even after controlling for entry level math skills. Emotional support and classroom organization correlated also negatively with teacher-rated task-avoidance, but the modeling failed to find statistically significant associations. Study 2: The results of multilevel modeling showed that high classroom organization predicted high learning motivation in children, and that children's learning motivation contributed to their level of phonological awareness in preschool. Study 3: High quality of instructional support was found to predict high levels of empathy and low levels of disruptiveness among children.

Theoretical and educational significance

The results of the present study add to the previous research by showing that children's achievement-related behaviours are sensitive to the quality of teacher-child interactions in the preschool classrooms. Support for the development of children's motivation and learning strategies clearly deserves more attention already in preschool. In our recent analyses we have used a microanalysis on a subset of videorecorded classroom learning sessions selected based on CLASS ratings of high instructional support. These analyses have identified patterns of teacher-student interaction with dialogical exchanges, and provided understanding of the means through which the preschool teachers foster educational dialogue (e.g., encourage children's participation and diverse contributions, and allow space for child-initiated sharing of ideas).

Language and Literacy Development in Preschool: Children's Engagement with Teachers, Peers, & Tasks

Jason Downer, University of Virginia, United States; Virginia Vitiello, University of Virginia, United States; Amanda Williford, University of Virginia, United States; Natalie Bohlmann, University of Virginia, United States

This study examined preschool children's positive and negative engagement with teachers, peers, and tasks in relation to language and literacy gains over time. During the fall, 381 diverse preschoolers (3 - 5 years old) were observed and rated on their classroom-based positive and negative engagement with teachers, peers, and tasks. Assessments of receptive vocabulary and expressive vocabulary, as well as teacher ratings of language and literacy and classroom communication were collected in the fall, spring, and fall of the following year (preschool or kindergarten). Positive engagement with teachers and tasks were associated with higher initial receptive vocabulary, language and literacy, and classroom communication, while negative engagement with teachers and peers was associated with lower initial classroom communication. Positive engagement with peers was associated with greater gains in teacher-rated language and literacy across the study period. Implications for fostering language and literacy through classroom engagement will be discussed.

The Aims

Studies have shown that supportive classroom-based interactions are important for fostering children's school readiness outcomes, including early language and literacy (Burchinal et al., 2008; Connor, Son, Hindman, & Morrison, 2005). However, research on classroom processes has focused primarily on understanding how teachers promote positive engagement in classrooms, de-emphasizing the role that children have in creating their own learning environments. According to ecological systems theory, children are active in shaping their own experiences; children's unique approaches to engaging with other people and with learning materials contribute significantly to their classroom experiences and to the acquisition of skills across both academic and social-emotional domains (Bronfenbrenner, 1979; Ladd, Birch, & Buhs, 1999). Thus, examining how individual children engage with classroom experiences is important to understanding how preschool contributes to early learning. The current study examined how individual children's classroom engagement in four domains (positive engagement with teachers, peers, and tasks, as well as negative classroom engagement) was related to the development of early language and literacy skills in an economically and linguistically diverse sample of preschoolers. Specifically, this study considered whether positive and negative engagement observed in the fall could forecast the development of language and literacy skills into the following school year.

Methods

Participants. Participants were 381 children enrolled in 103 preschool classrooms within a large urban area in the southwestern US. Children were largely Hispanic (66%), with the second largest group being white (14%). Fifty percent of the children were girls. Children's ages at the start of the study ranged from 25 - 61 months, with an average of 46.8 months ($SD = 6.7$). The average income-to-needs ratio, calculated by dividing each household income by the federal poverty level for households of the same size, was 1.7 ($SD = 1.5$); 48% of households had ratios lower than one, indicating that they lived below the poverty line. English was spoken in the majority of homes (61%), but Spanish was also a common home language (65%).

Measures and Procedure.

Children were observed in the fall of preschool using the Individualized Classroom Assessment Scoring System (inCLASS; Downer et al., 2010), an observational measure that yields scores of children's positive engagement with teachers, positive engagement with peers, positive engagement with tasks, and negative classroom engagement (including conflict with teachers and peers as well as difficulty matching classroom expectations in terms of activity level and noise). Each child was observed for an average of four, 10-minute cycles across a morning. Scoring was completed after each observation cycle, and summary scores were created by averaging across the observation cycles. Inter-rater reliability data were collected in 22% of classrooms and yielded an average intra-class correlation of .85. Children were administered two direct assessments of language: The Picture Vocabulary subtest of the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001) for expressive language, and the Peabody Picture Vocabulary Test (Dunn et al., 1997) for receptive vocabulary. Teachers rated children's language and literacy skills using the Academic Rating Scale (NCES, 2000); and their classroom communication skills using the California Preschool Social Competency Scales (CPSCS; Levine, Elzey, & Lewis, 1970), which assesses children's ability to follow instructions and communicate verbally. Children's language and literacy were assessed in the fall and spring of a single year of preschool as well in the fall of the following year, which was the start of kindergarten for 66% of the children and the second year of preschool for the remainder. Findings Growth models were used to determine whether aspects of children's classroom engagement were related to initial levels and growth in the language and literacy outcomes. Results indicated that positive engagement with teachers was positively associated with initial levels of teacher-rated language and literacy ($b = .21$, $SE = .09$, $p = .04$, $SE = .02$, $p = 3.02$, $SE = 1.44$, $p = .11$, $SE = .05$, $p = -.18$, $SE = .08$, p

Theoretical and educational significance

The study provided preliminary evidence that child-level learning processes are associated with language and literacy development among diverse preschool children. Children who were observed to engage more positively with teachers and tasks, as well as those who refrained from engaging negatively with teachers and peers, had higher initial levels of receptive vocabulary, language and literacy ratings, and classroom communication ratings, and maintained their advantage across the study period. Additionally, children who engaged more positively with peers made greater gains in language and literacy ratings across the study period. These results underscore how important it is for teachers, and for individuals who support teachers' work (e.g., mental health consultants, program directors), to recognize that providing opportunities for children to engage in a variety of high quality interactions daily can contribute to the development of children's school readiness. Carefully observing how a child interacts with other children, adults, and learning opportunities in the preschool classroom can potentially help teachers determine how to best support an individual child's development within the early education classroom environment. Future research is needed that further examines the variability of children's engagement in preschool and how this variability is related to children's learning.

SYMPOSIUM

Educational Effectiveness

Networks and education in resource-scarce schools

Chairperson: Susan Jones, Exeter University, United Kingdom

Organiser: Debra Myhill, Exeter University, United Kingdom

Discussant: Judy M. Parr, University of Auckland, Faculty of Education, New Zealand

The aim of this symposium is to illustrate how teachers establish, access and maintain social networks as ways of addressing adversity in resource-scarce school-environments to buoy resilience. Social capital is used as overarching theoretical lens. Whereas the first two presentations share knowledge co-constructed during intervention-based research with teachers in school-settings, the last paper presents an overview of existing knowledge on teachers' own resilience as outcome of supportive networks. Insights contribute to scholarship related to education in developing

contexts, and the way networks can serve as resources to mediate adversity and scaffold education-related resilience in resource-scarce settings.

A web of resilience: teachers promoting resilience in schools

Liesel Ebersohn, Unit for Education Research in AIDS, South Africa

Schools can serve as access points for the delivery of care and support to vulnerable members of communities. I explain how teachers in schools function as resources to buoy resilience in the face of cumulative adversities by drawing on participatory reflection and action data from a longitudinal study with teachers (n=57, 5 male, 52 female) from six schools in three South African provinces. The study tracks teachers' psychosocial support following their participation in STAR (Supportive Teachers, Assets and Resilience).

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From baseline data in a longitudinal study intervention (STAR, Supportive Teachers, Assets and Resilience) it was apparent that teachers had not identified and used community resources prior to STAR. Teachers expressed concern about levels of poverty, illness, absenteeism and fear related to HIV&AIDS in the respective school-communities. Even more apparent however was a sense of teachers being overwhelmed by the magnitude of needs. I provide evidence of how teachers accessed social capital to mediate the effects of adversity and promote resilience in schools. The guiding question is: How do teachers in cumulative risk school-settings promote resilience by implementing what they have learned from a strength-based intervention?

I report on the initial four schools (40 teacher participants) involved in the development/pilot phase (2003-2006), as well as the first two schools (17 teacher participants) involved in determining the fidelity of STAR (2007-2009) - totalling six schools (57 teacher participants).

Data collection and analysis was participatory and iterative with data sources for this paper limited to verbatim transcriptions (focus groups, interviews). We combined focus groups and individual interviews with PRA-interactive activities. Research activities focused on: (1) obtaining baseline data in each school (observation and focus group on first site visit), (2) implementing STAR, (3) data collection to explore the promotion of resilience, (4) member checking of data analysis, and (5) monitoring and evaluation. Focus groups, interviews and observations were guided by the following questions: (1) Which risks can be identified in the school/community?; (2) Which resources can be identified in the school/community?; (3) How do teachers mediate risks by relying on identified resources?; and (4) How and by whom is teacher-initiated school-based support used?

Teachers opted to establish mechanisms and processes that function to modify the effect of a cumulative risk. Protective processes teachers instituted to ameliorate adversity, on the one hand, assessed risk that increased children's response to adversities (rendering them more vulnerable), and on the other hand assessed available resources (structures to mediate). Teachers' modus operandi post-intervention was to (1) identify available assets and relevant risks; (2) initiate partnerships with people related to these assets in order to provide psychosocial support; (3) establish school-based community systems to identify vulnerability; (4) refer children and families for support to pertinent partners in the community systems, and (5) maintain and monitor partnerships.

Neighbourhoods have been identified as influential environmental resource, and the current study supports the role teachers can play in identifying, mobilising and linking resources to promote resilience through networks.

Characteristic of ecological perspectives on resilience the networks were systemically integrated, collaborative and referred vulnerable individuals to either community systems or on-site networks at schools.

Teachers expanded the framework of resilience using partnerships to link individual-level resources (e.g. teacher compassion and commitment), social-level resources (e.g. parents' willingness to cultivate gardens) and societal-level resources (e.g. school leadership, small businessmen, clinics and social workers). This finding corresponds with other development studies signifying networks, collaboration and partnerships as central to strength-based interventions. Significantly networks 'liberated' teachers to function in their primary roles as facilitators of teaching and learning, with teachers continuing to support resilience in collaboration with partners, via networks.

Relationships were central in teacher support. Teachers used relationships to: access and mobilise identified resources for addressing identified needs, and to establish and maintain networks. I contend that relationships are resilience-promoting resources that teachers use when promoting resilience. This finding echoes that of other studies indicating relationships as essential for strength-based capacity development. Partnerships, networks and relationships signal social capital.

Teachers and schools can mediate risk in resource-stretched environments. Amongst other factors (including teacher disposition, available resources), teachers' provision of psychosocial support is one catalyst for schools to potentially function as resilience-promoting resources. Significantly children, youth and families made use of tendered support demonstrating reciprocity and the value of protective resources. This finding support studies showing that available resources can be mobilised and accessed to promote resilience.

Like others I found that school-community collaboration significantly promotes resilience. Teachers used schools (as a social environment-resource) to direct the establishment of supportive communities, through partnerships. In cumulative risk school-contexts, teachers used partnerships to establish school-linked services and situate social and health services for children and their families in school-sites. In this way teachers and school-level resources were expanded as resilience experiences to thrive beyond supportive peers, positive teacher influences and success experiences as previously found. Teachers promote resilience by making the most of social capital to identify and harness community resources, thereby buoying vulnerable children. These relationship-driven support networks mediate the effects of cumulative risk. Relationships constitute the core of such systemic networks. School-based networks by teachers in partnership with others enable schools to function as resilience-promoting resources. A strength-based approach can enable teachers to establish and sustain networks across systems.

Portraits of care and hope: How teachers perform support in vulnerable school communities.

Estelle Swart, Stellenbosch University, South Africa

The time-honoured conventions of schools and classrooms are becoming obsolete as the political, economic, social and educational needs of society rapidly change. These changes challenge teachers and schools to not only alter their instructional methods but to also respond effectively to the diverse learning and social needs of the whole child. The international movement of inclusive education promotes the idea that school communities grounded in democratic principles and the values of equity and social justice serve as a vehicle to address these challenges. The foundations of such communities are caring, diversity and community and the assumption is that the school is responsible for the support needs of all its members.

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We contend that teachers are often the only sources of support in a community and play an important role in promoting pupils' well-being and development. Within the context of the contextual challenges of global and local change, and the adversities that children and families face in vulnerable contexts, this responsibility does not only refer to intellectual well-being and the teaching of basic academic skills. It also includes psychological, emotional and social well-being. The literature is clear that this will take a combined effort of not only teachers but also of pupils, families, educational professionals and communities which in itself is a new way of thinking and doing for teachers.

Teachers' roles therefore become increasingly demanding, complex and multifaceted. In addition, as a result of the demands of accountability measures and negative perceptions of teachers' work, they often experience feelings of hopelessness, decreased job satisfaction, demotivation and lack of confidence in their own knowledge and skills. The supporter therefore also needs support.

The concern of this paper is that education policies assume schools' and teachers' responsibility to create inclusive, caring communities that support all its members. This particular role represents the pastoral, citizenship and community work of teachers. In the adverse circumstances where our participants teach, they must be able to respond to socioeconomic and educational problems related to amongst others poverty, abuse, violence, illiteracy, unemployment and consequences of illnesses like HIV/AIDS. Teachers are consequently expected to counsel children with social and emotional problems, demonstrate caring and develop them as whole persons. However, this can only be done effectively if they work in partnership with the communities, families and professional services and redefine their roles as teachers.

This paper presents the findings of an ethnographic study that aimed to understand teachers' psycho-social support practices in the context of educational change and socio-economic challenges in two schools in the Western Cape province of South Africa. Our unit of analysis was therefore teachers' organic support and care practices and how they transcend their traditional roles to deal with the vulnerabilities that impact children's learning. As part of an intervention-based design, we move away from problem-saturated stories to a focus on what teachers already do and have to develop networks of support and care. Although we identified teachers who 'perform' support to fulfil the performance criteria, this presentation focuses on those teachers with a caring identity that practice support with care and hope to share counter-narratives and strengthen protective factors in these contexts.

The feminist perspective of 'ethic of care' framed our understanding which places the role of relationships at the heart of support and caring practice (See the work of both Noddings and Gilligan). This perspective highlights caring and support as a moral purpose and commitment to enter into caring-for relationships with others. From a health promotive perspective there is conclusive evidence that children can develop resilience within schools with a strong ethos of care and concern, showing protective factors of caring relationships, high expectations and opportunities to participate. This brings hope for those who have been marginalised before. Accordingly we believe that hopefulness is the glue that holds a caring relationship together.

The main question of the broader study was: What are teachers' prevailing practices of support in vulnerable school communities? The design type of the inquiry was ethnography. In participation with the teachers we designed ethnographic casebooks of support and care practices in the schools and communities in two different schools. The volunteer teachers worked in vulnerable school communities in the Western Cape Province in South Africa. Together we generated data over a period of two years through observation and composed field texts, different types of interviews (semi-structured, informal conversations, narrative), school artefacts and visual data. The data were transformed by various methods, including content analysis in constructivist grounded theory mode and narrative analysis. Bronfenbrenner's bio-ecological theory (2005) informed our scope of analysis. We limited our data generation and analysis to the immediate systems in which the individual's interpersonal relationships occur namely the microsystems and the mesosystems. Microsystems include basic relationships between individuals and parents, teachers, peers or siblings. Mesosystems refer to an individual's accumulated microsystems. The strengthening of what Bronfenbrenner calls proximal processes can bolster the protective influences.

Based on the themes we constructed two portraits to illustrate teachers' support practices. The portraits focus on the distinct characteristics of the participating teachers, whom they support and collaborate with, how they support and the conditions that sustain support. We therefore bring into focus how teachers work intuitively and use their practical wisdom to support not only the children, but also the parents, one another and members of the community. They develop networks and use resources in the school and community to provide the support. The nature of their support practices and networks is characterised by caring relationships and hope. Their support practices focused on the whole person including emotional, social, learning, physical and spiritual support. In this paper we maintain that individual teachers cannot support effectively unless they have a moral purpose to care, develop and nurture caring relationships, access and use relevant resources and practice within a supportive school culture that acknowledge and value their efforts. In conclusion we maintain that teachers, who share a common concern for humanity and also get the support they sometimes require, can learn together how to be a functioning community of concern and care.

Teacher career resilience and supportive networks - what do we know?

Sonja Coetzee, University of Pretoria, South Africa

The aim of this paper is to explore existing knowledge about career resilience as it relates to teachers. A time-line of theoretical development on career resilience and teacher career resilience will be presented signifying the advances made in career resilience literature. Age-old questions plague the minds of many careerists: Are you happy with your career choice? If you do not like what you do, why not change? Do you enjoy your job? Are you career-happy? Questions like these may consume some careerists more than others but certainly at least once or twice in a career life.

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The changing world of work requires modern day workers to adapt more frequently to working conditions (Coetzee, 2005). Portfolio careerists are qualified, skills orientated individuals who are contracted in different organizations and who are not part of the core long term employee-team (Templer and Cawsey, 1999:70). It can be argued that these individuals are career resilient since they do not depend on others, they take risks by not having a stable long term defined income and they strive to be autonomous in their career path. The question that arises is: what about the "other" group of workers that stays in a particular career, who still works efficiently without relying too much on others and who, despite job uncertainty and less than optimal working conditions take the risk of staying and coping? This group of workers somehow stay motivated enough to continue on their chosen career path. It can be argued that they exhibit a high level of what London (1983) called career motivation.

London (1983) based his theory of career motivation on the results of assessments of personality and individuals done by several researchers viz Bray (1982), Bray, Campbell and Grant (1974) and Murray (1938). The participants of the studies mainly consisted of managerial level workers or workers with the perceived potential to reach managerial levels. London (1983:621) deduced that career motivation consists of three domains: career identity (what career direction are you following?); career insight (how realistic or unrealistic are your perceptions of yourself or the organization?) and career resilience (can you function during career disruptions or despite unfavourable work contexts?). He (London, 1983:621) further explains career resilience as the ability to cope or function effectively even though working conditions are negative (career uncertainty; poor interpersonal relationships; discrimination or favouritism etc.). Furthermore, career resilience consists of three sub-domains: self-efficacy, risk-taking and dependency (London, 1983:621). A person with a high career resilience profile is more self-reliant and risk taking than a person with a lower career resilience that is more dependent on others and avoids taking risks (London, 1983:621). So, career resilience can be conceptualised in different ways: you can think of career resilience in terms of the portfolio careerist that adapt quickly to new and challenging career environments or the long-term careerist that adapt despite an unfavourable career environment. In returning to the question of career happiness, perhaps to understand career resilience one should investigate career satisfaction since both conceptualisations or career resilience mentioned above could include a level of satisfaction.

Job satisfaction and dissatisfaction depends on various factors. More than 30 years ago researchers already established that factors such as career values and rewards influence employees' feelings of job satisfaction (Kalleberg, 1977:124). Bretz and Judge (1994) concluded that a good fit between person and organization leads to a high level of job satisfaction. Job dissatisfaction, however, can be caused by how environmental stressors such as working conditions and organizational policies or practices are appraised by the individual (Greenhaus, Callanan and Godshalk, 2000) or certain personality traits such as a high degree of neuroticism (Judge, Heller and Mount, 2002). Greenhaus, Callanan and Godshalk (2000:265) also note that "economic dependency can breed attachment to a job that one otherwise despises." Thus, job satisfaction has a role to play in people deciding to stay in or leave a particular career and it can be argued that there is a link between job satisfaction and career resilience.

Teaching may be one of the more controversial careers when one considers satisfaction and resilience. Some declare teaching as the most rewarding job in the world whilst others will tell you that it is the last thing on earth they would do. Day, Stobart, Sammons, Kington, Gu, Smees and Mujtaba (2006:50) conceptualise resilience in teachers as the teacher's degree of commitment to the teaching profession. Johnson, Down, Le Cornu, Peters, Sullivan, Pearce, & Hunter (2010) asserts that relationships, school culture, teacher identity, teachers' work, and policy and practices are conditions for supporting early career teacher resilience. Johnson et al (2010) maintains amongst others that social and professional networks, professional learning communities, economic and political understanding of unpredictable

nature of teachers' work, social justice and community engagement are conditions that support early career teacher resilience. These conditions are closely related to some of the advantages and key characteristics of the asset-based approach which are shared responsibility, mutual support and caring environment, creating networks and building relationships, collaboration, dynamic partnerships and participation (Ebersöhn and Eloff, 2006). There is a link between resilience and the asset-based approach in that resilience follows the "glass-half full" approach whereby strengths and assets of an individual are emphasized and mobilized amidst a process of struggle or change (Ebersöhn and Eloff, 2006; Henderson and Milstein, 2003:3). In the face of change or disparity one may draw from your social networks albeit professional or personal to cope. As such it is evident that supportive networks are pivotal in facilitating resilience in teachers.

SYMPOSIUM

Initial Teacher Education (Pre service)

Effectiveness of Primary and Lower Secondary Teacher Education in 16 countries

Chairperson: Sigrid Blomeke, Humboldt University of Berlin, Germany

Organiser: Sigrid Blomeke, Humboldt University of Berlin, Germany

Fritz Oser, Universität Freiburg, Switzerland

Discussant: Eckhard Klieme, Deutsches Institut für Intern. Pädagogische Forschung, Germany

With the publication of many international comparative studies on student achievement, the competencies of their teachers and the education of these teachers have become areas of considerable interest. This interest is reflected by IEA's "Teacher Education and Development Study in Mathematics (TEDS-M)" carried out in 16 countries with representative samples of primary and lower secondary teachers in their final year of teacher preparation. Based on data from this study, the relationship between future teachers' background, their opportunities to learn in teacher education, and outcomes of teacher education in terms of knowledge and beliefs will be examined in this symposium using advanced multi-level modeling. With reference to the conference theme, there will be a special focus on similarities and disparities in the results across countries.

From a research point of view as well as from a policy point of view, it is of high relevance to learn how teacher education contributes to teacher competencies. TEDS-M offers a unique chance to do so because data was gathered about teacher education policies, programs and practices on the national level; about curricula and practices of teacher education on the institutional level; and about mathematics teachers' knowledge, skills and dispositions at the end of teacher education on the individual level. From Europe, Germany, Norway, Poland, Russia, Spain, and Switzerland participated in TEDS-M. The study was the first comparative large-scale assessment of higher education with standardized testing of outcomes.

What matters for outcomes of teacher education: background, selection or opportunities to learn?

Sigrid Blomeke, Humboldt University of Berlin, Germany; Gabriele Kaiser, University of Hamburg, Germany; Rainer Lehmann, Humboldt University of Berlin, Germany; Martina Dohrmann, University of Vechta, Germany; Anja Felbrich, Humboldt University Berlin, Germany; Johannes König, University of Cologne, Germany; Christiane Schmotz, Humboldt University of Berlin, Germany

First findings of TEDS-M had revealed significant differences in future teachers' background, their opportunities to learn (OTL) in teacher education, and outcomes at the end of their training between countries. It had to remain an open question to what extent future teachers' background had influenced the acquisition of mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) in relationship to OTL factors.

In this paper, we examine the hypothesis that – besides OTL – background characteristics known as powerful predictors on the school level are significant predictors of outcomes at the end of lower-secondary mathematics teacher education as well. In addition, we examine the hypothesis that effects of teacher education programs are mediated by differential amounts of OTL and differential teacher intake. The hypotheses are examined by applying three-level models.

The data mainly support our hypotheses. However, the background effects are generally larger with respect to MCK compared to MPCK. We interpret this result as a consequence of a long history of differential school success. Background effects vary substantially across countries. Such cultural differences may show ways for other countries how to improve their equity efforts in education. The effects of differential teacher background point to a selection

bias – either formally implemented by the teacher education institutions or caused by self-selectivity of future teachers.

Confusing relationships: teacher beliefs about training quality and their professional knowledge

Fritz Oser, Universität Freiburg, Switzerland; Horst Biedermann, University of Fribourg, Liechtenstein; Sibylle Steinmann, PHZ Luzern, Switzerland; Margit Kopp, University of Teacher Education in Lucerne, Switzerland; Christian Bruehwiler, University of Teacher Education St. Gallen, Switzerland; Samuel Krattenmacher, University of Teacher Education in St. Gallen, Switzerland

Despite enormous research efforts we still do not know how teachers' beliefs and knowledge are correlated, mainly because most studies only include beliefs or knowledge measures. The rich TEDS-M data sets provides for the first time the opportunity to examine the relationship of mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK), on the one hand, and beliefs about program quality, program coherence and personal preparedness for teaching, on the other. About 14,000 future teachers for primary and 8,000 future teachers for lower secondary schools from 16 countries were surveyed in their last year of teacher education. On the country level, we found a couple of surprising results. E.g. for lower secondary teachers the manifest correlation between their beliefs about "preparedness for teaching" and their PCK was strongly negative ($r = -.59$; p

A rich research tradition addresses the question of how teachers' beliefs relate to their mathematics content knowledge (MCK) and their mathematics pedagogical content knowledge (MPCK). Despite these research efforts we still do not know how beliefs and knowledge are correlated, e.g. regarding MCK and PMCK, on the one hand, and beliefs about program success, program coherence and personal preparedness for teaching, on the other. The justification to examine this research question stems from three perspectives: (a) primarily from the curriculum of teacher training. Decision makers often assume that those studying to become teachers already possess enough knowledge about the subject matter they will be teaching in the future. (b) A second justification comes from the design of the IEA study TEDS-M. In addition to MCK and PMCK, the two main elements of the study were beliefs and opportunities to learn (OTL). Thus, when viewed from the perspective of the study design, it is reasonable to examine the relationship between MCK, MPCK and beliefs. (c) A final justification stems from the general state of research of the relationship between teacher knowledge and beliefs. The relationship of teacher beliefs to their knowledge is still unclear.

Method

Data basis and random sample

The data basis for the analyses is the IEA-Study TEDS-M. In the last year of their teacher education program, 13,479 students for primary and 7,829 students for lower secondary school from 15 countries each participated in the study.

Measures

The TEDS-M research team used the Rasch model (Rasch, 1960) to derive the scales presented in this paper. To facilitate interpretation all beliefs were scaled across primary and secondary future teachers.

The scale "Beliefs about preparedness for teaching" is based on 13 items scored on a 4-point Likert rating scale ("not at all" to "a major extent"). The students had to evaluate the extent to which they think their teacher education program has prepared them to do their job well. The beliefs about preparedness for teaching indicate a mean of 11.69 ($SD = 1.20$) for future primary school teachers and a mean of 11.80 ($SD = 1.79$) for future lower secondary school teachers.

To rate the "Beliefs about program quality" students had to score 6 items on a 6-point Likert rating scale ("strongly disagree" to "strongly agree"). For primary, this scale has a mean of 12.58 ($SD = 2.54$) and for lower secondary 12.49 ($SD = 2.43$).

Two individual scales were modelled to measure mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK). Each scale has a mean of 500 points and a standard deviation of 100.

Data analysis

To show how the correlations look like between different beliefs about the teacher training program and knowledge we estimated as a first step Person's r on the country level. For the presentation, we also will check the results with multi-level analysis. Since for primary and secondary we have only 15 countries, it should be mentioned that the results need to be handled carefully. However, despite the relatively low number of countries available, surprisingly

high correlations were observed. This opens the door to some interesting interpretations both on the primary and the lower secondary levels.

First results

With respect to the scale "preparedness for teaching mathematics", all countries have scores above the value 10; thus, on average the teachers in all countries expressed agreement with the belief that they are well prepared. The United States (in addition to the Philippines, Botswana, Malaysia and Chile) rank very high on this survey. The students in these countries feel especially well-prepared to teach mathematics. The bottom third of the ranking is represented by Switzerland accompanied by Chinese Taipei, Poland, Norway and Germany.

Interesting are also the correlations between the beliefs "preparedness for teaching mathematics" and "quality of the program". Here we see that countries with a high estimation of their teachers' preparedness also highly agree with the quality of the program ($n=15$ countries; $r=.79$). The Philippines, Chinese Taipei, USA, Malaysia, Russia and Singapore rate the program quality especially highly whereas Norway, Germany, Spain and Switzerland are more critical.

With regard to correlations of beliefs with knowledge, we found a couple of very surprising results on the country level. E.g. for the lower secondary teachers the manifest correlation between "preparedness for teaching" and MPCK is strongly negative ($r= -.59$; p

Discussion

When discussing and interpreting these results, attention should be paid to the fact that we analyzed correlations at a country-specific level, not at an individual or at a school level. We hypothesize that our results reflect more or less a cultural effect. If a person intends to assess his/her own education, he/she orients him or herself by the context he/she knows best. Thus, one possible answer to the surprising result is that future teachers may be satisfied with their education in relationship to other well-known aspects within their learning environment, e.g. curriculum expectations. So, we see that students from Chile feel quite well-prepared even if they have low scores on MCK and MPCK. In contrast, Swiss teachers are the most sceptical.

However, even if this is a plausible explanation, in a next step we will analyze the data in a multilevel model. It seems that we have to look at the variance explained on each level. Maybe the correlation then becomes a different meaning.

Public or private – Does it make a difference in teacher education effectiveness?

William Schmidt, Michigan State University, United States

Over 1,300 institutions of higher education in the U.S. have approved teacher preparation programs. Roughly one-third of these are publically funded and administered with the other two-thirds privately funded and controlled. However, available records indicate that public institutions are responsible for more than 60 percent of teacher preparation program graduates each year. The U.S. Teacher Education Study – Mathematics (TEDS-M) surveyed nearly 3,300 future teachers from over 80 randomly selected public and private colleges and universities in 39 states. These data provide a unique opportunity to explore the learning opportunities the potential future teachers experienced in their programs and what they knew about mathematics and mathematics pedagogy at the end of their preparation program.

This paper examines the variation in these measures among U.S. institutions. It turns out that it was among the largest found in any of the TEDS-M countries but that it was only weakly related to administrative control (public vs. private) of teacher education. No statistically significant differences between the public and private institutions existed at the lower secondary level when controlling for OTL. For elementary programs the differences between public and private institutions when controlling for OTL were only statistically significant for the mathematics assessment. This surprising result was true in spite of the private institutions' more selective admission policies. It invites for discussions whether the administrative control matters for outcome of tertiary education.

Conclusion

The lack of statistically significant differences in mathematics content knowledge or mathematics pedagogy knowledge between public and private universities and colleges at the secondary level seems surprising given that institution characteristics do vary. The 25th and 75th percentile of matriculating students' ACT mathematics scores were higher in the private than in the public institutions as was the Barron rating associated with the prestige of those

institutions. The selection bias associated with the private schools would suggest that their knowledge of mathematics would likely be greater at the outset, however, at the end, controlling for learning opportunities, there were no significant differences between the public and private colleges and universities. This was true in spite of the private institutions' more selective admission policies. It invites for discussions whether the administrative control matters for outcome of tertiary education.

SYMPOSIUM

Mathematics Education

Sixty-four or four-and-sixty? Number transcoding in primary school children

Chairperson: Ineke Imbo, Department Experimental Psychology, Belgium

Organiser: Ineke Imbo, Department Experimental Psychology, Belgium

Discussant: Liane Kaufmann, UMIT-Private University for Health Sciences, Medical Informatics and Technology, Austria

Transcoding Arabic numbers (e.g., 64) from and into verbal number words ('sixty-four') is one of the most basic tasks in the domain of number processing and serves as a cognitive building block for the development of more complex arithmetic skills. Although transcoding is very simple for adults, it is often a great challenge for children – and especially so in inversed number languages such as Dutch and German ('four-and-sixty'). This symposium brings together three empirical studies focusing on primary school children's transcoding performance. The first study tested the effects of inversion in children from France, Wallonia, Flanders, Germany, and Austria, and showed that not only differences in the number language, but also cross-cultural differences in math curricula are an important reason for performance differences. The second study longitudinally tested German-speaking children, and showed that performance on basic numerical tasks (such as transcoding and number magnitude comparison) assessed in first grade predicted performance on a complex addition task in third grade. The third study showed that both Dutch- and French-speaking children relied on executive functions when transcoding; however, only Dutch-speaking children relied on phonological working-memory resources. To conclude, although mastery of specific basic numerical principles (such as transcoding) during early school years is essential for successful numerical development, it is not self-evident for many children. It is of great importance to know the underlying processes in order to foster children's mathematical competencies.

Differential inversion effects on numerical skills in second grade

Helga Krinzing, RWTH Aachen University Hospital, Germany; Jacques Gregoire, Universite catholique de Louvain, Belgium; Annemie Desoete, Ghent University, Belgium; Liane Kaufmann, UMIT - University for Health Sciences, Medical Informatics and Technology, Austria; Hans-Christoph Nuerk, Eberhard Karls University Tübingen, Germany; Klaus Willmes - von Hinckeldey, Medical Faculty RWTH Aachen University, Germany

Little is known about the causes of cross-cultural specifics of numerical development. We examined effects of inversion (a linguistic effect) on three different numerical tasks in 220 second graders from France, Wallonia, Flanders, Germany, and Austria tested for the standardization of the dyscalculia test TEDI-MATH.

Results revealed that performance differences between countries are only partly attributable to language effects, but group differences in recognition of unit- and decade-digits and subtraction are more likely due to curricular effects. As expected, language effects due to the inversion principle could be observed in writing Arabic numbers to dictation affecting performance both specifically as well as in a generalized way being present in other error types. These results clearly show that numerical skills do not develop in a unitary fashion and that cross-cultural differences can be due to several factors.

Aims of the study

In our modern society, numeracy is becoming even more important than literacy for employment rates and wages (Dowker, 2005). In all modern societies, having sufficient numeracy means at least mastery of the Arabic number system and basic arithmetic operations. These numerical skills are taught in primary schools of all countries. Yet, this does not imply that the development of numeracy, which is a comparably young cultural invention (see: Dehaene, 1997), is the same in all cultures.

Furthermore, if performance differences in specific numerical skills are found between children of two different countries, these differences are often not unambiguously attributable to one cross-cultural distinction such as differences in the number word systems like inversion (e.g., 21 is spoken as "einundzwanzig", literally "one-and-

twenty", in German). Rather, other cross-cultural differences (e.g. in math curricula) may be an important reason for performance differences as well. This means that if one wants to study the impact of a cultural difference like language effects on the development of numerical skills, possible confounding factors like curricular effects either have to be ruled out, or more than two different cultural groups have to be tested.

The aim of our study was therefore to investigate cross-cultural differences in the development of different numerical skills and to analyse whether eventual differences are due to linguistic or curricular effects.

Methodology

We compared the performance of parts of the standardization samples of the dyscalculia test TEDI-MATH (Van Nieuwenhoven et al., 2001; Grégoire, Noël, & Van Nieuwenhoven, 2004; Kaufmann et al., 2009) from France (49 children, 51% girls), Wallonia (French speaking part of Belgium; 21 children, 57% girls), Flanders (Flemish speaking part of Belgium; 46 children, 57% girls), Austria (38 children, 58% girls), and Germany (66 children, 55% girls). These 220 children were tested in the middle of second grade with three different tasks: recognition of unit- and decade-digits (pointing to the unit- or decade-digit in three two- and two three-digit numbers, respectively), writing Arabic numbers, and subtraction. For all tasks and groups, the numbers of correctly solved items were used as dependent variables.

To unambiguously test an effect of inversion, we used a family of tests to analyze this specific research hypothesis: First, a one-way ANOVA on means from independent samples between all children speaking a language with (Flemish, German, and Austrian children) vs. all children speaking a language without inversion (French and Walloon children) had to be significant. Second, a two-sided independent samples t-test between the French and the Walloon as well as a univariate ANOVA between the Flemish, German, and Austrian children had to be non-significant. Only then an unambiguous inversion effect can be assumed.

Results

In the current study, we found a negative inversion effect on one out of three mathematical skills of second graders by comparing the standardization samples of the dyscalculia test TEDI-MATH from France, Wallonia, Flanders, Austria, and Germany.

In summary, the hypothesis of an inversion effect on multi-digit number processing could be clearly confirmed for writing Arabic numbers to dictation, but not for recognition of unit- and decade-digits.

Concerning the unexpected performance pattern we found for the task recognition of unit- and decade-digits, the group differences can not be clearly interpreted as being indicative of an inversion effect. We did not find the expected advantage of all French speaking children over the others, as Walloon children scored not only lower than expected but even worse than German and Austrian children. If inversion would impair performance on this task, we would expect Walloon children to be better than German speaking children. Furthermore, teen numbers and simple decade numbers were also affected by the group factor, which is not expected if performance is influenced by inversion.

Alternatively, these results may suggest differences in the focus of math curricula in the different countries, with the strongest emphasis on understanding the value of digits in multi-digit numbers in France, followed by Germany and Austria, and the lowest in Belgium (Wallonia and Flanders).

Surprisingly, we also found a positive (i.e. error-reducing) effect of inversion on two items of Subtraction, namely "16-4" and "27-6". These two items have in common that a single-digit number has to be subtracted from a two-digit number. Therefore, we speculate that naming the unit-digit first in the minuend may enhance attention to the digit from which the second number should be subtracted, at least during a short time window in children's numerical development. This may be interpreted as a positive effect of the inversion property in a number word system for learning how to subtract.

Theoretical significance of this study

In general, the results of our study show that numerical skills do not develop in a unitary fashion. Rather, individual performance on specific mathematical skills can be differentially influenced by linguistic properties of the number word system. This means that for a promising investigation of cross-cultural differences in mathematical development, it seems fruitful to study the performance patterns of children from multiple countries, as it is very likely that cultural factors are confounded if only two countries are compared. For example, if we would have examined only German and French children, we would have misinterpreted all group differences as linguistic effects

on numerical achievement of these two groups. Furthermore, our results showed that two tasks tapping multi-digit number processing (recognition of unit- and decade digits and writing of Arabic numbers to dictation) were differentially affected by the existence of the inversion property in the respective number word systems. This calls for a multi-task approach in cross-cultural comparisons – in many instances only one or very few tasks have been used so far. Our results show that cross-cultural differences in one task are not readily transferable to another task.

Early place-value understanding as a precursor for later arithmetic performance

Korbinian Moeller, Knowledge Media Research Center, Germany; Silvia Pixner, University of Health Sciences, Medical Informatics and Technology, Austria; Liane Kaufmann, University of Health Sciences, Medical Informatics and Technology, Austria; Hans-Christoph Nuerk, Eberhard Karls University Tübingen, Germany

Recent research suggests that basic numerical competencies such as transcoding, this means the ability to transfer a number from one notation to another serve as a cognitive building block for the development of more complex arithmetic skills. However, in numerical cognition, there is a lack of longitudinal studies examining this issue. In a sample of 94 typically developing children we investigated longitudinally whether performance in basic numerical tasks (such as transcoding and number magnitude comparison) assessed in first grade predicted performance in a complex addition task in third grade. It was observed that early successful understanding the place-value structure as reflected in transcoding and magnitude comparison tasks was a reliable predictor for later successful application of place-value knowledge as indicated by the processing of carry addition problems - even when controlling for non-numerical concepts like IQ and working memory. These findings are important for two reasons as they (i) lend support to developmental accounts emphasizing the importance of basic number representations as well as they (ii) underline that mastery of specific basic numerical principles (such as the place-value structure) during early school years seems to be essential for successful numerical development of more complex but nevertheless related competencies.

Aims

The aim of the current study was to investigate the influence of early basic numerical competencies such as transcoding or number comparison on later arithmetic capabilities in typically developing children. Therein, we set out to resolve several limitations in the hitherto investigation of this developmental trajectory: (i) most recent studies employed a simple task approach in which one particular representation is indexed by an overall performance measure of one particular task. (ii) The stimulus sets used to assess basic numerical competencies mostly comprised one-digit numbers only, preventing an examination of the influence of place-value understanding on later arithmetic ability.

Method

We aimed at addressing these issues in a longitudinal investigation involving 94 typically developing children (German native speakers, 48 girls) assessed at the end of grade 1 and 3 (mean age grade 1: 7;4 years, SD = 7.1 months, range: 6 years 5 months to 8 years 7 months). Following the research question at hand our proceeding was three-staged: (i) We were interested whether overall performance as reflected by error rates for number comparison and/or transcoding assessed in first grade was a reliable predictor of overall addition accuracy in third grade. (ii) More specifically, attention was paid to whether mastery of place-value understanding in first grade as indexed by related numerical effects (e.g., inversion related transcoding errors) predicts overall addition performance two years later. (iii) Most specifically, we aimed at evaluating whether such specific basic numerical effects (e.g., percentage of inversion errors) predict specific effects in later addition (e.g., carry effect) that can be attributed to the same underlying concept of place-value understanding. Please note that in the latter case predictor and criterion are specific numerical effects. Yet, due to the fact that for transcoding performance no reaction times were measured all of these interrelations were evaluated for error data using stepwise multiple regression analyses.

Results

Our results were straightforward on each of these questions:

- (i) We clearly identified overall number comparison performance in first grade to be the only reliable predictor [$b = .25$, $t = 2.48$, $p = .02$, adjusted $R^2 = .05$, $F(2, 92) = 6.13$, $p = .003$]
- (ii) Following the approach suggested by Holloway and Ansari (2009) we took a successful next step in identifying precursors of arithmetic capability. The final model [$R = .44$, adjusted $R^2 = .16$, $F(4, 90) = 6.99$, $p = .001$, $b = -.18$, $t = 1.93$, $p = .06$, $b = .18$, $t = 1.87$, $p = .07$, $b = .33$, $t = 3.47$, $p = .001$]
- (iii) Finally, examining the influence of specific numerical effects in first grade (e.g., compatibility effect, pure inversion errors) on the corresponding carry effects in third grade addition revealed a meaningful interrelation when operationalizing both predictor and criterion by specific numerical effects rather than by an overall performance

measure [$R = .29$, adjusted $R^2 = .06$; $F(3, 91) = 4.08$, p carry effect in third grade addition was predicted reliably by the number of pure inversion transcoding errors committed in first grade: A higher number of pure inversion errors in first grade transcoding [$b = .21$, $t = 2.00$, p

Discussion

Taken together, the results of the present longitudinal evaluation indicated that if the place-value concept is not mastered in early schooling difficulties in the successful application of this concept will evolve in later numerical development, in particular, regarding the capability to integrate tens and units into the Arabic place-value system as required in basic arithmetic operations such as addition problems requiring a carry. To our knowledge, these are the first longitudinal data which directly evidence the importance of early place-value understanding.

The conclusions for future research are then straightforward. Multi-digit number processing and in particular, the importance of place-value understanding should receive greater attention as the development of place-value knowledge poses a major challenge for elementary school children (especially for those that have to struggle with an intransparent name- and place-value system). Moreover, the unproblematic acquisition of the base-10 place-value system cannot be taken for granted in all children (e.g., Gervasoni et al., 2003). Instead, early deficits in place-value understanding may still exert their influence on later more complex arithmetic processes. Hence, future research should not only focus on single-digit number processing but should also incorporate representations and concepts necessary to successfully process multi-digit numbers. Beyond being confined to basic research, the systematic investigation of the processes and mechanisms underlying the development of the base-10 place-value system and its interrelation to other aspects of multi-digit arithmetic should be considered a major interest in the applied sciences as well. To summarize, the present data suggest that more specific teaching and training of place-value understanding in education contexts may endorse children's numerical development.

The Influence of Language and Working Memory on Children's Number Transcoding

Charlotte Vanden Bulcke, Ghent University, Belgium; Jolien De Brauwier, Lessius University College, Belgium; Ineke Imbo, Department Experimental Psychology, Belgium

Two studies are reported in which the transcoding abilities of Dutch- and French-speaking children (e.g., writing 64 when hearing 'sixty-four') are tested. French is, like English, a non-inversed number language, which means that the tens are pronounced before the units ('sixty four'). Dutch, in contrast, is an inversed number language, which means that the ten-unit order is inversed when number words are pronounced (e.g., 64 is pronounced as 'four-and-sixty'), which gives rise to inversion errors (e.g., writing 46 when hearing 64). In the first study, we show that 7- and 8-year old Dutch-speaking children make significantly more inversion errors than do 7- and 8-year old French-speaking children. In the second study we show that both Dutch- and French-speaking 8-year-old children rely on their executive working memory when transcoding numbers, but that only Dutch-speaking children rely on their phonological working memory when transcoding numbers. For the Dutch-speaking children only, gender effects (bad transcoders are more often girls) and effects of intelligence (bad transcoders are more often less intelligent) were also observed. Implications for elementary school education as well as ideas for further research are discussed.

Aims

Transcoding Arabic numbers (e.g., 64) from and into verbal number words (e.g., 'sixty-four') is one of the most basic tasks in the domain of number processing. Although transcoding is very simple for adults, it is often a great challenge for children – and especially so in inversed number languages. In inversed number languages, such as Dutch and German, the ten-unit order is inversed when number words are pronounced or written down (e.g., 64 is pronounced as 'four-and-sixty'). This gives rise to inversion errors (e.g., writing 46 when hearing 64).

In a recent study, 7-year-old German-speaking children were asked to write down dictated Arabic numbers (Zuber et al., 2009). The error rate was very high (47%) and inversion errors were very frequent (50% of overall error rate). The children's transcoding performance was best predicted by executive working memory (WM), and – in a lesser degree – by visuospatial WM.

We conducted two studies in which we pursued the results of Zuber et al. (2009). As transcoding may be a rather difficult task for 7-year old children, we decided to run a first study in which we tested 7-, 8-, and 9-year-old children. We did not only look at the transcoding competencies of children speaking an inversed language (Dutch) – we also tested children speaking a non-inversed language (French). Based on the results of this study, a second study was run in which we compared 8-year-old Dutch- and French-speaking children's WM involvement in transcoding tasks.

Method

In Study 1, we tested 57 Dutch-speaking and 60 French-speaking children between 7 and 9 years old. All children completed a group-administered dictation of Arabic numbers. In Study 2, we tested 49 Dutch-speaking and 38 French-speaking children of 8 years old. They all completed a group-administered dictation of Arabic numbers. For each language group, we selected the 10 worst and 10 best transcoders (based on the amount of transcoding errors) of whom we further tested intelligence and WM. The intelligence measure was based on four tasks of the WISC-III: Picture arrangement, Block Design, Similarities and Vocabulary. Based on these four tasks, an estimate of total IQ was made (Grégoire, 2001). WM was tested by means of two phonological tasks (Digit span forwards and Letter span forwards), two visuospatial tasks (Corsi Blocks forwards and Mazes Memory), and four executive tasks (Digit span backwards, Letter span backwards, Corsi Blocks backwards, and Sun Moon Stroop). For each WM component, a compound score was calculated as the mean of the z-scores.

Results

The first study was meant to look at age differences in transcoding abilities. At 9 years old, children barely made transcoding errors. The amount of transcoding errors at 7 and 8 years old, in contrast, was reasonably high (around 15%). Although the total error rate was equally large in Dutch- and French-speaking children, the percentage of inversion errors differed significantly. As can be seen in Figure 1, Dutch-speaking children made more inversion errors than did French-speaking children, $t(35) = 5.48$ ($p < .001$) for the 7-year-olds and $t(37) = 1.71$ ($p = 0.07$) for the 8-year-olds. Based on the results of this first study, a second study was set up. Because the dictation task seemed somewhat too difficult for the 7-year-olds (cf. around 25% non-responses) and too easy for the 9-year-olds, we decided to look further into the transcoding abilities of 8-year-old children.

Hence, in Study 2, we tested the transcoding abilities of 8-year-old children only. The intelligence and WM of the 10 worst and 10 best transcoders in each language group (Dutch and French) was tested as well. A stepwise logistic regression analysis was performed on transcoding performance (bad vs. good) with intelligence, age, gender, and WM (phonological, visuospatial, and executive) as predictors. As can be seen in Table 1, executive WM was a significant predictor for both language groups, indicating that children with high executive WM resources are more likely to be good transcoders than are children with low executive WM resources. Intelligence, gender, and phonological WM, in contrast, were significant predictors for Dutch-speaking children only. Since boys were coded as 0 and girls were coded as 1, the negative B value indicates that Dutch-speaking girls are more likely to be bad transcoders than are Dutch-speaking boys. Further, Dutch-speaking children who are more intelligent and have higher phonological WM resources are more likely to be good transcoders than are Dutch-speaking children who are less intelligent and have lower phonological WM resources.

A test of the final model versus a model with intercept only was statistically significant, $\chi^2(4, N=20) = 27.73$ ($p < .001$), $N=20$) = 5.04 ($p = .03$) for French-speaking children. The final model was able to classify all Dutch-speaking children (100%) correctly as being good or bad transcoders, whereas the overall success rate for the French-speaking children was 65%.

Theoretical and educational significance

Children speaking a language with inversed number words experience great difficulties when transcoding numbers. They make many inversion errors (e.g., writing 46 when they hear 64) and rely to a great degree on their WM. Elementary school teachers should be aware of this, and may have to give extra attention to children with lower intelligence and/or lower WM scores. They may, for example, try to avoid redundant WM load as much as possible when young children are transcoding. Further research is also needed in order to test the effectiveness of possible interventions (such as training phonological working memory) for children bad in number transcoding.

It is important to note that the inversion property is not only present in Dutch and German, but also in many other languages such as Arabic, Danish, Maltese, Czech, and Norwegian. The results of the present study are thus relevant for elementary school teachers all over Europe. Although children speaking a non-inversed number language make very few inversion errors and rely to a lesser degree on their WM, they do make as many transcoding errors as children speaking an inversed number language. Hence, further research on the underlying processes of the transcoding competence of these children is also needed.

References

Grégoire, J. (2001). Comparison of three short forms of the WISC-III. *European Review of Applied Psychology*, 50, 437–441.

Zuber, J., Pixner, S., Moeller, K., & Nuerk, H.-C. (2009). On the language specificity of basic number processing: Transcoding in a language with inversion and its relation to working memory capacity. *Journal of Experimental Child Psychology*, 102, 60-77.

SYMPOSIUM

Assessment and Evaluation

Theoretical Issues in Measuring Interactive Problem Solving and in Defining the Domain for PISA 2012

Chairperson: Samuel Greiff, University of Heidelberg, Germany

Organiser: Samuel Greiff, University of Heidelberg, Germany

Joachim Funke, Psychology Department, Germany

Discussant: Jean-Paul Reeß, DIPF, Germany

Problem Solving has largely been an area of experimental research and much less an issue in the field of diagnostics during the last decades. However, one might consider problem solving competency as an important skill in our increasingly technology-rich and thus, technically demanding environment of the 21st century. Not surprisingly, there is a newly emerged focus on dynamic problem solving in the PISA-2012 assessment. There, it will be measured fully computer-based under the term Interactive Problem Solving emphasising the importance of active interaction between problem and problem solver.

This symposium's aim is to present and critically discuss theoretical and practical issues when introducing a new domain in an educational large-scale assessment. More specifically, it gives an overview on the theoretical rationale behind the assessment of problem solving considering scientific and political points of view (paper 1), describes the formalism behind the item pool and its conceptual, theoretical and psychometric advantages over traditional measurement approaches (paper 2) and closes with an in-depth discussion of challenges that are to be met and overcome when dealing with such a diverse domain as interactive problem solving and when administering it computer-based (paper 3).

In the general absence of appropriate empirical data on interactive problem solving, theoretical issues and practical obstacles have to be discussed even more thoroughly. This symposium wants to enhance the debate on advantages and disadvantages of capturing interactive problem solving competency in PISA 2012.

New Aspects Related to the Theoretical Framework of Problem Solving in PISA 2012

Romain Martin, University of Luxembourg, Luxembourg; Beno Csapo, University of Szeged, Hungary

Problem solving is a highly relevant skill for success in a modern society as it can be viewed as a transversal skill implying processes that can be applied in very different contexts and that contribute to the successful adaptation to novel and changing situations. In a study based on broad literacy concepts such as PISA, the definition of a theoretical framework for problem solving will not only have to address the question of the relevance of results from a scientific point of view, but also the question of their relevance for political and other stakeholders in the educational field in general. We will show how the theoretical framework which has been adopted for problem solving in PISA 2012 tries to fulfill all the requirements related to the definition of the construct, the relevance for participation in society, the delimitation against other theoretical constructs and the added-value compared to classical content-related assessments.

PISA is a large-scale comparative assessment aiming to "assess how far students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society" (OECD, 2007). Thus PISA goes beyond the assessment of particular curricular knowledge, as it aims at assessing competencies that are necessary for an active participation in a modern society. Essentially such a modern society is characterized by continuous changes in the working environments and their technologies. PISA studies made a great progress towards measuring knowledge relevant in these societies by introducing and elaborating a very broad literacy concept for the main domains (reading, mathematics and science). However, for assessing how well schools prepare their students for unknown future challenges, to solve problems which cannot be solved on the basis of domain-specific knowledge mastered at today's schools, new types of instruments are required. These new instruments should be able to assess how efficiently students act in novel situations, in unknown environments, how they are able to gain new knowledge and organize it according to the requirements of the actual demands of a given problem situation. Problem solving is a construct offering the possibilities of developing a framework satisfying the needs of these new

aims of PISA. On the other hand, problem solving is a very broad concept with many different facets, so developing a framework for this construct requires to choose theoretical approaches which fit the particular aims and characteristics of PISA, namely, that certain types of problem solving skills are already included in the main literacy domains.

Problem solving has been measured in the past in PISA 2003 and will again be measured in the context of PISA 2012. In light of the general objectives of the PISA study, it becomes clear that the elaboration of a theoretical framework for PISA will not only have to address the question of the relevance of results from a scientific point of view, but also the question of their relevance for political and other stakeholders in the educational field in general. It is thus important that the theoretical framework can respond to different constraints: (1) it should be rooted in existing theoretical frameworks about problem solving that have been proposed through research in the field; (2) the adopted definition should show the link with cognitive or motivational processes that are necessary for a successful participation in a modern society; (3) it should permit to delimit problem solving against other theoretical constructs such as intelligence; and (4) it should be possible to show the added value that can be expected from the measurement of problem solving as a separate domain in addition to the partial measurement of problem solving that is already included in the main domains. Finally, although the type of problem solving skills to be assessed cannot be directly taught, it should be amenable to education and be an indicator of the quality of schooling.

We will show how the theoretical framework which has been adopted for problem solving in PISA 2012 tries to fulfill all these requirements. Basically, the elaboration of the theoretical framework for PISA 2012 will be rooted in the research on problem solving done in the field of cognitive psychology (Mayer, 1992; Funke, 2009; Wang & Chiew, 2010). Based on a basic definition of problem solving coming from this field of research, it will be shown in which type of real-world situations these problem-solving skills will be needed. This analysis will open the possibility to define different types of problem solving situations according to the context in which they occur and according to the nature of the problem that has to be solved. Research about the link between intelligence and problem solving skills will be reviewed in order to show that the two constructs seem to be related, but not overlapping. A major importance in the theoretical definition of problem solving for PISA 2012 has to be attributed to the central cognitive (and motivational) processes that have to be used to various degrees in different problem solving situations. Being able to describe and assess these processes will be a core element in the theoretical framework of problem solving. One of the major goals of the problem solving assessment based on this theoretical framework will be to design measurement instruments which will maximize the variance that is attributable to these problem solving processes while at the same time minimizing the variance which is due to domain-specific knowledge unrelated to the problem-solving processes themselves. This effort to target the problem solving processes directly is the major difference between the assessment of “general” problem solving and the assessment of domain-specific problem solving such as mathematical problem solving. Being able to provide a “pure” measurement of problem solving skills seems to be very important in order to disentangle skills that can be considered to be truly transversal from skills that are bound to a specific content domain.

References

- Funke, J. (2009). Complex problem solving: a case for complex cognition? *Cognitive Processing*, 11(2), 133-142.
- Mayer, R. E. (1992). *Thinking, Problem solving, Cognition* (2nd Ed.). New York, NY: Freeman.
- Wang, Y., & Chiew, V. (2010). On the cognitive process of human problem solving. *Cognitive Systems Research*, 11(1), 81-92.
- OECD. (2007). *PISA 2006 Science Competencies for Tomorrow's World*. Paris: OECD.

Dynamic Systems and Their Importance in Competence Assessment of Problem Solving

Joachim Funke, Psychology Department, Germany; Samuel Greiff, University of Heidelberg, Germany; Sascha Wustenberg, University of Heidelberg, Germany

In PISA 2012, dynamic problem solving will receive special attention for at least three reasons: (a) It is an additional option for the participating countries (46 out of 68 voted for it), (b) it is measured for the first time computer-based, and (c) problem solving is understood as Interactive Problem Solving and uses dynamic systems. In our presentation, we focus on the dynamic systems approach for competence assessment. Interactive problem solving requires from participants to explore and control minimal but sufficient complex systems like remote control, mobile phone, or home appliances. To model such systems, we use the formalisms of structural equation systems and finite state automata. With both approaches, a psychometrically sound assessment of the three theoretically derived facets “information retrieval”, “model building”, and “forecasting” is possible and useful for the description of interactive problem solving.

In PISA 2012, dynamic problem solving will take special attention for at least three reasons: (a) It is an additional option for the participating countries (46 out of 68 voted for it), (b) it is for the first time computer-based, and (c) problem solving is understood as Interactive Problem Solving and uses dynamic systems. What the 2012 assessment of problem solving differentiates from the 2003 assessment is mainly the mode of delivery (computer-based) and the inclusion of problems that cannot be solved without interacting with the problem situation.

What is interactive problem solving? How can it be measured? In concentrating on interactive problem solving, we focus on a 21st century skill that is not easily captured by paper-and-pencil tests. The 21st century offers a technology-rich environment to its citizens. It is taken for granted that a person is able to use mobile communication, use household devices, use public transportation, and use technology at work place, shortly put: to use technologies that show a broad range of applications, are rapidly changing, and often introduce new features and services to their users. These require interaction with mostly automated environments (e.g., using credit cards for public transport; pay-via-phone) that are in principle similar to each other but at the same time very context specific and changing from region to region. For example, when travelling around the world one experiences a lot of different paying systems for public transport even if in principle the systems are the same.

Our definition of interactive problem solving is as follows: "interactive problem solving is the ability to explore and identify the unknown structure of devices in dynamic, technology-rich environments by means of interaction, and to reach certain goals with such devices." Let us comment on the different components of this definition.

- (1) The term "ability" refers to the fact that interactive problem solving develops over the life span and that it can be learned and fostered, e.g., by training.
- (2) The two mentioned tasks (to identify structure; to reach goals) refer to the abstract requirements of (a) system identification and exploration (knowledge acquisition) as well as (b) system control and steering (Funke, 1991). System identification simply means to find out how a given device (e.g., a new mobile phone) works, how it reacts to certain inputs. System control simply means to know how to get what you want.
- (3) The notion of "unknown structure" points to the fact that dynamic problem solving deals with new situations for which a routine solution is not at hand.
- (4) The term "dynamic, technology-rich environments" characterizes a prerequisite for interaction between a user and the device, namely the dynamics of the system. This interaction implies that during the course of interaction the state of the device changes depending on the type of intervention. The resulting dynamics stand in strong contrast to simple problems that are static in nature (like a chess problem situation).
- (5) The term "devices" contrasts the objects for interactive problem solving to natural objects, (social) events, and so on. It specifies for example, that interactive problem solving does not deal with problems resulting from social interaction, problems which might require another ability that could be called "emotional intelligence".
- (6) "By means of interacting" characterizes the mode of exploration and refers to the most important aspect of this type of problems, namely the active process of exchanging information with a system; this is done not by reading a text but by actively dealing with the system.

Not explicitly included in the definition is the aspect of metacognition, i.e. monitoring and reflecting one's own problem solving activities. But because problem solving is not only an ability but also a process, it needs some feedback and control structures which guide the activities.

How could dynamic problem solving be measured? Recently, Greiff and Funke (2009) proposed the MicroDYN and MicroFIN approach. This approach was developed under a psychometric perspective for the use in large-scale assessments (like PISA) with computer-based test administration (Reeff & Martin, 2008) and has compared to other approaches advantages in terms of (a) time used for testing, (b) realism, (c) measurement model, (d) available data on reliability and validity, (e) comparability between different scenarios, (f) scalability overall and with respect to difficulty levels. Actually, it consists of a set of "items" which each consists of a small system of causal relations that have to be explored within 3-4 minutes and afterwards controlled for given goal states. The main feature of MicroDYN is the use of minimal but sufficiently complex systems, that is, systems which at the same time contain all of the features of a complex system (complexity, dynamics, politely, intransparency; see Funke, 1991) and do have low values on these parameters. From a psychometricians' point of view, this approach has some advantages for test developers that can be characterized by the following points: (1) the time spent for a single scenario is not measured in hours but in minutes, thereby increasing the economics of test application; (2) due to the short time for item application, a series of items can be presented instead of one-item-testing, thereby increasing reliability; (3) because of our use of formalisms, arbitrary semantic embeddings could be chosen, thereby increasing ecological validity; and, (4) a broad range of difficulty levels can be addressed, thereby increasing conceptual validity.

References:

- Funke, J. (1991). Solving complex problems: Exploration and control of complex systems. In R. J. Sternberg & P. A. Frensch (Eds.), *Complex problem solving: Principles and mechanisms* (pp. 185-222). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Greiff, S., & Funke, J. (2009). Measuring complex problem solving: The MicroDYN approach. In F. Scheuermann (Ed.), *The Transition to computer-based assessment - Lessons learned from large-scale surveys and implications for testing* (pp. 157-163). Luxembourg: Office for Official Publications of the European Communities.
- Reeff, J.-P., & Martin, R. (2008). Use of the internet for the assessment of students' achievement. In J. Hartig, E. Klieme & D. Leutner (Eds.), *Assessment of competencies in educational settings*. Gottingen: Hogrefe & Huber.

Computer-Based Assessment of Problem Solving in PISA 2012: Opportunities and Challenges

Barry McCrae, Australian Council for Educational Research (ACER), Australia; Dara Ramalingam, Australian Council for Educational Research, Australia

The PISA 2012 assessment of problem solving competency of 15-year-olds is entirely computer based. This provides the first-time opportunity in a large-scale international survey to concentrate on problems that cannot be solved without the solver interacting with the problem situation. Examples of problems administered include the difficulties encountered in using a new remote control or vending machine when instructions are missing or inadequate. The 68 countries participating in PISA 2012 are spread geographically across the globe, range widely in their level of economic development, and form a very diverse cultural and linguistic mix. This paper discusses the challenges that this presents to test developers in devising appropriate examples and illustrates how these challenges were met. Other opportunities and challenges, such as those afforded by the computer's capability to capture the strategies employed by the problem solver, are also discussed.

PISA (Programme for International Student Assessment) is an international standardised assessment of 15-year-olds in educational programmes that takes place every three years in participating countries. Since PISA's inception in 2000, it has been conducted on behalf of the OECD by the Australian Council for Educational Research (ACER).

Problem solving was previously assessed in PISA in 2003, by means of a conventional pen-and-paper test (OECD, 2003, 2004). The 2012 assessment of problem solving is computer-based and so, for the first time in a large-scale international survey, problems that cannot be solved without the solver interacting with the problem situation can be included. Indeed, so-called "interactive problems", are the main feature of the assessment.

A consistent research finding is that problem solving is dependent on domain-specific knowledge and strategies (e.g. Mayer, 1992; Funke & Frensch, 2007). PISA avoids the need for expert prior knowledge as much as possible in order to focus on measuring the cognitive processes fundamental to problem solving. This also distinguishes the assessment from problem solving tasks in the core PISA literacy domains of reading, mathematics and science, which can call on expert knowledge in these areas.

68 countries and economies are participating in PISA 2012 and each of them could opt to undertake the problem solving assessment. They are spread geographically across the globe, range widely in their level of economic development, and form a very diverse cultural and linguistic mix. A PISA assessment task needs to satisfy the following conditions:

- meet the PISA criterion of measuring how well students, at age 15, are prepared to meet the challenges they may encounter in future life;
- be regarded, by the students, as interesting and authentic;
- maintain its level of difficulty when translated into the various PISA languages;
- be culturally acceptable throughout the PISA countries and economies; and
- be accompanied by a coding guide that enables student responses to be reliably coded (marked).

PISA problem solving tasks are mainly based around authentic, everyday situations which should be familiar to most students. Examples include the problems commonly faced when encountering devices such as remote controls, mobile phones, home appliances and vending machines for the first time, especially if a user guide is not available or not easily understood. Prior knowledge is often not sufficient to solve such problems and must be enhanced with new knowledge gained from observing and exploring (i.e. interacting with) the situation.

Interactive problems can be built on underlying mathematical models whose parameters can be varied systematically to achieve differing degrees of difficulty. There are two well-known paradigms: finite state automata and models based on linear structural equations.

Greiff and Funke (2008) use the term MicroDYN to describe the latter systems in which the problem solver must manipulate one or more input variables and consider the effect this has on one or more output variables. An example is controlling the volume and tone of a sound system. In more complex examples, the output variables may also influence themselves (i.e. the system is in itself dynamic).

A finite state machine is a system with a finite number of states, input signals and output signals (Buchner & Funke 1993). The system's next state (and output signal) is uniquely determined by its current state and the specific input signal. The problem solver must supply input signals (usually in the form of a sequence of button presses) to determine the effect on the system's states in an effort to understand its underlying structure and move it towards a goal state. Examples are digital watches and ticket vending machines.

Both paradigms have been implemented in the PISA 2012 problem solving assessment, primarily involving a range of technological devices. This raises the question of differential student familiarity and a challenge faced by item developers has been to devise strategies to minimise this potential inequality, including constructing non-technological and artificial examples. Other challenges include avoiding situations where trial-and-error is consistently necessary and varying the presentation of MicroDYN units to make them more interesting and authentic.

This paper discusses the political, scientific and technical issues mentioned above and provides an insight into the benefit of computer-based assessment that allow a much wider range of possible answers and behaviours than constructed responses in a paper-and-pencil environment.

References

- Blech, C. & Funke, J. (2005). Dynamis review: An overview about applications of the Dynamis approach in cognitive psychology. Bonn: Deutsches Institut für Erwachsenenbildung (available at http://www.die-bonn.de/espid/dokumente/doc-2005/blech05_01.pdf).
- Greiff, S. & Funke, J. (2008). Indikatoren der Problemlöseleistung: Sinn und Unsinn verschiedener Berechnungsvorschriften. Bericht aus dem MicroDYN Projekt [Measuring Complex Problem Solving: The MicroDYN approach]. Heidelberg, Germany: Psychologisches Institut.
- Funke, J. & Frensch, P. A. (2007). Complex problem solving: The European perspective – 10 years after. In D. H. Jonassen (Ed.), *Learning to Solve Complex Scientific Problems* (pp. 25–47). New York: Lawrence Erlbaum.
- Mayer, R. E. (1992). *Thinking, Problem solving, Cognition* (2nd Ed.). New York, NY: Freeman.
- OECD. (2003). *The PISA 2003 Assessment Framework. Mathematics, Reading, Science and Problem Solving Knowledge and Skills*. Paris: OECD.
- OECD. (2004). *Problem Solving for Tomorrow's World. First measures of Cross Curricular Competencies from PISA 2003*. Paris: OECD.

SYMPOSIUM

Social Aspects of Learning

Individual and social factors underlying school cheating on graded assignments

Chairperson: DORIT ALT, Zefat Academic College, Israel

Organiser: DORIT ALT, Zefat Academic College, Israel

Discussant: Roni Reingold, Achva-College of Education, Israel

This symposium aimed at empirically exploring the underlying factors of moral decisions regarding school cheating on graded assignments. Academic integrity is an important issue. Its absence may undermine the fundamental values and goals of education. Students who cheat bypass learning in an effort to obtain higher marks. Thus they are not engaged in a constructive learning process, and do not obtain academic skills. Moreover, cheating undermines equity, disorients teachers' feedback on the teaching effects, decreases the validity of measures on students' learning, increases damage to morale and threatens the integrity of school assessment. Therefore, it is important to examine individual and social factors which could dissuade students from this deviant behavior, thus developing strategies of dealing with the increasing problem. While academic cheating related studies suggest theoretical models of the phenomenon, this symposium provides empirical and practical contribution to the realm of moral rule breaking attitudes and behavior among students.

Motivational and cultural aspects related to students' academic dishonesty

DORIT ALT, Zefat Academic College, Israel

This study aimed at empirically examining the set of theoretical connections between several factors that may predict tendency towards neutralizing cheating among Jewish and Arab undergraduate students. The factors are: goal orientations, motivations and self-efficacy toward learning. Students who cheat bypass learning in an effort to obtain higher marks. Thus they are not engaged in a constructive learning process. Therefore, it is important to examine the factors which could affect academic cheating, and to develop strategies of dealing with the problem. Another aspect of the present study relates to social aspects and academic adjustment difficulties of Arab students that could lead to academic dishonesty. The present study seeks to empirically explore this assumption. In order to achieve these goals, three scales were administered to 122 undergraduate students, from three academic colleges, measuring the different variables. Findings suggest an empirical model in which performance goal orientations and extrinsic motivations - increase tendency to neutralize cheating; whereas mastery goal orientations, intrinsic motivations and self-efficacy towards learning - decrease this tendency. Arab students scored higher results than Jews students at: performance goal orientations, extrinsic motivations and tendency towards neutralizing cheating. Arab students appear to accept rule breaking if they can be justified by learning challenges, rather than instructional or social circumstances. This explorative study may lead to the development of different mechanisms suitable for each social group aimed at confronting academic cheating. These mechanisms could yield more effective learning and vocational training thus reducing the gaps between the Arab and Jewish populations.

This explorative study aimed at empirically examining the set of theoretical connections between several factors that may predict tendency towards neutralizing cheating among Jewish and Arab undergraduate students. The factors are: goal orientations (Urdu, 1997), motivations (Ryan & Deci, 2000) and self-efficacy toward learning (Bandura, 1997). Students who cheat bypass learning in an effort to obtain higher marks. Thus they are not engaged in a constructive learning process, and do not obtain professional skills (Whitley & Keith-Spiegel, 2002). Therefore, it is important to examine the factors which could affect academic cheating, and to develop strategies of dealing with the problem. Another aspect of the present study relates to academic adjustment difficulties of Arab students that may influence their goals, motivations, and self-efficacy toward learning (Benziman, 2002), therefore could be connected to academic dishonesty. The present study seeks to empirically explore this assumption.

Research questions

1. What are the empirical connections between purposes, motivations and self-efficacy towards learning, and tendency towards neutralizing cheating?
2. What are the differences between Jewish and Arab students (independent variable), regarding purposes, motivations and self-efficacy towards learning (mediating variables), and tendency towards neutralizing cheating (dependent variable)?

METHOD

Participants

The sample included 122 second year undergraduate students, from three academic colleges in north Israel, 63 Jewish, 59 Arabs. Mean age ranges from 21 to 25 years.

Data collection- Procedure and instruments

The following instruments were handed to the participants, who had the right to withdraw from the study at any time. All details regarding the participants' personal identity were kept anonymous. Data were collected during one academic year.

Instrument 1 – included three sub-scales measuring goal orientations from Patterns of Adaptive Learning Scales collection (Midgley et al., 2000):

- (1) Performance goal orientation: students' goal is to demonstrate their competence to other people within the academic institution sphere, namely, teachers or other students (9-item sub-scale, $\alpha=0.83$).
- (2) Parental Performance Goal: students' goal is to demonstrate their competence to their parents (5-item sub-scale, $\alpha=0.89$).
- (3) Mastery goal orientation: students' goal in an achievement setting is to develop their competence. Attention is focused on the task (4-item sub-scale $\alpha=0.72$).

Instrument 2 - included three sub-scales evaluating college student learning motivation and self-efficacy from Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993):

(1) Intrinsic motivation, measuring the student motivation for learning and understanding the courses' materials (9-item sub-scale $\alpha=0.77$).

(2) Extrinsic motivation, measuring the student motivation for achieving high grades (4-item sub-scale $\alpha=0.76$).

(3) Self-efficacy for learning, designed to measure the extent to which students believe that they have the competence and skills necessary for successful learning of the studied materials (4-item sub-scale $\alpha=0.70$).

All items in instruments 1 and 2 were arranged in Likert-style response format on a four-point scale ranging from (1) not at all true to (4) very true. Structural validity of the each questionnaire was examined using Principal Component Analysis with Varimax Rotation.

Instrument 3- Neutralization scale (Haines et al., 1986). The scale consists of 18-items, designed to measure respondents' tendency to neutralize cheating regarding three aspects:

- (1) Teacher's behavior, for example: doesn't care if the students study or not (6 items, $\alpha=0.87$).
- (2) Studied material, for example: too much material to study, the language is too difficult to understand (6 items, $\alpha=0.88$).
- (3) Social causes, such as: helping other student if he is in danger of losing his scholarship due to low grades (6 items, $\alpha=0.86$).

Respondents were asked to indicate their level of agreement with the items in a 4-point Likert type scale, ranging from (1) strongly disagree to (4) strongly agrees. Structural validity of the scale was examined using Structural Equation Modeling (SEM).

FINDINGS

First question was examined using SEM. Second question was examined by Multivariate analysis and Step-Wise Discriminant Function analysis.

The empirical model suggests parental oriented purposes (extrinsic) to be positively contributive to motivation towards scoring high grades (extrinsic) which increases tendency to neutralize cheating. Whereas, learning oriented purposes (intrinsic) positively contributes to motivation towards learning and understanding the material (intrinsic). This intrinsic motivation positively connected to self-efficacy perceptions regarding the studied materials, both these factors were found negatively connected to neutralizing cheating tendency (Chi-square = 23.34, $df = 18$, $p = .178$; RMSEA = 0.49; CFI = .989). Findings showed that Arab students, compared with the Jewish students: are more motivated towards grades, are aimed at showing their parents their performance, and tend to neutralize cheating when the studied material is perceived to be hard to understand.

DISCUSSION

This explorative study empirically tested several predictors of academic cheating with relation to cultural aspects. The study has theoretical as well as educational implications. For theory, the results suggests goal orientations to be indirectly connected to neutralizing cheating, namely, student's tendency to justify cheating will not be directly affected by his extrinsic purposes, as suggested by theory, unless he is motivated towards achieving them. Consistent with theory (Finn & Frone, 2004), self-efficacy was found connected to intrinsic motivation, both negatively connected to neutralizing cheating.

Regarding cultural aspects, findings indicate that Arab students consider their parents expectations while formulating their academic goals and are extrinsically motivated towards these goals. This could be explained by other studies indicating that minority parents are aimed at raising their children chances for successful integration, therefore put pressure on them to achieve high grades (Karipidis, 2002). Following this study results, this kind of pressure could lead to increased tendency to neutralize cheating once the student confronts academic challenges related to the studied materials.

The educational implications of the results could relate to the necessity for establishing frameworks aimed at first, identifying the Arab students academic needs, such as: language mastering skills. Second, equipping the Arab students with the tools they need to successfully cope with academic requirements.

Students' reasoning about cheating:

Lars-Erik Nilsson, Kristianstad University, Sweden; Henrik Svensson, Kristianstad University College, Sweden; Henrik Larsson, Kristianstad University College, Sweden

This study empirically investigates students' reasoning about right and duties in examinations. Student cheating on graded assignments has become a common research topic. Cheating on assessed work is often presented as endemic to suggest that it is present in all assessment and epidemic to suggest that cheating is increasing. Activities cited as

cheating in reports are for example using crib notes, plagiarizing, fabricating, impersonating and colluding. These activities are considered to threaten the integrity of assessment. Our aim is to contribute to research on cheating from the perspective of students' management of meaning as they are confronted with moral dilemmas that may occur when doing graded work. Four focus group discussions about two moral dilemmas have been videotaped and analyzed using positioning theory. The results indicate that students' categorization of actions as acts are not stable. Consequently we take issue with studies that constitute students actions as cheating based on presumptions of what these actions are to students. Some categorization such as for example to use crib notes or to impersonate appear less problematic while text-borrowing needs to be situated. Students appear to apply situational ethics as well as neutralizing techniques as they categorize actions. Actions can be treated as acceptable rule breaks if they can be justified by mitigating circumstances. The analysis of the results is discussed in relation to theories of neutralization and situational ethics. One conclusion is that situational factors appear to be important to determine subject positions such as honest or cheater.

Student cheating on graded assignments has become a common research topic. Activities cited as cheating in reports are for example using crib notes, plagiarizing, fabricating, impersonating, colluding and changing results (se e.g. Haines, et.al., 1986; Franklyn-Stokes & Newstead, 1995; McCabe & Trevino, 1996). By large there is an agreement in these studies that such activities should be categorized as forms of deception. Our aim is to contribute to this research from the perspective of students' management of meaning as they are confronted with moral dilemmas that may occur when doing graded work. Consequently we take issue with studies that constitute students actions as cheating based on presumptions of what these actions are to students.

The study

The data presented here are derived from four focus group discussions where students from upper secondary school talk about cases that have been designed to introduce moral dilemmas to them (Larsson & Svensson, 2010). The cases have been designed from investigations into academic misconduct in higher education (Nilsson, Lßnn-Svensson & Orlenius 2009). They have been revised, so that upper secondary students can more easily relate to the material. The students have been asked to discuss two cases. In the first a student has placed a crib note in the toilette to help another student. When caught the student refuses to give the name of the other student. The second case concerns a student who gets top grades on an assignment. He has compiled his text from web sources, and his fellow students composed their own texts to receive the same grades. The students were first introduced to the cases and discussed these. They were then exposed to other teacher and student voices commenting on the cases. These voices were introduced to elicit further comments from the participants.

The video recordings were transcribed and analyzed using positioning theory. (Harr   and van Langenhove 1999). Positioning is a dynamic process. Subject positions become available to people as episodes (called storylines) unfold. Positions such as cheater and honest student for example are being made available for participants through the way in which a particular action is talked about. Positioning theory posits a distinction between actions and acts hence allow persons to see actions as confirming to the rules and yet under particular circumstances to break the same rules constituting different acts. Storylines are considered to provide clues as to how actions should be constituted as acts hence what positions are being made available to participants in talk. Nilsson (2008) has argued that the distinction between actions and acts can be important particularly for positioning of students accused of cheating. We use positioning theory to engage in a discussion about the importance of such a distinction.

Results

The results indicate that students' categorization of actions are not stable. Some categorization such as for example to use crib notes or to impersonate appear less problematic. How a person that borrows text from another person should be positioned appears to be contingent on the students intentions. Collaboration may be construed as collusion depending on the situation.

Situational factors appear to be important to determine subject positions. Cheating in this sense does not appear as a stigmatizing, rather as an alternative to other actions dependant on considerations such as whether future learning can be impaired, whether the assignment invites taking short cuts and whether someone else may be harmed by the action.

Students appear to apply situational ethics as well as neutralizing techniques as they categorize actions. Actions can be treated as acceptable rule breaks if they can be justified by mitigating circumstances. The same actions can be treated as in compliance with rules depending on circumstances surrounding the situation in which they are carried out.

Concluding discussion

Michaels and Miethe (1989, 870) asserts that "studies of academic cheating often are not theoretically driven". A similar critique has been directed at research methodology. Ashworth and Bannister (1997) for example consider studies based on survey methods to be curbed by "the presupposition that the meaning of cheating is relatively univocal". We take the critique from Michaels and Miethe primarily to concern a lack of debate about theories and methodologies respective contributions to research.

Many theories of deviance are based on the assumption that deviant behaviors are learned. Sykes and Matza (1957) confront the problem of "why men violate the laws in which they believe" (p. 666). They argue that delinquency is often preceded by defenses to the crime. These defenses referred to as neutralizations are applied before a deviant action "in the form of justifications for deviance that are seen as valid by the delinquent but not by the legal system or the society at large" (p. 666). Seen this way, students' that willingly violate rules for examinations do not do so because they disagree with the norms, but because they are able to find favorable definitions that neutralize the norm. Students in our study do present rules they agree with and show evidence that there are ways to justify breaking these rules. Helping a friend may under some circumstances serve as such a justification, a technique called "appeal to higher loyalties" by Sykes and Mazda. However, in some cases these students do not consider such actions to be rules breaks and to warrant a position as cheater.

In many cases it appears as if rules are unclear instead of agreed with. Students need to engage in talk about the rules that apply to a certain action. Norris and Dodder (1979) argue that neutralization theory provides a narrow view on how people orient to norms and suggest four norm orientations; moral absolutes, situational ethics, neutralizations, and rebellious absolutes (pp. 546-547). While neutralizations can be considered as defenses for socially unacceptable actions situational ethics can be seen as legally acceptable albeit sometimes slightly wayward guidelines (p. 547). Positioning theory allows us to look beyond a treatment of students actions as simply a question of rule-following and rule-breaking. The distinction made between actions and acts reflects the uncertainty present in moral reasoning.

Adolescents' beliefs on the inhibiting factors of cheating in school exams

Catherine Dimitriadou, University of Western Macedonia, Greece

This study aims to identify certain reasons which could dissuade students from deviant behaviour, namely from cheating in school exams. Premised on the fact that students' decision to cheat or not to cheat is influenced by a variety of individual and social factors, we examined students' attitudes to cheating, possible reasons which could cause them to behave 'honestly' in exam situations, as well as how these factors correlate to each other. With these considerations, we addressed two groups of early and late adolescents aged 12 and 18 years old in a primary and a secondary school. In accordance with a scheduled scenario both groups, since their supervision was interrupted, had the opportunity to carry out deviant behavior whilst sitting a science and a math test. The development of a discussion and the application of a questionnaire followed the episode, thus providing data concerning the factors that could probably discourage students to cheat. Comparative results indicated that early adolescents consider normative aspects as more important reasons to avoid cheating, whereas the older ones give priority to grades and respect for their teacher. The results can possibly facilitate initiatives toward limiting deviant behaviour in the classroom.

Cheating in the classroom is considered immoral behaviour, since it^{*****} undermines equity, disorients teachers' feedback on the teaching effects, decreases the validity of measures on students' learning, increases damage to morale and degrades confidence to school as an assessing institution. Students' beliefs on this phenomenon are influenced by a variety of individual and social factors, whereupon students consider whether the benefits of the act outweigh the costs (Eisenberg, 2004; Passow et al., 2006). These benefit/cost tradeoffs may concern both students' beliefs and attitudes, and they may additionally refer to their intention to perform this behaviour and to their perception of control over it (Ajzen, 2002).

AIM

This study aims to investigate school students' beliefs about the possible reasons that could dissuade them from cheating in classroom-based exams, as well as the differences existing in these beliefs with regard to students' age.

Research questions

Premised on the hypothesis that there are some factors which could inhibit students' cheating with regard to their age and psychological development, the following research questions were posed:

- What is the attitude of early and late adolescents to cheating?
- Which individual and social factors could influence early and late adolescents' opinions on the acceptability of rule breaking concerning cheating?
- Are there any factors that could cause them to alter their unobserved behaviour and behave 'honestly' in exam situations?
- How do these factors correlate to each other among early and late adolescents?

METHOD

Participants

The study was held in a rural primary school and an urban senior high school, with student populations from medium socio-economic classes. A total of thirty two @@@@@@@@@@@@@@@@@@students took part. In the primary school classroom there were eleven (11) boys and eight (8) girls aged twelve (12). Eight (8) boys and five (5) girls, all eighteen (18) years old, constituted the secondary school class. Two experienced state-school teachers participated: a male primary school teacher and a female mathematics secondary education teacher.

Procedure

The study was built on a teaching episode which acted to assist the students to respond effectively to the main question posed: 'What kind of factors could prevent them from deciding to cheat during a test?' A three-phase procedure was organized in both classrooms:

- The students were invited to provide answers in a test, when an 'incidental' matter obligated the teacher to depart.
- The teacher returned shortly and instigated a discussion among peer-students concerning their cheating efforts while escaping detection.
- The students responded to a questionnaire intended to investigate the possible reasons which could reduce the probability of cheating in a particular situation.

Data collection

The research was conducted in actual classroom-based exam conditions. Qualitative and quantitative data were collected with the use of two instruments: (a) journals wherein the teachers kept notes of the students' answers during the discussion held in the classroom, (b) student questionnaires which were filled in after the end of the discussion. In the latter case, the students were asked to indicate on a 5-point scale the degree to which they agreed with seventeen statements ('I would not cheat if...') related to academic motivation and relationship variables (Murdock et al., 2001). The statements referred to a series of possible situations that would inhibit cheating.

FINDINGS

A 2 (school type) x 2 (sex) x 3 factors repeated measures ANOVA, with the last factor as within factor, did not reveal any significant main effect. Although the reasons to avoid cheating did not differ within the two school types ($F(2,54) = 1.748$, $p = .184$, $\eta^2_p = .061$), there was a trend according to which younger children ($M = 3.03$, $SD = 1.86$) perceived the reason to avoid cheating as being less important because of the grades than the older children ($M = 3.21$, $SD = .907$). Similarly, the older children ($M = 3.3$, $SD = 1.03$) perceived the reason to avoid cheating because of respect for their teachers as being more important than the younger children ($M = 3.01$, $SD = 1.02$). Contrarily, the older children ($M = 3.06$, $SD = 1.03$) perceived the social norms as being a more important reason to avoid cheating in comparison with the younger ones ($M = 3.5$, $SD = 1.18$).

These data appear to confirm the findings resulting from the discussion. According to the teachers' diary entries, primary school students do not consider cheating an immoral action, whereas secondary school students view it as a socially accepted practice pertaining to the competitiveness in a particularly demanding examination system (De Palma et al., 1995). The reasons that the participants acknowledged as discouraging them from cheating can be grouped into three main factors: (i) the social norms involving their fellow students and schooling as a system of behaviour rules, (ii) the grades as criteria which determine the students' progress, and (iii) the teacher as a key factor who is able to develop honourable relationships with the students and also persuade them to respect exams. More precisely, the early adolescents seem to consider the normative aspects (fear of punishment, peers' attitudes and school regulations) as more important reasons to avoid cheating, whereas the older ones give priority to grades and their relationship with the teacher (persuasion, agreement and respect).

THEORETICAL AND EDUCATIONAL SIGNIFICANCE

The results indicate that cheating in exams pertains both to morality and social norms, since it appears as a cultural construct. The classroom environment, the examination system and the teacher's individual personality impact the

likelihood of cheating in various ways, depending on the students' age. Early and late adolescents' differences in their disposition to avoid cheating can be explained according to the influence the identified factors have on the two student groups' developmental characteristics pertaining to their interests and the school community (Hutton, 2006). Educational settings characterized by the acknowledgement and the functional support 'for' or 'against' these factors are expected to have an impact on students' decisions not to cheat.

SYMPOSIUM

Beliefs

Self-concept development in the early school years

Chairperson: Karl-Heinz Arnold, Universität Hildesheim, Germany

Organiser: Karl-Heinz Arnold, Universität Hildesheim, Germany

Claudia Kastens, university of Kassel, Germany

Discussant: Kathy Sylva, University of Oxford, United Kingdom

Family education, schooling, and peer interaction provide three major sources of building and developing children's views on their abilities. As self-appraisals, these views have been conceptualized in the multifaceted framework of Shavelson, Hubner and Stunter (1976). Whilst there is a lot of research on the structure of academic self-concepts, less is known on impact factors other than achievement feedback on the development of the academic self-concept. Further on, research on non-academic self-concepts is scarce although it is clear that both family and school education intend to foster children's social skills. The symposium presents three studies analyzing the development of self-concepts in the primary schools years. Longitudinal design allows for answering the crucial question of decrease, increase and stability of self-concepts as well as of causal relationships regarding factors that are supposed to influence self-concept. The first study investigates how beliefs of significant adults—i.e. parents who closely interact with the children and thereby are likely to communicate their views on their children's abilities—influence self-concept development. In the second study, the development of the self-concept of social competence is analyzed over four points of measurement during the first four years of primary education considering the influence of and impact on the sociometric status of the child in its class. The third study takes a differential perspective by answering the question of gender differences not only at the level of group means but also at the individual level by analyzing self-concept growth curves.

Importance of parental beliefs for the development of children's self-concept: Effects and mediation

Alex Buff, University of Teacher Education, Switzerland; Iris Dinkelmann, Zurich University of Teacher Education (PHZH), Switzerland

Students' competence and value beliefs are seen as central to the quality of learning and achievements. Accordingly, the question of conditions or influences under which students' competence and value beliefs develop more or less favourably is by no means trivial in terms of educational practice. The contribution focuses on parental child-related competence and value beliefs, and addresses the importance thereof for children's own competence and value beliefs. Based on the model of parents' influence on children's achievement-related self-perceptions, values, and behaviors, and on the expectancy-value model of achievement choices (cf. Eccles, 2007), both direct and indirect effects – mediated by two aspects of parental behaviour (exercising control and providing structure) and by the children's perception of this behaviour – will be cross-sectionally and longitudinally examined.

Data were analysed from approximately 450 children and their parents who participated in the two longitudinal studies "TRANSITION" (Buff & Reusser, 2008) and the "State of Learning" (Moser & Hollenweger, 2008). As theoretically assumed, first results show that parental child-related competence and value beliefs directly influence the children's own corresponding beliefs. Moreover, it is indicated that a part of the effect of parental child-related competence beliefs on the children's competence beliefs is mediated by parental control and / or the children's perception thereof. In the case of value beliefs, parents' provision of structure and / or children's perception thereof appear to serve as mediating variables.

Method

The sample consists of approximately 450 children and their parents who are participated in the study "TRANSITION: Parental support and motivational-affective development in the transition to lower secondary level" (Buff & Reusser, 2008). The concern here is with a subsample of the "State of Learning Surveys at elementary schools in the Canton of

Zurich" (Moser & Hollenweger, 2008). Data collection took place in November 2008, March 2009 (TRANSITION) and June 2009 (state of learning surveys) during the sixth school year.

In the two data collection rounds in November 2008 and March 2009, the parents received their questionnaires first, and once these were returned, the children received their questionnaires. Thus, there is a clear temporal sequence between the information provided by the parents and the children in each case. Within the respective data collection rounds, the information given by parents and children provided cross-sectional data; thus, for the data collection in November 2008 and March 2009, the model checking is rather cross-sectional in nature. By considering the data collected in June 2009, however, the model depicted in figure 1 can also be longitudinally tested: parental child-related beliefs (November 2008), parental behaviour and perceived parental behaviour (March 2009), children's self-related beliefs (June 2009).

The data analysis ensues either through path models with manifest variables or – provided it is feasible based on the sample size (which still needs to be checked in detail) – through structural equation modelling with latent variables.

Results

First path analyses show that parents' child-related competence and value beliefs prove to be relevant predictors of children's own corresponding beliefs: the higher the better. Parental control appears to be primarily influenced by parents' child-related competence beliefs, while providing structure is primarily influenced by value beliefs. The higher the child-related competence beliefs of the parents, the less control is reported, whereas higher value beliefs are associated with more structure. Equally, it is indicated that parental control and structure do not influence the competence and value beliefs of the children directly, but rather indirectly via their perception by the children. Exercising control appears to negatively affect competence beliefs, while providing structure seems to positively affect value beliefs. Altogether, the results of the analyses conducted so far are very encouraging, firstly confirming available empirical findings, and secondly, supporting theoretical assumptions.

Self-concept of social competence and social preference: Development during the primary school years

Carsten John, University of Hildesheim, Institute of Educational Science, Germany; Frank Lipowsky, University of Kassel, Institute of Educational Science, Germany; Karl-Heinz Arnold, Universität Hildesheim, Germany

Schooling can be seen as a major developmental and learning opportunity for social competence because both interacting in classrooms and receiving feedback on social behavior foster not only students' development of social skills but also the acquisition of social knowledge and the development of self concept of their respective abilities. The longitudinal research project "Development of academic and social competence of primary school pupils in classrooms differing by their multilingual composition" (KEIMS-plus) supported by the German Research Foundation (DFG) investigates the development of social, academic and linguistic competencies and their interrelations during the early school years of nearly thousand students.

The study intends to work out the construct of social competence by analyzing the relationship between the self-perception of social skills and abilities (self-concept of social competence) and sociometric status as a major impact variable of social behavior and vice versa, i.e., the social position in the class group is supposed to influence the self-concept of social competence. The longitudinal design (four points of measurement, ca. 1000 students) of the study allows for cross-lagged panel modeling. Results show considerable structural and level stability; normative stability is found moderate for self-concept and high for social preference which in turn is supposed to be the cause of no significant impact of self-concept on social preference whereas a slight influence of social preference on social self-concept is revealed.

Major educational goals like maturity and social as well as professional responsibility refer to social competence (see overview by Brohm, 2009, for international and German educational guidelines concerning social competence). Schooling opens a variety of learning opportunities for social competence, e.g., interacting in classrooms and receiving feedback on social behavior might foster students' development of social skills, acquisition of social knowledge, and the development of self-concept of their respective abilities (for the latter see Berndt & Burgoyne, 1996). In this respect, social competence can be seen as an outcome variable.

Social competence is also conceivable as an input variable predicting school readiness (e.g. Hasselhorn & Lohaus, 2006) or academic achievement (see Welsh, Parke, Widaman & O'Neil, 2001). Hence, it seems of major interest to have a closer look on relevant facets of social competence in the early school years, their measurement, and development.

According to Rose-Krasnor (1997, p. 112) most definitions of social competence share the aspect of "effectiveness in social interaction", but measurement demands for criteria on more concrete levels of definition. In this respect, four central approaches to social competence are distinguishable: (1) social skill approaches, (2) peer status approaches, (3) relationship approaches, and (4) functional approaches.

The social self-concept refers to peer status as well as social skills; it is defined alternatively as (a) perception of social acceptance of one's own person or (b) perception of one's own social competence or social skills—usually social self-concept scales refer to the first definition (Berndt & Burgoyne, 1996, p. 171, 173).

Significant relations between social self-concept of acceptance and actual social acceptance are reported but turned out to be weaker for the early school years in some studies (see overview by Berndt & Burgoyne, 1996, p.195). They comment that there is much variation between perceived and actual acceptance depending on sample and measure whereby regular effects of age could not be detected and various sources of inaccuracy of self-evaluations have to be taken into account. In principle, correlational analyses of relations between social self-concept of acceptance and actual social acceptance investigate the correspondence between self and other perspective, more information is available by longitudinal data for investigating reciprocal effects.

Sociometric measures assess the social position (status) of individuals in their respective peer group and could be defined as an indirect measure of social competence; correlations between social status and behavior are mostly moderate because further characteristics of the person are influential (e.g. Bursuck & Asher, 1986, p. 41). In this respect it has to be noted that peer status can be defined by different patterns of association between acceptance and rejection (e.g. "social impact" is represented by the sum of a child's liking and disliking score, "social preference" by the difference of a child's liking and disliking score; Coie, Dodge, & Coppotelli, 1982, p. 559).

Investigating longitudinally the linkage between self-concept of social competence and peer status could help to understand whether self-perception of one's own skills in social situations has an effect on peer status (presumably mediated by one's own behavior) and / or whether peer status functions as a kind of social feedback for one's own perceived social skills.

Method

The study assessed the developmental period of grade 1 through 4 comprising four times of measurement. The first measurement started at grade 1 in April 2007; the last measurement at grade 4 was in spring 2010. Twenty-six schools, respectively fifty-four classes, took part in the study. The sample consists of 1003 children (at time 1; day 3 of assessment); for 188 children no parental permission was available. The measurements of the entire study include (1) central aspects of social competence like self-concept of social competence, social information processing (response generation), ratings of prosocial behavior, and sociometric indices, (2) cognitive and linguistic abilities and (3) academic achievement in reading, writing and mathematics (assessed by standardized instruments). Self-concept of social competence was measured by 15 items assessing contact, empathy, and emotion regulation (Arnold & Lindner-Mueller, 2004, rev. 2007). At grades 1 to 3 the self-concept questionnaire was administered as an individual interview, at grade 4 the children filled in the questionnaire by themselves. Sociometric status was assessed by asking the children to name those children they mostly favor to work together and those they like to work together least. Liking and disliking indices according to Pettit (1980) were calculated.

Complementary stability-indices ("structural stability", "level stability" and "normative stability") could be taken as a basis for analyzing the social self-concept (see Möller & Trautwein, 2009, referring to Mortimer, Finch, & Kumka, 1982). Reciprocal effects between social self-concept and sociometric status are analyzed investigating origins and effects of social self-concept over time. Structural equation modeling was employed using the software package Mplus.

Results

Referring to the first three points of measurement (1) structural stability for a two factor-model including only the contact- and empathy-items is indicated by good fit indices for each measurement point and a global measurement model over the three times. (2) Level stability could be found. In contrast to some other studies, no decrease of average scores of social self-concept shows up. (3) Stability of interindividual differences (normative stability) is substantial for social-preference and lower but even large for the social self-concept. (4) Only a slight influence of social preference on social self-concept is found. Further results will be presented testing whether this holds for the fourth point of measurement.

Gender differences in primary school students' domain specific self-concept development

Claudia Kastens, university of Kassel, Germany; Frank Lipowsky, University of Kassel, Institute of Educational Science, Germany

Within the PERLE-Study (Personality and learning development of primary school children) we reliably assessed primary school students' self-concept in three domains (numeracy, reading, and writing) from school enrollment to the end of fourth grade, which marks the end of primary school in most German states. Research on self-concept development in elementary school often reports a decline in self-concept over the school years. We applied Latent-Growth-Curve-Models to our longitudinal data to analyze self-concept development in all three domains by considering interindividual differences in initial level and trajectories over time. We also analyzed whether gender differences in self-concept development (change trajectories) exist for all three domains and if gender differences in level can already be seen when students enter primary school. The results of the LGCM (considering data from school enrollment to the end of third grade) undermine the importance of a domain specific perspective on self-concept development. A decline in self-concept cannot be shown for all domains. After controlling for achievement we only found significant gender differences for self-concept level for numeracy and for self-concept development for writing.

Tab. 2: Standardized regression coefficients of gender on level and slope; ***p<.001

SYMPOSIUM

Computer-supported Learning Environments

From concept to implementation: social presence in networked learning scenarios

Chairperson: Helga Dorner, Central European University, Hungary

Organiser: Ana Remesal-Ortiz, Universidad de Barcelona, Spain

Discussant: Jan-Willem Strijbos, Ludwig-Maximilians-Universitat, Germany

In a networked society, learners and also their teachers are increasingly using ICT tools to learn collaboratively and work together. Research has shown that establishing social presence is a prerequisite for interaction. This symposium gathers three different perspectives on the concept of social presence. The main purpose of the symposium is to generate debate, and challenge the current understanding of social presence in various contexts of computer supported education. In terms of theoretical background, the papers share different assumptions in different combinatorial pairs. While all of them depart from the original model of the Community of Inquiry, one paper proposes a revision of the concept. Two papers depart from a socio-constructivist conceptualization of the teaching and learning process, while a third paper takes a cognitive-constructivist perspective. Two of the papers purposefully link the object of study with motivation, from a Self-Determination Theory perspective, while the third does not this link. These differences at a theoretical level lead each of the authors to the search of the phenomenon in different interactional contexts, both with and without the instructors' intervention. The papers use a range of quantitative and qualitative methods in order to enhance the understanding of social presence. All authors agree with recognising social presence as a key factor for the successful development of online and blended courses. Nevertheless, each of the papers offers different arguments in favour of this point. In that sense, the contributors to the symposium expect to create a fruitful context for discussion with the audience.

The role of motivation and learning style on usage of ICT with low and high social presence

Bas Giesbers, Maastricht University, Netherlands; Bart Rienties, University of Surrey, United Kingdom

In recent years, the possibilities of Information and Communication Technology to support synchronous interaction in online learning have increased considerably. Web-videoconference systems offer several tools (like chat, audio, webcam) varying in the extent to which learners can display social and emotional information (social presence) when collaborating with others. In this study among 98 students in an online course on foundations of economics we examined whether the number of web-videoconferences a student participated in and the choice to use a range of communication tools was influenced by the individual characteristics motivation and learning style. We found a tendency toward intrinsic motivation and a disposition for stepwise learning in web-videoconference participants. Also, students participating more often tend to do so by using more rich communication tools. A challenge for future courses will be to find which students will benefit the most from the videoconferences and how they can be engaged more.

Conceptual Rationale Synchronous communication (like chat and videoconferencing) is superior to asynchronous communication (like discussion forums) in establishing discourse due to the ability to express immediate feedback (chat), ability to use voice and intonation and to show body language (videoconferencing) (Beers, Boshuizen, Kirschner, & Gijssels, 2007; Derks, Bos, & Grumbkow, 2007; Haythornthwaite, 2000; Tu, 2002; Tu & McIsaac, 2002). In terms of the Community of Inquiry model (Garrison, Anderson & Archer, 2000), synchronous communication fosters higher levels of social presence because there are more ways in which a person can project their personal characteristics to others. It is generally assumed that synchronous communication might reduce meaning barriers the obstruction of mutual construction of meaning of information from sender to receiver, when learners are working and learning together in an online classroom (Bromme, Hesse, & Spada, 2005; Rummel & Spada, 2005).

Research problem, aims and hypotheses

Adding web-videoconference to the course does not automatically lead to an increase in perceived usefulness of the course. Since students have the choice to participate and the means to project their identity, we want to know if there are individual characteristics that influence this choice. A large amount of research has found an influence of motivation, that is, the drive to learn, on contributions to discourse in a-synchronous discussion groups (Järvelä, Järvenoja, & Veermans, 2008; Veermans & Lalimo, 2008; Yang, 2006; Martens, Gulikers & Bastiaans, 2004). Intrinsically motivated students contribute more to task-related discourse, to planning and technical issues than extrinsically motivated students who contribute less actively, also in terms of social contributions. This leads us to expect that motivation also plays a role in a students' choice to participate in synchronous online communication which, to our knowledge, has not been addressed yet. We expect to find that students participating more often are more intrinsically motivated. In addition, we expect that intrinsically motivated students choose more rich communication tools. We expect that students who participate more actively, defined by the number of web-videoconferences attended and the richness of communication tools used, to have a strong disposition for stepwise learning and cooperation.

Research methodology

Participants were students in an online preparatory course for prospective bachelor students of an International Business degree programme of a Dutch university (N=98; age M = 19.5, SD = 1.28; 41% was female). For the purpose of this study, participants were divided into groups based on the number of times they participated in a web-videoconference: No participation (n = 15), participating once (n = 24), twice (n = 25), three times (n = 16), or four times (n = 18). Participation in the videoconferences was voluntary and to encourage students to do so, 1a participation score was calculated that constituted 10% of the final grade.

Results

Results indicate that the use of rich communication tools may be influenced by a more intrinsically directed motivation. Also, results show that students choosing to participate more often show a preference for a stepwise oriented learning style. With respect to performance measures we found the average score on the progress tests to be higher for students participating in all videoconferences compared to students participating once or twice. No significant result was found with respect to scores on the final test. Finally, the use of rich communication tools was found to be higher for students participating in all videoconferences compared to students participating once or twice. Discussion and conclusions When students can choose which ICT tools to use in an online classroom exercise, students do not automatically choose the richest ICT tools in terms of social presence. The use of rich ICT tools in our study is related to the type of motivation, whereby students with intrinsic motivation and stepwise oriented learning style were more inclined to use all web-videoconference facilities. Furthermore, these students were more inclined to continue with the online course and reach higher study success. In other words, differences in students' personal traits influence the selection, use and intensity of ICT tools. This implies that teachers should design online courses whereby students can choose a range of ICT tools that fit with their perception of social presence, learning style and motivation.

References

- Beers, P., Boshuizen, H., Kirschner, P. A., & Gijssels, W. H. (2007). The analysis of negotiation of common ground in CSCL. *Learning and Instruction*, 17(4), 427-435.
- Bromme, R., Hesse, F. W., & Spada, H. (Eds.). (2005). *Barriers and Biases in Computer-Mediated knowledge communication and how they may be overcome* (5 ed.). New York: Springer.
- Derks, D., Bos, A. E. R., & Grumbkow, J. v. (2007). Emoticons and social interaction on the Internet: the importance of social context. *Computers in Human Behavior*, 23(1), 842-849.
- Garrison, D., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education *The Internet and Higher Education*, 2(2), 87-105.

- Haythornthwaite, C. (2000). Online Personal Networks: Size, Composition and Media Use among Distance Learners. *New Media & Society*, 2(2), 195-226.
- Järvelä, S., Järvenoja, H., & Veermans, M. (2008). Understanding the dynamics of motivation in socially shared learning. *International Journal of Educational Research*, 47(2), 122-135.
- Martens, R., Gulikers, J., & Bastiaens, T. (2004). The impact of intrinsic motivation on e-learning in authentic computer tasks. *Journal of Computer Assisted Learning*, 20, 368-376.
- Rummel, N., & Spada, H. (2005). Instructional support for collaboration in desktop videoconference settings. In R. Bromme, Hesse, F.W., & Spada, H. (Ed.), *Barriers and Biases in Computer-Mediated knowledge communication and how they may be overcome* (5 ed., pp. 59-84). New York: Springer.
- Tu, C. (2002). The measurement of social presence in an online learning environment. *International Journal on E-Learning*, 1(2), 34-45.
- Tu, C., & McIsaac, S. M. (2002). The Relationship of Social Presence and Interaction in Online Classes. *American Journal of Distance Education*, 16(3), 131-150.
- Veermans, M., & Lallimo, J. (2007). Multimethod approach for analyzing students' motivational profiles and their participation in virtual collaboration. *Qwerty*, 1, 17-30.
- Yang, C.-C., Tsai, I. C., Kim, B., Cho, M.-H., & Laffey, J. M. (2006). Exploring the relationships between students' academic motivation and social ability in online learning environments. *The Internet and Higher Education*, 9(4), 277-286.

Training the trainers: Social and teaching presence in online mentoring

Helga Dorner, Central European University, Hungary

This study examines how Hungarian in-service teachers' social presence and their instructors' teaching presence are created and supported through online mentoring in the context of social interaction in an online collaborative professional development exercise. Transcripts of interactions among two groups of in-service teachers ($n = 23$, $n = 20$) and their instructors were analysed at the macro and micro level: at the macro level by Social Network Analysis; at the micro level by content analysis (Garrison, Anderson & Archer, 2001). When coding the interactions, we relied on numeric values indicating the agreement between two independent coders (Holsti's coefficient of reliability). Additionally to the above, we surveyed participants' satisfaction with the instructor's role and perceived social presence.

We found evidence of the effect of online interactions on the success of mentoring events i.e. participants' satisfaction with the experience. We also found that facilitator's activity and perceived social presence had significant influence on the participating in-service teachers' online communication. With the content analysis, we detected relations between facilitation approach and network interaction structures and strength of network ties. Accordingly, evidence of the effect of online mentoring on social presence was limited. We observed course characteristics (course structure, pragmatic and functional ways of instruction, scaffolding etc.) that can influence the creation of socially active communities. We intend to discuss the limitations of the applied research tools and suggest further research methodologies applicable in innovative mentoring models.

Conceptual rationale

Theories of social learning argue for the social aspects of learning and propose that cognition is a situated activity rooted in social, cultural contexts and interactions. From this perspective, learning is not the plain assimilation and accommodation of new knowledge, but it is the process by which learners become part of a knowledge community (Scardamalia & Bereiter, 1994; Vygotsky, 1978). The emergence of the new communication technologies enables new ways of designing and delivering education to learners. However, instructors are inadequately trained and not prepared for teaching and learning in an online environment (Harasim, 1991). Integrating the usage of computer-supported collaborative learning (CSCL) environments in in-service teacher training mentoring scenarios is one possible way to bring about change in communities where the intellectual traditions are merely based on individual knowledge creation processes. Accordingly, teachers' professional development has broadened to include learning communities that enable supportive interpersonal relationships and enhance professional growth. The success of such pedagogical scenarios is deeply impacted by the participants' experience of social presence, that is the degree to which a person is perceived as "real" in a mediated communication scenario (Short, Williams and Christie, 1976), and that is dependent on the extent to which the "illusion of nonmediation" (Lombard & Ditton, 1997) is maintained.

Research problem, aims and hypotheses

In such communities, the mistake of taking social interaction for granted often leads to „serial monologues" (Henri, 1991), which resemble the so-called IRE form of classroom discussion where the teacher initiates (I) the interaction,

learners respond (R), and the teacher evaluates (E) the responses (Lipponen, Rahikainen, Lallimo, & Hakkarainen, 2001). Since interaction does not simply occur but must be designed into the activities, the role of online instructors offering guidance and moderation in discussion is vital (Berge, 1999). Consequently, we focused on defining the online instructor's position within the ICT-based retooled mentoring scenarios. According to our hypothesis, online interaction facilitated by the instructor connected to creative collaborative activities is central to the success of mentoring events, and that instructors' teaching presence has an impact on participants' experience of social presence. We hypothesise that perceived social presence and online communication are interrelated phenomena and mutually impact each other in the mentoring process in the CSCL environment. We also address the questions whether the course structure and the facilitator approach provide adequate scaffolding to nurture development of social presence, if yes, then what pragmatic and functional ways of instruction can be designed to support these processes.

Research methodology

In order to be able to describe the underlying processes and the interrelatedness of social and teaching presence, transcripts of interactions among two groups of Hungarian in-service teachers ($n = 23$, $n = 20$) and their facilitators were analysed by two independent coders at the macro and micro level: at the macro level by carrying out Social Network Analysis; at the micro level by using content analysis, (Rourke, Anderson, Garrison & Archer, 1999; Anderson, Rourke, Garrison & Archer, 2001;) focusing on instructors' teaching presence and participants' social presence. Holsti's kappa was used for measuring interrater reliability. Additionally to the above methods, we surveyed participants' satisfaction with the online communication, instructor's role and perceived social presence.

Results

We found evidence of the effect of online interactions on the success of mentoring events i.e. participants' satisfaction with the experience, (p which could also imply that teaching and social presence are not interrelated phenomena. This provides for fruit for thought on challenging the concept of social presence, which is more frequently interpreted as a mediating variable between teaching and cognitive presence. However, with the content analysis we identified relations between facilitation approach and network interaction structures and strength of network ties. Additionally, we observed course characteristics that can influence the creation of socially active communities. We intend to discuss the limitations of the applied research tools and suggest further research methodologies applicable in innovative mentoring models.

References

- Anderson, T., Rourke, L., Garrison, D.R. and Archer, W. (2001). Assessing Teaching Presence in a Computer Conferencing Context. *Journal of Asynchronous Learning Networks*. 5(2). Retrieved on March 10 from http://www.sloan-c.org/publications/JALN/v5n2/v5n2_anderson.asp
- Berge, Z.L. (1999). Interaction in post-secondary Web-based learning. *Educational Technology*, 39(1), 5-11.
- Bonk, C. & Graham, C. (2005). *Handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer Publishing.
- Harasim, L.M. (1991). Teaching by computer conferencing. In A.J. Miller (Ed.), *Applications of computer conferencing to teacher education and human resource development*. Symposium conducted at the meeting of the International symposium on Computer Conferencing, Columbus, OH. (ERIC Document Reproduction Service No. ED 337 705)
- Henri, F. (1992). Computer conferencing and content analysis. In A. Kaye (Ed.) *Collaborative Learning Through Computer Conferencing: The Najaden papers* (p. 117-136). Berlin: Springer-Verlag.
- Lipponen, L., Rahikainen, M., Lallimo, J., & Hakkarainen, K. (2001). Analysing patterns of participation and discourse in elementary students' online science discussions. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning* (pp. 421-428). Maastricht: University of Maastricht.
- Lombard, M. and Ditton T. (1997). At the heart of it all: The concept of presence. *Journal of Computer Mediated Communications*, 3 (2). <http://jcmc.indiana.edu/vol3/issue2/lombard.html>
- Rourke, L., Anderson, T., Garrison, R., and Archer, W. (1999). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education* 14(2), 50 – 71.
- Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the Learning Sciences*, 3, 265-283.
- Short, J., Williams E., and Christie, B. (1976). *The social psychology of telecommunications*. London, John Wiley & Sons.
- Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Social Presence in small group work: it's all in the process

Rosa Colomina, Universidad de Barcelona, Spain; Ana Remesal-Ortiz, Universidad de Barcelona, Spain

In this study, the construct of social presence is approached from a socio-cultural perspective and thus recognised as an essential component of the virtual and blended collaborative learning process. Socio-cultural and social identity theory give support to interpret the development of a small group collaborative learning activity within a blended program at a bachelor program. Social presence is understood as the result of participants' enacted strategies to create and maintain a group identity and a shared goal, that is, social presence is seen as the sum of individuals' actions that contribute to the creation of a community feeling in such a way that the learning process is motivationally and emotionally supported. Participants of this study were 15 student-teachers who performed a collaborative writing activity during seven weeks, working in small groups of 3 and 4 members. They were expected to write a collaborative argumentative text by means of a non-specific asynchronous device (a forum space). Qualitative content analysis was carried out to classify the participants' interventions along two dimensions with each two opposite values: individual-oriented versus group-oriented, task-oriented versus people-oriented. Each of these dimensions holds three categories that contribute to draw an interaction map of each of the four groups in terms of their enacted social presence, highlighting different motivational aspects that appear to be playing a key role in their learning process.

Conceptual rationale

The importance of social presence was underlined in the late 1990s by the Community of Inquiry model (Rourke, Anderson, Garrison, & Archer, 1999). Social presence has been often equalled with students' satisfaction and learning post-hoc perception. Today, social presence is considered to be a mediating variable between teaching presence and cognitive presence.

In early studies, social presence has been mostly identified with off-task communication (Tu & McIsaac, 2002). However, recent research contributions highlight the importance of on-task figurative language in the process of creating a shared feeling of community, as a resource used by the participants to express their emotions along the learning process. Most of the previous studies have focused on online whole class discussions with no other expected shared result than the discussion itself. A quite different situation emerges when considering small group collaborative learning with different sorts of complex activities expected as group products. In that case, it seems necessary to rethink the concept of social presence from a different perspective. In this study social presence is understood as the result of participants' enacted strategies to create and maintain a group identity and a shared goal, that is, social presence is seen as the sum of individuals' actions that contribute to the creation of a community feeling in such a way that the learning process is motivationally and emotionally supported. From this perspective, there is a clear connection between the creation and maintenance of social presence and the regulation of motivational processes within the group, usually studied from a different perspective (Järvelä, Järvenoja, & Veermans, 2008). We also clame for a change of perspective in online learning that considers the contributions of social psychology and the notion of represented group, that is: the group is not an objective entity, but exists in the individuals' minds. The group members do act and react to the representation they have of the group and, in that sense, the group is continuously dynamically recreated (Rogers & Lea, 2005).

Research problem, aim, research questions

We approach social presence from a socio-cultural perspective and put the following research questions: How do the participants contribute to the creation and maintenance of social presence along the collaborative learning activity?

Design and analysis

We carried out a qualitative case study (Flick, 2002; Yin, 2009). Four small groups of student-teachers participated. The students worked together for a whole academic year in a blended program. Data were gathered during the realization of the last course assignment under complete on-line conditions, during seven weeks. The writing work was performed by means of a particular e-learning platform which offered asynchronous instruments (Moodle). Qualitative content analysis of the forum contributions (274 postings) was carried out. Two units of analysis were taken into account. First, the basic unit of meaning was the fragment of discourse in any posting. Second, the postings per se, and the historical development of the threads was taken as a contextual unit of meaning. The categories and indicators were initially defined based on the literature review. Progressively, they were revised and readjusted in an iterative analysis searching for inter-judges agreement.

Results

Categories were defined along two dimensions concerning the self-positioning of the individuals' in front of the task and in front of the other collaborators. The categories collect the individuals' positioning in terms of their explicit communication of positive or negative perceptions and expectations of the group performance. Results show, first of all, a great amount of social presence. This stands in contrast with previous studies, where only off-task conversation was considered to be 'social'. Results point, too, to certain gender-based differences in the process of social presence

management along the collaborative activity. Different emergent roles can be identified as well among the participants, pointing to power relations.

Discussion and conclusions

These results are important as far as they permit to rethink the concept of social presence within the field of collaborative computer supported learning in situations in which a real shared goal and product is expected from the participants, in contrast with previous studies, where social presence is considered a post-facto satisfaction measure of big-group debate situations. Thus, now it is possible to identify poor motivational situations and intervene appropriately as a teacher in order to enhance e-learning processes. For example, it is possible to identify groups focusing just on group-identity but forgetting about the task, or groups too much on the task and on the individual participation but not building a sense of group identity. Ideally, there should be a balance between all categories for a sound social presence leading to an enhanced learning.

Certainly, the fact that only four groups were analysed poses important limitations to the results. Nevertheless, the explorative purpose of this first study allows such a qualitative small-sample approach. Another shortcoming of the study is its relatively short duration. The fact that this learning activity took place at the end of course, with all group members knowing each other already for months, definitely must have an impact. Different results ought to be expected at the beginning of a course, when group members first meet. A definitive open issue pointed out by this study is the gender composition of the groups and its influence on social presence.

References

- Flick, U. (2002). Qualitative research. State of the Art. *Social Science Information*. 41(1), 5-24.
- Järvelä, S., Järvenoja, H., & Veermans, M. (2008). Understanding the dynamics of motivation in socially shared learning. *International Journal of Educational Research*, 47(2), 122-135.
- Rogers, P. & Lea, M. (2005). Social presence in distributed group environments: the role of social identity. *Behaviour & Information Technology*, 24(2), 151-158.
- Rourke, L., Anderson, T., Garrison, R., and Archer, W. (1999). Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education* 14(2), 50 – 71.
- Tu, C., & Mclsaac, S. M. (2002). The Relationship of Social Presence and Interaction in Online Classes. *American Journal of Distance Education*, 16(3), 131-150.
- Yin, R.K. (2009). *Case Study research. Design and methods* (4th Ed). Los Angeles, CA: SAGE.

SYMPOSIUM

Teacher Education

Studying Effectiveness of TPD at the Level of Individual Teachers and Local Communities

Chairperson: Alexander Groeschner, Technische University Munchen, Germany

Organiser: Alexander Groeschner, Technische University Munchen, Germany

Tina Seidel, Technische Universität München, Germany

Discussant: Manfred Prenzel, TUM School of Education, Germany

Aims of the symposium.

Recent research on teacher professional development (TPD) emphasizes a number of factors influencing the effectiveness of such programs for promoting teacher learning. So far, emphasis has been placed especially on the relationship between characteristics of TPD (duration, active learning, cooperative learning) and individual teacher factors (knowledge in a domain, motivation for professional development). In addition, TPD characteristics in relation to factors at the level of schools and the local school community have been pointed out. The aim of this symposium is to present research findings investigating the relationship between TPD and individual and local community factors, as well as to provide a systematic overview of recent approaches to studying effective TPD. In order to achieve this aim, the symposium includes both a meta-analysis and review summarizing the state-of-art and identifying fields of future research, as well as two papers which provide an in-depth look at particular aspects of TPD. Scientific and educational relevance. Research on TPD suggests that there is still a range of professional development formats that either have been shown to lead to different effects or have not yet been studied in detail. This symposium provides both a broad perspective, considering broadly applicable findings with respect to TPD, as well as detailed consideration of factors at both the individual and school community levels. In this way, the symposium contributes examples of evidence for effective factors in TPD and points to directions for future research.

Effective Interventions for Professional Development of Teachers: A Review Study

Klaas van Veen, Leiden University, Netherlands; Rosanne Zwart, VU University, Netherlands; Jacobiene Meirink, ICLON Graduate School of Teaching, Leiden University, Netherlands; Nico Verloop, ICLON Graduate School of Teaching, Leiden University, Netherlands

This review study aims to explore what is currently known about the effectiveness of teachers' professional development programs or PD interventions on the quality of teachers, their teaching, and student learning. The review brings together 11 major reviews and texts on effective PD, and 37 recent empirical studies from the last ten years. Next to reviewing the effective characteristics of PD interventions, it also explores the often neglected domain in PD literature of the school organizational conditions necessary to implement and sustain successfully PD in the school. One major conclusion and point of discussion is that reviewing the field of effective PD is actually mapping out the terrain of research that still needs to be done.

Aims

Teacher professional development in this review is referred to as those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students (Guskey, 2000). The focus of the review is on those activities explicitly designed for professional development of teachers, which are described as interventions for PD. The review refers to four main problems in this field: 1) The state of the art of research on effective PD is problematic because most research only refers to the effects of one PD program, and still little is known about effective PD when a program is delivered in a range of typical settings and by multiple trainers. Furthermore, the evidence on features of effective PD is weak (Borko, 2004; Wayne, Yoon, Zhu, Cronen & Garet, 2008); 2) Different theoretical frames are (often implicitly) used to explore and develop effective PD (Desimone, 2009); 3) There are more empirical studies on traditional PD interventions than on the more current progressive ones (Wayne et al., 2008); 4) Research on effective PD hardly explores the school organizational conditions necessary to implement and sustain successfully PD in schools (Imants & van Veen, 2010). So, this review aims first to bring together what is the state of the art of research on effective PD and what is known about the features and conditions of effective PD. Second, the review uses the findings to discuss these four problems. Considering that most of these problems are well known for the last ten years (cf. Kennedy, 1998; Borko, 2004), the nature and implications of these problems are discussed, and directions for further research suggested.

Methodology

Literature searches were conducted with the use of ERIC, PsychINFO, Dissertation Abstracts, Sociological Collection, PiCarta en Google Scholar. Furthermore, references of previous reviews were examined, and various international experts in the field were consulted (including well-known researchers in the US, and Europe). The review focuses explicitly on the effects of PD interventions, so activities deliberately designed for teachers' professional development. This implies that related fields as informal learning has been excluded. Furthermore, in line with Desimone's (2009) conceptual frame, the studies should refer to effects of PD interventions on teachers and/or students. The review first brings together 11 major reviews and texts on effective PD that cover the last 25 years of research on PD interventions. Furthermore, 37 empirical studies are included from the last 10 years. Together they provide an impressive collection of theoretical and empirical body of research of the last 25 years.

Findings

Regarding the nature of research on effective PD, the review summarizes and discusses the problems found. The problems refer to teacher knowledge and skills as the major outcome measure (studies that include teaching behavior or student outcomes are relatively rare); the most common measure is teachers' perceptions (more quasi-objective measures are hardly used); general measures instead of PD specific ones; most effect research is on traditional PD; and Borko's (2004) observation of the lack of studies exploring PD programs in a range of typical settings and by multiple trainers. Considering these problems, some prefer to speak of a consensus on features for effective PD, some argue for improved and more rigid research designs. The review summarizes the empirical evidence on effective features. Despite the current tendency to favor more progressive PD interventions, the type of interventions in terms of traditional versus progressive does not seem to matter significantly: in both cases evidence is found that it is effective or not effective. Other features are more relevant for effective PD, such as a focus on subject content, subject pedagogy, active learning, coherence, duration, collective participation, and an explicit theory of change and instruction. However, the problem remains these effective features lack sufficient specificity to guide practice. Often it is too general, or the study is too context-specific. And most studies refer to math and science, and hardly to other subject areas. A last set of conclusions refers to the school organizational conditions for PD interventions to be successfully implemented and sustained. Only a few PD studies pay attention to this topic. In related bodies of literature, such as workplace learning, more relevant insights can be found about the conditions for learning in the workplace. However, hardly any empirical studies can be found exploring PD interventions in relation to those

conditions. Still, a relevant overview of potential relevant factors can be given. In general it can be stated that schools and classrooms are mainly designed for student to learn and for teachers to work, and hardly for teachers to learn.

Educational and theoretical relevance

A first contribution of this review is that it brings together a collection of relevant reviews and texts, and adding new empirical studies, trying to synthesize the different findings and perspectives. Secondly, Desimone's conceptual frame is used for this review, supporting her proposal to use one general frame in this largely fragmented field of research. Lastly, an attempt is made to combine insights from literature on PD with literature on workplace learning to gain more insights in how to successfully implement and sustain effective PD in schools.

References

- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 3–15.
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181–199.
- Guskey, T.R. (2000). *Evaluating Professional Development*. Thousand Oaks: Corwin Press.
- Imants, J., & Veen van, K. (2010). Teacher Learning as Workplace Learning. *International Encyclopedia of Education*. P. Peterson, Baker, E., & McGraw, B. Oxford, Elsevier. 7: 569-574.
- Kennedy, M. (1998). *Form and substance of inservice teacher education* (Research Monograph No. 13). Madison: University of Wisconsin-Madison, National Institute for Science Education.
- Wayne, A. J., Yoon, K. S., Zhu, P., Cronen, S., & Garet, M. S. (2008). Experimenting with teacher professional development: Motives & methods. *Educational Researcher*, 37(8), 469-479.

Learning Processes in a Video-based Learning-Environment

Marc Kleinknecht, TU Munchen, Germany

Currently, there is a growing interest in using video as a reflective tool for professional teacher development. However, there is still little evidence for the specific effects that different types of video-based learning environments may have on teacher's learning processes. This study focuses on cognitive, motivational, and emotional processes that teachers experience during the analysis of videos of their own teaching compared to a group commenting videos of other teachers. For answering this question, a sample of ten eighth-grade experienced mathematics teachers analyzed 10 to 15 minute segments of videos of their own or external classroom situations in a newly developed computer-based learning environment. During their work on the videos, the teachers answered either open questions or structured questions with regard to 'cognitive activation'-focused observation tasks. Content analysis of the teachers' answers revealed strong differences between the teachers who commented their 'own teaching' versus teachers who commented 'other's teaching'. Particularly, the findings indicate that teachers who analyzed their own videos are more intensively emotionally involved than others. This emotional involvement has a detrimental impact on cognitive aspects of analyzing the videos because it draws away resources that are necessary to describe teaching situations in a neutral manner. The study emphasizes that different learning objectives need to be addressed before using videos of teachers' own teaching or that of others. The applied learning environment is used primarily for the process-orientated future research on teachers' differential learning processes.

Aims

Currently, two different learning arrangements are used widely in video-based teacher trainings: an individual reflection on the video or a discussion and joint reflection in groups (Brophy, 2004). These two settings allow both the usage of own videos and videos of others' teaching. This study focuses on the one hand the individual observation of own versus other teaching and on the other hand two different structured instructions for observation. The study refers to three main research questions:

- 1) What cognitive learning processes are activated when teachers observe video clips of their own teaching or that of others?
- 2) What emotional and motivational learning processes are initiated when teachers observe clips of their own teaching or that of others?
- 3) To what extent do cognitive and motivational-affective processes influence each other while commenting on video?

According to the findings of Seidel et al. (2011) we expected positive motivational effects derived by teachers who have analyzed videos of their own classrooms. The observation of others' classroom situations should lead to viewer's deeper reflection on critical incidents.

Methodology

Ten grade 8 mathematic teachers took part in this study. For the five teachers in the group 'own video' we selected 10-15 minutes videoclips from previously videotaped lessons. The clips show classroom dialogues before and after student seatwork phases. Teachers were matched to the two groups taking gender and the duration of teaching experience into account. Five pairs of teachers were grouped together with one person commenting the own video and one person commenting the same clip as 'other video'.

The videos were implemented in a computer-based learning environment. All teachers observed their video clip on their own and two times. First, no specific instructions were given. Afterwards teachers were able to pause and comment the clip whenever a scene of interest occurred. In the second stage, teachers were supposed to identify situations in which the teachers in the videos demonstrated behavior that cognitively activates the students. Before completing this task, the learning environment prompted an explanation of the concept of cognitive activation. As before the participants were asked to answer open-ended questions on their emotion and motivation. Additionally fixed questions with rating format items were used to evaluate the trait emotions and motivations after the two stages of observation (cf. Seidel et al., 2011).

Teachers' written comments were analyzed using a category system that focused on noticing classroom situations and knowledge-based reasoning processes which is based on the works by Sherin (2007) and Seidel et al. (2011).

Findings

In cognitive terms, the two groups differ in the perception of events ('noticing') and the knowledge-based reasoning process. Teachers of the 'own video'-group stopped the video especially in the first stage of observation more often. They frequently commented more scenes than teachers of the 'other video' group. An opposite picture emerged in different categories of the knowledge-based reasoning process. Teachers of the 'other video'-group named more alternatives with regard to teachers' ability of behavior in observed situations. Moreover, they discussed the filmed classroom situations more critically.

In terms of emotion and motivation the results also show a disparity between the groups. Teachers of the 'own video'-group reported more likely to be emotionally involved in the observed scenes. In particular, they account their perceived anger and disappointments. Furthermore, their comments contained evidence of a higher degree of involvement in observed situations and more reported connections to own teaching.

Educational and theoretical relevance

The findings of this study show substantial differences between the two groups. The observation of videos of others' teaching enables deeper reflection processes, while observing videos of own teaching leads to a higher degree of emotional and motivational involvement. Results suggest that video-clips of 'others teaching' are valuable to initiate emotionally distant and theoretically oriented systematic reflection in teacher professional development closely connected to classroom practice. In contrast, observing of video-clips of 'own teaching' should be guided more by teachers' experienced situations. Questions or tasks of reflection should be induced selectively and carefully. Through the conclusiveness of the study is limited by the small sample size. A follow-up study with a larger sample should prove evidence of this research. For this purpose the developed video-based learning-environment could be used for the process-oriented, introspective analysis of teacher cognition, motivation and emotion.

References

- Brophy, J. (2004). Using video in teacher education. Oxford, UK: Elsevier.
- Seidel, T, Styrmer, K., Blomberg, G., Kobarg, M. & Schwindt, K. (2011). Teacher learning from analysis of videotaped classroom situations. Does it make a difference whether teachers observe their own teaching or that of others? *Teaching and Teacher Education*, 259-267. doi: 10.1016/j.tate.2010.08.009
- Sherin, M.G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron & S.J. Derry (Eds.), *Video research in the learning sciences* (pp. 383-395). Mahwah, NJ: Lawrence Erlbaum.

Practicing Teachers' Engagement with Video Clips Designed to Support PCK Development

Alicia Alonzo, Michigan State University, United States; Jiwon Kim, Michigan State University, United States

Video can be a powerful tool for teacher development (e.g., Borko, Jacobs, Eiteljorg, & Pittman, 2008; Sherin & van Es, 2009), offering a common classroom context for discussion. However, the interplay between work in professional development and classroom settings is influenced by the way in which artifacts of practice are used in professional development and, thus, depends, in part, upon the types of videos selected for discussion (Sherin, Linsenmeier, & van Es, 2009; van Es & Sherin, 2008). In this study, we sought to explore the types of conversations elicited by video clips selected to support beginning physics teachers' pedagogical content knowledge (PCK; Shulman, 1986) for teaching force and motion concepts. Video clips from experienced teachers' classrooms were used in a short, relatively unstructured professional development workshop. Teachers' conversations were analyzed both broadly – using a framework developed by Alonzo and Sato (2010) and by Sherin et al. (2009) – and more specifically – making comparisons to researchers' expectations for the specific discussions the video clips would elicit. Teachers' conversations were generally of high quality (according to the Sherin et al. framework) and broadly covered the three areas predicted by researchers – student thinking, pedagogical potential of instructional representations, and physics content. However, the specific foci of these conversations differed in important ways from researchers' expectations. These results have important implications, both for the selection of video clips and for the support for teachers' discussions of video evidence in professional development settings.

Aims

Video can be a powerful tool for teacher development (e.g., Borko et al., 2008), offering a common classroom context for discussion. However, we know too little about the interplay between teachers' work in professional development and classroom settings (Kazemi & Hubbard, 2008). This interplay is influenced by how artifacts of practice are used in professional development and, thus, depends, in part, upon the videos selected for discussion (Sherin et al., 2009). We are interested in identifying video clips that can be used to support beginning physics teachers' pedagogical content knowledge (PCK; Shulman, 1986) for teaching force and motion concepts. Therefore, we focus upon video clips that highlight student thinking and hope to elicit conversations about students' ideas, pedagogical responses to those ideas, and puzzling aspects of physics content. In this study, we sought to explore the types of conversations elicited by such video clips.

Methodology

Using the coding and selection procedures described in Alonzo and Sato (2010), we created video clips from video-taped observations (3-4 per teacher) in three experienced teachers' classrooms. Ten video clips with potential to elicit conversations about student thinking, pedagogical potential of instructional representations, and/or physics content were organized into five "video cases", each containing 1-3 video clips and associated classroom artifacts (e.g., a lab worksheet). A researcher not involved in the creation of the video clips rated each according to Sherin et al.'s (2009) criteria for evidence of student thinking – windows into student thinking, depth of student thinking, and clarity of student thinking. Eight physics teachers with a range of experiences engaged with the video cases as part of a relatively short (2-hour) professional development workshop. In groups of 2-3, teachers discussed 1-2 video cases during the workshop. The facilitator posed two questions designed to focus attention on student thinking and pedagogical responses to that thinking, but provided little additional guidance. Cameras recorded each group's conversation; transcripts were created to aid the analysis, which proceeded in two stages. First, teachers' conversations about each video clip were rated according to Sherin et al.'s (2009) criteria for discussions of student thinking – focus on student thinking, substance of discussion, and joint sense making. Second, an exploration of teachers' conversations was undertaken to examine the match to researchers' predictions – both broadly, in terms of whether teachers discussed student thinking, pedagogical potential, or physics content, and specifically, in terms of whether teachers noticed (van Es & Sherin, 2002) the same aspects of student thinking as the researchers did.

Findings

Researchers predicted that all ten video clips would elicit discussions of student thinking. About half of the video clips were thought to raise interesting issues with respect to the pedagogical potential of an instructional representation, and only a few were predicted to seed conversations about physics content. The 10 video clips rated highly on Sherin et al.'s criteria; 22 of the 30 ratings were medium-high or high, and none were below medium. Broadly, the nature of teachers' discussions was consistent with that predicted by the researchers. Student thinking (the nature of students' ideas and/or pedagogical responses to that thinking) was discussed most often, followed by consideration of instructional representations depicted in the videos; only a few conversations focused on physics content. The video clips elicited conversations which rated highly on Sherin et al.'s criteria. Discussions about all clips were consistent with a rating of high for joint sense-making. Ratings for the focus on student thinking tended to be slightly lower (typically, medium-high); although student ideas were identified and oriented teachers' conversations, they were not consistently treated as objects of inquiry. The lowest ratings (typically medium) were awarded in "substance of discussion" category; consideration of students' ideas was not always linked to the underlying physics content. While teachers' conversations were generally of high quality and broadly covered the three areas predicted by researchers,

their specific foci differed in important ways from researchers' expectations. This was often simply a matter of teachers and researchers noticing different aspects of the video. In addition, while researchers tended to view the videos as providing evidence of a general class of student idea, the teachers focused on specific students and classroom contexts; their pedagogical responses tended to be more contextualized and less focused on specific features of the content.

Theoretical and educational significance

Much of the work examining teachers' interactions with video evidence has taken place in mathematics (e.g., Borko et al., 2008; Sherin et al., 2009); this study provides an extension to science education. In addition, while much of the work in mathematics has focused broadly on the nature and quality of teachers' discussions, this study more specifically explores the substance of teachers' conversations and, thus, has implications for both the selection of video clips and needed support for teachers' discussions of video in professional development settings. Theoretically, as part of a larger program of research, this study contributes to a greater understanding of the ways in which teachers engage with video and the relationship between these discussions and classroom practice.

References

- Alonzo, A. C., & Sato, T. C. (2010, May). Using "noticing" to select video clips for beginning teacher professional development. Paper presented at the annual meeting of the American Educational Research Association, Denver, CO.
- Borko, H., Jacobs, J. K., Eiteljorg, E., & Pittman, M. E. (2008). Video as a tool for fostering productive discussions in mathematics professional development. *Teaching and Teacher Education*, 24, 417-436.
- Kazemi, E., & Hubbard, A. (2008). New directions for the design and study of professional development: Attending to the coevolution of teachers' participation across contexts. *Journal of Teacher Education*, 59, 428-441.
- Sherin, M. G., Linsenmeier, K. A., & van Es, E. A. (2009). Selecting video clips to promote mathematics teachers' discussion of student thinking. *Journal of Teacher Education*, 60, 213-230.
- Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- van Es, E. A., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education*, 10, 571-596.

SYMPOSIUM

Social Interaction in Learning and Instruction

A less partial vision: Multi-theoretic research into science classrooms

Chairperson: Ida Ah Chee Mok, The University of Hong Kong, China

Organiser: David Clarke, University of Melbourne, Australia

Discussant: Neil Mercer, University of Cambridge, United Kingdom

A key aspiration of classroom research is the generation of empirically-grounded instructional advocacy. Since different research studies undertake data generation and analysis using different theories, the warrant that might be claimed for the consequent advocacy of any particular instructional action is contingent on the chosen theory, among other considerations. In the analyses that provide the focus of this symposium, multi-camera on-site video technology and post-lesson video stimulated interviews were used in a purposefully inclusive research design to generate a complex data set amenable to parallel analyses from several complementary theoretical perspectives. This symposium reports the results of parallel analyses employing distributed cognition, systemic functional linguistics, and positioning theory of the same nine-lesson sequence in a single science classroom during the teaching of a single topic. While each analysis is demonstrably valuable in itself, in combination, these results demonstrate the inadequacy of any single theory or theoretically-driven analysis to capture the complexity of the science classroom and the corresponding need for inclusive multi-theoretic research designs. In this symposium, while also addressing other goals, each of the three presentations examines student meaning making in relation to the concept of expansion in the same lesson sequence using the different theoretical lenses already identified.

The research design employed multiple, synchronised recordings of classroom interaction in order to maximize the sensitivity of the parallel analyses to a wide range of classroom actions and learning outcomes. This symposium specifically addresses the challenge of generating evidence-based instructional advocacy from multiple analyses drawing on different theoretical perspectives, even where the focus of analysis is the same setting and relates to the learning of the same science content.

The Challenges of Making Sense of the Microscopic World in a Secondary Science Classroom

Despite its importance, many studies have found that students experienced great difficulties in understanding the ideas behind the particulate nature of matter and its associated concepts (Driver, et al., 1985; Driver & Project, 1994). Based on the perspective of Distributed Cognition (Hutchins, 1995), our analysis focused on social interactions between classroom participants and their interactions with physical, conceptual and symbolic artefacts. Student understanding was examined as performed in their actions and displayed in their written work. This paper examines a group of students' attempt to make sense of the particulate ideas and to explain several phenomena such as melting, boiling, expansion, and contraction in their classroom. It appears that even though the Particle Theory had been introduced as a model in the classroom that can be used to explain many changes undergone by matter, the students tended to use the macroscopic properties to explain the microscopic ones, rather than the opposite. We propose that substance could be the key to unlock the macroscopic-microscopic relationship, and an explicit introduction to the idea of substance in particulate terms could have provided the students with a mechanism to generate the connection between the macroscopic phenomena and the microscopic model, and could have helped the students to see how the particle model could be applied in a variety of situations.

The particulate nature of matter is one of the most important ideas in science, particularly in chemistry, it is believed to be fundamental to every topic (Harrison & Treagust, 2002). Despite its importance, many studies have found that students experienced great difficulties in understanding the ideas behind the particulate nature of matter and its associated concepts (Driver, et al., 1985; Driver & Project, 1994). In this paper, we explore a group of students' attempts to make sense of the particulate ideas presented in their classroom. Based on the perspective of Distributed Cognition (Hutchins, 1995), the analysis focuses on social interactions between participants and their interactions with physical, conceptual and symbolic artefacts. Student understanding was examined as performed in their actions and displayed in their written work. The analysis identified similar student difficulties found in the literature, but the detailed analysis of the learning process revealed the potential sources of student difficulties and suggests a possible way forward.

In the classroom studied, the Particle Theory was formally introduced in Lessons 5 and 6 as an explanatory framework for why changes of state occurred. It was presented in the form of five statements (see table 1).

Table 1 Particle Theory of Matter (notes from the board)

See Appendix 1

Using the Particle Theory to explain expansion

One of the examples in which the students were expected to use the Particle Theory was found in Lesson 9, in which the class discussed several physical phenomena such as diffusion, contraction, expansion, and air pressure. To illustrate the phenomenon of expansion, the teacher gave a demonstration of activity C (see table 2). Two other activities (A and B) were assigned to be completed by each student group. For each activity, the students were asked to provide their predictions, observations, and explanations.

Table 2 Practical Activities in Lesson Nine (instructions from the prac worksheet)

See Appendix 2

For all three activities, the students were expected to make connections between the macroscopic world (e.g. the inflating of the balloon) and the microscopic world (the movement and the arrangement of particles). The analysis of student interactions showed that the students had different ideas about expansion, and their explanations also differed depending on the state of the object. While it is easier for the students to conceive the expansion of the balloon in terms of an increase in the amount of gas (Sydney) or the movement of gas particles (Lionel and Keith), the expansion of the metal ball appear to be less comprehensible in terms of conceiving what was happening at the microscopic level. The comprehending process is not the same as the process of understanding the expansion of the balloon because the expansion of the metal ball was not embodied graphically to be visible to the students, instead it has to be inferred from the action of fitting the ball through the ring. Furthermore, although the students frequently employed the word "particles" in their explanations of the inflation of a balloon, a careful scrutiny revealed that the students were thinking of particles based on their observations of what was happening at the macroscopic level without giving much attention to the microscopic events.

It appears that even though the Particle Theory had been introduced as a model in the classroom that can be used to explain many changes undergone by matter, the students did not have a clear idea of how the particle model could be applied in all situations. From the analysis reported above, student conceptualization of what was happening at the particle level was largely constrained by what they could “see” at the macroscopic level. And the students tended to use the macroscopic properties to explain the microscopic ones, rather than the opposite. This is consistent with findings reported in the literature (see also Pozo & Crespo, 2005). Such a tendency, as can be argued, was due to the lack of clarity about the relationship between the microscopic model and the macroscopic phenomena. We propose that substance could be the key to unlock the macroscopic-microscopic relationship, and an explicit introduction to the idea of substance in particulate terms could have provided the students with a mechanism to generate the connection between the macroscopic phenomenon and the microscopic model, and could have helped the students to see how the particle model could be applied in a variety of situations.

Reference

- Driver, R., Guesne, E., & Tiberghien, A. (1985). *Children's ideas in science*. Philadelphia: Open University Press.
- Driver, R., & Leeds National Curriculum Science Support Project (1994). *Making sense of secondary science: research into children's ideas*. London: Routledge.
- Harrison, A. G., & Treagust, D. F. (2002). The Particulate Nature of Matter: Challenges in understanding the submicroscopic world. In J. K. Gilbert, O. D. Jong, R. Justi, D. F. Treagust & J. H. V. Driel (Eds.), *Chemical Education: Towards Research-based Practice* (Vol. 17, pp. 189-212). Dordrecht: Kluwer Academic Publishers.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge, Mass.: MIT Press.
- Pozo, J. I., & Crespo, M. A. G. (2005). The Embodied Nature of Implicit Theories: The consistency of ideas about the nature of matter. *Cognition and Instruction*, 23(3), 351-387.

Understanding the conceptual and representational demands of learning the language of school science

Lay-Hoon Seah, University of Gothenburg, Sweden; Christina Hart, University of Melbourne, Australia; David Clarke, University of Melbourne, Australia

The appropriation of the language of school science is a widely acknowledged goal of science education. By focusing on the role of language as both cognitive and semiotic tools, this study sought to understand the conceptual and representational demands on students when they employ the language of school science in response to written tasks. Grade 7 students' written assignments related to expansion were examined in terms of their content and their use of linguistic or lexicogrammatical (LG) resources. Similarities and differences in the use of LG resources among the students' writings were identified from which we derived patterns of language use that appeared to be significant for realising scientific meanings. To illuminate the challenges that students encountered when representing scientific meanings related to expansion, we examined these patterns of language use through the lens of an integrated framework of socio-constructivist and socio-semiotic perspectives. The findings of this study point to the productivity of examining the students' language at a lexicogrammatical level as well as some pedagogical strategies that can be adopted to facilitate the appropriation and employment of the language of school science.

Numerous studies have been conducted on the conceptual demands involved in the learning of particular science topics. By contrast, there are few studies that focus on the linguistic demands that students face when representing scientific meanings of specific topics. Research on the features of the language of school science generally focused on language used in science in general rather than that encountered in specific topic domains. With the data available, this study sought to address this gap in the research by surfacing both the conceptual and representation demands when students attempted to represent scientific meanings specific to the topic of thermal expansion. The classroom data source for this study was generated by a larger project entitled 'Causal Connections in Science Classrooms' (CCSC project), which employed a variety of data-generation techniques. Among them were: video-recordings of the lessons using four video-cameras (focusing on the teacher, the whole class, and two groups of focus students), video-stimulated teacher and student interviews after each lesson, and collection of classroom artefacts (including teaching materials and the students' written work).

This study adopted an interpretive approach to qualitative data analysis. In order to gain an in-depth understanding of the process of appropriation and employment of the language of school science, a single case study approach was adopted. A case study approach was particularly suitable for this study as it provided a bounded system that facilitated the study of language-in-use within, and as a consequence of, the social context. In this study, the case was the use of language in a sequence of lessons on the topic “States of Matter” conducted in a Grade 7 suburban Melbourne classroom. Within this case were instances in which the language used concerned a variety of distinct sub-

topics. Specifically, for the purpose of this study, the data presented were confined to the language related to expansion.

The data consisted mainly of the students' written responses to two tasks related to expansion. We subjected the students' writings to two phases of analysis:

Phase 1 - Content analysis: This phase involved classifying the students' writings according to their content, using coding categories (referred to as "explanatory foci") that were inductively derived through the method of constant comparison (Glaser & Strauss, 1967).

Phase 2 - Lexicogrammatical analysis: This phase involved identifying the lexicogrammatical (LG) resources (that is, vocabulary and grammatical resources such as pronouns and conjunctions) found within each explanatory focus and classifying these into linguistic classes taken from the ergative model of the Systemic Functional Linguistics framework (Halliday, 1994).

Both phases of analysis revealed similarities and differences in the use of LG resources among the students' writings, from which we identified several patterns of language use that appeared to be significant for realising scientific meanings. Some of these patterns of language use were: the association of the different explanatory foci with distinctive sets of LG resources; the use of the same LG resources across different explanatory foci; different expressions of heat-related cause of expansion; and the indiscriminate use of pronouns. We then examined these patterns of language use through the lens of the socio-constructivist (emphasizing the use of language as cultural and cognitive tools) and the socio-semiotic (emphasizing the use of language as semiotic tools) perspectives to understand the conceptual and representational demands that students face when representing scientific meanings related to expansion. The conceptual demands relate to the need to differentiate phenomena at the macro- and submicro-levels of representations, while the representation demands relate to the need to learn about the conventional and functional use of different types of LG resources so as to represent one's intended meaning accurately and precisely. This study further supports the assumption that underlines both the socio-constructivist and socio-semiotic perspectives of learning - that learning the language of school science is constitutive of learning science. Our findings point to the productivity of adopting an analytical frame that targeted students' written language at a lexicogrammatical level as well as pedagogical interventions that facilitate the learning of the language of school science specifically related to expansion.

References

- Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory*. Chicago: Aldine.
- Halliday, M. A. K. (1994). *An introduction to functional grammar* (2nd ed.). London: Edward Arnold.

"I need to think of a prediction" – An Analysis of Students' Meaning Making in Science Using Discurs

Jennifer Arnold, The University of Melbourne, Australia

This paper reports findings from a study concerned with students' meaning making in a middle school science classroom. Student discourse that was recorded in a sequence of classroom videotapes and post-lesson, video-stimulated interviews was analysed using discursive psychology and, in particular, positioning theory. Conversational episodes related to practical work on the expansion of solids, liquids and gases structured as P.O.E (Predict. Observe. Explain) activities have been selected as representative of the findings of the study. It was found that the students took the practice of writing practical reports as a personal responsibility. In taking personal responsibility, discussion and argumentation of their predictions and explanations related to the expansion activities using scientific concepts was limited. The practice of observing during practical activities was found to be taken by the students as a shared endeavour. In taking shared responsibility, their observations cannot be understood in terms of individual perception of an ontologically given reality such as the expansion of the liquid when it was heated, calling pedagogical initiatives grounded in cognitive psychology and perceptualism into question. The findings highlight the complex social process of meaning making in science classrooms and the need to attend to local moral orders of rights and duties in research on student language use and learning in science.

Researchers in science education have been concerned with understanding the science student (Goodrum and Rennie 2007). The need for such research is grounded in contemporary issues such as providing opportunities for all students to develop scientific literacy (Osborne 2003) and the failure of school science to connect with student's lives, interests and their sense of personal identity (Brickhouse 2001; Lemke 2001; Kozoll and Osborne 2004). The purpose of this research was to contribute to an understanding of the way students make meaning in secondary school science.

The focus on meaning rather than student attitudes (Costa 1995; Brown 2004), knowledge (Talanquer 2009), cultural affiliations (Costa 1995; Aikenhead 2001; Brown 2004) or identity (Brickhouse and Potter 2001) reflects the growing body of theoretical and empirically grounded insights in the social sciences that language use is a social act (Harre 1992b). This insight, often referred to as the discursive turn (Kroger and Wood 1998) or the second cognitive revolution (Harre 1992b) shifts the focus of research from hidden mechanisms behind discursive practices, such as cognitive or social structures to discourse as social practice (Potter and Wetherell 1987; Davies and Harre 1990; Edwards and Potter 1992).

From the discursive psychological perspective, science classroom practices are maintained or transformed relationally through interaction (Linehan and McCarthy 2000; Wood and Kroger 2000; O'Connor 2001; Harvey 2002). The focus from the discursive perspective shifts from the role of students as passive receivers of curriculum imperatives and pedagogical moves to the discursive practices of students as they make meaning in context, including the way they position themselves and are positioned by others (Davies and Harre 1999). The focus of this paper is meaning making by students in conversational episodes related to practical work on the expansion of solids, liquids and gases structured as P.O.E (Predict. Observe. Explain). The questions addressed are: How can the discursive practices of the students be described? How are students positioned, and how do they position themselves within science classroom discourses?

The discourse analytic perspective emphasizes the need to work with recordings and records (not reports) of verbal and nonverbal aspects of discourse (Wood and Kroger 2000). A year-seven class taught by an experienced middle school science teacher who had been recommended by his peers as a highly competent teacher of science and who agreed to participate was chosen for the study. Videotaped student discourse in and about their science classroom was the main data source used in the study. The generation of suitable data was achieved with support from the International Centre for Classroom Research at the University of Melbourne.

The results of the study have been presented as the discursive *umwelten* of three focus students (Tasha, Angie and Kesar), consisting of the representation and analysis of conversational episodes that were chosen as representative of the breadth of the students' science classroom discursive practices. Conversational episodes related to practical work on the expansion of solids, liquids and gases structured as P.O.E (Predict. Observe. Explain) activities have been selected as representative of the findings of the study. The focus students' practices have been described in terms of the degree of personal responsibility the students took with respect to the task at hand, specifically writing down predictions, making observations of the expansion of a liquid and explaining observed phenomena related to expansion of solids, liquids and gases. The consequences of these practices, evident in the analysis, have been discussed in relation to the students' learning and participation in science.

It was found that the students took the practice of writing practical reports as a personal responsibility. In taking personal responsibility, discussion and argumentation of their predictions and explanations related to the expansion activities using scientific concepts was limited. For example, Kesar drew upon a logic of pedagogical practice in writing her predictions rather than the scientific theories provided in instruction. The practice of observing during practical activities was found to be taken by the students as a shared endeavour. In taking shared responsibility, their observations cannot be understood in terms of individual perception of an ontologically given reality such as the expansion of the liquid when it was heated, calling pedagogical initiatives grounded in cognitive psychology and perceptualism into question. The findings highlight the complex social process of meaning making in science classrooms and the need to attend to local moral orders of rights and duties in research on student language use and learning in science. More attention needs to be directed to the consequences of our theories of learning and pedagogical initiatives for the public, collective practices promoted in science classrooms including the meanings made of these by our students.

SYMPOSIUM

Reflection

Researching reflection: Capturing the different ways reflection is being approached in teaching

Chairperson: Fritz C. Staub, University of Fribourg, Switzerland

Organiser: Juan Jose Mena Marcos, University of Salamanca, Spain

Discussant: Harm Tillema, Universiteit Leiden, Netherlands

This symposium explores research approaches to the domain of reflection in the fields of teaching and arts. Much of the available work (syntactic approach) focuses on trying out reflection model(s) and components (i.e. action-research steps) or classifying reflection into different levels (i.e. critical reasoning or pedagogical argumentation). Other studies content analyze practitioners' discourses and infer the conceptual categories (i.e. rules or artifacts) that were displayed for problem solving in practical settings (semantics approach). The main interest of this symposium is not only differentiating the way both approaches measure reflection but essentially to examine what knowledge for the profession they are giving rise to. These are the outcomes for practice (productions): i.e., the results from research that practitioners could use for their work. The symposium will aim at establishing new research criteria for addressing this issue in studies on reflection and will draw implications for practice.

Educational relevance

Reflection has been positioned as the central strategy for grounded practices since it helps to construct new situational understandings for the profession. In this symposium we regard gathering research productions as essential to construct an epistemology of practice. Three evaluative criteria may be followed: (a) validity of outcomes for practice (not only for research); (b) transference to other work-situations and (c) degree of impact on the profession (not only for academia).

Based on these criteria we invited three contributors to explicate their approach and means by which they study reflection. We intend to gain insights about solutions to extract outcomes for practices; not to offer strict guidelines for conducting research.

Quantitative Content Analysis of students' reflection: what are they writing about?

Eric Poldner, INHOLLAND university, Netherlands; P. Robert-Jan Simons, Utrecht University, Netherlands; Guus Wijngaards, Hogeschool INHOLLAND, Netherlands

This paper presents results of a quantitative content analysis (QCA) procedure for analyzing the reflective writing by students in the first year of a teacher education programme. We developed the QCA procedure as a part of an integrated model for analysing the concept of reflection in a curriculum. Different concepts of reflection and the implications for purpose, focus and process of reflection in the curriculum were introduced. It is widely held that teacher education should aspire to engender high-level critical reflection leading to professional growth. A coding schema was developed for analyzing students' reflective writings within a small sample of high and low reflective ranked students within teacher education. The implications of these findings are addressed.

Introduction

In higher education the main educational goal is to develop reflective practitioners (Dochy, 2001). The students should be prepared to function in the rapidly changing world of professional practice. In an education programme the development of students to become a reflective practitioner is based on a view or concept of reflection. In teacher education it is common to refer to the reflection concepts descriptive technical, deliberative, and social critical (Procee, 2006; Serafini, 2000; Valli, 1997; Van Manen, 1977). For example, Lee (2005) concluded that many researchers used the same reflection concepts for describing levels of reflective thinking. These reflection concepts can be described in dimensions purpose, focus and process according to Serafini (2000). The purpose of reflection is related to the view of what constitutes good teaching (Mansvelder-Longayroux, Beijaard, & Verloop, 2007). The focus is related to the object of reflection: thoughts, experiences, or feelings. The process of reflection is related to the context of the reflection (individual, individual in context, critical social in context) and could be seen as a cyclic process of learning, researching (see for example Harinck, 2007; Kolb, 1984; Korthagen & Vasalos, 2005). The stages of this cyclic process are mostly described in terms of noticing, analyzing, evaluating, developing alternatives, experimenting and acting, and again noticing. Mezirow (1998) described critical reflection of assumptions (CRA) and critical self reflection of assumptions (CRSA) as the crucial aspects in this reflection process for transformation or reflection development. CRA refers to objective reframing and CRSA to subjective reframing. Objective reframing means "critically examining the validity of concepts, beliefs or actions being communicated to you" (p. 192) and subjective reframing refers to be critical on "one's own assumptions" (p. 192). Both aspects are needed in our view for transformative learning.

Research on students' reflection development is concentrated on measuring the construct of reflection by analyzing reflective writings, students' reflective essays (Broekman & Scott, 1999; Hoover, 1994; Thorpe, 2004). The product of the reflective writing offers different opportunities for learning by writing, reading, discussion, feedback and re-writing activities (Vanhulle, 2005). Reflective writing is accepted as a tool for learning to stimulate reflective thinking (Broekman & Scott, 1999) and as a tool for assessment of reflective competence in productive tasks like portfolio's

(Borko, Michalec, Timmons, & Siddle, 1997; Orland-Barak, 2005; Van der Schaaf & Stokking, 2008). As a part of a curriculum evaluation study, 26 reflective essays were analyzed with QCA. The research questions of the study were the following: What are students in the first year of teacher education writing about in the reflective essays? Which aspects revealed the QCA of the reflective essays related to process, focus and purpose? Are highly reflective ranked students writing about different aspects in their essays than low reflective ranked students?

Methods

Participants and data collection In the School of Education of the Inholland University students in the first year have to write a reflective essay about the experiences in workplace after a period of ten weeks. First, we collected from 69 students several reflective essays. Second, we selected reflective essays of 26 students from four different groups by reputational case-selection (Miles & Huberman, 1994). Each teacher of a group had to rank the students in their group based on reading and assessing the reflective essays after 20 weeks and after 40 weeks. We used this reputational case selection for collecting essays from 13 high reflective ranked students and from 13 low reflective ranked students. We can characterize this research as a syntactic approach. We are interested if the content of the reflective essays mirror the aspects of (critical) reflection as formulated in the curriculum.

Data analysis

First, qualitative analysis or open coding (Boeije, 2005; Wester & Peters, 2004) was used for analyzing all collected reflective essays. Second, based on the results of the open coding process we developed a coding schema with categories and subcategories. A coding protocol was developed (procedures for analyzing units and a coding scheme with examples) and tested on reliability of coding for two coders on a sample of ten percent of the total coding units of 26 selected reflective writings. The categories were compared with aspects of the three reflection concepts. After coding these reflective writings descriptive statistics were calculated to find out if there were significant differences in coded categories in the reflective essays of high reflective ranked students and low reflective students.

Results and discussion

After the open coding process we established that there were three thematic codes related to student-mentor, student-pupil/group, and student learning process. Each thematic code had several sub codes. For example, the sub-categories of the third thematic code (student learning process) category were teaching activities, analysis of learning goals/situations, justification, learning goals, approach to learning goals/situations, lesson preparation plans, evaluation of learning goals/situations, learning benefits, and own feelings and own opinion. All coded fragments of reflective essays of high reflective ranked students and low reflective ranked student were related to the descriptive technical reflection concept. Students wrote a substantive part of the reflection report about the performance situation in relation to the context (group, mentor, pupils). This can be seen as noticing, the start of reflection. All the text fragments coded as "Evaluation" and "Analysis" were restricted to instructional and organizational activities, actions executed by the students. The combination of "Evaluation" and "Analysis" in the reflection papers is a possible indication of diagnosis (see Mansvelder-Longayroux, et al., 2007) the next step to reflection. Although students ranked as low-reflective and high-reflective devoted a substantial part of their reflection papers to "Evaluation" and "Analysis", we were unable to identify text fragments which point to critical processing, weighing up alternatives, an intending to experiment. We can conclude that QCA as a syntactic approach can reveal in a systematic way what the students are writing about in their reflective essays. Students, teachers and mentors can use this approach for better understanding of and reflection on students' reflective writing related to the practice.

An alternative approach to determine the quality of students' reflection

Ali Leijen, Tartu University, Estonia; Djuddah A J Leijen, University of Tartu, Estonia; Margus Pedaste, University of Tartu, Estonia

This paper discusses some of the ambiguities related to the concept of reflection in education and presents an alternative approach for determining the focus and quality of students' reflection. Accordingly, the focus of reflection can vary from a concrete technical aspect of an experience to the broader societal context of that experience, and the quality of reflection can be described through successive stages of argumentation: describing, justifying, evaluating, and discussion. The developed coding schema for determining the focus of reflection and the level of argumentation in reflection was pilot tested on reflection fragments written by a small sample of tertiary dance students. The findings, regarding dance students reflection and their implications for practice, are presented and discussed.

Introduction

Developing students' reflection on their learning and behaviour is currently one of the major learning goals in higher education. Reflection can generally be defined as a cognitive process carried out in order to learn from experiences

(Moon, 2004) through individual inquiry and collaboration with others (Dewey, 1933). It is known that reflection leads to deeper learning (Moon, 2004), to achievement of more complex and integrated knowledge structures, and to more accessible and usable knowledge (Billing, 2007). The high relevance and inclusion of reflection in several pedagogical practices of higher education would suggest that the term reflection is well defined in literature. However, several authors (e.g. Griffiths, 2000; Gur-Ze'ev, Masschelein, and Blake, 2001; Hatton & Smith, 1995; Van Manen, 1995) point out that the concept of reflection in literature is intangible and ambiguous regarding how to determine, facilitate, and assess reflection in practice. It seems that the term reflection contains a wide range of different or even conflicting concepts and strategies which are derived from different notions and schools of thought. Two most commonly known notions of reflection in education are the pragmatists' (e.g. Dewey, 1933; Korthagen, 1985) and social critical theory (e.g. Mezirow, 1991) approaches. The followers of these interpret reflection differently. However, in several writings, ideas of different or even contradicting traditions are used in a closely intertwined manner. This article aims to unfold some of the ambiguities related to the term and present an alternative view on determining the quality of reflection.

Unlike the dominating approach to determining the quality of reflection in education (Van Manen, 1977) where the focus of reflection (technical, practical, and critical reflection) has been used to determine the value of reflection, we propose an approach that looks at two components of reflection: the focus of reflection and the level of argumentation in reflection (syntactic approach, see summary of the symposium). The focus of reflection as a term is useful as it illuminates the scope of reflection and is sufficiently neutral to allow considering pragmatists' and critical social theory perspective to reflection on equal grounds. The most commonly used division is technical, practical, and critical reflection. Owing that critical reflection is mostly associated with the social critical perspective, we chose the term sensitizing instead, as suggested by Tsangaridou and O'Sullivan (1994), for our categorization. Regarding the level of argumentation in reflection, we adopted the categorization of Tsangaridou and O'Sullivan (1994), and McCollum (1997): a description (descriptive information), justification (logic or rationale), and critique (explanation and evaluation) of an aspect related to practice. Inspired by Moon (2004), a fourth level was added to this categorization. At this level of argumentation, one moves beyond self evaluation and discusses alternative solutions for changing one's practice. A pilot study among a small group of dance students was carried out to collect illustrative data about the focus and the level of argumentation in reflection. The research question of the study was: What is the focus and level of dance students' reflections in a ballet class and in a choreography class?

Methods

Participants and data collection

We analysed self reflections and peer feedback accounts collected in the context of a previous study (Leijen, Lam, Wildschut, Simons, and Admiraal, 2009) where dance students carried out reflection assignments in a ballet and a choreography course. Data was collected from 16 students (3 male, 13 female) who study in a dancer / choreographer bachelor's programme at a dance academy in the Netherlands.

Data analysis

The focus and level of reflection in the self evaluations and peer feedback accounts (180 fragments in total) were analysed by three researchers (investigator triangulation suggested by Denzin, 1970) using a developed coding scheme. Descriptive statistics related to the focus and quality of students' reflections were calculated. Chi square tests were used to find out whether there were differences regarding the division of reflection fragments on particular levels and foci in different phases (self evaluation phase, feedback phase) of the reflection assignment.

Results and discussion

Ballet students' reflections focused mainly on technical aspects of the ballet technique execution. The developed coding scheme allowed investigating the depth and the line of reasoning in reflections rather than considering the writings as low level, merely because of their technical focus. The translation of choreographic intentions into physical movements was the most important question for choreography students. They also reflected on the composition details presenting a more technical focus and on the frames of references in arts and in wider contexts displaying sensitizing reflection. This shows that, as also Hatton and Smith (1995) pointed out, different contexts may lend themselves more towards a certain focus of reflection, and it is the purpose of teachers and the instruction of reflection to guide students into the relevant foci. While considering the focus and quality of reflection among different stages of the assignment, it was noted that the focus of reflection did not differ across different stages of the assignment (self evaluation and feedback) in both courses. However, we found that the level of argumentation was higher in feedback than in self evaluations (more evidently in ballet class). The results showed that students had the ability to present higher order reasoning in their writing; however, it seemed to be more difficult for them to deepen the reasoning in reflection concerning own actions as opposed to looking at others. This finding suggests that peer feedback could raise the overall quality of students' reflection and presents for teachers an instructional principle how to improve the quality of students' reflection. A completely different topic of discussion is whether the highest level of

argumentation is always desired. We believe that similarly to the focus of reflection, it is the task of teachers and the instruction of reflection to guide students towards the necessary quality standards of reflection. Some topics might need mere descriptions or justifications; however, each discipline also has its core concepts and principles which need to be dealt with on the highest level of reflection.

Action-oriented knowledge: How teachers get professional expertise from reflection.

Juan Jose Mena Marcos, University of Salamanca, Spain; Maria-Luisa Garcia Rodriguez, University of Salamanca, Spain

Action Oriented Knowledge (AOK) is conceptualized as all profession-related insights that are relevant to the teacher's activities (Verloop, van Driel&Meijer, 2001) and can be formulated into concepts, pedagogic rules or strategies. Verbalizing and codifying this knowledge in practice could be as relevant for training processes in teacher education programs as placing teachers' reflections into predefined theoretical levels.

This study aims at extracting propositional knowledge from teachers' accounts. We try to (1) describe what AOK arises when student teachers reflect on practice (after the action is done) and in practice (during performance) (Schßn, 1983), and (2) value which knowledge is more precise to understand practice. One hundred and seventeen preservice teachers, who worked in 86 different schools, participated in the study. They wrote a report about their teaching (4-5 pages) and planned and taught a lesson as part of their practicum. Thirteen of them were also interviewed. Reports and interview transcriptions were content-analyzed following propositional analysis. Inter-rater reliability coefficients ranged from $\kappa = .78$ to .91. Three main sorts of AOK were found: appraisals (both positive and negative), rules (methodological strategies) and artefacts (instruments for practice). Results indicate that rules and artefacts may better help to understand teaching performance than appraisals, since they can be generalized and further applied to other situations. This primarily occurs when teachers reflect in practice rather than on practice. In addition there were statistically significant differences between the generation of some types of knowledge (i.e. artefacts) and more precise evaluation of teachers' performance.

Introduction.

One of the most significant trends in education in past decades is the notion of reflective practice (Schßn, 1983, 1987). Reflection makes teachers aware of their experiences through self examination and critical inquiry. Consequently it is a crucial process in sustaining teachers' professional competence (Loughran, 2002) since it enables us to genuinely understand the way they conduct their work. All of this has lead to the recognition of reflection as a central tenet of many teacher education programs all over the world (Valli, 1993; Brookfield, 2005). However what makes reflection substantial is the fact that calls attention to the type of action-oriented knowledge (AOK) that practitioners generate in problem-solving and decision-making situations (Urzúa and Vásquez, 2008). AOK could be defined as the representation and formulation of practice into concepts, pedagogical techniques and strategies. It refers to "...all profession-related insights that are potentially relevant to the teacher's activities" (Verloop, van Driel, and Meijer, 2001: 443). This in-practice knowledge needs to be researched in order to construct a knowledge for-practice (Cochran-Smith and Lytle, 1999) more useful for teacher training in education programs. In this study the objective is twofold: On one hand (1) examining what AOK is produced (semantic approach of reflection: please see the symposium abstract) when teachers reflect both on practice -after the action is completed- and in practice -while the action is performed-; and, on the other hand, (2) valuing the quality of AOK by analyzing the number of statements that have informative weight (e.g. precision) to reframe teachers' conceptions of their own practice.

Methods.

Participants and data collection

One hundred and sixty four students enrolled in the third year of teacher training at the University of Salamanca participated in a two year long study in which they learned about the basic concepts and strategies on problem-solving in the classroom. They all did their practicum in 86 Early Childhood Education Centres and Elementary schools. As part of their work, they did a planned lesson, video-recorded one session and wrote a field-learner report about their teaching experience under the supervision of their cooperating teachers. Out of 164, 104 preservice teachers submitted their planed lessons and action research reports. Additionally, 13 were interviewed watching their own performance following Stimulated Recall interviews techniques.

Data analysis

Reports and transcribed interviews were content-analyzed following propositional analysis (Bovair and Kieras, 1985; Kintsch and Van-Dijk, 1978). The content (propositions) was analyzed in three steps: (a) Selection of propositions ($k_1=0.82$); (b) Grouping propositions into themes ($k_2=0.88$); (c) Theme hierarchisation (categories) following the Grounded Theory Analysis (Corbin and Strauss, 1990), ($k_3=0.79$). Each proposition was also coded under

0=imprecise (vague information: i.e. the activity satisfied the children) or 1= precise (informative weight; i.e. the student can now properly read closed syllables), in order to measure the quality of the student teachers' knowledge production. Finally chi square tests were used to find out whether there were differences between the kind of knowledge generated and its precision.

Results and discussion.

Teacher productions.

Overall, 1750 propositions were identified in the reports and transcriptions which referred to self-learning statements on the lessons they taught. 1520 were finally coded into an inductive category. The acquired practical understandings revolved around three dimensions: pupils' learning (53.4%), teaching strategies (34.7%) and students' family support (21.9%). Much knowledge focused on realizing how pupils' attitudes such as coexistence, interactions or respect for norms and authority were difficult to manage (23.1%). Personal insights about how pupils become skilled at basic competences (i.e. reading fluently) allowed them to understand different learning paces (10.3%). Choosing motivational teaching methods seemed crucial for their lessons as well as collaboration with colleagues. Fewer insights were posted about family cooperation and home discipline, and most exclusively when teachers reflected on action. Effective use of school spaces and teaching materials were hardly ever addressed. These contents were further classified under three major types of AOK: (1) Appraisals: Teachers' self judgements about the consequences of their actions and decisions in the classroom. They may be either positive (i.e. Pupils paid attention the whole hour to the explanation) or negative (i.e. Andrew never finishes his class work). (2) Rules or practical principles: Methodological maxims that these student teachers extracted from their experiences (i.e. we teachers should control pupils' classroom behaviour according to previously agreed norms). (3) Artefacts: instruments or physical supports teachers envisage from what they have experienced. (i.e. I would hang a poster on the classroom board with the five agreed-upon behavioural rules to keep in mind). Reflection on action produced 61.1% appraisals, 12.3% rules and 1.6% artefacts. On the other hand reflection in action framed student teachers' knowledge mainly into rules (57.5%) and artefacts (13.2%). Fewer propositions were found as evaluative knowledge (i.e. positive appraisals: 12.1%).

Knowledge precision.

50.2% of the evaluations were precise and the other 49.8% imprecise. Precise positive appraisals accounted for 38.6%, whereas precise negative appraisals totalled 73.6%. 44.6% of the rules and 87.5% of the artefacts were concrete. It seems that evaluating teaching practice from negative appraisals and elaborating artefacts is regarded to be more informative ($\chi^2 = 93.31$; p

Theoretical significance

Characterizing the ways in which teachers conceptualize their practice (i.e. teachers' productions) is complex inquiry. It can be argued that much of the action-oriented knowledge resides outside of verbalized constructs. Professional performance is situationally and socially embedded (Eraut, 2004) and therefore "... we can know more than we can tell " (Polanyi, 1967, 4). However, this study shows how part of this knowledge can be stated through language operations that establish the correspondence between actions and concepts. In other words, teachers' productions may be sorted into propositional knowledge which, in the end, helps teachers to learn from their experiences. Main findings indicate that teachers' reflections on action essentially focus on recalling and valuing events (more episode-oriented: gathering experience). Reflection in action better allows for codifying experiences into practical principles (more skill-oriented: acquiring expertise). Finally, envisaging artefacts and appraising practice from its negative consequences permits the construction of more precise understandings of practice.

SYMPOSIUM

Reading

Sociocultural and linguistic determinants of reading in first- and second-language learners

Chairperson: Petra Stanat, Humboldt Universitaet Berlin, Germany

Organiser: Petra Stanat, Humboldt Universitaet Berlin, Germany

Discussant: Christina van Kraayenoord, The University of Queensland, Australia

Current theories of reading acquisition assume that reading comprehension is an active process which is influenced by a variety of factors on the individual as well as on the sociocultural level. However, only few studies on determinants of reading comprehension explicitly consider students' language background. As a result, it is largely unclear whether the models identified in these analyses are equally valid for reading comprehension in a first language (L1) and in a second language (L2) (cf., August & Shanahan, 2006). The presentations in the symposium focus on differential

relationships between sociocultural and linguistic predictors of reading skills and reading motivation in first- and second-language students. Based on theoretical models of reading comprehension and second-language acquisition, assumptions about the development of reading determinants and their influence on L2 reading skills are analyzed. The determinants considered include school factors, characteristics of student background, as well as linguistic skills that have been shown to be relevant for reading comprehension.

August, D., & Shanahan, T. (2006). *Developing literacy in second-language learners: Report of the national literacy panel on language-minority children and youth*. Mahwah, NJ: Lawrence Erlbaum.

The Development of Reading Skills and Reading Motivation in Students with Immigrant Backgrounds

Rebecca Miriam Hartmann, Technical University of Dortmund, Germany; Nele McElvany, Max Planck Institute for Human Development, Germany; Michael Becker, Max Planck Institute for Human Development, Germany

Text comprehension, vocabulary and reading motivation have been identified as important and mutually linked aspects of reading acquisition (Bialystok, 2002; Möller & Schiefele, 2004). International studies show significant differences in reading skills and motivational variables between students with and without immigrant backgrounds (Stanat & Christensen, 2006). The degree to which these are caused by group differences in socioeconomic status and cultural capital is disputed. Moreover, group-specific predictive power of socioeconomic status and cultural capital for reading achievement is discussed. The analyses are based on data of the Berlin Longitudinal Reading Study. Approximately 700 students were tested in grades 3, 4 and 6. Cross-lagged panel models show that the incongruity between home and school language has negative effects on text comprehension and vocabulary in grade 3 and on vocabulary development from grades 3 to 6 as well as positive effects on the development of reading motivation from grades 3 to 6. The successive introduction of socioeconomic status and cultural capital into the model leaves language incongruity a significant predictor. Multiple group analyses show reduced predictive power of socioeconomic status and cultural capital for text comprehension in the group of children with immigrant backgrounds. Confirming the crucial role of home language for reading acquisition, the findings indicate a need for intensified high-quality reading training for L2-learners to promote their reading development and, moreover, to identify potential starting points for interventions.

Goals

Children with immigrant backgrounds in the educational systems of many countries are considerably less successful than their peers from native families. This presents a major challenge to the educational policy, administrations and practitioners. The problematic situation was revealed by, for example, the results of the large international student assessment surveys PIRLS and PISA, which showed significantly lower competence levels for children with immigrant backgrounds compared to their native peers (Mullis, Martin & Gonzales, 2004; OECD, 2001). This is not only an issue for the individual students and their families, but also for society and the economy of the respective countries. In Germany, the differences are especially problematic because of the high selectivity of the school system. Achievement scores in the early grades are highly relevant for the transition to more advanced secondary school types and, as a result, for vocational training or tertiary education opportunities. It is assumed that reading literacy plays an important role in explaining group differences between students with and without immigrant backgrounds with regard to participation in the educational system, with the incongruity between school and family language being of major importance in this context. In order to identify starting points for the effective reduction of differences in educational success, it is crucial to identify and explain similarities and differences in the reading acquisition process of multilingual and monolingual children. Text comprehension, vocabulary and reading motivation have been identified as important and mutually related aspects of reading acquisition (Bialystok, 2002; Möller & Schiefele, 2004). International studies do not only reveal significant differences in reading skills between students with and without immigrant backgrounds but also heightened motivation in students with immigrant backgrounds (Stanat & Christensen, 2006).

The degree to which the reported gaps in achievement and motivation are caused not only by the incongruity between school and family language but also by differences in socioeconomic status and cultural capital is disputed. Many of the studies that are available use only one point of measurement and hence do not allow for the investigation of developments. Moreover, group-specific predictive power of socioeconomic status and cultural capital for reading acquisition may occur. The following research questions were addressed based on longitudinal data and will provide new insights into the long-term development of reading skills and reading motivation in students with immigrant backgrounds at the EARLI 2011-meeting: 1. Is the incongruity between school and family language a significant predictor of the level of text comprehension, vocabulary and reading motivation in grade 3 and of the development of text comprehension, vocabulary and reading motivation from grades 3 to 6? 2. Does the incongruity

between school and family language stay a significant predictor of text comprehension, vocabulary and motivation when socioeconomic status and/or cultural capital are taken into account?3. Are there group-specific differences in the predictive power of socioeconomic status and/or cultural capital for reading acquisition?

Methodology

The analyses were conducted with data from the Berlin Longitudinal Reading Study (READING 3-6), which was carried out by the Max Planck Institute for Human Development in Berlin, Germany. Approximately 700 students were tested in grades 3 (2003), 4 (2004) and 6 (2006). The points of measurement were chosen because students are expected to have completed the acquisition of basic reading skills in grade 3 and classroom instruction focuses increasingly on text comprehension in the following grades. Also, reading skills in grade 6 are highly important for the successful transition to high school, which takes place in Berlin, Germany, after grade 6. 32.4% of the students and parents in the sample indicated that they speak German and another language or exclusively another language at home.

Findings

Cross-lagged panel models show that the incongruity between school and family language has negative effects on text comprehension and vocabulary in grade 3 and on vocabulary acquisition from grades 3 to 6 and positive effects on the development of reading motivation from grades 3 to 6. The successive introduction of socioeconomic status and cultural capital into the model leaves incongruity between school and family language a significant predictor. Multiple group analyses show substantially reduced predictive power of socioeconomic status and cultural capital for text comprehension in the group of children whose family language differs from the school language.

Theoretical and Educational Significance of the Research

The panel design of the study allowed for the analysis of the relationship between reading acquisition and the incongruity between school and family language over the course of three school years. Thus, the study complements the numerous cross-sectional studies in educational research. Effects of the incongruity between school and family language on the level and on the development of text comprehension, vocabulary and reading motivation were analyzed and confirmed. The results demonstrate the crucial role of home language for reading acquisition, controlling for socioeconomic status and cultural capital. The findings of the analyses clearly indicate that there is a need for intensified high-quality reading training for L2-learners focusing on both text comprehension and vocabulary to promote their reading development and, moreover, to identify potential starting points for interventions.

References

- Bialystok, E. (2002). Acquisition of literacy in bilingual children: A framework for research. *Language Learning*, 52(1), 159-199.
- Müller, J., & Schiefele, U. (2004). Motivationale Grundlagen der Lesekompetenz [Motivational foundations of reading literacy]. In U. Schiefele, C. Artelt, W. Schneider & P. Stanat (Eds.), *Struktur, Entwicklung und Förderung von Lesekompetenz: Vertiefende Analysen im Rahmen von PISA 2000* [Structure, development and training of reading literacy: Analyses in the context of PISA 2000] (pp.101-124). Wiesbaden: VS Verlag für Sozialwissenschaften.
- Mullis, I.V.S., Martin, M.O., & Gonzales, E.J. (2004). *International achievement in the processes of reading comprehension: Results from PIRLS 2001 in 35 countries*. Chestnut Hill, MA: Boston College.
- OECD (2001). *Knowledge and skills for life: First results from PISA 2000*. Paris: OECD.
- Stanat, P., & Christensen, G. (2006). *Where immigrant students succeed. A comparative review of performance and engagement in PISA 2003*. Paris: OECD.

First- and second-language reading: Differential patterns in the prediction of reading comprehension

Alexandra Marx, Humboldt University Berlin, Germany; Petra Stanat, Humboldt Universität Berlin, Germany; Thorsten Roick, Freie Universität Berlin, Germany; Robin Segerer, University of Würzburg, Germany; Wolfgang Schneider, University of Würzburg, Germany; Peter Marx, University of Würzburg, Germany

The present study explores the effects of linguistic determinants on reading comprehension in students speaking German as a first (L1) or as a second language (L2). Based on the simple view of reading model of reading comprehension, it was hypothesized that the link between listening comprehension skills and reading achievement is especially pronounced in L2 students and largely explains their weaker reading outcomes. In the context of the study, 473 9th-grade students completed the reading test administered in the 2009 cycle of the Programme for International Student Assessment (PISA) as well as measures of working memory, decoding skills, vocabulary, morpho-syntactic skills, phonological awareness, and listening comprehension. Results indicated that L2 students lagged behind L1 students on most linguistic measures. For L1 students as well as for L2 students, listening comprehension skills were strongly related to reading achievement. Multigroup structural equation modeling provided evidence that this

relationship is stronger for L2 students than for their monolingual peers. The results are discussed against the background of current models of reading comprehension in a first and in a second language.

Introduction

Findings from international studies, such as the Programme for International Student Assessment (PISA), suggest that immigrant students are highly overrepresented in the group of weak readers (Stanat & Christensen, 2006). In Germany, the achievement gap between students speaking the test language at home (L1) and students using another language at home (L2) is especially pronounced and continues to be substantial even after parents' socio-economic status and educational level are controlled for. The distinctive effect of the language use at home indicates that immigrant students may lack the opportunity to develop their oral L2 skills which, in turn, influences their L2 reading comprehension. This assumption is in line with the simple view of reading model of reading acquisition (Hoover & Gough, 1990). According to this model, reading comprehension is influenced by two major determinants, namely decoding skills and listening comprehension. While phonological skills are necessary to develop adequate word recognition skills, listening comprehension is more strongly related to vocabulary and morpho-syntactic knowledge (c.f. Lundberg, 2002). As data from various studies indicate, L2 students' oral proficiency skills tend to lag behind those of L1 students. Children learning to read in a second language often exhibit a smaller vocabulary size and less developed listening skills than their monolingual peers (c.f. Geva, 2006; Droop & Verhoeven, 2003; Proctor, Carlo, August & Snow, 2005). On the other hand, L2 students seem not to experience specific problems associated with decoding skills or their phonological awareness (Koda, 1998). Given that L2 students perform at lower levels of reading comprehension than L1 students, but rarely have problems mastering decoding, it can be assumed that their weaker listening skills strongly determine these students' reading outcomes. In the present study, determinants of reading skills and their impact on reading comprehension are analyzed in L1 and L2 students. We tested the assumption that German L2 students' reading achievement is more strongly influenced by their listening comprehension scores than are L1 students' reading skills. No differences are expected with regard to the influence of decoding and phonological skills on reading outcomes.

Method

Data from N = 473 9th-grade students attending the lower and comprehensive tracks of the German school system were analyzed. Of these, N = 294 learned German as a second language (L2). Reading comprehension was measured with the reading test administered in the 2009 cycle of the Programme for International Student Assessment (PISA). On a second test day, students completed computer-administered measures of phonological awareness, working memory, listening comprehension, and morpho-syntactic skills. In addition, paper-and-pencil measures of general cognitive abilities, vocabulary, and decoding skills were administered. Multivariate analyses of variance (MANOVA) were carried out to test differences between L1 and L2 students' achievement on all measures. Structural relationships between reading achievement and its determinants were investigated using multigroup structural equation modeling, with cognitive skills and socio-economic status serving as control variables. In a first step, the model was tested for measurement invariance across the groups. Subsequently, differences in the structural relationships between L1 and L2 students reading models were identified using Wald Chi-square tests.

Results

Preliminary results indicate that students with German as L2 reach significantly lower levels of vocabulary, morpho-syntactic knowledge, decoding skills, listening comprehension, and reading comprehension than their L1 peers. No group differences were observed for phonological skills or working memory. The structural equation model used to explain reading skills fitted the data well (Chi-square(201)=267,885; $p=.00$; CFI=.97; RMSEA=.04). For both groups, listening comprehension was shown to have a stronger impact on reading outcomes than decoding skills. However, the association between listening comprehension and reading comprehension was significantly stronger for L2 students. In contrast, no differential influence of vocabulary and morpho-syntactic skills on listening comprehension could be stated. In the symposium, we will present findings on differences in linguistic determinants of L1 and L2 student' reading skills as well as the results of the multigroup structural equation model of reading comprehension. The results will be discussed against the background of current models of L1 and L2 reading comprehension and implications for promoting L2 students' reading achievement will be drawn.

References

- Droop, M., & Verhoeven, L. (2003). Language proficiency and reading ability in first- and second-language learners. *Reading Research Quarterly*, 38(1), 78-103.
- Geva, E. (2006). Second-language oral proficiency and second-language literacy. In D. August & T. Shanahan (Eds.), *Developing literacy in second-language learners: Report of the National literacy panel on language-minority children and youth* (pp. 123-139).

- Mahwah, NJ: Lawrence Erlbaum. Hoover, W.A., & Gough, P.B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal*, 2, 127-160.
- Koda, K. (1998). The role of phonemic awareness in second language reading. *Second Language Research*, 14(2), 194-215.
- Lundberg, I. (2002). The child's route into reading and what can go wrong. *Dyslexia*, 8, 1-13.
- Proctor, C. P., Carlo, M., August, D., & Snow, C. (2005). Native spanish-speaking children reading in English: Toward a model of comprehension. *Journal of Educational Psychology*, 97(2), 246-256.
- Stanat, P., & Christensen, G. (2006). Where immigrant students succeed – a comparative review of performance and engagement in PISA 2003. Paris: OECD.

Linguistic and Socio-cultural Diversity in Reading Literacy Achievement: A Multilevel Approach

Andrea Netten, National Center for Language Education, Netherlands; Ludo Verhoeven, Radboud University Nijmegen, Netherlands

The purpose of the present study was to identify factors that explain the variation in reading literacy achievement among fourth grade children in the Netherlands, with a focus on the differences between first and second language students. Measures at the level of the students, his or her parents, and the student's school were used to predict reading literacy. The data of 3549 first language learners and 208 Turkish and Moroccan second language learners who participated in the IEA Progress in International Reading Literacy Study 2006 were analyzed. Multilevel analyses were conducted and showed the level of the student to account for most of the explained variance. The results of multilevel modelling showed 34, 7% of the total variance in reading literacy to be explained by the entered variables. Furthermore the results indicate that there are strong links between the entered endogenous and exogenous socio-cultural factors and reading literacy achievement.

Introduction

Previous studies have shown that first language students still outperform second language students in regard to their reading literacy skills in the Netherlands (Verhoeven, 2000; Droop & Verhoeven, 2003). Minority students make up about 15% of the school population in primary education in the Netherlands, students with a Turkish and Moroccan ethnic background form the largest group. Apart from linguistic diversity, several socio-cultural factors are associated with differences in reading literacy among both L1 and L2 learners. Factors on the part of the child, such as reading motivation, and self-confidence (Guthrie & Wigfield, 2000), as well as home factors, are related to the quantity and quality of parental input (De Jong & Leseman, 2001; Tabors & Snow, 2001) and school related factors (Rauh et al., 2003). The influence that these background factors have on a student's reading ability may differ between the subgroups of first and second language students (Van Elsäcker, 2002). However, so far a multilevel approach regarding differences in reading literacy for L1 versus L2 learners was generally lacking. The data in the research design have a hierarchical structure, students are nested in classes, which are nested within schools. For this reason a multilevel design, who takes into account the correlation and data dependence, seems a valid approach.

In the present study the relationship between various home, school, and student background characteristics, to the students' reading literacy achievement will be examined using a representative sample of first and second language learners living in the Netherlands, by means of a multilevel design. The following research questions will be addressed:

1. What are the differences between L1 and L2 learners in reading literacy achievement and various endogenous and exogenous socio-cultural factors?
2. To what extent are the endogenous and exogenous socio-cultural factors at the level of the student, family and school related to the students' reading literacy achievement at grade 4 in the Netherlands?
3. Are the endogenous and exogenous socio-cultural factors to the same extent related to the reading literacy achievement of L1 and L2 learners?

Method

A representative sample of 3757 children from 207 classes in 139 schools in the Netherlands who participated in the IEA Progress in International Reading Literacy Study 2006 were analyzed in the present study. To identify the groups of first and second language learners the question "Which language did you speak before you started school" from the student questionnaire (IEA, 2006) was used. The students who answered "yes" for either Turkish or Moroccan were selected for the second language group which consisted of 208 students. The students answering "yes" to another language than Dutch were deleted, leaving only those students in the first language group who indicated that they spoke Dutch before they started school (N=3549). Descriptive statistics, followed by Analysis of Variances (ANOVA) were carried out to investigate significant differences between the means of the L1 and L2 students on the predictor measures. To find an answer to the second research question, a series of multilevel analyses were conducted to explore the relations between the student's reading literacy and its predictors. The multilevel analyses were

conducted with MLWin software using sampling weights and plausible values (repeated analyses). Finally to answer research question three and to determine whether the strengths of the relationships between the entered variables are similar for the two subgroups of L1 and L2 learners the interaction effects for the variable Linguistic diversity, which entails the L1 and L2 students, were examined.

Results

First preliminary results confirm the results found in previous research and shows that Turkish and Moroccan fourth grade students lag behind their monolingual Dutch peers in their reading literacy abilities. Furthermore the results show that there are strong links between the entered endogenous and exogenous socio-cultural factors and the reading literacy results; the full model explained 34, 7% of the variance in reading literacy. The analyses that were conducted to examine the differences between first and second language students showed linguistic diversity to explain 5.34 % of the variance in reading literacy. Next the interaction effects were analysed. Although the effect sizes for some of the predictors were large, there were no significant interaction effects found. At the Earli, the results of the multilevel analyses and the differences between the two subgroups of first and second language students will be presented and the results will be discussed in terms of the theoretical starting points.

References

- De Jong, P.F., & Leseman, P.M. (2001). Lasting effects of home literacy on reading achievement in school. *Journal of School Psychology*, 39(5), 389-414.
- Droop, M., & Verhoeven, L. (2003). Language proficiency and reading ability in first- and second-language learners. *Reading Research Quarterly*, 38 (1), 78-103.
- Elsäcker, W. van. (2002). Development of Reading Comprehension: The Engagement Perspective. Enschede: Feboprint.
- Guthrie, J.T., & Wigfield, A. (2000). Engagement and motivation in reading. In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, & R. Barr (Ed). *Handbook of reading research: Volume 3*. Mahwah, NJ: Lawrence Erlbaum.
- International Association for the Evaluation of Educational Achievement (IEA). (2006). PIRLS 2006 questionnaires. Chestnut Hill, MA: Boston College.
- Rauh, V. A., Parker, F. L., Garfinkel, R. S., Perry, J. & Andrews, H. F. (2003). Biological, social, and community influences on third-grade reading levels of minority head start children: a multilevel approach. *Journal of Community Psychology*, 31, 255-278.
- Tabors, P., & Snow, C. (2001). Young bilingual children and early literacy development. In S. Neuman & D. Dickinson (Eds.), *Handbook of early literacy research* (pp. 159-178). New York, NY: Guilford Press.
- Verhoeven, L. (2000). Components in early second language reading and spelling. *Scientific Studies of Reading*, 4(4), 313-330.

SYMPOSIUM

Cognitive Development

Working memory and metacognition - early development and relevance for reading and math

Chairperson: Claudia Maehler, Institute of Psychology, Germany

Organiser: Claudia Maehler, Institute of Psychology, Germany

Discussant: Lucy Henry, London South Bank University, United Kingdom

The current discussion of precursors for school achievement is taking domain-general as well as domain-specific competencies into account. In this symposium we will focus on domain-general competencies, especially executive functions, working memory and metacognition. Three contributions will answer typical questions within the developmental perspectives on preschool age: How can the development be described? What relationships and mutual influences can be detected? And how can development be enhanced?

The first talk by Piekny et al. will focus on metacognition and theory of mind and will analyze correlations between these concepts as well as common precursors. Results reveal a close relationship but not a complete redundancy between the two concepts. In the second talk by Rößthlisberger et al. not only the developmental progression within the preschool years is described in a longitudinal design, but also the relevance of executive functions for higher vs. lower achievement in maths and reading. Data clearly support the impact of executive functions on maths and reading, showing substantial differences between children with higher vs. lower skills. The last presentation by Kroesbergen et al. finally explored the possibility to improve children's working memory abilities with a domain-

general and a domain-specific training. Results reveal positive effects of both interventions not only on the working memory performance but also on early math skills.

In sum, the symposium may stimulate the discussion about the relevance of executive and metamemory functions as precursors of school achievement and especially about the need for early intervention.

Precursors of theory of mind and metacognition

Jeanette Piekny, University of Hildesheim, Germany; Kirsten Schuchardt, University of Hildesheim, Germany; Ariane von Goldammer, University of Hildesheim, Germany; Dietmar Grube, University of Oldenburg, Germany; Claudia Maehler, Institute of Psychology, Germany

Theory of mind (ToM) and metacognition research share the same object: They investigate cognitions about cognition. However, ToM and metacognition research have been predominantly unrelated so far (Flavell, 2000). The aim of this study was to analyze the relation between ToM and metacognition by investigating if ToM and metacognition performance can be predicted by the same or different domain-general cognitive precursors.

We included measures of language (expressive vocabulary, morphological rules), executive functioning (dimensional change card sort), working memory (word span, nonword repetition, corsi block, matrix span) and intelligence (verbal, nonverbal) as precursor key candidates and a ToM scale (Hofer & Aschersleben, 2007) and a declarative metamemory interview (Lockl & Schneider, 2007) into a larger longitudinal study (Grube & Mähler, 2008). 170 Children at the age of four were tested twice. At the first time of data collection, we administered the potential precursor measures. At the second time of data collection about half a year later, we assessed children's ToM and metamemory.

We found a moderate, but significant correlation between ToM and metacognition. Hierarchical regression analyses showed that expressive vocabulary and word span predict ToM performance, while metamemory performance was predicted by expressive vocabulary as well, but also by nonverbal intelligence and word span in the reverse direction. These results show a close relation but not a complete redundancy between two previously unconnected concepts in research on cognitive development.

Theory of mind refers to the ability to attribute mental states to oneself and to other people (Premack & Woodruff, 1978). One aspect that has recently been discussed in theory of mind research is the relation between theory of mind and metacognition. Metacognition has been defined as any knowledge or cognitive ability that takes as its cognitive object any aspect of any cognitive activity (Flavell, 1993). Following this definition, theory of mind research should be closely related to metacognition research because both research traditions share the same object, which is cognitions about cognition. In order to theoretically elaborate on the relation between these concepts, Kuhn (2000) suggested a conceptual framework, using the term "metaknowing" as an umbrella term. She distinguished two components of metaknowing: a declarative, "metacognitive knowing" component and a procedural, "metastrategic knowing" component. The metacognitive knowing component refers to young children's developing knowledge of mental states as a product, usually assessed using theory of mind paradigms, while the metastrategic component refers to what children know about their cognitive processes and how they affect performance, typically addressed by metacognition research. Though theory of mind and metacognition clearly seem to be theoretically connected, empirical research on young children's theory of mind and metacognition abilities and their relation to each other has been rare (Flavell, 2000).

Another recently discussed aspect in theory of mind research is the changed focus on theory of mind development. Instead of focusing on typical age-related changes, several performance-based approaches now concentrate on interindividual differences in theory of mind performance (Jenkins & Astington, 1996). It was argued that variance in theory of mind performance can at least partly be explained by domain-general cognitive skills (Jenkins & Astington, 1996). The domain-general cognitive skills that have been identified as key candidates in predicting theory of mind performance are linguistic skills (e.g. Astington & Jenkins, 1999), executive functioning (e.g. Carlson, Mandell & Williams, 2004), working memory (e.g. Hasselhorn, Mähler & Grube, 2005), and intelligence (e.g. Schneider et al. 1999).

The study reported here combines both of these new aspects in theory of mind and metacognition research. The first aim of this study was to investigate the relation between theory of mind and metacognition abilities in young children in order to find out if theory of mind and metacognition are not only theoretically but also empirically connected.

Our second aim was to apply the focus of the performance-based approaches on explaining interindividual differences to both theory of mind and metacognition task performance, in order to investigate if there are differences and similarities concerning domain-general cognitive precursors. Differences and similarities between predictors of theory of mind and metacognition task performance might help to elaborate on the conceptual differences and similarities between these two constructs.

One of the shortcomings of previous studies was that most studies only included one or two cognitive abilities as key candidate precursor measures. Accordingly, the third aim of this study was to include a wide range of cognitive abilities, in order to investigate how much variance these measures explain in theory of mind and metacognition performance when they are all included concurrently.

In order to achieve these aims, we included measures on theory of mind, metacognition and potential precursors into a longitudinal study that explores differential trajectories of cognitive development in preschool children (Grube & Mähler, 2008). 170 Children (93 boys, 77 girls) were tested twice, separated by intervals of half a year. At the first time of data collection when the children were approximately 4;0 years old, we used measures on language (expressive vocabulary, morphological rules), executive functioning (dimensional change card sort), working memory (word span, nonword repetition, corsi block and matrix span), and intelligence (verbal and nonverbal) as potential precursors. At the second time of data collection when the children were about 4;6, we assessed children's theory of mind using a theory of mind scale (Hofer & Aschersleben, 2007) and metacognitive abilities using a declarative metamemory interview (Lockl & Schneider, 2007).

In the first step of our analyses, we correlated the composite score of the theory of mind scale with the composite score of the metamemory interview and found a moderate, but significant correlation between these measures ($r = .30$, p

In order to find out if variance in theory-of-mind and metamemory performance can be predicted by the same or different precursors, we conducted two hierarchical regression analyses with the theory of mind composite score as the criterion in the first, and the metamemory composite score as the criterion in the second analyses. We decided to enter the potential precursors according to the relative empirical support we found for them in the literature. Our results show that expressive vocabulary and word span are significant predictors of the theory of mind composite score. The composite score of the metamemory interview was significantly predicted by expressive vocabulary as well, but also by nonverbal intelligence and word span in the reverse direction. These results are interpreted against the background of the relay race model on theory of mind development (Hasselhorn, Mähler, & Grube, 2005) and show a close relation but not a complete redundancy between two previously unconnected concepts in research on cognitive development.

Executive Functions from ages 5 to 8 in children with high and low math or reading skills

Regula Neuenschwander, University of Bern, Switzerland; Patrizia Cimeli, University of Bern, Switzerland; Claudia Roebbers, University of Bern, Switzerland; Marianne Rethlisberger, psychology, Switzerland

The present longitudinal study addresses developmental changes in different aspects of executive functions (EF) - working memory, inhibitory control and cognitive flexibility - in a sample of first/second graders (age in months : $M = 92.3$; $SD = 4.3$ / $M = 102.4$; $SD = 3.9$) showing different mathematical and reading abilities. Of special interest were issues of developmental progression and the predictive power of EF for a correct assignment to an either low or high achieving group. It was expected that children with different levels of math/reading skills at the end of the first or second class would show different performance in tasks measuring EF, and that specific aspects of EF, measured in the previous years, would correctly classify the low and high achieving school children. EF were assessed annually during three consecutive years; math and reading skills were measured only at the last measurement point. From a total of 353 children, subsamples of 80 (for math), 105 (for reading) children with either low or high skills were selected. The findings revealed that children with low vs. high academic skills differed substantially in all EF tasks over time, with consistently poorer performance in the low compared to the high achieving group. Concerning the predictive value of EF, cognitive flexibility together with inhibitory control allowed the optimal classification of children into the low and high achieving groups in math. For reading skills, inhibitory control best classified children into the low and high achieving groups two years later.

Aims:

It has consistently been shown that executive functions (EF) undergo substantial improvements in childhood with rapid changes typically being observed between the age of 4 and 8 (Carlson, 2005; Davidson, Amso, Anderson, &

Diamond, 2006; Cragg & Nation, 2008, 2009). Moreover, EF have proven to be predictive for both school readiness and later school achievement (Blair & Razza, 2007). However, educational research has rarely examined the association between EF and academic skills in the context of longitudinal studies or during early childhood, a phase of rapid growth. Although prior cross-sectional studies report a direct association between EF and children's mathematical skills in school age children, the specific functional relations between different aspects of EF and math achievement is less clear (Bull & Scerif, 2001; St Clair-Thompson, & Gathercole, 2006). Some researchers argue that working memory plays an important role in acquiring math skills (Bull, Espy, & Wiebe, 2008; Meyer, Salimpoor; Wu, Geary, & Menin, 2010), whereas others propose that inhibitory control accounts for unique variance in mathematical achievement (Espy, McDiarmid, Cwik, Stalets, Hamby, & Senn, 2004). With respect to reading skills, even less is known about the relationship or predictive power of specific aspects of EF (Alloway, & Alloway, 2010; Bull et al., 2008). Therefore, the aim of this study was to extend the existing research in terms of determining the specificity of the relationship between different aspects of EF and academic skills (in this case reading and mathematics) within a longitudinal framework. In order to present a detailed picture, two different approaches of analyses were chosen: First, we set the focus on the developmental progression of different aspects EF in low and high achieving children in math/reading skills over the course of three years. Second, we conducted a discriminant function analysis to evaluate the extent to which performance on different aspects of EF accurately predicted children's later classification into the low or high achieving group in math/reading skills. It was hypothesized that low achieving first and second graders would show significant lower EF performance compared to the high achieving group earlier in their development and that depending on the outcome, different aspects of EF would optimally classify the high and low achieving children in mathematics or reading skills.

Methodology:

N= 353 children from two age cohorts (5-yr-olds: N =182, 85 girls; 6-yr-olds: N = 171, 88 girls at the beginning of the study) were involved. To form the low and high achieving groups, first/second graders with a performance in math or reading skills 1 SD below, respectively 1 SD above the mean - based on the third measurement point within the corresponding age cohort - were selected. For the first graders, 47 children (low achiever: N =23; high achiever: N = 24) in mathematical skills and 49 children (low achiever: N =21; high achiever: N = 28) in readings skills were selected. For the second graders, 33 children (low achiever: N =15; high achiever: N = 18) in mathematical skills and 56 children (low achiever: N =25; high achiever: N = 31) in readings skills were selected. All children were tested at three measurement points with an interval of exactly one year. EF were assessed at all measurement points: For working memory, the Backward Color Recall Task, for inhibitory control, the Fruit-Stroop Task and for cognitive flexibility, an adapted Shifting Task from a standardized test battery were included. Reading and mathematical skills were assessed at the third measurement point: For mathematical skills, a composite score of three tests (addition & subtraction, equations, and sequences of numbers) and for reading skills, a composite score of two reading task were calculated. The data were analyzed with a mixed ANOVA with time (three measurement points) as within-subject factor, age cohort and achieving group as between-subject factors, and as well with a mixed ANCOVA with IQ, SES, and age as covariate. Furthermore, a discriminant function analysis was conducted with EF measures entered stepwise.

Findings:

First, it was expected that low achieving children in math/reading skills would show significant lower performance in EF compared to high achieving children. The analyses confirmed this hypothesis: The high achieving groups in math/reading skills performed consistently better than the low achieving groups in both age cohorts over time. Moreover, the high and the low achieving children showed mainly parallel developmental progression over the course of the study with one exception: The low achieving group increased performance in the inhibitory control significantly more pronounced than the high achieving groups. Even when IQ, SES, and age were statistically accounted for, performance on all EF measures was still significant different between the high and low achieving groups in math/reading skills. Finally, the discriminant function analyses revealed that the cognitive flexibility and inhibitory control measures were identified as reliable in classifying the low and high achieving children in math two years later (group membership was classified correctly for 82% of the children). For reading, the optimal classification of children was achieved with the inhibitory control measure (group membership was classified correctly for 72% of the children). Theoretical and educational significance: The results support the hypothesis that EF contribute to the acquisition of domain-specific skills (i.e. reading and math skills). Our findings extend previous cross-sectional research documenting a predictive relation between EF and later mathematical competencies (Espy et al., 2004; Meyer et al., 2010). Importantly, these findings suggest that early development of EF provides an important foundation not only for mathematical but also for reading achievement. Therefore, efforts to enrich pre-academic curricula should more strongly recognize the significance of EF and design programs for promoting EF already in preschool years. In addition, the findings show that children with low academic skills have early and persistent EF deficits. Specifically, inhibitory control was the best predictor that reliably classified first and second graders with low reading skills and for math skills both cognitive flexibility and inhibitory control were the most powerful predictors.

Training working memory in kindergarten children: Effects on working memory and early math

Evelyn Kroesbergen, University of Utrecht, Netherlands; Meijke Kolkman, Utrecht University, Netherlands; Jaccoline van't Noordende, University of Utrecht, Netherlands

This study explored the possibility to improve children's working memory abilities with a domain-general and a domain-specific training. The domain of the latter was early mathematical skills. Working memory and early math measures were administered to children in kindergarten who performed below the 50th percentile on a criterion-based mathematics test. A total of 51 second-year kindergarten children (mean age = 5.83 years, SD = 0.32) received a domain-general working memory training, a domain-specific working memory training or no training. After a pretest, four weeks of intervention took place, followed by a posttest. Children in both the domain-general working memory intervention and the domain-specific working memory intervention showed improvement on working memory tasks. Also both the domain-specific working memory intervention and the domain-general working memory intervention had a significant positive effect on children's early math skills. The domain-specific training had the highest effect on children's counting and number comparison skills.

Aims & background

Early mathematical tasks rely on a constant process of perceiving, coding, interpreting, comparing and retrieving information. In a numerical comparison task, for example, information about the numerical quantity of the presented numbers is retrieved from long term memory after which this information is integrated with the incoming information. The role of working memory in this is that the central executive helps to coordinate the processing of numerical information in order to perform the task. So it seems theoretically reasonable that performance on mathematical tasks is facilitated by working memory.

A large body of research (e.g. Geary, 2010, Passolunghi et al., 2008) has demonstrated correlations between working memory and (early) math. However, to test a possible causal relation, it would be better to investigate these relations with an experimental design. The main goal of this study was to test the hypothesis that improvement of working memory skills benefits early math learning. It should be noted that we do not pretend to offer an alternative for math interventions, because when the goal is to improve math, it would be better to use interventions focused on math itself. Two hypotheses were tested: (a) working memory can be trained in 5-year old children, (b) improved working memory leads to better early math performance. Working memory is always used within a domain-specific content. It appears that skills in a specific domain are related to working memory capacity in that domain (cf. Ericsson & Kintsch, 1995). Therefore, a distinction was made between domain-general working memory training, and a domain-specific training, focused on working memory within the numerical domain.

Methodology

A total of 51 second-year kindergarten children who scored in the lowest 50% on two standard national criterion-based math tests were selected to participate (mean age = 5.83 years, SD = 0.32) and randomly divided in three groups: (1) domain-general working memory training, (2) domain-specific working memory training, (3) no-intervention control group. The three groups did not differ in age, $F(2, 48) = 1.40$, $p = .26$, or sex, $\chi^2(2) = 2.56$, $p = .29$. Pre- and posttests were conducted to measure working memory and early math skills. The children were trained twice a week for about 30 minutes in groups of five children. The training lasted four weeks.

Working memory was measured with two subtests of the AWMA (Alloway, 2007), both a verbal and a visuospatial working memory task: word recall backwards and Odd one out. Early math was measured with a dot comparison task (cf. Gebuis, Kadosh & de Haan, 2008) and the Utrecht Early Numeracy Test-revised (Van Luit & Van de Rijt, 2009).

The domain-general training was aimed at improving the verbal and visuospatial working memory skills of the children. All the activities concentrated on working memory, in that they required the children to memorize, process and activate information simultaneously, which is in line with the definition of working memory as given by various researchers (e.g., Passolunghi & Pazzaglia, 2004, 2005). It was assumed that playing games that concentrate on working memory, is useful in enhancing working memory skills, as it has been shown that using (computerized) activities related to the processing and memorization of information are effective in improving working memory skills (Klingberg et al., 2005; Thorell et al., 2009).

The aim of the domain-specific working memory training was to improve the working memory skills in the domain of mathematics. It was tried to find similar activities as in the domain-general working memory training, but all with a

numerical content. The training thus included memorizing, processing and activating numerical and counting information simultaneously.

Findings

A repeated measures MANOVA showed significant differences for both training conditions (domain-general: $F(4, 11) = 10.91$, $p^3 = .80$; domain-specific: $F(4, 11) = 6.99$, $p^3 = .72$), but not for the control condition, $F(4, 17) = 1.61$, $p = .22$. Univariate within-subjects analyses showed large effects on working memory for both training groups (p

Between-group comparisons revealed a multivariate effect of condition on the posttest scores, $F(8, 82) = 2.79$, $p^3 = .14$. The univariate tests showed that both training conditions performed higher on Odd One Out than the control group (p). Furthermore, the domain-specific training group showed higher scores on the Early math tasks than the control group (p

Finally, it was investigated if improvement in working memory leads to improvement in early mathematics. Children who showed more improvement on the Odd One Out task, improved more on the Early Numeracy Test-Revised than children with less improvement on the working memory task ($r = .49$).

Theoretical and educational significance

This study shows large effects after a relatively short intervention. No significant differences were found between the domain-general and the domain-specific training group. It thus can be concluded that working memory skills can be enhanced by training at kindergarten age, and that the content of the trained working memory tasks is of minor importance. Furthermore, this study is the first that found generalization effects of working memory training on early math in young children. These results provide evidence for the causal relation between working memory and mathematics. Furthermore, it is promising that training working memory is effective, even in young children. These results could be helpful in interventions for children with either working memory deficits or mathematical deficits, although the largest effects may be found with children experiencing difficulties in both working memory and (early) mathematics.

SYMPOSIUM

Teaching and Instructional Design

Cognitive Load Theory revisited and revised

Chairperson: Joerg Zumbach, University of Salzburg, Austria

Organiser: Joerg Zumbach, University of Salzburg, Austria

Neil Schwartz, California State University, United States

Discussant: Tamara Van Gog, Erasmus University Rotterdam, Netherlands

One of the most successful theories for the design of instructional media during the past years is Cognitive Load Theory (CLT). CLT has spawned a large set of empirical. In fact, since its debut in 1988, hundreds of articles have investigated elements of instructional design through the lense of CLT. However recently, CLT has been criticized on a number of fronts. For example, intrinsic cognitive load has been considered by the designers of CLT as fixed and therefore immutable to instructional adjustments. Nevertheless, there is evidence that element interactivity is relative to a learner's prior knowledge of the material and the ontological characteristics of certain concepts. It also seems that extraneous cognitive load is not always deleterious to learning. Finally, germane cognitive load might not always be beneficial to learning, especially when, e.g., inadequate problem solving schemata are applied. Within this symposium, three different papers aim to clarify conceptual problems of CLT. Ayres suggests here to consider germane and extraneous cognitive load exclusively in terms of element interactivity. Thus, germane cognitive load is regarded here not as a separate source of working memory load. The contribution made by Schnotz introduces a motivational perspective of CLT. He argues that the cognitive load concept addresses rather heterogeneous aspects than a mere cognitive level. Finally, in the contribution by Zumbach and Schwartz, the role of germane cognitive load is re-conceptualized. In their empirical contribution they suggest a revised model of CLT where germane load is treated separately from both other kinds of CL.

Rethinking Germane Cognitive Load

Paul Ayres, University of New South Wales, Australia

Like any theory, cognitive load theory has had its fair share of doubters and critics. Unlike earlier times, when many criticisms were based on ideological grounds, commentators have recently adopted a more analytical and scientific based approach to identify some key conceptual issues that suggest potential weaknesses and inconsistencies in the theory. One major source of conceptual disagreement often reported focuses on considerations of the three different types of cognitive load (intrinsic, extraneous and germane), and in particular germane cognitive load. The main aim of this paper is two-fold. Firstly it documents some of the main problematical issues associated with germane cognitive load. Secondly it presents an argument that seeks to clarify some of these theoretical difficulties by reporting on a new conceptual framework that links germane cognitive directly to element interactivity and intrinsic cognitive load. It concludes by discussing the implications for the theory and educational outcomes.

Aims.

This paper has two main aims. Firstly it aims to document some of the problematical issues associated with germane cognitive load. Secondly it presents an argument that seeks to clarify some of these theoretical difficulties by reporting on a new conceptual framework that links germane cognitive directly to element interactivity and intrinsic cognitive load.

Methodology.

This theoretical paper brings together some of the key findings from three major sources (Beckmann, 2010; de Jong, 2010; Schnotz & Kyršchner, 2007) that have reported conceptual issues associated with cognitive load theory, and germane cognitive load in particular. It reports on a re-conceptualisation of germane load, that links it directly to element interactivity and intrinsic cognitive load (synthesised from Sweller, 2010; Sweller, Ayres & Kalyuga, 2010), thus providing a more robust framework.

Findings.

One major source of conceptual disagreement with CLT has been the various mechanisms associated with the three different types of cognitive load (intrinsic, extraneous and germane). In the early development of CLT, cognitive load was considered a single construct- the total working memory load invested in the learning episode. However, Sweller, van Merriënboer and Paas (1998) later identified three types of cognitive load- intrinsic, extraneous and germane. Intrinsic cognitive load was defined as the load caused by the materials to be learned; extraneous load by the load associated with dealing with the instructional materials; and germane load, the load directly invested in schema formation. A key aspect in this theoretical development was element interactivity that generates intrinsic cognitive load. Element interactivity is the number of elements that must be processed simultaneously. When the task to be learned is high in element interactivity, so is intrinsic cognitive load, and vice versa for low element interactivity (Sweller & Chandler, 1994). Sweller et al. (1996) considered each load as mutually exclusive and total cognitive load was calculated by adding the three loads together. The initial consideration of the three loads as independent has recently come under considerable scrutiny and has ultimately led to the changes outlined in this paper. A reconsideration of germane cognitive load by Schnotz and Kyršchner (2007) linked germane load to intrinsic by arguing that germane load is constrained by intrinsic load. In other words, germane cognitive load cannot exceed intrinsic load.

Whereas it is possible to have high intrinsic load and low germane load (little reflection on a difficult task) but not vice versa (much reflection on a simple task). Schnotz and Kyršchner concluded that it is the combination of germane load and intrinsic load rather than just germane load that leads to optimal learning, because little can be learned from easy tasks (low intrinsic load). Beckmann (2010) also theorised a closer relationship between intrinsic and germane load, arguing that germane load results from the cognitive behaviours that process element interactivity. Consequently, germane load is dependent upon intrinsic load. Beckmann also argues that element interactivity not only generates intrinsic cognitive load, but also extraneous cognitive load. Instructional materials contain a number of elements that need to be processed in working memory, in much the same way as the information to be learned. Sweller (2010), Sweller, Ayres and Kalyuga (2010) in their re-conceptualisation also argue that both intrinsic and extraneous load is generated by element interactivity. Furthermore, germane cognitive load can be considered exclusively in terms of element interactivity. It is defined in terms of working memory resources that are devoted to dealing with intrinsic cognitive load generated by the information to be learned. This consideration is in line with Schnotz and Kyršchner's argument that intrinsic load constrains germane load. However, germane load is not considered to be a separate source of working memory load, but purely a function of the number of interacting elements that generate intrinsic cognitive load. If intrinsic load is high (dependent upon the learner's prior knowledge) then a high amount of germane cognitive load is required to learn the materials. The reverse situation is true for materials low in element interactivity. The central role played by extraneous cognitive load in cognitive load theory remains the same, if extraneous cognitive load is high fewer working memory resources are available the less resources are available for dealing with intrinsic cognitive load. Hence fewer resources are available for germane cognitive load.

De Jong (2010) makes the point that cognitive load is often poorly defined in terms of mental load and mental effort, by frequently not making a clear distinction between a learner's efforts and the load imposed by the task. Sweller et al. (2010) make a much clearer distinction between the two by considering required cognitive load and invested cognitive load. The required intrinsic cognitive load is the load generated by the materials to be learned dependent upon the learner's prior knowledge. However, the learner still has to invest that level of cognitive load for learning to be optimised. If the intrinsic load demands are too high (exceeding WM capacity) or the learner does not invest enough due to motivational reasons (Beckman, 2010; Schnotz & Kýrschner, 2007; Sweller, 2010) learning is reduced. Measurement of cognitive load, and in particular the individual loads has been identified as another problematical area of cognitive load (Beckmann, 2010; de Jong, 2010; Schnotz & Kýrschner, 2007). Critics argue that learners are unable to differentiate between the three loads; not only through their own introspection but also because of the difficulty in defining them from a conceptual point of view. To-date attempts to measure the three loads separately have not been convincing (Sweller et al., 2010). The proposed reconsideration of cognitive load has direct consequences for measuring both individual and total cognitive load.

Theoretical and educational significance of the research.

This re-consideration of germane load has theoretical significance because it potentially improves the theory and reduces a number of conceptual issues. CLT has identified a number of effects that have facilitated learning and led to improved instructional designs. Any refinement of the theory has the potential to generate further effects and lead to further improvements in educational outcomes.

References

- Beckman, J. F. (2010). Taming a beast of burden- On some issues with the conceptualisation and operationalisation of cognitive load. *Learning and Instruction*, 20, 250-264.
- de Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional Science*, 38, 105-134.
- Schnotz, W., & Kýrschner, C. (2007). A reconsideration of cognitive load theory. *Educational Psychology Review*, 19, 469-508.
- Sweller, J., Ayres, P., & Kalyuga, S. (2010). Cognitive load theory. Book submitted for publication.

Working Memory and Learning: What Kind of Load Do We Talk about?

Wolfgang Schnotz, University of Landau, Germany

Cognitive load theory aims at integrating knowledge about the structure and functioning of the human cognitive system with principles of instructional design. Cognitive load theory makes a distinction between different kinds of cognitive load. Nevertheless, the general load concept is considered as something unitary, because the different kinds of cognitive load are assumed to draw on the limited capacity of working memory in an additive way. A closer look reveals, however, that the cognitive load concept addresses rather heterogeneous aspects. The paper will analyze some conceptual shifts that have been made in cognitive load theory. The concept of cognitive load in the original version of the theory was derived from the number of cognitive elements that have to be held simultaneously in working memory, which was called 'element interactivity'. When recent versions of the theory try to explain split-attention effects, however, they refer to maintenance processing rather than to element interactivity. When they describe waste of time and effort as cognitive load on the working memory of advanced learners, they refer to the amount of cognitive operations and to motivational resource rather than cognitive ones. The theoretical and practical implications of these conceptual shifts will be pointed out.

Cognitive load theory tries to integrate knowledge about the structure and functioning of the human cognitive system with principles of instructional design. The theory argues that many traditional instructional techniques do not adequately take the limitations of the human cognitive architecture into account as they unnecessarily overload the learner's working memory, the central "bottleneck" of his/her cognitive system (Paas, Renkl, & Sweller, 2004; Sweller, 2005). Intrinsic load is the unavoidable load caused by the task-intrinsic aspects of learning. Extraneous load is unnecessary load caused by inappropriate design and organization of the learning material. Germane load is caused by effortful learning and corresponds to the working memory capacity required for schema abstraction and automation (Sweller, van Merriënboer & Paas, 1998). Because the different kinds of load are assumed to draw on working memory capacity, the concept of cognitive load is generally considered as something unitary. A closer look reveals, however, that the concept addresses rather heterogeneous aspects. Whereas the concept of cognitive load of the original theory was derived from the number of cognitive elements that have to be held simultaneously in working memory (the so-called element interactivity), it includes nowadays also facets such as maintenance processing, amount of cognitive operations, and use of motivational resources.

Maintenance Processing

Working memory is limited not only in terms of capacity, but also in terms of duration. If instruction unnecessarily requires extra effort to compensate for the limited temporal duration of information in working memory, this is considered as an extraneous load. For example, if an instruction requires split of attention between text and pictures and if the two kinds of sources are presented in a segregated rather than in integrated format, the learner has to invest additional effort to keep information in working memory while his/her attention is shifting from one source to another source of information. Note, however, that there is no change in element-interactivity, because the number of cognitive elements to be held simultaneously in working memory is exactly the same. What makes learning more difficult when text and pictures are presented in a segregated format is the need of maintaining cognitive elements in working memory rather than an increase in element-interactivity. Amount of cognitive operations An instructional format that is beneficial for novices can lose its advantage with increasing expertise of the learners and finally become disadvantageous for individuals with higher expertise (Kalyuga, Ayres, Chandler, & Sweller, 2003). In order to explain this so-called expertise reversal effect, cognitive load theory assumes that information which is necessary for novices may become redundant for more advanced learners. Redundant information is assumed to impose an unnecessarily high cognitive load on working memory of advanced learners. It is obvious that this view is for the following reasons not consistent with the original concept of cognitive load as the amount of element interactivity (i.e. the number of cognitive elements that have to be held simultaneously in working memory). If an instructional format is beneficial for novices, it does obviously not overload their working memory. When novices increase their expertise through learning by construction of new schemata and automation, this results in lower (rather than higher) cognitive load for the same tasks. In other words, an information format that does not overload the working memory capacity of novices will not be able to overload the capacity of experts. It follows that cognitive load due to the processing of redundant information must be explained in a different way.

When cognitive processing of irrelevant information is considered as extraneous load, this load is simply a waste of time and effort on the side of the learner (Kalyuga, Chandler & Sweller, 1998). If, for example, an advanced learner studies a diagram that is perfectly intelligible for him/her without further explanation and if afterwards he/she reads an accompanying text that explains the diagram for novice learners, reading this text by an advanced learner means processing unnecessary information with no added value for learning. Note, however, that the text does not overload the working memory of the advanced learner, simply because it does not overload novice learners. Cognitive load due to waste of time and effort means that learners perform cognitive processes that do not result in additional learning. It is the amount of cognitive processing that seems to be critical here, which is very different from the original concept of cognitive load. Remember that the load concept was derived from the number of cognitive elements that have to be held simultaneously in working memory. Cognitive activities such as vocabulary learning (although time consuming and exhausting) were assumed to have a low cognitive load, because only a few elements have to be held simultaneously in working memory at any time (Sweller, van Merriënboer and Paas, 1998). However, cognitive load due to waste of time and effort is a load caused not by cognitive elements held in working memory, but by the amount of cognitive processes. Motivational Resources Learning is a process, which requires time and can be more or less exhausting. The effort invested by an individual can be considered as a kind of 'mental energy'. An individual's reservoir of energy can be exhausted by the process of learning and then needs to be recharged in order to continue learning. His/her willingness to invest energy into learning leads to the field of motivation. The close relation between cognitive load and motivation remains usually hidden, but becomes obvious when one considers the measurement procedures (Schnotz, Fries & Horz, 2010). Cognitive load is usually measured by self-judgements of the effort invested into learning or solving a task (Paas, van Merriënboer & Adam, 1994). However, the same measurement is also used in questionnaires for the learner's present motivation (QAM; Rheinberg, Vollmeyer & Burns, 2001). Highly motivated learners show higher persistence, invest more time and energy into the process of learning, which finally results in better learning results. In other words, cognitive load due to a waste of time and effort is essentially a load on a motivational resource rather than a cognitive one.

Cognitive Load Theory Re-Examined: A Dynamic Model of Cognitive Load

Joerg Zumbach, University of Salzburg, Austria; Neil Schwartz, California State University, United States

In two experiments, a revised model of Cognitive Load Theory has been examined. Within this model, we suggest that the assumption of additivity of all three types of cognitive load cannot be kept. We rather assume that intrinsic and extraneous cognitive load have to be treated separately when examining problem-solving. In addition, it is postulated here that germane cognitive load does have an active impact on how information occupying intrinsic and extraneous load resources are processed without being subject to cognitive overload itself. Using the Tower-of-Hanoi-task we could show that a series of highly difficult problem-solving tasks contributes to develop effective problem-solving

schemata better than a task with increasing difficulty. These differences finally vanish when the adequate problem-solving schema is trained in advance. Based on these findings we suggest a revised model of cognitive load mapped on working memory architecture.

Aims.

Learning performance is enhanced when instruction is properly designed; instructional design is best when it is guided by theory. One of the most successful theories for the design of instructional media is the theory of Cognitive Load (CLT). However, recently, CLT has been criticized on a number of fronts (de Jong, 2010)—among them, the nature of the specific types of cognitive load and the degree to which they are clearly distinguishable. Extraneous load reduction may undercut the potential for germane processing—processing that is good for learning; instructional material appearing to cause extraneous load is often circumvented by learners' prior knowledge; thus, some material incurring extraneous load does not necessarily compromise learning (cf. Mayer & Johnson, 2008). Higher cognitive load leading to better schema construction (and hence, better learning) is not always of the type that is germane to the task. Thus, the construct of CL, with its differentiation between the three types and the theorem of additivity, does not appear to accurately represent the nature of human information processing. It seems unlikely that ICL, ECL and GCL are well differentiated with each load type having a distinctive function during learning. Sources of CL are sometimes assumed to be "overload" when they are not, and the origin of their influence is not always clear. We contend that ICL and ECL are influenced by information from the outside, and GCL is influenced by information represented inside memory. If true, it is likely that GCL has a reserved storage space in working memory that maintains active information processing in severe conditions where ICL and ECL are high. We assume that under such circumstances, higher load (especially ICL) might even increase effort to process current information and foster schema construction better by using GCL more efficiently.

Methodology.

Here, we examined cognitive load using a task commonly employed to test the activation of executive function—the Tower of Hanoi. The Tower-of-Hanoi task is fixed in the ICL it incurs because its element interactivity is fixed, unless the number of disks, and thus the number of steps necessary to solve the task, is increased. GCL, alternatively, is a load type incurred by the deployment of cognitive operations associated with executive regulation. We manipulated the learning conditions of the Tower-of-Hanoi task in two experiments to examine schema construction and schema automation to determine: a) in which components of the working memory system the construction and automation is likely to occur, and b) which types of cognitive load are likely incurred during the construction and automation processes. We varied the number of disks required to solve the task and the training learners' received in the most efficient strategy for solution; we measured the time and number of moves to solve the task, as well as learners' perceptions of CL. In experiment one, participants had to solve the Tower-of-Hanoi problem over three consecutive trials. Half the learners were given six disks on each trial to construct the schema of the task. The other half were given four, five, and six disks on trial one, two, and three, respectively. If CLT is correct, the number of errors (of moves) as a percentage of the optimal number of moves should decrease over trials while the number of disks is increased. The increasing difficulty should contribute to develop a problem-solving schema that will, starting with subtask two, be able to reduce CL by means of chunking. There should also be no difference in the percentages when the number of elements begins high and remains high over trials since the intrinsic cognitive load remains consistently high. We argue that the need of active information processing in the condition with high difficulty contributes to the development of a problem-solving schema rather than the increasing difficulty condition. We assume that ICL and ECL must be treated separately from GCL. Here GCL might influence how information processing is handled depending on task difficulty and available resources. Consequently, a continuous series of high complex tasks might be better for developing adequate problem-solving schemata than increasing difficulty due to an increased need of information processing. This requires the assumption that GCL does not have an additive relation with ICL and ECL yielding an overall sum of CL. In experiment two, we replicated and extended experiment one by training two additional groups in the algorithm of the Tower-of-Hanoi-task. We expected the same pattern for the untrained groups as in experiment 1. For the trained groups, we did not expect to find differences between both conditions related to the number of discs because problem-related GCL should reduce ICL significantly.

Findings.

Results of experiment one (n=60) yielded significant effects for all three subtasks (pIn experiment two (n=120) the same findings were replicated (pSignificance of the research. Results of both experiments suggest that CLT is not able to explain the findings, and that the addition theorem of CL is not valid. Instead, it appears that ICL and ECL operate in a separate subsystem of working memory than GCL, though, both subsystems interact together. Furthermore, it seems likely that GCL occupies a reserved space in working memory—a space reserved for active information processing germane to a task. If the reserved space hypothesis is true, then learners have a reservation of resources that allows them to process information even under the worst conditions and might even foster and support problem-

solving processes better than CLT-adequate instruction. Based on these findings, we suggest a revised model of CLT that directly maps cognitive load to established working memory models.

References

- de Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional Science*, 38, 105-134.
- Mayer, R. E. & Johnson, C. (2008). Revising the redundancy principle in multimedia learning. *Journal of Educational Psychology*, 100, 380-386.

SYMPOSIUM

Meta-cognition

Self-Regulated Study and its Cues: The Road to Hell Is Paved with Good Intentions

Chairperson: Nathalie Huet, University of Toulouse, France

Organiser: Ladislav Motak, The French National Institute for Transport and Safety Research (INRETS), France

Discussant: Rainer Bromme, Universität Muenster, Germany

Despite the undeniable progress of networking and globalism, current educational curricula may be successful only insofar as the target population is able to consequently self-regulate its activities in a well adapted and efficient manner. Indeed, it has been recently shown that people rely on metacognitive processes to regulate their behaviour: Those processes not only reflect--more or less correctly--one's cognitive states, but also allow for regulating one's cognitive activity strategically towards the predetermined goals. In this respect, the three presented papers are concerned with metacognitive cues and heuristics that may guide people's self-regulation in such tasks as learning (Undorf & Cýpper), understanding (Ackerman & Leiser), and even driving (Motak et al.). However, while it appears that human metacognition as a complex system is able to take into account a wide range of diverse metacognitive cues, the three presented papers not only approach the theme of self-regulation in thus far sometimes scarcely related contexts, but also point out metacognitive cues that may prove detrimental to one's efficient self-regulation: Implicit memory processes (Undorf & Cýpper), an inflated sense of understanding (Ackerman & Leiser), and a stereotype threat effect (Motak et al.). From an educational point of view, this summary of research on metacognitive regulation of study effort identifies cues and heuristics worthy to be aware of when conceiving educational curricula aimed at self-consciousness and self-regulation enhancement.

Implicit and Explicit Memory Processes Affect Self-Regulated Learning

Monika Undorf, Chair of Psychology III, Germany; Lutz Cüpper, University of Mannheim, Germany

Metacognitive processes are known to be important for successful self-regulated learning. This can, for example, be seen from the fact that people use judgments of learning (JOLs) to regulate their learning behavior. We present a series of three experiments that investigated whether JOLs rely selectively on either implicit memory processes or explicit memory processes or on both processes. In order to assess implicit and explicit memory processes, the process-dissociation procedure was used in combination with a word stem completion task. We found that explicit memory processes are more accurately reflected in JOLs than implicit memory processes are. Nevertheless, our results showed that JOLs are based on both implicit and explicit memory processes. The conducted experiments thus revealed that metacognitive monitoring is not confined to explicit memory processes. From a theoretical point of view, this finding emphasizes the considerable capability of the metacognitive system. In educational settings in which test performance is mainly governed by explicit memory processes, however, the influence of implicit memory processes on JOLs might be detrimental.

Metacognitive processes are known to be important for successful self-regulated learning. This can, for example, be seen from the fact that people use judgments of learning (JOLs) to regulate their learning behavior. JOLs are predictions of the likelihood with which recently studied information will be retrieved in future. Both people's choices concerning the relearning of to-be-studied information and people's allocation of study time to different pieces of to-be-studied information are systematically related to JOLs (e.g., Metcalfe & Finn, 2008; Son & Metcalfe, 2000).

Metacognitive judgments, as for example JOLs, in turn are generally agreed to be inferences on the basis of a variety of cues and heuristics that convey information about cognitive processes. Their validity in predicting cognitive processes therefore is not guaranteed but is an empirical question. In this context, an important question relates JOLs

to the well established distinction of implicit and explicit memory processes (e.g., Graf & Schacter, 1985). According to Jacoby (1991), implicit memory processes are considered as automatic processes—i.e., as fast processes that do neither demand attention nor exhaust cognitive capacity—whereas explicit processes are regarded as controlled processes, i.e., as slower processes that demand attention and can be deployed flexibly to achieve one's aims.

The question whether JOLs rely selectively on either implicit or explicit processes or on both has been discussed frequently (e.g., Benjamin, 2005; Daniels, Toth, & Hertzog, 2009) but was seldom investigated. A study that is related to this question was conducted by Daniels et al. (2009) and investigated how the accuracy of JOLs changes with memory retrieval experiences. The authors employed an experimental procedure that closely resembled the remember-know task (cf. Tulving, 1985), in which metacognitive judgments concerning the experiences associated with memory retrieval are used for separating the contributions of recollection and familiarity to recognition memory. The results obtained by Daniels et al. are consistent with the idea that recollection is more important for JOLs than familiarity. The validity of this conclusion, however, is challenged by an ongoing debate concerning the suitability of the remember-know task to disentangle implicit and explicit processes. First, it is controversial whether remember and know judgments reflect different memory processes at all (e.g., Dunn, 2008). Second, both remember and know response rates are affected by response bias and thus cannot be interpreted as pure measures of implicit and explicit memory processes (e.g., Erdfelder, Cýpper, Auer, & Undorf, 2007). Third, soliciting for each item both a JOL and a judgment on memory retrieval experience might distort results.

A less controversial and therefore preferable empirical approach that allows investigating the influence of implicit and explicit memory processes on JOLs and self-regulated learning is the process-dissociation procedure introduced by Jacoby (1991). The process-dissociation procedure separates the contributions of implicit and explicit processes by means of combining a facilitation condition and an interference condition. In the facilitation condition, controlled processes and automatic processes act in concert towards correct responses. In contrast, only controlled processes promote correct responses in the interference condition, whereas automatic processes favor erroneous responses. In word stem completion experiments, participants are asked to complete presented stems to previously studied words in the facilitation condition, whereas they are required to complete word stems with any meaningful word except for learned ones in the interference condition. Combining these tasks permits to estimate the relative contributions of controlled and automatic processes by means of an appropriate measurement model as the extended measurement model (Buchner, Erdfelder, & Vaterrodt-Plýnnecke, 1995; Cýpper & Erdfelder, 2004).

We conducted a series of three experiments that separately investigated the contributions of implicit and explicit memory processes to JOLs in both experimenter-controlled and self-regulated learning conditions. In these experiments, we used the process-dissociation procedure in combination with a word stem completion task to assess implicit and explicit memory processes. Our results first showed that JOLs are based on both implicit and explicit memory processes: The probabilities of implicit and explicit memory processes increased with increasing JOLs. Second, we found that explicit memory processes are more accurately reflected in JOLs than implicit memory processes are: The probability of explicit memory processes increased with increasing JOLs more considerably than the probability of implicit memory processes did.

The conducted experiments thus revealed that although explicit memory processes are more closely related to JOLs than implicit memory processes are, metacognitive monitoring is not confined to explicit memory processes; rather, both types of memory processes were subject to metacognitive monitoring. From a theoretical point of view, this finding emphasizes the considerable capability of the metacognitive system. In educational settings in which test performance is mainly governed by explicit memory processes, however, the influence of implicit memory processes on JOLs might be detrimental.

References

- Benjamin, A. S. (2005). Response speeding mediates the contributions of cue familiarity and target retrievability to metamnemonic judgments. *Psychonomic Bulletin & Review*, 12(5), 874-879.
- Buchner, A., Erdfelder, E., & Vaterrodt-Plýnnecke, B. (1995). Toward unbiased measurement of conscious and unconscious memory processes within the process dissociation framework. *Journal of Experimental Psychology: General*, 124(2), 137-160.
- Cýpper, L., & Erdfelder, E. (2004). Die Wortstammlänge beeinflusst kontrollierte, nicht aber automatische Gedächtnisprozesse im Wortstammerngänzungsparadigma [The stem length affects controlled but not automatic processes in word stem completion]. *Zeitschrift für Psychologie*, 212(3), 167-176.
- Daniels, K. A., Toth, J. P., & Hertzog, C. (2009). Aging and recollection in the accuracy of judgments of learning. *Psychology and Aging*, 24(2), 494-500.

- Dunn, J. C. (2008). The dimensionality of the remember-know task: A state-trace analysis. *Psychological Review*, 115(2), 426-46.
- Erdfelder, E., Cýpper, L., Auer, T., & Undorf, M. (2007). The four-states model of memory retrieval experiences. *Zeitschrift für Psychologie/Journal of Psychology*, 215(1), 61-71.
- Graf, P., & Schacter, D. L. (1985). Implicit and explicit memory for new associations in normal and amnesic subjects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11(3), 501-518.
- Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, 30(5), 513-541.
- Metcalfe, J., & Finn, B. (2008). Evidence that judgments of learning are causally related to study choice. *Psychonomic Bulletin & Review*, 15(1), 174-179.
- Son, L. K., & Metcalfe, J. (2000). Metacognitive and Control Strategies in Study-Time Allocation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26(1), 204-221.
- Tulving, E. (1985). Memory and consciousness. *Canadian Psychology*, 26, 1-12.

The Effect of Concrete Illustrations on the Metacognitive Regulation of Study

Rakefet Ackerman, Technion--Israel Institute of Technology, Israel; David Leiser, Ben-Gurion University, Israel

Study materials often include illustrations for decoration and organization of text. Ackerman and Leiser found that increased concreteness enhanced through inclusion of illustrations increased the metacognitive Sense of Understanding (SOU) even when illustrations did not contribute to actual understanding of the topic. The present study examined practical implications of this finding. In three experiments, participants studied texts, in either a plain text version or accompanied by uninformative illustrations. In two of the experiments, participants studied expository texts. Immediately after studying each text, they rated their SOU and were tested for comprehension, either with open books (Experiment 1) or without (Experiment 2). In Experiment 3 the texts were explanations of solutions for difficult logic problems. Participants attempted to solve each problem on their own, read explanation of its solution and rated their SOU for that explanation. Understanding was evaluated by a transfer problem similar to the initial problem. Under all the conditions tested, study efficiency was lower for illustrated texts than for plain texts. When more time was invested in processing illustrated texts, either during study (with closed books) or during testing (with open books), participants succeeded in reaching comparable test scores for the two versions. When no compensatory time was invested, illustrated texts led to a reduction in performance and to a larger upward bias of the SOU. These findings suggest that, by enhancing the subjective concreteness of texts, illustrations may bias the SOU and reduce study efficiency.

According to the metacognitive approach, efficient study depends on the accuracy of the subjective assessment of knowledge level. Knowledge monitoring that results in a mistakenly high self-assessment is expected to lead learners to cease studying too soon and perform lower than expected (Winne, 2004). Ackerman and Leiser (2010) suggested that one heuristic cue that may bias the metacognitive monitoring of understanding is the feeling of concreteness generated by the text. A sense of concreteness refers to the ability to focus on the surface level rather than on the abstract structure of the subject matter (Smith, diSessa, & Roschelle, 1993) and was operationalized in several studies by the inclusion of illustrations in study materials (Carney & Levin, 2002; Chen & Daehler, 2000). Indeed, Ackerman and Leiser (2010) found that concreteness increased by topic-related but uninformative illustrations enhanced the Sense of Understanding (SOU) even when they did not contribute to the actual understanding.

The three reported experiments aimed to specify conditions under which illustrations bias the SOU and affect regulation of study efforts. In Experiment 1, undergraduate students (N=44) studied printed explanatory texts (300-600 words). The illustrated versions included verbal examples and pictorial illustrations pointedly designed not to contribute to understanding and were compared to plain versions. Each participant studied one illustrated text and one plain text under self-paced study instructions. Time was documented at each step. Immediately after studying, the participants rated their SOU on a 0-100% scale and got tested by 5-7 inference questions. Importantly, the participants were allowed to look back at the text whilst taking the test (open-books condition).

The findings support the hypotheses (see Table 1). SOU was higher for the illustrated than for the plain versions of the texts, while the actual test scores did not differ significantly. At first sight, it seems that concreteness manipulation did not affect the study process. However, an examination of the time invested for achieving this similar performance revealed that although the study time was similar for the two versions of text, the test-taking time was longer for the illustrated than for the plain versions. This result suggests that during test taking the participants realized that their study of the illustrated versions had not been thorough enough, and took successful compensatory action by taking advantage of the open-books conditions.

Continuing this line of analysis, Experiment 2 examined the effect of more detailed text processing on SOU. Experiment 2 replicated the procedure of Experiment 1 but with closed books, now requiring participants to memorize in addition to high-order understanding. This procedure was expected to lead to one out of the following two outcomes: (a) If the study process is similar to that involved in Experiment 1, we would expect to find weaker performance, shorter study times, and a larger SOU bias for the illustrated versions, as participants were expected to regulate their study in accordance with an inflated SOU. (b) The requirement for memorizing may generate a qualitatively different study process, focusing participants' attention on the processing of details rather than on their overall feeling of understanding. Consequently, the need to integrate the illustrations with the text should increase cognitive load (Chandler & Sweller, 1991) and result in longer time investment and a sense of difficulty that in turn is expected to reduce the SOU (Rawson & Dunlosky, 2002). The results support the second outcome (see Table 1). SOU was now lower for the illustrated than for the plain versions and it took participants longer to achieve a similar level of performance. Thus, once again, study efficiency was lower for the illustrated versions.

In Experiment 3, we attempted to focus the participants' attention on an even higher order processing than that required in Experiment 1. We challenged the participants with four difficult logic problems. After trying to solve each, the participants read the solutions (70–150 words). The solutions appeared either with or without uninformative illustrations manipulated within participants. Participants rated their SOU regarding each solution and then faced a closely related transfer problem. The findings (see Table 1) support our hypothesis regarding the generalized effect of illustrations on the SOU when high-order inferences are required: SOU was higher for the illustrated than for the plain solutions and performance was (marginally significant) lower. Thus, in this case, the concreteness manipulation increased the SOU bias, the discrepancy between SOU and test score (overconfidence), with no evidence of any compensation attempt during study or test time. This increased bias is expected to misguide future regulatory decisions.

To summarize, across the three experiments study efficiency was lower for the illustrated versions than for the plain versions of the texts. Our findings strongly suggest that the effects of illustrations are not limited to being either helpful or neutral: illustrations can also harm the study regulation process, by biasing the SOU and reducing study efficiency. Calling attention to risks in inclusion of redundant illustrations may guide study-material designers and contribute to the development of metacognitive-instruction programs for students.

References

- Ackerman, R., & Leiser, D. (May, 2010). Meta-comprehension bias generated by illustrated texts. Paper presented at The 4th Biennial Meeting of the EARLI SIG 16 – Metacognition, Muenster, Germany.
- Carney, R. N., & Levin, J. R. (2002). Pictorial illustrations still improve students' learning from text. *Educational Psychology Review*, 14, 5-26.
- Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and instruction*, 8, 293-332.
- Chen, Z., & Daehler, M. W. (2000). External and internal instantiation of abstract information facilitates transfer in insight problem solving. *Contemporary Educational Psychology*, 25, 423-449.
- Rawson, K. A., & Dunlosky, J. (2002). Are performance predictions for text based on ease of processing? *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 28, 69-80.
- Smith, J. P., diSessa, A. A., & Roschelle, J. (1993). Misconceptions reconceived: A constructivist analysis of knowledge in transition. *The Journal of the Learning Sciences*, 3, 115-163.
- Winne, P. H. (2004). Students' calibration of knowledge and learning processes: Implications for designing powerful software learning environments. *International Journal of Educational Research*, 41, 466-488.

Keeping aware of being an older driver? Stereotype threat as a cue in older adults' self-regulation

Ladislav Motak, The French National Institute for Transport and Safety Research (INRETS), France; Nathalie Huet, University of Toulouse, France; Catherine Gabaude, The French National Institute for Transport and Safety Research, France; Jean-Claude Bougeant, University of Lyon 2, France

Research has previously demonstrated older adults succeed to self-regulate their activity respectfully of their available cognitive resources. Yet question remains, which metacognitive cues may allow--or hinder--older adults to self-regulate in an adaptive way. While stereotypes represent basically an extrinsic, theory-based cue, a stereotype threat effect--i.e. lower performance when facing a stereotype--occurs through depleting working memory resources, and as such represents an internal, experience-based cue. To which of these cues would then the older adults' self-regulation be more sensitive? Twenty drivers under stereotype threat of an "older driver" and twenty controls (mean age 70

years) drove on simulator through four differently difficult circuits, and had then only restricted time to train themselves before a fictitious test. If the older adults' self-regulation was based on internal cues, inducing a stereotype threat--i.e. an extra working memory charge--would result in a self-paced training focused on easier items. If their self-regulation was based on extrinsic cues, focus should shift towards harder items, as subjects might try to disconfirm the stereotype at hand. Control group drivers self-regulated in an adapted manner, focusing their training mostly on circuits of medium difficulty. However, inducing stereotype threat in experimental group resulted in absence of any metacognitively guided self-regulation, as drivers of this group allocated time almost equally to all four circuits, regardless of their difficulty. Results are discussed in terms of older adults' self-regulation cues, but also regarding possible contributions of metacognitive models to development of elderly drivers' preventive and educational programs.

The Region of Proximal Learning framework of self-regulated learning (RPL; Metcalfe, 2002) predicts that people should adjust their learning as a function of their available cognitive resources, and namely when given only a limited amount of time to enhance their performance. That is exactly what has been found recently in older adults (Motak, Huet, Gabaude, & Bougeant, 2010), thus challenging the longstanding view that despite their rather intact monitoring skills, older adults would not spontaneously draw on to accurately self-regulate their learning (see Hines, Touron, & Hertzog, 2009, for review).

However, it is not clear which metacognitive cues (Koriat, 1997) may allow--or hinder--older adults to self regulate in an adaptive way. Stereotypes represent basically an extrinsic, theory-based cue regarding one's cognitive characteristics. However, a stereotype threat effect--i.e. lower performance when facing a self-relevant stereotype--occurs through depleting working memory resources as one presumably tries hard to disconfirm the stereotype (Schmader, Johns, & Forbes, 2008). As such, stereotype threat may represent an internal, experience-based cue, turning the task at hand to a seemingly harder one. To which cue would then the older adults' self-regulation be more sensitive?

In accordance with the RPL experimental paradigm, twenty drivers under stereotype threat of an "older driver" (i.e. to whom the study has been portrayed as investigating why older drivers are more at risk) and twenty controls (to whom the study has been described as a study of driving simulator characteristics; mean age 70 years for both groups) drove on driving simulator through four differently difficult circuits, and had then only restricted time to train themselves before a fictitious test. If the older adults' self-regulation was based on internal cues, inducing a stereotype threat--i.e. an extra working memory charge--should result in a self-paced training focused on easier circuits. If their self-regulation was based on stereotype as an extrinsic cue, however, focus should shift towards harder items regardless of experienced difficulties, as subjects might try to disconfirm the stereotype at hand.

Metcalfe in her RPL framework advocates (Metcalfe, 2002; but see also Kornell & Metcalfe, 2006) that for a self-regulation to be adapted, it must be centred on items of medium difficulty, as spending more time in the easiest items would yield no further benefit and engaging in the hardest items would necessitate more time than allowed. Based on this assumption, our preliminary results suggest that control group drivers self-regulated in an adapted manner, focusing their training mostly on circuits of medium difficulty, i.e. presumably within their reach as predicted by the RPL framework. However, inducing the stereotype threat did not lead to a shift nor towards easier, neither towards harder items, and resulted simply in absence of any metacognitively guided self-regulation, as drivers of the experimental group allocated their time almost equally to all four circuits.

In respect to older adults' self-regulation, it can then be concluded that these are actually able to allocate their self-paced training time in a RPL-consistent, adapted way, but only thus far as their working memory resources are not overloaded. Our results further support findings reported by Inzlicht, McKay, and Aronson (2006), suggesting that stereotype threat affects not only one's performance, but also impedes one's capacity to self-regulate in an efficient manner--in other words, weakens one's self-control capabilities. It is argued that older adults' self-regulation is based namely--although presumably not solely--on internal cues, but that these can be easily shadowed by a stereotype threat.

Finally, results are discussed not only in terms of cues older adults use to self-regulate their activity, but also regarding the possible contribution of metacognitive models to the development of elderly drivers' preventive and educational programs.

References

Hines, J.C., Touron, D.R., & Hertzog, C. (2009). Metacognitive Influences on Study Time Allocation in an Associative Recognition Task: An Analysis of Adult Age Differences. *Psychology and Aging*, 24, 2, 462-475.

- Inzlicht, M., McKay, L., & Aronson, J. (2006). Stigma as Ego Depletion. How Being the Target of Prejudice Affects Self-Control. *Psychological Science*, 17, 3, 262-269.
- Koriat, A. (1997). Monitoring One's Own Knowledge During Study: A Cue-Utilization Approach to Judgments of Learning. *Journal of Experimental Psychology: General*, 126, 4, 349-370.
- Kornell, N. & Metcalfe, J. (2006) Study Efficacy and the Region of Proximal Learning Framework. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 3, 609-622.
- Metcalfe, J. (2002). Is Study Time Allocated Selectively to a Region of Proximal Learning? *Journal of Experimental Psychology: General*, 131, 3, 349-363.
- Moták, L., Huet, N., Gabaude, C., & Bougeant, J.-C. (May, 2010). The elderly drivers' reduction of discrepancy: How does their self-regulation really differs from that of younger drivers? Paper presented at the 4th Biennial Meeting of the EARLI SIG 16 – Metacognition, Múnster, Germany.
- Schmader, T., Johns, M., & Forbes, C. (2008). An Integrated Process Model of Stereotype Threat Effects on Performance. *Psychological Review*, 115, 2, 336-356.

SYMPOSIUM

Professional Development

Understanding and improving the quality of feedback processes

Chairperson: Regina Mulder, Universitaet Regensburg, Germany

Organiser: Regina Mulder, Universitaet Regensburg, Germany

Discussant: Thomas Garavan, Kemmy Business School, Ireland

Feedback can cause cognitive conflicts that can lead to reflection: feedback has the potential to improve learning. Research on feedback in education shows for instance it has to be given directly after an incident occurs to be most effective, and that it is a complex process. In this symposium, by discussing a selection of relevant aspects, insight will be gained in this process and opportunities are identified to improve the effects of feedback. In the concept of feedback culture (Kahmann & Mulder, 2007) one of the important aspects is the process of feedback: leading from seeking feedback (symposium-contribution C3), over giving feedback (C1), to receiving feedback (C2). To increase our understanding of the feedback process, C2 and C3 focus on understanding the processes, C1 intervenes to optimize feedback. A second aspect concerns the quality of feedback. In C1 it is tried to optimize the quality by discussing it, in C2 the quality is assessed by finding out what the relation between characteristics of feedback with learning activities is, and C3 focuses on the quality of feedback sought in the social network. All three contributions question how 'peer feedback', either with students or colleagues at work, can reach its potential.

Peer feedback in primary school: The effects of knowledge on feedback style

Frans Prins, Dept of Pedagogical and Educational Sciences, Utrecht University, Netherlands

This experimental study aims at examining the effect of a specific intervention – providing students in primary education with information about criteria and standards – on peer feedback style. Knowledge about criteria and standards could lead to terms such as 'right' or 'good', so called 'final vocabulary', and it is expected that our intervention will lead to final vocabulary, which in turn will lead to a more authoritative style. In total, 95 sixth grade students were randomly assigned to one of two conditions. In the experimental condition, the students first discussed the criteria and standards that a good brochure should meet. In the control condition, the students provided peer feedback without a group discussion of the criteria and standards. To determine the feedback style, the written feedback was analysed to identify different kinds of verifications and elaborations. A K-Means cluster analysis showed that students in the experimental group had a chance on having an authoritative style that was approximately three times bigger than in the control group. Theoretical and practical implications of the study are discussed. For instance, it is recommended that, besides providing students with information about criteria and standards, students in primary education should be prompted to substantiate their feedback comments and to provide suggestions and reflective questions for improvement. Furthermore, it is argued that the processes described in this study and the provided recommendations are also relevant for secondary and higher education and workplace settings.

(Quasi-)experimental studies and descriptions of specific peer assessment mechanisms are needed to unravel effects of peer feedback and peer assessment (Strijbos & Sluismans, 2010). Furthermore, there is very little research concerning peer assessment in primary school (Topping, 2010). This experimental study is aimed at revealing a peer

assessment mechanism in primary education, that is, the effect of a peer assessment intervention on peer feedback style was examined.

An often heard complaint about peer assessment is that the quality of peer feedback is low (e.g., Prins et al., 2006). This threat is probably more severe in primary education compared to higher education. Thus, when a teacher wants to use peer assessment in primary education, specific intervention concerning peer assessment is needed in order to reach a sufficient quality level of peer feedback. The examined intervention in this study is the provision of information about criteria and standards that a specific student product has to meet. When a feedback provider receives knowledge about criteria and standards, peer feedback quality is assumed to increase. However, information about criteria and standards could also affect the feedback style of the students in primary education. Knowledge about criteria and standards could lead to terms such as 'right' or 'good'. According to Boud (1995), great care has to be taken in using this so called 'final vocabulary' (Rorty, 1989), which included terms as 'right' or 'good'. Final vocabulary is positive, but it has a final say and it leaves no space for manoeuvre. Thus, it has no place in any discourse about learning. A judgment does not encourage the student to undertake further action (Boud, 1995, p. 45).

Thus, it is expected that our intervention will lead to final vocabulary, which in turn will lead to changes in feedback style. Van den Berg (2003), following Lockhart and Ng (1995), distinguished four types of feedback style: authoritative, where the provider gives feedback without explanations or suggestions for revision; interpretive, where the provider sticks to her/his own experience and ideas when giving suggestions for improvement; probing, where the provider takes the perspective of the receiver and explains her/his remarks, structures feedback according to the performance and provides suggestions for performance improvement; and collaborative, which resembles probing, but where the provider and receiver create a collaborative product. The first two styles can be linked to the controlling and directive way, the last two styles can be linked to the facilitative way of commenting (Straub, 1996). When in the feedback the judgement is emphasized, and less explanation is given, the style is authoritative. By the interpretative as well as the probing style explanations and suggestions for revising the performance are provided, but someone with an interpretive style sticks to his own experiences and ideas. Someone with a probing style takes the perspective of the student and gives explanations and suggestions that correspond with the intention of the student. With a collaborative style, the provider and the student deliberate about the performance, and create a collaborative product (Van den Berg, 2003).

In total, 95 students (58 boys, 37 girls) in sixth grade (age between 10 and 12 years) participated in this study. Students were randomly assigned to one of two conditions. In the experimental condition, the students first discussed the criteria and standards that a good brochure should meet. In the control condition, the students provided peer feedback without such a group discussion. To determine the style of the provided feedback, the written feedback was analysed to identify different kinds of verifications and elaborations. To establish the style of the peer feedback, the scores on these kinds of comments were clustered, using K-Means clustering.

Results showed that three clusters could be identified. Cluster one includes 27 students, who used a lot of prescriptions. These students provided feedback with a predominantly interpretative style. The 29 students in cluster two used a lot of positive judgments (i.e., final vocabulary), and thus provided feedback with an authoritative style. The third cluster included 39 students who used a lot of neutral statements. The students in this cluster predominantly used a probing style. The feedback style of the students depended on the condition they were in. The chance on having an interpretative style was about two times bigger for the students in the control group compared to students in the experimental group. The chance on having an explorative style is about twice as big for the experimental group. In contrast, students in the experimental group had a chance on having an authoritative style that is about three times bigger than this chance in the control group.

Theoretical and practical implications of the study are discussed. For instance, it is recommended that students in primary education should be prompted to substantiate their feedback comments and to provide suggestions and reflective questions. Furthermore, it is argued that the processes described in this study as well as the provided recommendations are also relevant for secondary and higher education and workplace settings.

References

- Boud, D. (1995). Assessment and learning: contradictory or complementary? In: P. Knight (Ed.), *Assessment for Learning in Higher Education* (pp. 35-48). London: Kogan.
- Lockhart, C. & Ng, P. (1995). Analyzing talk in ESL peer response groups: Stances, functions, and content. *Language Learning* 45, 605-655.
- Prins, F. J., Sluismans, D. M. A., & Kirschner, P. A. (2006). Feedback for general practitioners in training: Quality, styles, and preferences. *Advances in Health Science Education*, 11, 289-303.

- Rorty, R. (1989). *Contingency, irony, and solidarity*. Cambridge: Cambridge University Press.
- Straub, S. (1996). The concept of control in teacher response: defining the varieties of "directive" and "facilitative" commentary. *College Compositions and Communication*, 47, 223-251.
- Strijbos, J. W., & Sluijsmans, D. M. A. (2010). Guest editorial – unravelling peer assessment: methodological, functional, and conceptual developments, *Learning and Instruction*, 20, 265–269
- Topping, K. J. (2010). Commentary e methodological quandaries in studying process and outcomes in peer assessment. *Learning and Instruction*, 20, 339-343.
- Van den Berg, B. A. M. (2003). *Peer assessment in universitair onderwijs [Peer assessment in academic education]*. Unpublished doctoral dissertation. Utrecht: IVLOS.

The relation between feedback processes and informal learning activities at the workplace

Regina Mulder, Universitaet Regensburg, Germany

In this contribution we focus on the relation between the characteristics of feedback with informal learning activities that are caused by that. Based on a literature review on feedback a model of feedback culture is developed. Important aspects concern the quality of feedback (such as the content of feedback) and the importance of feedback. On all aspects of this model data is collected among 31 employees. They filled out a learning log. That consisted of standardized items on informal learning activities, such as asking colleagues for advice, reflecting on the incident, reading a journal, finding information on the internet. In total 367 feedback incidents caused 913 informal learning activities. The relation between the incidents and the learning activities correlation analyses are carried out. One example of a relation that was found is that if the feedback giver is in a bad mood, the receiver does not take feedback seriously, and it will therefore not lead to informal learning activities. In this contribution all relations will be presented and the results of the additional qualitative analyses.

Ongoing demographic and technological developments lead to increasing complexity in work settings. Therefore, there is a need for further development of employees. Many employees learn in formal training. Because of discrepancies between the content of the courses and the specific demands of the workplace, these trainings are not always perfectly fitting. Interesting is that although this seems an imperfect situation, employees can also learn from informal learning activities during work. These activities can result in profit for companies (e.g. Fuller et al. 2003). More understanding is needed on how companies can improve informal learning activities of their employees. In this research we focused on the role that feedback can play in this respect. The central question is: 'What is the relation between the feedback that employees get at the workplace with their informal learning activities?'

With feedback we mean: '... a subset of information available to individuals in their work environment. Feedback is that information that denotes how well individuals are meeting various goals. In the interpersonal realm, feedback involves information about how their behaviors are perceived and evaluated by relevant others' (p.372, Ashford and Cummings, 1983). We distinguish different components of feedback processes, such as the feedback source, the perceived quality of feedback, and the acceptance of feedback (e.g. Ilgen et al, 1979). Our assumption is that when researching feedback in relation to informal learning activities, the perceived feedback culture has to be taken into account. Therefore a model of feedback culture was conducted. With researching feedback culture companies are able to find out what the actual feedback culture is, and are able to optimize it. Feedback culture consists of the quality of feedback (e.g. the content of feedback and the support for using the feedback) and the importance of feedback (Kahmann & Mulder, 2007 /submitted).

Formal and informal learning has to be distinguished. Mostly with formal learning organized learning in a setting specifically focused on learning is meant, such as a training. These processes mostly lead to a certificate of diploma. With informal learning we focus on all kinds of learning that are not organized, and that happen during work performance. Eraut (2000) distinguishes deliberate learning, reactive learning and implicit learning. Examples of informal learning activities are (e.g. Kwakman, 2003) reading professional journals, exchanging knowledge with colleagues, reflecting on own behavior. The second dimension for learning activities we work with deals with how people learn, individually or in social exchange. This is a common distinction for learning activities in research literature (e.g. Anderson, Greeno, Reder & Simon, 2000).

For answering the research question data were collected amongst 31 employees. They filled out learning logs during 5 work days. They work in a private enterprise (n1=11), in the public sector (school; n2=13) or in the health sector (n3=7). These learning logs consisted of standardized items on informal learning processes. All components of the feedback culture are assessed. In the learning logs the participants wrote down what kind of feedback incident occurred, and if that resulted in a certain kind of informal learning activity. For instance reading professional

textbooks, trying out new strategies at work and reflecting on own work behavior. In addition, background variables were measured, such as age, sex, work experience.

With quantitative data analyses (factor analyses, reliability test, and correlations analyses) we found reliable scales of learning activities (deliberate, reactive, individual and social). We did not find all expected correlations between components of feedback and feedback culture with the informal learning activities (Mandl, 2007). Nevertheless, there are significant relations found, for instance between the items 'I ask my supervisor for advice', or 'I ask my colleagues for advice' with 'support for improvement at the workplace'. In total 367 feedback incidents were reported. They caused in total 913 informal learning activities. Only 45 feedback incidents did not lead to informal learning activities. So, there is a relation between the feedback processes and informal learning activities, but it is not a linear relation and there might be additional factors that are of importance. Because of the outcomes we analyzed our data more in depth with qualitative data analyses, to get more understanding of the relation between feedback processes, feedback culture and informal learning activities.

In this presentation we will elaborate on the theoretical framework, the quantitative and qualitative analyses that we carried out, and on the outcomes. For instance if feedback is given by someone with a bad mood (a characteristic of a feedback giver), feedback is not taken seriously by the receiver. The interpretation of the results will be presented. We gained better understanding of the relations between the perceived feedback culture, the received feedback and the informal learning activities.

References

- Anderson, J. R., Greeno, J. G., Reder, L. M. & Simon, H. A. (2000). Perspectives on learning, thinking and activity. *Educational Researcher*, 29 (4), 11-13.
- Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Education Psychology*, 70, 113-120.
- Fuller, A., Ashton, D., Felstead, A., Unwin, L., Walters, S. & Quinn, M. (2003). The impact of informal learning at work on business productivity. Leicester: Departement for Trade and Industry.
- Kahmann, K. & Mulder, R. H. (2007). Construction and validation of an instrument for assessing feedback culture in organisations. Paper presented at the HRD-Conference, Oxford.
- Kahmann, K. & Mulder, R. H. (submitted). Feedback in organizations, a review of feedback literature and a framework for future research.
- Kwakman, K. (2003). Factors affecting teachers' participation in professional learning activities. In: *Teaching and teacher education*, 19, 149-170.
- Livingstone, D. W. (2000). Exploring the icebergs of adult learning: Findings of the first Canadian survey of informal learning practices. NALL Working Paper 10. (taken Mai 2007) <http://www.oise.utoronto.ca/depts/sese/csew/nall/res/10exploring.htm>.
- Mandl, M. (2007). Feedbackkultur, Feedbackprozesse und informelle Lernhandlungen am Arbeitsplatz – eine empirische Untersuchung. Unpublished Master-Thesis, University of Regensburg.

Understanding Self-Motivated Feedback Exchanges: A social network perspective

Janine van der Rijt, Universiteit Maastricht, Netherlands; Piet Van den Bossche, University of Antwerp, Belgium; Margje W.J. van de Wiel, Faculty of Psychology and Neuroscience, Maastricht University, Belgium; Mien Segers, Universiteit Maastricht, Netherlands; Wim Gijselaers, Universiteit Maastricht, Netherlands

This study aims to get a more comprehensive understanding of the underlying dynamics of feedback processes during day-to-day interactions in the workplace, by viewing the informal feedback processes from a social network perspective. Furthermore, this study examines whether self-motivated feedback exchanges within the work-related social network lead to increased perceived career development and performance. This study was conducted in the expert field of Finance and Control. The main findings indicate that the quality of the relationships within the work-related social network is an important factor in feedback exchanges. Furthermore, the perceived quality of the feedback influenced performance positively. This underlines the suggested importance of the quality of the generated feedback for performance. There were no relations found between the feedback exchanges and career development. Additionally, the size of the work-related network was not related to performance, but did relate positively to perceived career development. Overall, the study highlights the importance of feedback exchanges in the workplace and put forward implications for practice.

Today's knowledge-intensive society, with its current uncertain economy, requires organizations to innovate and learn continuously. Therefore, many organizations invest in formalized training programs and coaching. However, a majority

of what people learn is tacit and is learned informally on-the-job from the people with whom they work (Tannenbaum, Beard, McNall, & Salas, 2010). In this respect, it is shown that one of the key components of informal learning processes in the workplace is feedback (Tannenbaum et al., 2010). Traditionally, feedback theories considered feedback as an organizational resource. More recently, research has moved from this traditional focus on feedback as a resource that is formally given and passively received to a more dynamic view of actively seeking feedback in everyday work lives (Ashford, Blatt, & VandeWalle, 2003). Feedback seeking behavior can be described as an active process by which professionals initiate a feedback exchange themselves. In spite of a growing body of research on feedback-seeking behavior, less attention is given to situational conditions that induce feedback seeking behavior in the workplace (Steelman, Levy, & Snell, 2004). Salas and Rosen (2010) recently called for a more comprehensive understanding of what drives feedback-seeking behavior and how to develop it in organizations. In response to this call, the current study makes a first step to address this limitation.

The prime purpose we are concerned with in this study is twofold. First, we aim to better understand the broader context that generates self-motivated feedback processing, by viewing the informal feedback processes from a social network perspective. Second, we examine whether self-motivated feedback exchanges lead to increased perceived career development and performance.

This study takes a social network perspective (Borgatti & Cross, 2003), instead of conventionally used measures in the feedback literature (e.g., Steelman et al., 2004). To our knowledge, the feedback literature has not addressed the implications of social network structures for feedback exchanges in organizations. Yet, social network research suggests that network relationships may be very important for learning (Borgatti & Cross, 2003), and outcomes in terms of career development and performance.

This study was conducted in the field of Finance and Control. Participants were 72 financial controllers from various multinational corporations (79.2 % men, ages ranged from 24 to 50 years with a mean age of 30.4 years).

Based on Borgatti and Cross (2003), we developed an egocentric network questionnaire in which respondents rated several network questions for all persons in their personal work-related social network. Further, job performance was measured by the respondents themselves using the 6-item performance scale developed by Becker, Billings, Eveleth and Gilbert (1996). Career development was measured using a 3-item instrument of intrinsic career development of Van der Sluis and Poell (2003).

Our findings concerning the relational characteristics of the work-related social network indicate that quality of the relationships within the work-related social network is an important factor in feedback exchanges. More specifically, the results indicate that the awareness of the knowledge and skills of persons in the network (awareness) and whether these relationships are characterized as safe (safety) are both positively related to feedback seeking behavior. Furthermore, we found a positive relation between feedback seeking behavior and performance. The average frequency with which the respondents turned to their contacts for feedback was not related to performance. Furthermore, the perceived usefulness of the feedback influenced performance positively. This underlines the suggested importance of the quality of the generated feedback for performance. Additionally, we found that the size of the work-related network was not related to performance, but did relate positively to career development. This means that a larger network is good for a person's career, but does not influence performance. A larger network related negatively to feedback seeking behavior, the frequency of feedback seeking, and the perceived usefulness of feedback. The awareness and the safety of the relationships are negatively related to a larger network as well. This could imply that persons with a smaller network seem to have a clearer picture of their contacts' expertise and that their relationships are characterized by a higher degree of safety. These findings also suggest that a smaller network is more beneficial for obtaining feedback. These outcomes relate to the findings of Cross and Thomas (2008). They found that high performers invest in the strength of relationships and do not necessarily have big networks.

Overall, this study underpins the importance of feedback exchanges in the workplace and puts forward implications for practice. Organizations should encourage employees to seek feedback and should recognize the value of feedback to support performance and professional development. Moreover, investing in the strength of relationships in the workplace seems worthwhile.

Ashford, S. J., Blatt, R., & VandeWalle, D. (2003). Reflections on the looking glass: A review of research on feedback-seeking behavior in organizations. *Journal of Management*, 29(6), 773–799. doi:10.1016/S0149-2063(03)00079-5

Borgatti, S. P. & Cross, R. (2003). A relational view of information seeking and learning in social networks. *Management Science*, 49, 432-445.

- Cross, R. & Thomas, R. J. (2008). How top talent uses networks and where rising stars get trapped. *Organizational Dynamics*, 37(2), 165-180.
- Salas, E., & Rosen, M. A. (2010). Experts at work: Principles for developing expertise in organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp.99-134). New York: Routledge Taylor & Francis Group.
- Steelman, L. A., Levy, P. E., & Snell, A. F. (2004). The feedback environment scale: Construct definition, measurement, and validation. *Educational and Psychological Measurement*, 64, 165-184. doi:10.1177/0013164403258440
- Tannenbaum, S. I., Beard, R. L., McNall, L. A., & Salas, E. (2010). Informal learning and development in organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp. 303-331). New York: Routledge Taylor & Francis Group.
- Van der Sluis, E. C., & Poell, R. F. (2003). The impact on career development of learning opportunities and learning behavior at work. *Human Resource Development Quarterly*, 14(2), 159-179.

SYMPOSIUM

Motivational, Social and Affective Processes

An In-depth Understanding of the Dynamics and Practicalities of Teacher Autonomy-Support

Chairperson: Johnmarshall Reeve, Korea University, Korea, Republic of

maarten vansteenkiste, Gent University, Belgium

Organiser: Hyungshim Jang, Inha University, Korea, Republic of

Discussant: Avi Assor, Ben Gurion University, Israel

As a broad-band theory of motivation and personality development, Self-Determination Theory (Ryan & Deci, 2000) has attracted an increasing interest among educational scholars over the past 15 years (see Reeve, 2009 for an overview in the educational domain). Several studies have demonstrated the manifold advantages of autonomy-supportive, relative to controlling, teaching including deep level processing, higher engagement, more persistence, and better grades, presumably because autonomy-supportive teaching allows for greater satisfaction of the basic psychological needs for autonomy, competence, and relatedness. Yet, numerous questions remain unanswered to date. This symposium aims to gain a more in-depth understanding of the dynamics and practicalities of autonomy-supportive teaching. First, Hyungshim Jang (first contribution) presents classroom-based research on the longitudinal relations between perceived teacher autonomy-support and student outcomes, an understudied issue within SDT given the majority of available cross-sectional research. Second, Johnmarshall Reeve (second contribution) presents experimental research in which the effects of novel autonomy-supportive practices were tested against a standard or typical teaching approach. Those studies indicate that implementing an autonomy-supportive teaching approach is practically doable and beneficial. Given the benefits associated with teacher autonomy-support, the question is raised as to which factors lead teachers to adopt such a style. Guy Roth (third contribution) addresses this issue by examining which teacher characteristics are associated with an autonomy-supportive teaching style. Collectively, the current studies make use of variety of designs (correlational, experimental) and analytic techniques (SEM, multilevel modeling), and draw upon samples from diverse nationalities (Korea, US, Israel). As a whole, they provide deeper insight in the dynamics associated with autonomy-supportive teaching.

Longitudinal Test of Self-Determination Theory in a School Context

Hyungshim Jang, Inha University, Korea, Republic of

Empirical tests of self-determination theory's motivation mediation model (autonomy support → psychological need satisfaction → student outcomes) have consistently found support for the model. Without exception, however, all these empirical tests have used either a cross-sectional research design or only a prospective multi-wave design (Black & Deci, 2000; Jang, Reeve, Ryan, & Kim 2009). It is crucial to note, however, that cross-sectional research designs fail to address the issue of (temporal) causality. To test temporal causality among these variables requires the employment of a multi-wave longitudinal, classroom-based research design (Cole & Maxwell, 2003). The purpose of the present study was to test the temporal causative relations among perceived autonomy support, need satisfaction, engagement, and achievement via a three-wave longitudinal classroom design.

In the hypothesized model, students' perceptions of teacher-provided autonomy-support were predicted to explain changes in students' mid-semester psychological need satisfaction (controlling for early-semester psychological need satisfaction). Changes in students' need-satisfaction were then predicted to explain changes in the quality of students'

classroom engagement (controlling for early and mid-semester levels of quality of engagement). Finally, changes in the quality of students' engagement (rather than either perceived autonomy support or psychological need satisfaction) was predicted to explain students' achievement gains (or losses) during the semester (controlling for early-semester anticipated level of achievement). Participants were 500 students (257 females, 243 males) from 14 classes situated in a large, urban middle school in Seoul, Korea. Participants completed the same two-page questionnaire three times during the semester—three weeks into the semester (time 1), two weeks after the mid-term exam (time 2), and two weeks prior to the end of the semester (time 3). To test the motivation mediation model, structural equation modeling (LISREL 8.51; Joreskog & Sorbom, 1993) was used. To assess students' perceptions of teacher-provided autonomy support, participants completed the 6-item short version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996; alphas of .89, .93, and .92). To assess psychological need satisfaction, participants completed the 10-item Activity-Feelings States scale (AFS; Reeve & Sickenius, 1994) that assessed perceived autonomy (alphas of .71, .73, and .73 across the three assessments), perceived competence (alphas of .76, .82, and .81), and perceived relatedness (alphas of .77, .83, and .80). To assess engagement, participants completed a 12-item engagement scale that assessed behavioral, emotional, cognitive, and agentic aspects of engagement (Skinner et al., 2009, alphas of .83, .86, and .84).

The hypothesized motivation mediation model (i.e., the structural model) was that perceived autonomy support (time 1) would predict changes in psychological need satisfaction (time 2) which would predict changes in the quality of engagement (time 3) which, in turn, would predict end-of-course achievement. Anticipated (time 1) achievement was added as a covariate so that our outcome measure was achievement gains rather than achievement per se. This model fit the data fairly well, $\chi^2(711) = 1,758.65$, SRMR = .062, RMSEA = .052, CFI = 0.94. Importantly, perceived autonomy-support at the beginning of the semester explained mid-semester changes in students' psychological need satisfaction (beta = .10, p beta = .16, p beta = .21, p R^2 = .45 for need satisfaction at time 2; R^2 = .53 for need satisfaction at time 3; R^2 = .52 for quality of engagement at time 3; and R^2 = .48 for end-of-course achievement). The findings provide rather strong support for SDT's the motivation mediation model. Relatively high temporal stability in students' self-reports of perceived autonomy support, need satisfaction, and engagement were observed (the betas from each latent variable from time 1 to time 2, from time 2 to time 3, and even from time 1 to time 3 were high). Still, perceived autonomy support early in the semester did contribute to increases in mid-semester need satisfaction, and mid-semester changes in student motivation predicted end-of-semester changes in student outcomes. In presenting this empirical support, this study is the first to show the hypothesized temporal causative relations among the variables within the SDT framework in the naturally-occurring setting of the classroom.

References

- Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, 84, 740-756.
- Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: Questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology*, 112, 558-577.
- Jang, H., Reeve, J., Ryan, R.M., & Kim, A. (2009). Can self-determination theory explain what underlies the productive, satisfying learning experiences of collectivistically-oriented South Korean adolescents? *Journal of Educational Psychology*, 101, 644-661.
- Joreskog, K. G., & Sorbom, D. (1993). LISREL 8: Structural equation modeling with The SIMPLIS command language. Hillsdale, NJ: Scientific Software International.
- Reeve, J., & Sickenius, B. (1994). Development and validation of a brief measure of the three psychological needs underlying intrinsic motivation: The AFS scales. *Educational and Psychological Measurement*, 54, 506-515.
- Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and Psychological Measurement*, 69, 493-525.
- Williams, G. C., & Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology*, 70(4), 767-779.

Effective but Impractical: Overcoming Instructional Roadblocks to Teacher-Provided Autonomy Support

Johnmarshall Reeve, Korea University, Korea, Republic of

Two empirical findings formed the foundation of the present research. First, students benefit when teachers support their autonomy; second, teachers do not commonly support students' autonomy during instruction (Reeve, 2009). Many reasons explain why teachers are not autonomy supportive, but a key reason is that supporting autonomy is hard, time consuming, and impractical (compared to standard practice). That is, in many teachers' minds, autonomy support is effective but impractical.

Autonomy support is what teachers say and do during instruction to promote students' perceived autonomy and psychological need satisfaction. In practice, it centers on the following five categories of instructional behavior: nurture inner motivational resources; provide explanatory rationales; rely on informational language; display patience to allow time for self-paced learning; and acknowledge and accept expressions of negative affect (Reeve, 2009). A meta-analysis of training programs to help teachers learn how to support students' autonomy showed that teachers can learn to become more autonomy-supportive (Su & Reeve, in press), with one exception—namely, teachers find it difficult to learn how to nurture students' inner motivational resources. Hence, a key part of what makes teacher-provided autonomy support hard (or harder than standard practice) is answering the question, "How do I nurture students' inner motivational resources?"

The goal of the present investigation was to test the validity of two instructional strategies that could serve as valid exemplars. Specifically, Study 1 was designed to nurture students' preferences and psychological need satisfaction, while Study 2 was designed to nurture students' perception of optimal challenge. In both studies, the methodology started with the same lesson and presented it to students in two different ways—one that was autonomy supportive and another that represented standard practice (the same lesson delivered in a neutral way) with the two lessons matched on teacher (a hired professional who was blind to the purposes of the study), content (subject matter), and duration (in minutes). The hypothesis was that when the lesson was designed to nurture (vs. neglect) inner motivational resources, students would perceive their teachers as more autonomy supportive and would experience enhanced motivation (i.e., psychological need satisfaction in Study 1, sense of optimal challenge in Study 2), engagement, and perceived learning.

In Study 1, a pilot test first determined students' preferred ways of learning a lesson. Students were shown a list of 10 ways to learn any lesson, rank ordered them, and two preferred ways were "view videotape" and "whole-class discussion" while two non-preferred ways were "independent work" and "drill-and-practice." In Study 1, all participants (51 students at a university in the Midwest) first received the same 12-minute PowerPoint presentation on attachment theory. Participants in the experimental group then viewed a 4-minute videotaped lesson and engaged in a 10-minute group discussion, using a prepared set of questions. Participants in the control group read the videotape's transcript for 4 minutes (independent work) and worked on the same set of prepared questions for 10 minutes (drill-and-practice). Hence, students in the experimental condition received instruction in their preferred (i.e., need satisfying) way, while students in the control group received instruction in their non-preferred (i.e., need neutral) way. After the lesson, participants completed a post-experimental questionnaire assessing perceived teacher autonomy support (6 items, $\alpha = .92$), psychological need satisfaction (10 items, $\alpha = .90$), engagement (4 items, $\alpha = .86$), and self-reported learning (3 items, $\alpha = .74$). Participants in the experimental group perceived the teacher to be more autonomy supportive (M_s , 6.04 vs. 4.61, $t(51) = 5.11$, $p < .001$, $d = 1.42$) and self-reported significantly greater need satisfaction (M_s , 5.74 vs. 5.11, $t(51) = 2.42$, $p < .05$, $d = .68$), engagement (M_s , 6.29 vs. 5.52, $t(51) = 3.01$, $p < .01$, $d = .85$), and learning (M_s , 6.24 vs. 5.71, $t(51) = 3.05$, $p < .01$, $d = .88$).

In Study 2, all participants (64 students at a university in the Midwest) received the same 12-minute PowerPoint presentation on the human brain (its anatomy and function). Following the lesson, all participants engaged in a 20-minute review session that featured 25 lesson-related questions. For participants in the experimental group, the review session involved a "Jeopardy" game in which the questions were arranged into 5 topics (e.g., Neurons) with 5 levels of difficulty. Participants were in small groups, and the teacher asked the questions and kept score of team points on the chalkboard. For participants in the control group, the review session involved independent seatwork in which they answered the same questions arranged in a prepared booklet (with attractive photographs). After the review session, participants completed a post-experimental questionnaire assessing perceived teacher autonomy support (6 items, $\alpha = .94$), perceived challenge (1-item), engagement (4 items, $\alpha = .84$), and learning (3 items, $\alpha = .70$). Participants in the experimental group perceived the teacher to be more autonomy supportive (M_s , 4.13 vs. 2.65, $t(62) = 3.79$, $p < .001$, $d = .95$) and reported experiencing significantly greater optimal challenge (M_s , 0.45 vs. 0.77, $t(62) = 2.01$, $p < .05$, $d = .50$), engagement (M_s , 5.34 vs. 3.69, $t(62) = 3.10$, $p < .01$, $d = .79$), and learning (M_s , 5.67 vs. 5.10, $t(62) = 1.98$, $p = .05$, $d = .52$). These studies affirm that standard lessons can be presented in an autonomy-supportive way and that, in doing so, can facilitate students' motivation, engagement, and learning, even while not requiring additional instruction time. Other researchers have shown that explanatory rationales (Jang, 2008) and brief videotestimonials (of how important the subject matter is, Husman et al., 2010) can be inserted into the flow of otherwise uninteresting lessons to nurture students' inner motivational resources ("perceived value" in these two examples). The long-term goal of this program of research is to create options and exemplars that teachers can use to nurture students' inner motivational resources (e.g., preferences, sense of optimal challenge) in an easy, practical way.

References

- Husman, J., Puruhito, K., Genesh, T., Stump, G., & Brem, S. K. (2010). Increasing motivation without decreasing instructional time: A brief intervention to improve engineering students' task value. Paper presented at the 12th bi-annual international conference on motivation. EARLI SIG Motivation and Emotion, Porto, Portugal.
- Jang, H. (2008). Supporting students' motivation, engagement, and learning during an uninteresting activity. *Journal of Educational Psychology*, 100, 798-811.
- Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, 44, 159-178.
- Su, Y., & Reeve, J. (2010). A meta-analysis of the effectiveness of intervention programs designed to support autonomy. *Educational Psychology Review*.

Personal Characteristics of Teachers and Schools' Principals as Predictors of their Autonomy-Support

Guy Roth, Ben-Gurion University of the Negev, Israel

Considerable research has indicated that autonomy supportive socializing context is associated with desirable outcomes for children and students (Deci & Ryan, 2008); however, research exploring antecedents of autonomy support is quite scarce. bridge this gap the current research project investigated the relations between teachers' and school principals' personal characteristics as predictors of their autonomy supportive behaviors.

Autonomy support is defined socializing agents act in ways that encourage choice and self-initiation, take the other's perspective, provide meaningful rationales and relevance and refrain from using language or other behaviors that are likely to be experienced as pressure toward particular conducts (Grolnick, Deci, & Ryan, 1997). Supporting autonomy in these ways has been found to result in autonomous regulation, effective performance, and psychological well-being (Deci & Ryan, 2008). Given the important role of autonomy supportive behaviors for adaptive socialization, the limited research on its antecedents is quite surprising. Grolnick (2003) explored contextual pressures that may predict parents' autonomy supportive behavior, whereas Pelletier, Seguin-Levesque and Legault (2002) explored the effect of contextual pressures on autonomy supportive teaching. Nevertheless, Landry et al. (2008) is the only study that directly explored a social agents' characteristic (namely, parental trust in organismic development) that may predict autonomy supportive behaviors.

The present research consists of three studies. Two studies focus on teachers' personal characteristics as predictors of students' perceptions of teachers' autonomy supportive teaching, and one study focuses on school principals' personal characteristics and their relations to teachers' perceptions of the principal's autonomy supportive behavior toward them. Specifically, the research explores four personal characteristics of teachers and principals that may predict autonomy support: (1) Teacher's/principal's belief that intrinsic motivation is essential for life-satisfaction and well-being, which stands in contrast to materialistic views in which life satisfaction is based mainly on one's possessions, status and fame (Kasser & Ryan, 1996). (2) Teachers'/principals' trust in organismic development (OD), which following Landry et al. (2008) and Deci & Ryan (2008), was defined as the belief that humans are active, growth-oriented organisms inclined to engage in interesting activities, to exercise capacities, and to pursue connectedness in social groups. More specifically, in terms of teacher-student relations, trust in OD would involve trust in the child's tendency to learn and to be considerate toward others. (3) Teachers' belief that organismic development is vulnerable and can be easily frustrated by the environment. (4) Teachers'/principals' authenticity (Kernis & Goldman, 2006). Data were collected from multiple reporters: principals, teachers and children.

The first study focuses on the relations between teachers' beliefs and students' perceptions of teachers' autonomy support. Thus, it was hypothesized that the teachers' three beliefs (that intrinsic motivation is essential for life satisfaction, the teachers belief in OD, and the belief that OD is vulnerable) will predict students' perceptions of autonomy supportive teaching. The research was based on 27 teachers and their 815 students in the 7th and 8th grades. The data was subjected to hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) analysis while following Krull and MacKinnon's (2001) approach for mediation testing. The results confirmed the hypothesis. The second study was based on 32 teachers and their 896 students and tested the hypothesis that teachers' authenticity would be related to students' perceptions of autonomy supportive teaching by predicting the teachers' three beliefs. A HLM analysis confirms the hypothesis. The third study extended the previous two by exploring the relations between principals' beliefs (the belief that intrinsic motivation is essential for life satisfaction and trust in OD) and teachers' perceptions of the principals' autonomy supportive behaviors. The sample consisted of 20 school principals and 220 teachers. A HLM analysis confirms the hypothesis. Theoretical and practical Implications of the findings will be discussed.

References Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology*, 49, 14-23.

Grolnick, W. S. (2003). The psychology of parental control: how well-meant parenting backfires. Mahwah, NJ: Erlbaum.

Grolnick, W. S., Deci, E. L., & Ryan, R. M. (1997). Internalization within the family: The self-determination theory perspective. In J. E. Grusec, & L. Kuczynski (Eds.), *Parenting and children's internalization of values* (pp. 135-161). New York: Wiley.

Kasser, T., & Ryan, R. M. (1996). Further examining the american dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin*, 22., 280-287

Kernis, M. H., & Goldman, B. M. (2006). A multicomponent conceptualization of authenticity: Theory and research. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (pp. 284-357). San Diego: Elsevier Academic Press.

Krull, J. L., & MacKinnon, D. P. (2001). Multilevel modeling of individual and group level mediated effects. *Multivariate Behavioral Research*, 36, 249–277.

Landry, R., Whipple, N., Mageau, G., Joussemet, M., Koestner, R., DiDio, L., Gingras, I., Bernier, A., & Haga S. M., (2008). Trust in organismic development, autonomy support, and adaptation among mothers and their children. *Motivation and Emotion*, 32, 173-188.

Pelletier, G. L., Seguin-Levesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers motivation and teaching behaviors. *Journal of Educational Psychology*, 94, 186-196.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. London: Sage.

SYMPOSIUM

In-service Teacher Training

Research-based teacher education

Chairperson: Jan Vermunt, Utrecht University, Netherlands

Organiser: Jan Vermunt, Utrecht University, Netherlands

Discussant: Sanna Jarvela, University of Oulu, Finland

Evidence-based, research-informed, culture of evidence, inquiry-oriented: the increasing use of these terms signals a shared plea to employ research in the design and evaluation of teacher education. In an effort towards conceptual and empirical clarification, the authors in this symposium present work using different perspectives on research-based teacher education. They discuss a research-based design, research-informed content and a rigorous evaluation of teacher education programs in three different countries. In doing so, they draw attention to its promises, but also to its challenges. For one, how do we adequately measure the effects of purposeful interventions, as there is great diversity in the structure and content of the programs. The studies in this symposium try to achieve this by using mixed-methods and longitudinal designs. Next to this issue of methodological rigor in real-life contexts, the outcomes question (Cochran-Smith, 2001) is also addressed, as the different papers in this symposium use diverse outcome measures, all potentially valuable in research-based teacher education.

Building a culture of evidence: A longitudinal study on student teacher learning

Larika Bronkhorst, Utrecht University, Netherlands; Maaïke Endedijk, University of Twente, Netherlands; Bob Koster, Utrecht University, Netherlands; Paulien Meijer, Utrecht University, Netherlands; Jan Vermunt, Utrecht University, Netherlands

This study describes a two year longitudinal study into teacher learning and development in a one-year post-graduate teacher education program in the Netherlands. Using three different types of instruments, the authors documented the nature of student teachers' learning in the first year. Based on the alarming results, which were contrary to what could be expected based on theory, a small-scale intervention was conducted during the second year. The use of identical instruments, afforded the incorporation of two control groups, adding to the robustness of the analyses. Our analyses show that the nature of student teachers' learning is robust to change, as is their regulation of learning. Yet differences were found across both control groups in the perception of the learning environment: student teachers perceive the refined teacher education program to be more challenging, integrating theory and practice. This results illustrate the challenges involved in establishing and building on a culture of evidence in teacher education.

Building a culture of evidence

In the past years an increasing amount of research on teacher education, student and beginning teacher learning and development, and professional learning has been generated. Based on recent studies, we advocate that effective

(student) teacher learning constitutes meaning oriented learning (Oosterheert and Vermunt, 2001) and effective regulation of learning can be achieved with deliberate practice (Dunn & Shriner, 1999). Using the knowledge generated by these studies affords research-based teacher education: teacher education programs based on research – albeit not always evidence (Vermunt, 2006), including active incorporation of research in their programs' evaluation (Ludlow et al., 2008). This study describes a two year longitudinal study into teacher learning and development in a one-year post-graduate teacher education program in the Netherlands. The original aim was to document the development student teachers' learning orientations and regulation of learning using three different types of instruments, thus building a culture of evidence. As the results of the first year were rather alarming and contrary to what could be expected based on existing theory, the authors also conducted a small scale intervention during the second year to stimulate the desired nature of learning and regulation. This intervention was based on a synthesis of recent research into student teachers learning (summarized in Bronkhorst, Meijer, Koster, Vemunt, 2010). Our main research question is: what is the effect of this intervention on the development of student teachers' learning orientation and quality of regulation?.

Methodology

Context.

This study was conducted in a one-year postgraduate teacher education program, leading to the highest level of teacher certification in the Netherlands. Before enrolment, students first obtain their master's degree in a specific subject area. The program consists of weekly classes at the university, and teaching practice at schools – either as an intern or as a paid job.

Participants.

All student teachers of the teacher education program were invited to participate. In the first year 78 out of 90 student teachers participated; in the second year 71 out of 82 student teachers participated. The experimental group consisted of 17 of these 71 students. Two control groups are singled out: control group 1 is the matched group of students of the first cohort and control group 2 is the group of students of the second cohort that was not subjected to the intervention.

Intervention.

The 12 design principles obtained in prior work (Bronkhorst et al., 2010) formed the starting point to refine the teacher education program. These design principles are generic, in the sense they can be applied across different classes of the teacher education program. The principles specify the approach to instruction expected to lead to the desired student teacher learning and regulation of learning (being meaning oriented learning and deliberate practice). Recognizing that curriculum design principles can be worked out in many ways (Collins et al., 2004), the design principles were translated and adapted to the local context in close collaboration with all teacher educators involved in the experimental groups' classes.

Instruments.

All participants were asked to fill out 3 electronic questionnaires on two occasions: at the end of the first semester and at the end of the program. To measure student teachers' nature of learning the Inventory Learning to Teach Process (ILTP) was used (Oosterheert, Vermunt, & Denessen, 2002). Based on this questionnaire different learning orientations can be distinguished, namely survival-oriented, reproduction-oriented, dependent meaning-oriented or independent meaning-oriented learning to teach. The perception of the learning environment instrument that was developed for this study, measured three elements of the learning environment: Constructive Communicative press (.83), Integrating Theory and Practice (.84) and Support for Regulation of Learning (.84). These scales were developed based on the perception of the learning environment scales of Oosterheert, Vermunt, and Veenstra (2002). The regulation of learning was assessed with a structured digital log in which the student teachers had to describe six self-chosen learning experiences and corresponding regulation activities with help of multiple choice questions (Endedijk, 2010). For the current study the only some questions of these logs are used.

Analyses.

With the help of z-scores of the ten scales of the ILTP, student teachers' learning orientations were established. Comparisons between the experimental and control groups were done with Chi-square tests. The same tests were used to describe differences in spreading of the learning experiences over the different regulation activities. T-tests were used to compare differences in means between experimental and control groups on the different perception of learning environment scales.

Findings

Based on our analyses, it appears that the learning orientation of student teachers is robust to change, as the experimental condition does not significantly differ from the control conditions. The same applies to the regulation of that learning: small differences were found, which were not consisted across the two control conditions. Only in terms of perception of the learning environment a consistent pattern seems to emerge: student teachers perceive the refined teacher education program to be more challenging, integrating theory and practice. Moreover, they also experience more support for their regulation. Hence, our preliminary results indicate that altering the nature of student teacher learning, based on a culture of evidence, is a challenging task.

This implies that teacher education programs, even though aiming to support the desired teacher learning, might not work out as intended. And even with a purposeful, research-based intervention it appears to be challenging to alter student teacher learning during a one-year program. As meaning-oriented learning and deliberate practice are essential during teachers' professional careers, we should explore alternative ways to stimulate this part of the student teachers' professional development in the teacher education curriculum.

Uncovering practice and the horizon of observation: The dynamics of observation in teacher education

Paul Conway, University College Cork, Ireland; Rosaleen Murphy, University College Cork, Ireland; Kathy Hall, University College Cork, Ireland; Fianchra Long, University College Cork, Ireland; Dan O'Sullivan, University College Cork, Ireland

In the context of moves toward promoting research-informed perspectives on teacher education, this paper examines the dynamics of observation while learning to teach during a year-long post-graduate programme in initial teacher education (ITE). Adopting a socio-cultural research-informed perspective on teacher education, we focus on assisted performance (Tharp & Gallimore, 1998; Mewborn & Stinson, 2007) view of learning to become a competent secondary teacher. The central socio-cultural concept we address in this study is 'horizon of observation' (Hutchins, 1993) as it offers a lens on the nature and dynamics of student teachers' access to accomplished teachers in teaching practice schools. Adopting a mixed-methods approach, the study involved semi-structured interviews with 17 student teachers and a survey (n=133, i.e. 60% of the student cohort). The findings were (i) that only a minority of student teachers had opportunities to observe other teachers teach, (ii) the limited observation opportunities on teaching practice schools led to a reliance on apprenticeship of observation-based role models, (iii) student teachers' limited horizon of observation while learning to teach made the apprenticeship of observation and the lesson observation-based feedback from university tutors especially salient. We discuss the implications of the limited horizon of observation in ITE in terms of what Lieberman et al (2009) term 'uncovering practice' in the service of deepening engagement with pedagogy. In doing so, we draw attention to 'uncovering practice' as a key principle of research-informed initial teacher education.

Aims

In the context of moves toward promoting research-informed perspectives on teacher education, this paper examines the dynamics of observation while learning to teach during a year-long post-graduate programme in initial teacher education. The idea of research-informed teacher education is not new given that it was a central tenet of Holmes Group initiative from the mid-1980s onwards in the USA (Holmes Group, 1986; 1990; 1995). However, the identification of research-informed principles for guiding initial teacher education has been a significant feature of research on teacher education over the last decade (e.g. Darling-Hammond & Bransford, 2005; Darling-Hammond, 2006; Korthagen et al, 2010)

Adopting a socio-cultural research-informed perspective on teacher education, the study adopts an assisted performance (Tharp & Gallimore, 1998; Mewborn & Stinson, 2007) view of learning to become a competent teacher. The present study sought to understand the dynamics of observation, as a central feature of ITE, on a post-graduate ITE programme within a context where there have been no formal structures in relation to school-university partnerships, and consequently no formal agreement between schools and university on the type of assistance and structured support (observation, co-planning, co-teaching) that should be made available to student teachers. As such, our assumption, based on research, was that observation (Grossman, 1991) is a fundamentally important aspect of initial teacher education. That is, to observe others, to be observed and get feedback and to reflect on the legacy of the observation-based apprenticeship is central to becoming a competent teacher.

Methodology

The study adopted a mixed-methods approach involving semi-structured interviews, analysis of documents and a survey questionnaire. Using a multiple-case study research design, seventeen student teachers were interviewed on three occasions over the course of an academic year. A survey focused on the prior experiences and beliefs about

learning to teach and opportunities to learn to teach in schools was administered in March 2009 (n=133, with a response rate of 60% from the 2008-09 cohort of student teachers). In analyzing the interviews data, we used a phenomenological (Huntly, 2008) approach to understand student teachers' experiences of learning to teach.

Findings

Findings of the study are discussed under four headings:

- (i) There were few opportunities to observe experienced teachers or be observed by these same teachers in teaching practice schools. As such, the opportunities for deep professional engagement about pedagogy were significantly constrained. This finding is consistent with the OECD TALIS cross-national study which highlighted the dominance of 'exchange and coordination'-oriented professional collaboration in schools (Gilleece et al, 2009).
- (ii) Negotiating images of curriculum and relationships presented by teacher role models past and present (i.e. observational learning) was a significant feature of the learning to teach experience and the development of competence, for student teachers (Sugrue, 2004).
- (iii) Feedback following lesson observations provided by tutors was vivid, memorable and consequential in terms of student teachers' understanding of professional standards and expectations. The variation in emphases on particular aspects of practice by different tutors was a significant feature of student teachers experience of learning to be a 'good teacher' in their subject areas
- (iv) Finally, student teachers' limited horizon of observation while learning to teach made the apprenticeship of observation and the lesson observation-based feedback from university tutors especially salient.

Theoretical and educational significance of the research

The present study sought to understand the dynamics of student teachers' opportunities to learn to teach within a context where there have been no formal structures in relation to school-university partnerships, and consequently no formal agreement between schools and university on the type of assistance and structured support (observation, co-planning, co-teaching) that should be made available to student teachers. The central socio-cultural concept we address in this study is 'horizon of observation' as it offered a lens on the nature and dynamics of student teachers access to accomplished teachers in teaching practice schools. The term 'horizon of observation', refers to: Lines of observation and limits on observation of the activities of others have consequences for the knowledge acquisition process... Let us refer to the outer boundary of the portion of the task that can be seen or heard by each team member is that person's horizon of observation. (Hutchins, 1996, p. 52)

A number of significant issues emerge from this study. First, the focus on observation and its different forms proved informative in terms of extending our understanding of learning to teach. In particular, Hutchins' concept of horizon of observation was especially germane to theorising the role and dynamics of observation and its impact on the knowledge acquisition process in ITE. Second, we argue that the 'horizon of observation' available to students in ITE is limited by current structural and cultural arrangements - notwithstanding the existing significant support available to ITE students in schools. Third, we address two dimensions of the learning to teach context in terms of how they impact the dynamics of observation in ITE: school university partnership models (Maandag et al, 2007) and a school's professional learning cultures (Moore-Johnson, 2004; Meirink et al, 2009). Finally, we discuss the implications of the limited horizon of observation in ITE in terms of what Lieberman et al (2009) term 'uncovering practice' in the service of deepening engagement with pedagogy. In doing so, we draw attention to 'uncovering practice' as a key principle of research-informed initial teacher education.

Finnish teacher students' approaches to learning, cognitive and attributional strategies

Kirsti Lonka, University of Helsinki, Finland; Annamari Heikkilä, University of Helsinki, Finland; Juha Nieminen, University of Helsinki, Finland; Markku Niemivirta, University of Helsinki, Finland

Aim.

Current theories of learning emphasize the role of motivational and affective aspects in university student learning. The aim of the present study was to examine the interrelations among approaches to learning, self-regulated learning, and cognitive strategies in the context of teacher education. Cognitive-motivational profiles were identified among novice teacher students. It was also looked at, whether well-being, epistemological beliefs, and study success in an activating lecture course were related to these profiles.

Method.

The participants were 213 first year teacher students, who participated in an activating lecture course at a major Finnish university. The students filled in a questionnaire including items based on the MED NORD instrument (Lonka et

al., 2008). The structural validity of the scales was tested by means of a series of factor analyses. Latent class clustering was used for clustering students into homogeneous groups. Finally, a series of ANOVAs was conducted to examine between-group differences across the criterion variables.

Results.

A three-group solution described the data best: (1) students with insufficient regulatory skills (50%), (2) self-directed students (28%), and (3) non-reflective students (22%). The students in Group (1) expressed the highest levels of stress, exhaustion, and lack of interest. Group (2) received the highest grades.

Conclusions.

The profiles were not only related to study success, but also to the general well-being of the students. It was concluded that motivational profiles may have not been optimal, even in this highly-selected population.

Theoretical background

Current theories of learning emphasize the role of motivational and affective aspects in university student learning. When examining studying in university, previous research has applied a number of frameworks, such as student approaches to learning (SAL, e.g. Marton & Säljö, 1976; Entwistle & McCune, 2004; Lonka, Olkinuora & Mäkinen, 2004), self-regulated learning (SRL, e.g. Vermunt, 1998; Pintrich, 2004), and cognitive strategies (e.g., Nurmi, Haavisto & Salmela-Aro, 1995; Nurmi et al., 2003). However, the interrelations among these aspects have seldom been systemically examined.

In the present study, a group of highly-selected university students were looked at: first year teacher students. We wanted to see what was the starting point of their journey of becoming teachers. Teachers working in future learning environments should be able to actively regulate their own learning. In order to become an expert teacher, self-regulatory skills are necessary (Kreber, Castlede, Erfani, & Wright, 2005). It is not enough that teachers regulate their own learning, they should also be able to help their students to become active and self-regulated learners.

Aims

The present study aimed to examine the following research questions: 1) How are approaches to learning correlated with cognitive and attributional strategies among first year teacher students? 2) What kinds of cognitive-motivational profiles can be identified among these novice teacher students? 3) Are there differences among students with varying cognitive-motivational profiles in terms of well-being, and epistemological beliefs? 4) Were the profiles related to study success in an activating lecture course?

Method

The participants were 213 first year elementary teacher and kindergarden teacher students, who participated in an activating introductory lecture course in educational psychology during either of two consecutive fall terms at the University of Helsinki, Finland. Both courses were interactive in nature, and the students gave positive evaluations afterwards.

At the end of the course, the students filled in a questionnaire including items from various scales that were shortened versions, based on the MED NORD instrument (Lonka et al., 2008):

- 1) Approaches to learning (based on Entwistle and Ramsden, 1983 and ILS, Vermunt, 1998; Lonka & Lindblom-Ylänne, 1996). Deep approach (divided into Deep understanding and Critical evaluation), Surface approach, and Lack of regulation.
- 2) Cognitive and attributional strategies (SAQ, Nurmi et al., 1995): Optimism and Task avoidance.
- 3) Epistemological beliefs (Certain knowledge, Practical value; Lonka et al., 2008) and
- 4) Well-being (Exhaustion, Stress and Lack of interest)(Elo et al., 2003; Maslach & Jackson, 1981; Mäkinen et al, 2004)).

The structural validity of the scales was tested by means of a series of factor analyses. Correlations were computed in order to study relations among the scales. Latent class clustering was used for clustering students into homogeneous groups. Finally, a series of ANOVAs was conducted to examine between-group differences across the criterion variables.

Results

Correlative results.

Deep Understanding correlated positively with Critical Evaluation and Optimism and negatively with Lack of Regulation. Critical Evaluation had a positive correlation with Optimism. Surface Approach correlated negatively with Optimism. Lack of Regulation correlated negatively with Optimism and positively with Task avoidance. There was a negative correlation between Task Avoidance and Optimism.

Cognitive-motivational profiles.

The results from a series of LCCAs using Latent Gold statistical software suggested that a three-group solution described the data: The first group (n = 106) had a maladaptive profile with high scores on Task Avoidance and Lack of Regulation, low score on Optimism and average scores on Deep Understanding, Critical Evaluation, and Surface Approach. The second group (n = 60) had a very adaptive profile altogether: students in this group scored high on Optimism, Deep Understanding, and Critical Evaluation and low on Task Avoidance, Surface Approach, and Lack of Regulation. The third group (n = 46) scored the lowest on Deep Understanding and Critical Evaluation, but interestingly, also on Task Avoidance. The three groups were labelled, according to the score mean profiles, as (1) students with insufficient regulatory skills (50%), (2) self-directed students (28%), and (3) non-reflective students (22%).

iesinents to withdraw. a symposium8Pairwise comparisons showed that the students with insufficient regulatory skills reported highest levels of stress, exhaustion, and lack of interest. Non-academic and self-directed students did not differ from each other in terms of stress and exhaustion. Non-reflective students scored lowest on lack of interest, but most often expressed appreciating certain knowledge. Self-directed students received the highest grades in the course examination.

Conclusions

The correlative results support our previous findings with students from other fields (Heikkilä & Lonka, 2006; Heikkilä et al, in press): Deep approach (Critical Evaluation and Deep Understanding) was positively related with optimism and negatively to problems in self-regulation. Lack of regulation had a strong positive correlation with avoiding difficult tasks.

Three groups were identified: students with insufficient regulatory skills, self-directed students, and non-reflective students. Our results showed that cognitive and motivational aspects were not only related to study success, but also connected with general well-being of the students. The three groups differed from each other in terms of well-being, epistemological beliefs, and study success. The students with insufficient regulatory skills expressed some symptoms of burnout. For teacher educators, this study has an important message: only one third of the students showed a truly favorable and adaptive cognitive-motivational profile. Even in a highly selected teacher student population, two thirds of the students express some kind of a maladaptive profile in relation to the goals of the course. Teacher students may be, more that we believe, dependent on external regulation. Their problems may encompass insufficient study skills, lack of appropriate goals, emotional exhaustion, and concerns with their own competence. Many of the teacher students were coming directly from high school, and problems in self-regulatory or reflective skills made it difficult for them to understand complex concepts of educational psychology that were central in the course in question. Even if the students expressed enjoying the course, their approaches to learning and their attributions may have not been optimal.

SYMPOSIUM

Instructional Strategies

How Instructional Explanations Can Work

Chairperson: Kirsten Berthold, University of Bielefeld, Germany

Organiser: Kirsten Berthold, University of Bielefeld, Germany

Discussant: Joerg Wittwer, University of Goettingen, Germany

Instructional explanations are used widely, however, empirical studies show that they often have no effect on learning outcomes. This ineffectiveness might be due to several main factors. First, learners might lack relevant prior knowledge to understand the explanations. Second, learners often have problems to match instructional explanations with other learning materials such as animations. Third, learners might not be aware of their misunderstandings and, consequently, they think they do not need the explanation. Against the background of these problems, the aim of the symposium is to explore how instructional explanations can work. All contributions address this aim in experimental

studies and test different instructional approaches of how to foster the effectiveness of explanations in computer-based learning environments. In Contribution 1, the learners were prepared to learn from instructional explanation by constructing relevant prior knowledge. In Contribution 2, the authors combined explanations with attention-directing cues while the learners watched an animation. In addition, they presented the instructional explanations after the learners had self-explained on the topic. In Contribution 3, learners received explanations in combination with indications that included devices pointing out typical misunderstandings. As main findings, the authors of all contributions found positive effects of instructional explanations or the specific approach to foster the effectiveness of instructional explanations on learning outcomes. These findings are of important scientific and educational relevance because they show that a) instructional explanations can be effective, and b) that instructional approaches that construct relevant prior knowledge or point out typical misunderstandings can even increase their effectiveness.

How to Prepare Learners to Learn from Instructional Explanations

Julian Roelle, University of Bielefeld, Germany; Kirsten Berthold, University of Bielefeld, Germany

Instructional explanations are commonly used, however, previous studies have often shown that their effects on learning outcomes are minimal. This failure of instructional explanations may partly be due to a lack of preparation for future learning from explanations on part of the learner. In other contexts, a promising means to prepare for future learning is working with contrasting cases. When working with such cases it is as yet unclear whether instructional guidance is beneficial or detrimental for subsequent learning. Against this background, we developed two types of preparation intervention to foster learning with explanations in the domain of management theory: (a) contrasting cases plus an inventing task including the request to explore and interpret the contrasts between the cases (b) contrasting cases plus worked-out solutions which included highlighting and interpreting the contrasts between the cases. We tested their effects in a one-factorial design comprised of three experimental conditions: (a) contrasting cases plus an inventing task, (b) contrasting cases plus worked-out solutions, and (c) no preparation (control group). Participants were 57 university students. As main findings, we found that working with contrasting cases can effectively and efficiently prepare learners for subsequent learning from instructional explanations. In addition, contrasting cases plus worked-out solutions were more efficient than preparation by inventing.

Instructional explanations are commonly used, however, empirical studies often show that their effects on learning outcomes are minimal (Wittwer & Renkl, 2008). This failure of instructional explanations might partly be due to a lack of preparation to learn from the explanations on part of the learner. To learn from instructional explanations, learners rely on their prior knowledge that serves as a cognitive anchor for future learning. A beneficial cognitive anchor for future learning helps learners to make sense of subsequent instructional explanations and thus cognitively prepares the learners to deeply understand concepts and principles included in the explanations. If a learner has low prior knowledge in a domain, however, they might lack such a beneficial cognitive anchor for learning. A viable approach to generating a cognitive anchor was proposed by Schwartz and Martin (2004). They found that analysing contrasting cases (i.e., cases that differ in important features in a domain) prepared learners for future learning. In the field of fostering learning from instructional explanations, the effects of contrasting cases have seldom been explored. In addition, there remains the open question as to whether instructional guidance should be given or withheld in the phase of preparation. Schwartz and Martin (2004) argued that to make contrasting cases effective, learners would need to explore and compare the cases on their own within an inventing task. However, research in this field mostly indicates that minimally guided instruction is both less effective and less efficient than direct instruction (Kirschner, Sweller, & Clark, 2006). Therefore, given that understanding the contrasts between the cases cognitively prepares learners for subsequent learning, direct instruction highlighting the contrasts should be even better preparation than a minimally guided inventing task. Against this background, we aimed to prepare learners, either with contrasting cases plus an inventing task (i.e., minimal guidance), or with contrasting cases plus worked-out solutions (i.e., direct instruction) to foster effective and efficient learning from subsequent instructional explanations on the domain of management theory. The following hypotheses were tested: 1. Working with contrasting cases fosters effective and efficient learning from subsequent instructional explanations. 2. Working with contrasting cases plus worked-out solutions is more effective and efficient than working with contrasting cases plus an inventing task.

Methodology

We tested these hypotheses in a one-factorial between-subjects design comprised of three experimental conditions: (a) contrasting cases plus an inventing task, (b) contrasting cases plus worked-out solutions, (c) no preparation intervention. Participants were 57 university students. In the conditions that received a preparation intervention, the learners were provided with a pair of contrasting cases. The cases briefly contrasted two companies that were either managed in accordance to scientific management or to the socio-technical systems approach. Learners in the condition that received contrasting cases plus an inventing task were required to explore and interpret the contrasts

between the cases on their own, whereas learners in the condition that received contrasting cases plus worked-out solutions received an expository text that highlighted and interpreted the contrasts between the cases. The time spent on the contrasting cases was held constant (15 min). Afterwards, all participants worked on instructional explanations on the domain of management theory (specific topics: scientific management and socio-technical systems approach) that were provided within a computer-based learning environment. Learning outcomes were assessed with a post-test on both conceptual knowledge and transfer. Learning efficiency was computed as the ratio of the total post-test performance score and the learning time.

Findings

To test our hypotheses we followed the recommendations of Rosenthal and Rosnow (1985), and calculated a priori contrasts comparing the conditions that worked with contrasting cases to the condition without contrasting cases (i.e., hypothesis 1), and comparing the condition with contrasting cases plus an inventing task to the condition with contrasting cases plus worked-out solutions (i.e., hypothesis 2). Working with contrasting cases significantly fostered conceptual knowledge, $F(1, 54) = 29.28$, $p = .35$, and transfer, $F(1, 54) = 26.85$, $p = .33$. Additionally, we found that learners who worked with contrasting cases showed a higher learning efficiency, $F(1, 54) = 5.79$, $p = .020$, $\eta^2 = .09$. With respect to hypothesis 2, we found that working with contrasting cases plus worked-out solutions was as effective as working with contrasting cases plus an inventing task regarding the acquisition of conceptual knowledge, $F(1, 54) = 1.25$, $p = .269$, and regarding transfer, $F(1, 54) = 4.53$, $p = .038$, $\eta^2 = .07$.

Theoretical and Educational Significance of the Research

We found that working on contrasting cases effectively prepared learning from subsequent instructional explanations. Working with contrasting cases was more effective and more efficient with respect to fostering conceptual knowledge and transfer when compared to working without contrasting cases. Additionally, it was more efficient to work with contrasting cases plus worked-out solutions than with contrasting cases plus an inventing task. These findings imply two conclusions regarding learning and instruction: 1. Evidently, working on contrasting cases can cognitively prepare learners to learn from subsequent instructional explanations and hence creates a time for learning from instructional explanations. 2. Contrasting cases plus worked-out solutions are a more efficient preparation for subsequent learning from instructional explanations compared to contrasting cases and a minimally guided inventing task.

References

- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75–86.
- Rosenthal, R., & Rosnow, R. L. (1985). *Contrast analysis: Focused comparisons in the analysis of variance*. Cambridge, England: Cambridge University Press.
- Schwartz, D. L., & Martin, T. (2004). Inventing to prepare for future learning: The hidden efficiency of encouraging original student production in statistics instruction. *Cognition and Instruction*, 22, 129–184.
- Wittwer, J., & Renkl, A. (2008). Why instructional explanations often do not work: A framework for understanding the effectiveness of instructional explanations. *Educational Psychologist*, 43, 49–64.

Talk or Listen, or Both? Understanding a Dynamic System by Producing and/or Receiving Explanations

Huib Tabbers, Erasmus University Rotterdam, Netherlands; Bjorn de Koning, Erasmus University Rotterdam, Netherlands; Denise de Jel, Erasmus University Rotterdam, Netherlands

In this study participants watched an animation on the cardiovascular system. In order to improve understanding of the dynamics of the system, participants were required to either self-explain or to listen to an instructional explanation, or to do both, while they were watching the animation. Subsequently, participants were given retention, inference, and transfer tests. Results showed better inference and transfer performance with instructional explanations only. Thus instructional explanations can be effective in promoting understanding animations, and do not need to be combined with self-explanations.

Keywords: instructional animation; self-explaining, instructional explanation; cuing

Understanding an animation depicting a dynamic system implies that learners create some kind of 'runnable' mental model that can simulate the dynamics of the system (Schnotz & Low, 2008). This model should capture the structural and temporal aspects of the system that can be directly perceived in the animation. In order to be able to reason about the dynamic system however, the mental model should also contain functional relations that cannot be perceived directly but have to be inferred from the animation. Recently, De Koning, Tabbers, Rikers, and Paas (in

press) showed that prompting learners to self-explain while studying an animation results in more correct inferences of functional information and higher transfer performance than studying the animation without self-explanations. In a follow-up study however, De Koning et al. (2010) showed that accompanying the animation with a narration describing the correct functional information seemed to be at least as effective as self-explaining. According to Renkl (2002), with self-explanations not all functional relations will be extracted accurately, which may leave learners with incomplete or incorrect mental models. Instructional explanations on the other hand only contain correct information and thus aid in creating a correct and complete mental model. Nevertheless, with instructional explanations learners do not actively build on prior knowledge and information is processed more superficially (Wittwer & Renkl, 2008). Moreover, learners may have difficulties integrating the instructional explanation with the dynamics of the animation. Although this problem can partly be solved by adding visual cues in the animation (De Koning et al., 2010), the integration of explanation and animation is more adaptive with self-explanations. In this study, we investigated whether a combination of self-explanation and instructional explanation would be the optimal way to improve learning from a dynamic system. We set up an experiment in which participants studied an animation and manipulated whether they had produce self-explanations or not, and whether they received an instructional explanation or not. In the combined condition, participants had to self-explain first and then received the narrated explanation, to stimulate activation of prior knowledge and inference of functional relations from the animation rather than recalling this information from the narration.

Method

Ninety-two students participated for course credits (28 males; age: $M = 21.73$ years, $SD = 3.00$). They were randomly assigned to one of four conditions: no explanation, self-explanation, instructional explanation and self-explanation followed by instructional explanation. Participants were first checked on their familiarity with the cardiovascular system. This was followed by a short animation on plate tectonics, to familiarize participants with the upcoming learning task and (if applicable) with the self-explanation strategy. Subsequently, participants studied a labeled diagram to learn the names of the main structures of the cardiovascular system. They then studied a 5-minute animation of the cardiovascular system, with each of its five subsystems being highlighted consecutively by slightly darkening the other four subsystems. In the no-explanation condition, participants just watched the animation twice in silence; in the self-explanation condition participants were prompted to self-explain aloud while they viewed the animation; in the instructional-explanation condition participants watched the animation while listening to a narration; in the self-explanation-followed-by-instructional-explanation condition participants were prompted to self-explain during the first viewing of the animation and listened to the narration in the second viewing. In the narration mainly functional information was given that otherwise had to be inferred from the animation. Finally, participants answered 32 multiple choice retention items (structural and temporal aspects), 14 open-ended inference items (functional relations), and five open-ended transfer items (reasoning about the system). This test was repeated after one week.

Results

A MANOVA on retention, inference, and transfer scores with instructional explanation (yes-no) and self-explanation (yes-no) as between factors and time of test as within factor only showed a main effect of instructional explanation, Wilks' $\lambda = 0.68$, $F(3,86) = 13.21$, $p F(1,90) = 22.69$, $p F(1,90) = 8.16$, $p = .005$, partial $\eta^2 = .08$, but not on retention, $F(1,90) = 1.75$, $p = .19$, partial $\eta^2 = .02$. So participants receiving instructional explanations knew more correct functional relations (inference: $M = 15.63$, $SE = 0.54$) and knew better how to apply their knowledge (transfer: $M = 7.08$, $SE = 0.34$) than participants receiving no instructional explanations (inference: $M = 12.00$, and transfer: $M = 5.70$).

Discussion

In our study only instructional explanations are effective in improving learners' understanding of the dynamic systems. This is quite surprising as previous research showed that self-explanations do seem to improve learning from animations (e.g., De Koning et al., in press). Perhaps watching the animation a second time has led to more active construction of functional information in the condition without explanations. Also, hearing the instructional explanation a second time or after having self-explained may in both cases have led to better processing of this information. To conclude, this study suggests that understanding animations can best be promoted by instructional explanations combined with attention-directing cues.

References

- De Koning, B. B., Tabbers, H. K., Rikers, R. M. P. J., & Paas, F. (in press). Improved effectiveness of cueing by self-explanations when learning from a complex animation. *Applied Cognitive Psychology*.
- De Koning, B. B., Tabbers, H. K., Rikers, R. M. J. P., & Paas, F. (2010). Learning by generating vs. receiving instructional explanations: Two approaches to enhance attention cueing in animations. *Computers and Education*, 55, 681-691.

Renkl, A. (2002). Learning from worked-out examples: Instructional explanations support self-explanations. *Learning and Instruction*, 12, 529-556.

Schnotz, W., & Lowe, R. K. (2008). A unified view of learning from animated and static graphics. In R. K. Lowe, & W. Schnotz (Eds.), *Learning with animation: Research and design implications*. New York: Cambridge University Press.

Wittwer, J., & Renkl, A. (2008). Why instructional explanations often do not work: A framework for understanding the effectiveness of instructional explanations. *Educational Psychologist*, 43, 49-64.

Fostering Active Processing of Instructional Explanations

Hector Garcia Rodicio, University of Cantabria, Spain; Emilio Sanchez, University of Salamanca, Spain

Instructional explanations can address learners' problems of understanding and help in repairing them. However, they are ineffective more often than not. Our goal was to evaluate a strategy to make learners deeply process them, which consists of presenting indications of learners' misunderstandings before providing the explanations. In Experiment 1, 65 participants learned about plate tectonics from a multimedia presentation with animation and concurrent narration. In addition to the presentation, participants received instructional explanations in one of three forms: explanations with indications, explanations in isolation or no explanations. After the presentation, participants solved retention and transfer tests. Participants receiving explanations in isolation outperformed those in the condition with no explanations whereas participants receiving explanations with indications outperformed both. This means that indications enhanced explanations' effectiveness. In Experiment 2 we explored why the strategy worked effectively. Fifty-one participants learned from a multimedia presentation on plate tectonics while thinking-aloud. In addition to the presentation, half the participants received explanations combined with indications while the rest received the explanations in isolation. As revealed by thinking-aloud protocols, participants receiving explanations with indications were more able to detect and repair flaws in their ongoing understanding, with respect to participants in the explanation alone condition.

According to Wittwer and Renkl (2008) there are two kinds of instructional explanations. Some explanations introduce new concepts to learners. Other explanations are given when learners have gained some knowledge on a topic with the goal of revising possible misunderstandings. We are interested in the latter. It is important to make these explanations effective as they have the advantage of providing learners with complete and correct information when they have problems of understanding but cannot do anything to solve them. Despite this, instructional explanations are ineffective very often (Wittwer & Renkl, 2008).

The mental model repair view (Chi, 2000) suggests that, in order to learn deeply from expository prose, learners have to perform two processes: (a) monitoring their ongoing understanding to detect flaws and (b) generating explanations to repair these flaws. In the light of this view, one possible interpretation for instructional explanations' ineffectiveness is that learners cannot detect flaws in their understanding, which makes them perceive instructional explanations as ancillary (instead of repairing) information, thus ignoring them. Experiment 1 In order to test this interpretation we combined instructional explanations with indications pointing out the flaws in learners' ongoing understanding. We expected these indications to make learners aware of the limitations in their understanding. This, in turn, would make learners profit from instructional explanations by using them as a basis for repairing their flawed understanding.

Method

Sixty-five undergraduate students were assigned to one of three conditions: explanations with indications (EwithI), explanations (Enol) and no explanations (control). First, participants started viewing the multimedia presentation. It consisted of seven modules comprising animation with concurrent narration, which described events concerning plate tectonics. The presentation also included instructional explanations, which were interjected in between the modules. The explanations were designed to revise typical learners' misunderstandings that were identified in prior studies. Participants in the EwithI condition received these explanations in combination with indications, which were devices pointing out the misunderstandings (e.g., "What you probably see is that in both the Andes and the Himalaya two plates collide forming mountains. This is correct, however, it is not enough to completely understand how plate collisions work. What you probably did not realize is that collisions in the Andes and the Himalaya have big differences, critical to understand the modules."). Participants in the Enol condition received the explanations in isolation whereas participants in the control condition received no explanations but only the multimedia modules. After the presentation, participants solved a retention test consisting of eight open-ended questions (max. score = 24). Finally, participants solved a transfer test consisting of ten open-ended questions (max. score = 30).

Results

RetentionTransferMSDMSDEwithI15.335.9612.754.55Enol11.685.119.055.03Control8.445.275.163.84 If this

An ANOVA with condition as the between-subjects factor was performed on all dependent variables. There were significant differences in retention and transfer with participants in the EwithI condition outperforming those in the Enol condition, $F(1, 50) = 6.24$, $p = .02$ and $F(1, 50) = 14.60$, $p = .001$, $F(1, 50) = 10.99$, $p = .003$, respectively. Table 2. Descriptive statistics, Experiment 2.

Experiment	2.	RetentionTransferParaphrasingElaboratingDistortingDetecting	&
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Chi, M. T. H. (2000). Self-explaining expository texts. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 161-238). Mahwah: Lawrence Erlbaum.

Wittwer, J., & Renkl, A. (2008). Why instructional explanations often do not work. *Educational Psychologist*, 43, 49-64.

Motivation

Interest, Learning, and Development: Insights from Qualitative Data

Organiser: Flavio Azevedo, University of Massachusetts, United States

Discussant: Paul W. Richardson, Monash University, Australia

current study and use it as the basis for addressing the following questions:

- How is interest conceptualized as developing over time? What is the relation between learning and [interest?] development?

Paul Richardson will serve as discussant. Richardson's own work bridges research and practice. It draws heavily on qualitative methods and is informed by self-determination theory, expectancy-value theory, and interest theory.

Using Cognitive Validation to Explore the Development of Interest in Adolescence

Anne Christiane Frenzel, Universitat Augsburg, Germany; Anna-Lena Dicke, University of Tübingen, Germany; Reinhard Pekrun, University of Munich, Germany

Our research explored the development of mathematics interest across adolescence. We interviewed $N=70$ adolescents (grades 5 and 9), using the methodology of cognitive validation to explore changes in the conceptualization of interest. Findings showed significant shifts in students' conceptualization of interest across time, with aspects of autonomic task choice and thirst for knowledge gaining weight, and positive experiences losing importance for the conceptualization of the construct of interest among 9th graders as compared to 5th graders. Consequently, qualitative changes should be attended to when exploring quantitative changes of psychological constructs over time, and interventions for interest should be tailored to specific age groups.

Aims and Theoretical Framework

Considerable research attention has been directed to the construct of mathematics interest, not only regarding its (positive) effects on learning and achievement, but also regarding its (negative) trajectories across primary and secondary school years (Eccles et al., 1983; Eccles, Adler, & Meece, 1984; Eccles et al., 1989; Fredricks & Eccles, 2002; Gottfried, Fleming, & Gottfried, 2001; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Koeller, Baumert, & Schnabel, 2001; Spinath & Steinmayr, 2008; Watt, 2004). Longitudinally, mathematics interest is typically assessed with identical items across several school years. The development of mathematics interest is then typically measured based on absolute differences in responses on these self-report measuring instruments (e.g., a change from "strongly agree" to "agree"). This approach assumes that not only the understanding but also the relevance of the different items is the same for all respondents, independent of respondents' characteristics, such as age. Thus, measurement invariance of responses over time is implicitly assumed in longitudinal studies. However, if statements about quantitative changes are to be unambiguous, it is important that the elements of composite measurements be invariant over time over which change is said to occur (Horn, 1991).

A key suspicion guiding our research on interest development during adolescence was that such invariance of measurement is not given because students of different ages might conceptualize the construct of interest differently. That is, we suspected that a subjective reconceptualization of the construct of interest would occur during the adolescent years. To test this, we used the method of cognitive validation. This method is predominantly used to judge the cognitive validity of newly developed items (Bowen, Bowen, & Wolley, 2004), but it is applicable also to the question of qualitative changes in the item interpretation across different ages in the developmental continuum (Karabenick et al., 2007). So far, no such tests regarding the invariance of cognitive validity in the assessment of academic interests seem to have been undertaken.

Methodology

Participants of our study were $N = 70$ students from the highest ability track of the German state school system from grade 5 ($n = 21/14$ girls/boys, mean age 10.4 years, $SD = 0.60$ years) and grade 9 ($n = 17/18$ girls/boys, mean age = 14.7 years, $SD = 0.60$ years). Students were interviewed individually using the recommended guidelines for cognitive validation (Bowen et al., 2004; Karabenick et al., 2007) to explore students' cognitive conceptualization of the six items on mathematics interest (e.g., "I am interested in mathematics", "I often find the things we deal with in mathematics are really exciting").

Interviews were digitally recorded and subsequently transcribed verbatim. Transcripts were coded using the computer program MAXQDA (Kuckartz, 1995-2007). Drawing upon current conceptualizations of interest, student answers were categorized into the following components of the construct (typical statements in parentheses): affective experiences ("It is fun"), value of the respective domain ("I like it"), subjective competence in the respective domain ("I can do it"), thirst for knowledge ("I want to know more"), (repeated) behavioral engagement in the respective domain ("I spend time with it"), autonomic task choice in the respective domain ("I do it voluntarily"), and energization or motivation ("I really want to do it").

Interviews were rated by three independent raters. Inter-rater reliability was obtained by cross-coding 6 of the 70 interviews (Cohen's Kappa rater 1/2 = .92, rater 1/3 = .84, rater 2/3 = .85).

Findings

To investigate potential developmental changes concerning item interpretation, we ran a MANCOVA with the seven predefined categories as dependent variables and age group as independent variable and verbal fluency as a covariate. The overall multivariate test for the age comparison of the category frequencies was significant ($F = 3.64$; p

< .01). In separate comparisons, significant differences occurred for the categories of affective experiences (higher for 5th graders), autonomic task choice, thirst for knowledge and behavioral engagement (higher for 9th graders). Thus, there were significant qualitative changes in the conceptualization of the construct of interest between the two age groups, with younger students associating predominantly affective experiences with the construct of interest, and older students increasingly incorporating more cognitive aspects into their conceptualization of interest.

Significance

Our findings clearly indicated that one fundamental prerequisite of assessing quantitative change across time, namely measurement invariance, might not be given for the construct of academic interest if measured with typical self-report items such as those used in our study, because the construct undergoes qualitative changes in its conceptualization across adolescence. Therefore, a qualitative check of potential measurement variation seems imperative for any future study addressing such questions.

In terms of educational implications, intervention directed at the improvement of academic interests should be designed according to the interest conception of the specific age group. Given our observed conceptual shifts in the interest construct across adolescence, younger students should be provided with positive affective experiences, while one should appeal to autonomy to instill academic interest among older students. Positive affective experiences could for example be conveyed by offering real-life, exciting mathematics problems or by enthusing the students through one's own authentic display of enjoyment of practicing mathematics (see Frenzel et al., 2010). Autonomy could be achieved by providing choices or by emphasizing that several solutions to a math problem are possible.

The Development of Well-developed Interests: Theoretical and Pedagogical Implications

Flavio Azevedo, University of Massachusetts, United States

Based on a 3-year-long ethnography of the hobby of model rocketry, I investigate the development of well-developed (i.e., individual) interests. Hobbies are paradigmatic of elective, self-motivated, open-ended practices, and thus they offer an excellent window into interest-based forms of participation. Using a grounded theoretical approach, I iteratively compare and contrast rocketeers' practices, looking for patterns in their pursuits. I then attempt to explain where such patterns emerge from (i.e., their structure), as well as how they change and evolve in the long haul. Overall, I find that an individual interest develops simultaneously in multiple directions, each of which represents the multiple motives that a hobbyist develops in the practice, as well as interactions among such motives. For example, a rocketeer may at one time engage the practice for the sake of doing design and construction work, while at another time using the hobby as a way to socialize and strengthen friendships, as well as to advance an identity of competence. Of course, all such motives could be (and most often are) pursued at the same time, interacting in specific ways across contexts. This complex, multi-dimensional structure has several theoretical and pedagogical implications. Indeed, while hobbies and schools are radically different institutions, I will show that the theoretical developments I propose here can inform classroom practice at several levels.

Aims and Theoretical Framework

Designing instruction such that students' emergent disciplinary interests can be nurtured towards more stable, well-developed interests is often proposed as a major goal of modern instruction. To support this goal, researchers have studied how interests develop from moments of fleeting attention in a topic or activity (i.e., a situational interest; Schraw & Lehmann, 2001) to long-term, individual interests (Hidi & Renninger, 2006). Here I contribute to this research agenda by studying how individual (i.e., well-developed) interests themselves constantly change and evolve. The premise is that understanding development of any phase of an interest (Renninger, 2009) may inform our overall understanding of larger processes of interest development.

The focus of my investigation is the hobby of model rocketry. Hobbies are paradigmatic of elective, self-motivated, open-ended practices (Valsiner, 1992), and thus they offer an excellent window into interest-based forms of participation. While hobbies and schools are radically different institutions, I will show that the theoretical developments I propose here can inform classroom practice at several levels.

An interest appears first as a curiosity or attraction (Hidi & Renninger, 2006), and with time it evolves and becomes established as a fabric of activities (diSessa, 2000). Framed in this manner, several strands of social, cultural, and historical approaches to the study of social practices bear on my research. For example, as in Lave and Wenger's (1991) study of communities of practice, I consider that long-term practice engagement is partly a result of one's felt sense of future in the practice and the communities that enact them. Facilitating these developments, guided

participation (Rogoff, 1995) in hobbies is part and parcel of the process through which individuals come to develop interests in the practice. Within this context, I pay particular attention to individuals' access to resources in the community (e.g., material infrastructures, such as rockets and rocket parts/tools), which function at times to mediate people's long-term engagement (Engestrom & Middleton, 1996), and at times as goals in and of themselves (Krapp, 2003). The point of my analysis is to elucidate how these structures and processes interact to shape and sustain individuals' long-term pursuits.

Methodology

In ethnographic fashion, my role was that of a participant observer (Hammersley & Atkinson, 1995) in two model rocketry communities. Empirically and analytically, my strategy was to focus on a single case—that of 14-year-old David, who has been a rocketeer since he was six—and to compare and contrast it to the practices of other rocketeers. For all subjects, I documented their practice-linked activities and routines (e.g., flying rockets and chatting about model rocketry), as well as any “parallel” activities (e.g., socializing) that the practice of model rocketry might serve to mediate. The ethnographic period lasted three years, and resulted in about 20 hours of videotapes and several pages of field notes.

My analytical procedure was the grounded theoretical methodology (Corbin & Strauss, 1990), which outlines a method for collecting and analyzing data such that conceptual categories reflecting emergent analytical codes are iteratively refined in subsequent data collection and analysis. Following my research goals, coding of the data was specifically geared towards identifying patterns of practice participation over the very long term and to explain (a) how such patterns change over time and (b) where these patterns emerge from (i.e., what is their structure).

Findings

Briefly, my analysis reveals three central aspects about the nature and development of individual interests:

1. An individual interest develops simultaneously in multiple directions, each of which can be seen in clusters of inter-related activities. For example, David engages in designing and building a variety of low-powered rockets made from cheap, reusable materials (e.g., Paper Cups and Bottles), as well as building off-the-shelf, high-powered rockets, among others. Each of these simultaneous “lines of work” in his practice—call them “cheap and wacky rockets” and “high-powered rockets,” respectively—entails a distinct set of activities, which themselves represent the various motives that a person develops in the hobby.
2. Over the long haul, each “line of work” in a hobbyist's practice shifts its focus of action. For instance, at the beginning of the ethnographic period, David's “cheap and wacky rockets” focused on a variety of rocket forms (e.g., Paper Cup, Bottle, and Shuttlecocks). Towards the end of the study, however, that “line of work” had shifted to a single rocket form (i.e., Shuttlecocks), with variations within—e.g., single- and multi-stage versions of it.
3. Also across the long run, an individual enacts his/her interest in different ways. Thus, David at times spent more time with his “cheap and wacky rockets,” say, building and flying them more often than other rockets in his fleet. At a later point, however, he dedicated more time to other lines of his hobby.

Significance

These observations have a number of theoretical and pragmatic implications, including:

- i. Item 1 above suggests that interests have a complex motivational structure, regardless of their phase of development. At the earliest stages of interest development in the classroom, then, we expect to see the student engaging in a particular activity from various angles, each of which reflects his/her emerging motives to participate in the activity. If any form of well-developed disciplinary interest is to evolve, we must design opportunities for students to continuously experience these disciplines from a variety of personally relevant positions. In the presentation, I will consider how this finding might be antithetical to our current schooling practices.
- ii. Items 2 and 3 afford us a better interpretation of dynamic phenomena in interest-based practice participation. For example, in long-term inquiry-based science activities, students' interests are sometimes interpreted as flailing (e.g., Blumenfeld et al., 1991). From the perspective advanced here, however, “flailing interests” might simply be an artifact of how interests evolve and/or are differentially enacted across time. In the presentation, I will offer a number of such “small” classroom interpretation/implementation lessons.

Rich Descriptive Data and Its Implications for Understanding Interest Development: “L” and Science

K. Ann Renninger, Swarthmore College, United States; Kathryn R. Riley, Swarthmore College, United States

Symposium questions will be addressed using data from a multi-method study of the case of L—, an adolescent girl, who was one of a total of 8 (5 girls, 3 boys) inner-city participants in out-of-school science workshops over five years. Participant observation, yearly pre-post and follow-up interviews, assessments of science literacy, artifacts from workshop participation, and interviews with parents inform this study. Findings from this study suggest that in order to engage, a learner needs to perceive the features of particular content, such as science, as something to which to attend. It also suggests that interest influences the “what” of cognition: to what the learner attends and how he or she engages.

Aims and Theoretical Framework

Consistent with Hidi and Renninger’s (2006) Four-Phase Model of Interest Development, interest is conceptualized as both a psychological state and a predisposition to return to engagement with particular disciplinary content (e.g., science). Phases in the development of interest range from an initial triggered situational interest that may only last for a few moments, to a well-developed individual interest that is relatively long lasting. They also have been described as including the learner’s evolving knowledge about, valuing of, and feelings for particular content.

Differences exist in researchers’ understanding of the relative emphasis of knowledge, value, and affect in the development of interest, however. The work on attention and cognitive processing suggests that there is individual variation in the types of questions and/or topic interest of the learner (e.g., Renninger, 1990; Neitzel, et al., 2008). The work on the characteristics of the learning environment calls attention to the role of others and objects as supports for engagement and to likely differences in learners’ needs for support for development (e.g., Nolen, 2007; Palmer, 2009). The work on knowledge and value as components of interest underscores potential differences in the contributions of each to interest and also to their coordination as interest develops (e.g., Lawless & Kulikowich, 2006; Schiefele, 2009).

Not addressed in these discussions is what needs to be in place for the learner independently to begin asking curiosity questions, seeking resources, and making use of feedback. Learners like L—, who initially have little to no interest in learning content such as science, pose a challenge for educators as well as researchers.

Methodology

L— was selected for study from a cohort of 8 (5 g, 3 b) inner city youth on whom we also have data over the years of their participation in the science workshops. She is emblematic of the participants: inner-city youth who at the beginning of the study had an average age of 10 years. She had little initial interest in science, no formal experience with science (her school did not teach science), and was a participant in the workshop because she was a participant in a choral training program run concurrently with the science workshops.

Methods employed included participant observation, pre-post workshop interviews each year of the study including three assessments of science literacy, and five-week-post-workshop interviews that included parallel assessments of science literacy. Interviews with parents each summer and artifacts from workshop participation also inform this study.

Interest was assessed using methods adapted from Renninger and Wozniak’s (1985) ethnological methods, assessing voluntary reengagement, engagement overall, independent engagement and complexity of engagement.

Findings

Participant observation notes and interviews with L— indicated that initially she thought about science the way she would think about anything else; she was more philosophical than scientific. For example, her questions during the week she and her workshop group learned about worms included: “What do worms die from?” “What kind of culture do they have?”

Five years later, L— asked to be a teaching assistant in the Chemistry Workshop, a position that had not previously existed.

She was now aware that science was fun for her. After some deliberation, the workshop programming was adjusted to allow her to help out with the younger children as a peer tutor. She worked with the younger children alongside a college student. Even before the workshop addressed acid-base neutralization, and only two weeks into the workshop, she asked to take an experiment further by combining an acid and base and observing the resulting solution. The instructors suggested that she share this idea with the group of children to whom she was assigned. She

did, and engaged them all in thinking with her about each of the trials (and, as it turned out, all of the other children's groups decided to explore this issue as well). (Notes, June 2009)

L—'s thinking about science had changed. She had a broader perspective. She now focused on patterns in phenomena and how they together provided explanation. She was willing to think about content generally and to explore new materials.

L— shifts from being a person with little to no background knowledge to seriously wanting to engage and learn. Data from L—'s participation in the workshops are consistent with those of the other participants in her cohort, and allow consideration of the interplay between interest development and cognition.

For the first few summers she participated in the workshops, L— has a triggered situational interest in the scientific material. Her affect can be heightened; she clearly is attending and has some questions, but it is not until the fourth year that her phase of interest begins to shift to a maintained—and soon after to an emerging—individual interest, signaled by her independent efforts to understand.

Significance

Based on the data from L—'s case, it appears that shifts in the development of interest can be expected, but may not be immediately obvious to the observer. However, patterns such as the kinds of questions asked and the extent to which these questions map onto the questioning of the discipline can be tracked. They suggest that the initial process of triggering interest occurs over time. Furthermore, they suggest that as interest develops, attentional resources are freed up. In the first workshop, L—'s own questions appeared to take so much of her energy that she did not have the capacity to benefit from the group, even though it is in the group that she continues to grow. In an open-ended inquiry context, moreover, questions and engagements of L— and her group appear to be increasingly aligned with the disciplinary goals and skills of science. Such data have intriguing suggestions about the role of the learning environment as a support for both interest development and learning.

SYMPOSIUM

Continuing professional development in Teachers

Beyond Recipes: How Can Psychology Contribute to Teacher Education and Professional Development

Chairperson: Elsbeth Stern, ETH Zurich Institute for Behavioral Sciences, Switzerland

Organiser: Elsbeth Stern, ETH Zurich Institute for Behavioral Sciences, Switzerland

Discussant: Elsbeth Stern, ETH Zurich Institute for Behavioral Sciences, Switzerland

For more than a century, psychology has delivered various scientific insights into reasons for success and failure of academic learning. Nonetheless, there is still a wide gap between what psychology has ascertained about powerful learning environments, and how these findings do inform daily classroom practice. On the one hand, schools are still governed by traditions that are in conflict with well accepted principles of human learning and functioning. On the other hand, findings from research on learning and instruction hardly ever go along with clear practical implications, and therefore may be more confusing than helpful for teachers. In principle, psychologists have good opportunities to inform educational practice because educational psychology is a core subject in teacher education programs at most universities, and psychologists get many invitations to participate in professional development programs for in-service teachers. In this panel discussion we want to generate ideas on how to use these resources more efficiently in future. What insights and concepts from Psychology should leave their mark on teacher education and how should this work? Should concepts such as motivation, working memory functions, or problem solving be taught similar to the way they are taught in psychology courses, or do they have to be translated from the very beginning into a language of didactics and merged into Pedagogical Content Knowledge? Psychologists from Finland, Germany, Switzerland, and the US with major responsibilities in teacher education programs will present their current practice as well as their future goals, and afterward controversial questions will be discussed.

What has been the contribution of Psychology to school reforms in Finland?

Erno Lehtinen, University of Turku, Finland

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Psychology has further developed many concepts which are relevant for education. However, this may have increased the gap between scientific understanding of those concepts and the way they are used in everyday contexts. For example, this is the case for the concept of motivation. In its everyday use, motivation is understood more like a trait. In contrast, Educational Psychology has researched the circumstances under which motivation can be changed. As a consequence of this research, psychologists understand motivation more like a competence which can be acquired by learning, rather than as a trait. It is thoroughly important to convey these insights to teacher education programs, but how do we ensure that teachers really make use of it in their daily classroom practice? Birgit Spinath will present attempts which go in this direction.

It is, however, a general question whether concepts such as motivation, working memory functions, or problem solving should be taught similarly to the way they are taught in psychology courses. In Finland, which is the most successful country in term of education in the Western World, teacher education is strongly based on scientific psychology, as Erno Lehtinen will show. In contrast, Lauren Resnick argues that insights developed in psychological research should be translated from the very beginning into a language of didactics and merged into Pedagogical Content Knowledge.

Recently, more and more teacher educational programs at various places try a compromise between basic research and applicable skills. Henrik Saalbach will present an example from the ETH Zurich where a program has been designed on the basis of the so-called supply-and-utilization-model (Angebots-Nutzungs-Modell) which conceptualizes instructional quality as depending not only on instructional methods but also on factors of the learner, the teacher, and the school. The learner side includes various learning processes as well as stable and unstable preconditions (e.g., SES, IQ, attitudes). The teacher side contains professional competencies such as content knowledge, pedagogical content knowledge and beliefs, diagnostic competencies, as well as skills concerning coping with the psycho-social demands of teaching. The program is thus based on four columns: subject matter (e.g., mathematics, physics, chemistry), didactics, teaching practice, and educational psychology. The latter part contains issues such as cognitive foundation of learning, learning theories with a special emphasis on constructionist approaches, motivation, conceptual change, formative assessment, instructional design, coping with stress as well as communication and conflict resolution skills. All courses are designed in a way that student are encouraged and supported to link theories to their subject and to teaching practice in order to build up content-focused pedagogical knowledge.

The panelists who have long-standing major responsibilities in teacher education programs in their countries will discuss the different approaches on how psychology can contribute to teacher education and professional development. The aim of the discussion panel is thus to develop recommendations for designing teacher education programs which are research based and ensure transfer to daily classroom practice.

Psychology in nested Learning Systems

Lauren B. Resnick, University of Pittsburgh, United States

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Supporting teachers in becoming adaptive experts: The teacher education program at ETH Zurich

Henrik Saalbach, ETH Zurich, Switzerland

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A major message from Psychology: Understanding motivation as a competence rather than as a trait

Birgit Spinath, Heidelberg University, Germany

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ICT DEMONSTRATION

Using Personal Digital Assistants (PDAs) in intrapersonal educational research

Lars-Erik Malmberg, University of Oxford, United Kingdom

An intrapersonal (within-person) approach to educational research offers a unique window into learners' and teachers' beliefs, experiences and behaviours, which is different from that of an interpersonal (between-person) approach. Techniques geared toward investigating experiences as they unfold in the real-world in real-time are referred to as diary studies and experience sampling. Such studies are still quite rare in educational research, although the process nature of learning and teaching lend themselves well to such a methodology. Inspired by developmental research in other fields (e.g., emotion), available and user-friendly technology for data-collection, and recent advances in statistical modelling, the workshop on intrapersonal modelling covers the following topics.

- (1) A brief introduction to the intrapersonal research approach
- (2) Planning and starting up an intrapersonal study. When, in which situations, and how to administer questionnaires?
- (3) Programming a PDA questionnaire using commercial software
- (4) Data management
- (5) Participant recruitment, training and monitoring
- (6) A brief overview of statistical modelling of intensive longitudinal data

Examples will be drawn from the literature, software comparisons and experiences from two empirical studies: the Learning Every Lesson (LEL) study (5,000+ lessons of 320 primary school children; Malmberg & Halliburton), and the Teaching Every Lesson (TEL) study (1,000+ lessons of 43 teachers; Malmberg & Hagger). The workshop is open for all researchers who are interested in the investigation of intrapersonal educational phenomena. No prior knowledge is required. About 60 minutes of demonstration time is allocated, leaving ample time for discussion.

Two broad approaches to the investigation of humans belief systems exist: the interpersonal approach (between-person, variable-approach) and the intrapersonal approach (within-person, process oriented). Much educational research is cross-sectional or longer-term longitudinal. Data collected in such studies, either by questionnaire or interview is susceptible to memory biases. Techniques geared toward investigating experiences as they unfold in the real-world in real-time are referred to as diary studies, experience sampling, and ecological momentary assessment

(Hektner et al., 2007). As learning and teaching are viewed as processes unfolding over time, it appears that an intrapersonal process approach would be fruitful to advocate in educational research. To date only few studies have, to the best of our knowledge, been carried out. Schmitz and Skinner (1993) investigated more than 25 homework learning experiences among primary school students. Tsai et al (2008) studied secondary school students' science and maths interest and perceived autonomy support during three weeks. Schmitz and Weise (2006) report on a six week self-regulation intervention study among university students. Carson et al. (2010) report that only four intrapersonal studies of teachers have been carried out. The benefits of an intrapersonal (process) approach are that they can increase our knowledge about: (1) interpersonal differences in stability of intrapersonal processes, i.e., to what extent persons vary in their stability from one situation to the next (from time-point T-1 to time-point T); (2) whether one aspect of an intrapersonal process predicts the same or another aspect of the intrapersonal process over time; (3) intrapersonal variance, that is how much a person varies with regard to an intrapersonal aspect within a given time-interval; and (4) the extent to which intrapersonal processes are related to (inter)personal characteristics and contextual features, for example whether students' intrinsic motivation is predicted by communication with the teacher (e.g., Nesselroade, 2001). Taken together, Zimmerman (2008) refers to the study of intrapersonal beliefs as the next generation of research into self-regulatory processes. Modern technology has made life easier for researchers who wish to investigate how persons vary in their experiences and beliefs from one situation to the next. Personal Digital Assistants (PDAs) have become reasonably accessible (Le et al., 2006), prices from £50 upwards. While some commercial software are quite expensive but relatively easy to use, non-commercial software are freely available, but at times more complex to programme for the non-savvy researcher. Modern statistical software (e.g., MLWin, Mplus) allow researchers to specify models taking account of the complex nested structures within which the data were collected (e.g., time-points nested within days, nested within students, nested within classrooms). The proposed demonstration workshop is geared towards researchers who wish to get a first insight into the methodology. Presentation time is approximately 60 minutes allowing ample time for participants to ask advice, discuss any points raised, and follow up on details. Examples will be drawn from the literature, software comparisons and experiences of two empirical studies: the Learning Every Lesson (LEL) study (Malmberg and Halliburton, 2007-08; more than 5,000 responses of 320 primary school children), and the Teaching Every Lesson (TEL) study (Malmberg and Hagger, 2009; more than 1,000 responses of 43 teachers). The contents cover: (1) A brief introduction to the intrapersonal research perspective (as juxtaposed with an interpersonal perspective; 5 min). (2) Planning and starting up an intensive longitudinal study (10 min). (2b) Focus on time. Whether to probe experiences at fixed time-points (e.g., end of lesson, lunch break), when a certain event occurs, or randomly? (2a) Questionnaire and item construction. Focus on trade off between content coverage (how many constructs to include?), and numbers of items per construct (how many items to ask in total?). (3) Programming. Example of how to programme Hewlett-Packard iPAQ 2140 PDAs (Windows 5 operating system), using the DaneSoft Survey System: Setting up templates and how to manage files. Other systems will be referred to (10 min). (4) Data management. How to download data, store and error check data. Using participant log-on codes and time-stamped data. How to create person-period datafiles (10 min). (5) How to recruit participants (e.g., longer term commitment), train participants to use PDA (e.g., technical info, how to charge machines), and monitor participant compliance (e.g., courtesy calls or e-mails)(10 min). (6) A brief overview of statistical modelling of intensive longitudinal data (Walls, Jung, & Schwartz, 2006), including the following: (a) Multilevel Confirmatory Factor Analysis (MLCFA) allows the specification of factor structures at two levels (i.e., time-points nested within students). (b) Random Intercept and Random Slope models allows the investigation of relationships between intrapersonal constructs at both the situation and person levels. (c) The Dynamic Factor Analysis (DFA) allows the time-dimension (lagged relationships between time-points) of the data to be taken into account (15 min).

Carson, R. L., Weiss, H. M., & Templin, T. J. (2010). Ecological momentary assessment: a research method for studying the daily lives of teachers. *International Journal of Research & Method in Education*, 33, 165–182.

Hektner, J. M., Schmidt, J. A., & Csikszentmihaly, M. (2007). *Experience sampling method: measuring the quality of everyday life*. Thousand Oaks: Sage.

Le, B., Choi, H. N., & Beal, D. J. (2006). Pocket-sized psychology studies: Exploring daily diary software for palm pilots. *Behavior Research Methods* 38(2), 325–32. Nesselroade, J. R. (2001). Intraindividual variability in development within and between individuals. *European Psychologist*, 6, 187–193.

Schmitz, B., & Skinner, E. (1993). Perceived control, effort, and academic performance: Interindividual, intraindividual, and multivariate time-series analyses. *Journal of Personality and Social Psychology*, 64, 1010-1028.

Schmitz, B., & Weise, B. S. (2006). New perspectives for the evaluation of training sessions in self-regulated learning: time-series analyses of diary data. *Contemporary Educational Psychology*, 31, 64–96.

Tsai, Y-M., Kunter, M., Lýdtke, O., & Trautwein, U. (2008). Day-to-day variation in competence beliefs: how autonomy support predicts young adolescents' felt competence. In H. W. Marsh, R. G. Craven & D. M. McInerney, (Eds.), *Self-processes, learning, and enabling human potential: dynamic new approaches* (pp. 119-143; *International Advances in Self Research*, Volume 3). Greenwich, CT: Information Age Press.

Walls, T. A., Jung, H., & Schwartz, J. E. (2006). Multilevel models for intensive longitudinal data. In T. A. Walls & J. L. Schafer (Eds.), *Models for intensive longitudinal data* (pp. 3-37). Oxford: Oxford University Press.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45, 166-183.

ICT DEMONSTRATION

Demonstration of the SimScientists Formative and Summative Simulation-Based Assessments

Edys Quellmalz, WestEd, United States; Michael Timms, WestEd, United States

The SimScientists research and development program at WestEd combines a model-based learning approach with evidence-centered design into a powerful framework for transforming science assessment. This session will demonstrate simulation-based assessments for two middle school science topics, ecosystems and force and motion. The assessments were field tested in three states with 55 teachers and 5500 students. Findings documented the feasibility, utility, and technical quality of science simulations for formative, curriculum-embedded assessment and summative, end-of-unit benchmark assessment. SimScientists projects contribute to the research base on the design and validation of the next generation of assessments and their articulation throughout an assessment system.

Aims.

This session will demonstrate simulation-based assessments funded by the U.S National Science Foundation and the U.S. Department of Education designed as formative, curriculum-embedded assessments and as summative, end-of-unit benchmark assessments. The formative assessments provide immediate feedback and customized coaching along with reports for students and teacher on progress on content and inquiry targets. The summative benchmark assessments generate reports of proficiency and report it for teaching and accountability purposes. The SimScientists program at WestEd seeks to provide evidence that simulation-based assessments can gather and document evidence of students' understanding of connected science knowledge and extended inquiry not often or well measured in the U.S. by conventional tests (See simscienists.org).

In addition, these assessments are envisioned as components of multilevel, balanced state science assessment systems. The assessments to be demonstrated test U.S. national science standards at the middle school level (grades 6-8).

Methods.

The SimScientists research and development program combines a model-based learning approach with evidence-centered design into a powerful framework for transforming science assessment and learning (Buckley, in preparation; Mislevy et al, 2003). The SimScientists projects proceed through phases of design, expert review, programming, small scale feasibility testing, and classroom testing. The design process involves analyses of learning research, national science standards, and curriculum materials to specify grade-appropriate system components, interactions, and emergent behavior. For example, ecosystem components consist of organisms in the roles of consumers, producers, and decomposers. Interactions involve transfer of energy and matter through the ecosystem, represented in food webs. Emergent system behaviors involve population levels of organisms and changes in them due to varying conditions. Inquiry practices, as specified in the 2009 NAEP Science Framework, include designing, conducting, interpreting, and evaluating. Simulation shells specify the representations of science phenomena to be modeled by the simulation environment. Model-based progressions proceed from observations of organisms, inferences of interactions, and predictions, observations, and explanations of varying population levels.

In 2010, the U.S. Department of Education funded a large-scale pilot of simulation-based assessments for two middle school topics to investigate the feasibility, utility, and technical quality of the simulation-based formative and summative assessments. Fifty-five teachers, 5,500 students, in 28 districts in three states participated. Data included expert reviews of the alignments of the assessments with national science standards, quality of the science, items, and tasks, cognitive labs in which students think aloud as they respond to the assessments, classroom observations, teacher surveys and interviews, and psychometric analyses. An external evaluation of the project was conducted by UCLA's Center for Research, Evaluation of Students and Standards (CRESST). A Design Panel of representatives of six state departments of education science assessment directors reviewed the pilot test findings and a policy brief summarizing the pilot test and offering alternative models for integrating science simulations into state science assessment systems.

Findings.

Feasibility and utility of the simulation-based assessments were indicated by evidence that the students were engaged in the simulation-based assessments and that the teachers found the reports of student progress useful for

understanding student learning and for adjusting instruction. Across the 28 school districts and 55 classrooms, teachers were able to implement the simulation-based assessments in computer labs. Psychometric analyses of the benchmark assessment data indicated that they were reliable and valid.

Theoretical and Educational Significance.

A growing body of research shows model-based reasoning to be a signature practice of the sciences, as scientists create insights and understandings of nature through conceptual, physical, and computational modeling. Further, cognitive research shows that learners who internalize schemas of complex system organization – structure, functions, and emergent behaviors – can transfer this heuristic understanding across systems. Simulations can represent dynamic science systems "in action", making visible the causal, temporal, and spatial phenomena that are invisible and making models available for extended, active investigations of authentic problems. A technical infrastructure that captures and analyzes students' actions and answers can yield cognitively rich evidence of learning in reports for teachers and school systems and can also provide feedback and customized, graduated coaching. The multiple physical and symbolic representations in simulations can also reduce language demands.

In large-scale assessments, the area of science is leading the way in exploring complex, multi-faceted problem types and assessment approaches. The 2006 Programme of International Student Assessment (PISA) pilot tested a Computer-based Assessment of Science specifically to test knowledge and inquiry processes not assessed in the paper-based test booklets. Topics included the functions of a nuclear reactor and genetic breeding of plants. The 2009 National Assessment Educational Progress (NAEP) for Science administered Interactive Computer Tasks (ICT) to test students' inquiry practices. The 2014 NAEP for Technology and Engineering Literacy will be entirely computer delivered and will administer interactive, scenario-based tasks (See www.naep-tech2014.org). States such as Minnesota have online science tests with simulated laboratory experiments or investigations of phenomena such as weather or the solar system. The SimScientists projects to be demonstrated contribute to the research base on the design, development, and validation of the next generation of innovative assessments and their articulation throughout the levels of an educational assessment system.

References

- Buckley, B. C. (in preparation). Model-Based Learning. In N. Seel (Ed.), *Encyclopedia of the sciences of learning*. New York: Springer Science.
- Mislevy, R. J., Steinberg, L. S., & Almond, R. G. (2003). On the structure of educational assessment (with discussion). *Measurement: Interdisciplinary Research and Perspective*, 1(1), 3–62.
- Quellmalz, E.S., Timms, M.J. & Buckley, B.C. (in press). 21st century dynamic assessment. In J. Clarke-Midura, D. Robinson, M Mayrath (Eds.) *Technology-Based Assessments for 21st Century Skills: Theoretical and Practical Implications from Modern Research*.
- Quellmalz, E.S. (2010). Assessing new technological literacies. In F. Scheuermann, (Ed). *Assessing the Impacts of Information Communication Technology (ICT)*. Brussels, Belgium, Organization of Economically Developed Countries (OECD).

ICT DEMONSTRATION

A multi-modal, web-based inquiry learning environment on Genetically Modified Organisms

Christothea Herodotou, Cyprus University of Technology, Cyprus; Iolie Nicolaidou, Cyprus University of Technology, Cyprus; Eleni Kyza, Cyprus University of Technology, Cyprus; Andreas Hadjichambis, Cyprus Center for Environmental Research & Education, Cyprus; Frederiki Terzian, Ministry of Education and Culture, Cyprus; Dimitris Kafouris, University of Exeter, United Kingdom

A multi-modal, web-based inquiry learning environment (LE) on Biotechnology and Genetically Modified Organisms (GMOs) is the focus of this presentation. The LE has been developed for use in science education as a means to raise students' interest in socio-scientific problems and create a bond between the scientific enterprise and human life through the use of new information technologies. The LE was built around the idea of software-based scaffolding, the role of which is crucial for successful reflective inquiry and synchronous and asynchronous collaboration among students. A design-based approach was followed for the development of the LE; the LE was designed by a Local Working Group (LWG) in Cyprus, piloted, redesigned and re-enacted in a high school class. The analysis of pre and post tests administered to students during the LE's reenactment demonstrated the effectiveness of the intervention; students' conceptual understanding and credibility skills were significantly improved by the end of the enactment. Such approaches can become the catalyst for making science education more attractive and appealing to students' learning needs.

Extended summary

Aims

Students' interest in science education has declined considerably during the past decade. A very low number of students wishes to pursue a career in science (Sjöberg & Schreiner, 2006), an indication that the "swing from science" phenomenon (Ormerod & Duckworth, 1975) still endures. This disinterest is attributed to schools' failure to sustain students' motivation to learn about science and a lack of authentic science teaching and learning. The role of new technologies is critical in this respect; they can be the conjunction between the scientific enterprise and human life, making science more appealing to young people. Integrating new technologies in the process of learning science - not only learning about but also learning with technology would be highly beneficial. In this study, we present one such approach. A multi-modal, web-based inquiry learning environment (LE) about Biotechnology has been developed on the STOCHASMOS platform (Kyza & Konstantinou, 2007) allowing students to learn about a socio-scientific issue working on a project-based investigation which integrates reflection, collaboration and scaffolding. This work was implemented under the European project "Digital support for Inquiry, Collaboration, and Reflection on Socio-scientific Debates" (CoReflect), the aim of which is to develop and validate a multi-lingual library of web-based, multi-modal inquiry LEs for use in science education.

Theoretical framework

The idea of scaffolding underlies the development of the presented LE. In the study of socio-scientific problems, scaffolding is of core importance (Davis, 1998) since learning is often based on understanding complex data sets which without appropriate scaffolding can become major obstacles for students' understanding. A software-based scaffolding mechanism is embedded in the development of the LE assisting students' reflective inquiry. Reflection is perceived as an ongoing process of students' thinking about and with the data, practiced throughout the learning process. The LE we present provides supports for organizing, analyzing, synthesizing and communicating evidence-based explanations promoting reflective practices. Finally, the software-based scaffolding supports collaborative learning practices specifically synchronous and asynchronous communication among students and between students and teachers. Description of the web-based inquiry LE The web-based inquiry LE consists of two environments: an authoring environment, in which teachers can develop web-based environments for use in the classroom and the students' inquiry environment, in which students collect, explain and organize data communicating their understanding of the socio-scientific issue at hand. The latter is the focus of this presentation. The students' learning environment is composed of (a) the inquiry investigation area, and (b) the reflective WorkSpace area, where students access template pages, articulation and inquiry management tools that help them structure their work. The topic of the LE was Biotechnology and Genetically Modified Organisms (GMOs). It was chosen because it affords authentic inquiries of multi-modal, rich scientific data and problem-based learning. The question driving the design of the LE was whether students would allow the growing of genetically modified plants in their country. Diverse sources of data for and against GMOs were accessible through the LE. The aims of the LE were for students to: (a) understand basic concepts related to Biotechnology and GMOs, (b) evaluate the credibility of evidence by applying specific criteria, (c) provide an evidence-based answer as to whether they would allow the growing of GM plants in their country.

Methodology/Research design

The development of the web-based inquiry LE presented in this ICT demonstration is the result of the collective effort of a LWG in Cyprus consisting of university researchers, teachers, and scientists. Following a design-based approach the LE was first piloted in an 11th grade class ($n=12$) over eleven 90-minute lessons. The LE was then redesigned, refined and re-enacted with a different 11th grade class ($n=21$) over eight 90-minute lessons. Pre- and post-tests were administered in order to assess the effectiveness of the LE. In particular, test items assessed students' conceptual understanding and credibility assessment skills.

Findings

Data from pre- and post-tests were statistically analyzed to evaluate the effectiveness of the intervention. Statistically significant results for both conceptual understanding and credibility assessment skills demonstrated the usefulness of the LE for students' learning, using non-parametric statistics, due to the small number of participants. Of 18 students, 11 had higher scores in the posttest on conceptual understanding ($Mdn=7$) and only 3 had higher scores in the pretest ($Mdn=6$). There were 4 ties. This difference was significant, $Z=-2.24$, $p=.025$, $r=-.52$. Similarly, credibility assessment scores as measured by the open-ended questions for evaluating credibility were significantly higher in the posttest ($Mdn=6$) than the pretest ($Mdn=4$), $Z=-3.63$, $p=.001$, $r=-.85$. Significant differences were also found for credibility assessment skills as measured by the 22-item scale, with $Z=-3.41$, $p=.001$, $r=-.88$. Scores in post test ($Mdn=97.5$) were higher than scores in pretest ($Mdn=86.5$).

Theoretical/educational significance

Teaching science and simultaneously promoting students' interest in scientific issues is a challenge educational systems are currently facing. This work presents an innovative way of meeting this challenge through the use of a web-based, inquiry LE that promotes collaboration, reflection, and scaffolding. The presented LE was found to be beneficial raising students' conceptual understanding and learning skills. Youth attitudes on the importance of scientific and technological issues to society are positive (Sjöberg & Schreiner, 2006) pointing out that the potential for making science attractive and meaningful exists. The step forward, therefore, is for school to become the catalyst for capturing students' interests and addressing their learning needs.

References

- Davis, E. A. (1998). Scaffolding students' reflection for science learning. Unpublished doctoral dissertation, University of California, Berkeley, CA.
- Kyza, E. A., & Constantinou, C. P. (2007). STOCHASMOS: A web-based platform for reflective, inquiry-based teaching and learning. Cyprus: Learning in Science Group.
- Ormerod, M. B., & Duckworth, D. (1975). Pupils' attitudes to science: A review of the research. Atlantic Highlands, NJ: Humanities Press.
- Sjöberg, S. & Schreiner, C. (2006). How do learners in different cultures relate to science and technology? Results and perspectives from the project ROSE (the Relevance of Science Education). *Asia-Pacific Forum on Science Learning and Teaching*, 6 (2), 1-17.

ICT DEMONSTRATION

The Writing-Pal: An Intelligent Tutoring System to Provide Writing Strategy Training

Danielle McNamara, University of Memphis, United States; Rod Roscoe, University of Memphis, United States; G. Tanner Jackson, University of Memphis, United States; Jianmin Dai, University of Memphis, United States; Roxanne Raine, University of Memphis, United States; Russell Brandon, University of Memphis, United States; Jennifer Weston, University of Memphis, United States; Loel Kim, University of Memphis, United States; Arthur Graesser, University of Memphis, United States; Scott Crossley, Georgia State University, United States

The purpose of this ICT demonstration is to provide researchers and educators with information about the Writing-Pal (W-Pal), which is a newly developed intelligent tutoring system that provides writing strategy instruction to high school students and entering college students. This is a ground breaking intelligent tutoring system that will allow educators and researchers to explore the value of writing strategy training on the quality of essay writing. A teacher interface allows the teacher (or experimenter) to create classes, co-manage other classes, monitor students' performance, post bulletins, assign practice essays, create and assign new essays, and make comments on essays. The student interface comprises nine strategy lessons: Prologue, Freewriting, Planning, Introduction Building, Body Building, Conclusion Building, Paraphrasing, Cohesion Building, and Revising. Each lesson includes game based challenges to practice writing strategies. The student also has opportunities to write essays with automated feedback driven by natural language algorithms and instructs the students to focus on 'next steps' and strategies to improve the essay. W-Pal is intended to improve high school students' writing abilities and reduce demands on teachers. Our current work in classroom studies is focused on evaluating the usability, feasibility, and efficacy of W-Pal. We are modifying W-Pal based on feedback from the teachers and students and we are analyzing the efficacy of W-Pal in improving students' writing abilities. We look forward to sharing W-Pal with other researchers and educators and working towards the objective of better understanding how to help students improve their writing skills.

The purpose of this ICT demonstration is to provide researchers and educators with information about the Writing-Pal (W-Pal), which is a newly developed intelligent tutoring system (ITS) that provides writing strategy instruction to high school students and entering college students. W-Pal is easily accessible via the internet. Although W-Pal targets the needs of high school students, who are often required to write short prompt-based essays, the writing strategies that W-Pal teaches are sufficiently general to be applicable for a wide range of students. It is interactive, adaptive, engaging, provides game-based practice, and provides automated, directive feedback on practice essays.

W-Pal consists of both student and teacher interfaces. The teacher interface allows an instructor (or experimenter) to create classes, co-manage other classes, monitor students' performance, post bulletins, assign practice essays, create and assign new essays, and make comments on essays (Figure 1 in the Appendix). The teacher interface also allows the teacher to engage in all of the student activities. The student interface comprises three principle components: Strategy Lessons, Lesson Challenges, and Essay Writing (see Figure 2).

The Strategy Lesson component includes lessons corresponding to three phases of the writing process: Prewriting, Drafting, and Revising. Lesson content is based on English Composition curricula and is designed to provide strategies that will help students to compose a persuasive essay. Although there is an implicit, recommended sequence for these lessons, the students are not obligated to complete them in any particular order and teachers are free to develop their own lesson plans.

The lessons, averaging 20-30 minutes in length, provide strategies that facilitate each phase of writing. Prewriting lessons include (a) Freewriting, and (b) Planning. Drafting lessons include (a) Introduction Building (b) Body Building, and (c) Conclusion Building. Revising lessons include (a) Paraphrasing, (b) Cohesion Building, and (e) overall Revising. In addition, a Prologue module introduces the students to the program. W-Pal lessons are presented by three pedagogical agents, Dr. Julie, a teacher agent, and Sheila and Mike, two student agents. The student agents learn the strategies, engaging in discussions and asking questions about the strategies. Throughout the lessons, students practice the strategies by completing brief exercises (i.e., checkpoints). Checkpoints are brief probes, multiple choice questions, tasks, or mini-games inserted into the lessons that help to maintain student engagement and provide reinforcement of learning through multiple testing opportunities.

The second component is game-based Challenges, which are accessible after the corresponding lesson has been completed. To potentially enhance student engagement, all of the challenges are designed as games (McNamara, Jackson, & Graesser, 2010; references can be found and downloaded at csep.psy.memphis.edu/vita.htm). Many of the challenge practices parallel the structure of one or more of a lesson's corresponding checkpoints. For example, within the Freewriting lesson, students practice freewriting in the context of a game called Freewrite Feud. The goal of this game is to freewrite, generating as many keywords as possible that overlap with the game's nine keywords. Points are awarded for matching keywords and bonus points are awarded based on an algorithm that assesses the quality of the freewrite. There are currently 16 game-based challenges that help students practice the various writing strategies covered in W-Pal, and more are being developed.

The third component of W-Pal is the Essay Writing module, in which students write complete essays and are provided feedback and suggestions to use particular strategies to improve the essays. One unique quality of W-Pal is that it provides feedback to students' natural language input (McNamara, Raine et al., in press). Teachers may choose to assign practice essays for which the students will receive automated feedback, or the teacher may create a new essay assignment within the W-Pal system, which is evaluated by the teacher.

Our motivation to develop W-Pal rests on two underlying assumptions. First, we assume that writing well is important to success academically as well as professionally. Writing skills allow individuals to articulate ideas, argue opinions, and synthesize multiple perspectives. Effective writing is essential to communicating persuasively with others, including teachers, peers, colleagues, co-workers, and the community at large. Second, we assume that strategies facilitate performance on tasks, and that teaching students to use strategies can hasten the acquisition of skills (McNamara, 2009). Strategies have been found to facilitate and enhance performance on a variety of learning-related tasks, which leads to the expectation that the same might be found for writing.

W-Pal was also founded on the successful implementation of the ITS, iSTART, which was developed to teach reading strategies to high school students (McNamara, Levinstein, & Boonthum, 2004). W-Pal modules follow the three heuristics that are used in iSTART (McNamara, O'Reilly, Rowe, Boonthum, & Levinstein, 2007). The first is that to-be-learned information needs to be presented, modeled, and practiced following a faded scaffolding model. The second is that of vicarious learning, whereby the learning process is modeled by animated pedagogical agents. The third is that the modules are interactive, eliciting responses from and holding interactive dialogues with the student. As such, computational algorithms guide the interactions with the students and provide adaptive feedback. These heuristics help to ensure that the system induces self-reflective, generative, and metacognitive learning for students.

Our current work is focused on evaluating the usability, feasibility, and efficacy of W-Pal. We are currently conducting studies in which teachers are using W-Pal in classrooms. We plan to modify W-Pal based on feedback from the teachers and students, and we also anticipate analyzing the efficacy of W-Pal in improving students' writing abilities. Additionally, we look forward to sharing W-Pal with other researchers to further our understanding of writing and how to more effectively improve writing skills.

W-Pal is intended to improve high school students' writing abilities and reduce demands on teachers. This objective contributes to a foundation for a better-prepared youth, as more adept writers have increased aptitude in career and personal success. Also worth noting is that the development of W-Pal's components will certainly have secondary

benefits to a number of other professionals, including teachers, human-computer interaction researchers, gaming designers, education researchers, linguistics scientists, computer scientists, and interface designers.

ICT DEMONSTRATION

Using videos to teach parent-teacher communication skills: The ProfKom learning environment

Martin Gartmeier, Technische Universität München, Germany; Johannes Bauer, TU München, Germany; Manfred Prenzel, TUM School of Education, Germany; Michaela Zupanec, Universität Witten-Herdecke, Germany; Grit Möller, Friedrich-Karls-Universität Kiel, Germany

Despite the important role of parent-teacher communication in teachers' work, the acquisition of respective competencies is currently not part of German teacher education programs. The project ProfKom aims at advancing prospective teachers' communicative competence by means of a blended learning environment which combines e-learning with guided role-play. The e-learning environment adheres to didactical principles and current theories of learning and instruction: As communication is a very practical skill, model based learning is realized through the usage of authentic videos of parent-teacher interviews. Learners comparatively analyse video clips demonstrating professional and inadequate communicative behavior in order to instigate reflection upon mistakes in communication. This comparative approach is based on theories of discriminative learning and negative knowledge. In this ICT demonstration, we present the ProfKom e-learning environment with a special focus on the use of the videos and the described approach of communication training. Moreover, we seek to discuss our conception of communicative competence in parent-teacher communication with the participants.

Communicating effectively with parents is a frequent and important task for teachers. Many parent-teacher conversations may be unproblematic and harmonious. However, teachers also experience difficult situations in the communication with parents: Parents may complain about certain practices of the teacher, teachers may have to deliver bad news to parents or it may simply be difficult to come to a shared understanding of a student's problems at school. For handling such difficult situations professionally, teachers need to acquire communicative competencies (Graham & Clay, 2005). This notion is further underlined by the relationship between parents and teachers being an important part of the educational quality of schools. Communication is a crucial aspect of this relationship, regardless if taking place in parent-teacher conferences or in other situations. Despite their importance, these skills are rarely part of teacher education curricula – at least in German universities. In the proposed ICT-demonstration, we present the virtual learning environment ProfKom. Drawing upon input from the audience, the presenter will demonstrate an instructional sequence realized in ProfKom which consists of instructional videos and video-based reflection. Together with a brief introduction to the theoretical ideas behind our approach as well as the hypothesized model of communicative competence, our aim is to instigate discussion on these issues. The main aim of ProfKom is to advance teachers' skills to communicate with parents concerning three frequent types of communicative situations. These situations include, (a) preparing a joint decision together with parents, (b) delivering bad news about a student, and (c) handling parents' complaints. While the first part of the ProfKom-learning environment imparts knowledge about generic principles of communication, the further parts focus specifically on these situations. All parts of the learning environment aim at fostering competences that concern four key tasks in parent-teacher communication: (i) to take care of the context of the conversation (e.g., concerning spatial, informational and timely aspects); (ii) to appropriately structure different phases of the conversation (e.g. greeting the parents, identifying the parents' interest etc.); (iii) to establish and maintain a positive interpersonal relationship to the parents; (iv) to take care of the problem solving processes and the outcomes of the encounter. The situation-specific parts of the ProfKom learning environment focus upon training students in recognizing and evaluating the application of these competence aspects when watching video clips of communication between teachers and parents (see image). For this purpose, videos are used as an instructional medium in the following way: In a first instructional step, a short video shows a teacher talking to parents and making mistakes in communication. The students watch this video with the purpose of recognizing the mistakes made by the teacher. They are asked (i) to write down the time(s) (of the video) at which the teacher makes a mistake, (ii) to describe the nature of the mistake, (iii) to relate it to one of the four competence facets hypothesized and (iv) to describe the possible effect upon the conversational partner. After having reflected upon the video clip in the described way, the learners watch another video showing the same passage of the conversation, but with the teacher showing good communication. The theoretical rationale behind the described approach is to demonstrate how the hypothesized facets of communicative competence apply in communicative practice by contrastively showing good and bad practice related to the facets. This strategy of video-based instruction applied in ProfKom is based on current theories of learning: Firstly, the theory of negative knowledge (Gartmeier, Bauer, Gruber & Heid, 2008) argues that knowledge about what not to do in a certain situation is valuable for professional practice. This is because an actor being aware of what is wrong in a certain situation is able to recognize the leading signs of certain disadvantageous situations and to purposefully avoid actions which lead to these situations. Because the ProfKom

learning environment realistically shows suboptimal communicative behavior as well as its negative impact on the further course of interpersonal interaction, it fosters the development of practically relevant negative knowledge. Secondly, the basic idea of the concept of discriminative learning (Dodge, 1986) is to model desired behavior and to inhibit undesired behavior by simultaneously or successively presenting respective stimuli. This basic idea of successive discriminative learning is realized in ProfKom by illustrating appropriate communicative behavior after the learner has watched and reflected upon instances of utterly bad communicative behavior. After having passed through the described instructional sequence for several times, the learners watch a video of the full conversation (which was only shown in outtakes before). The teacher shows good communicational practices throughout the whole of this final video clip. In this way, we seek to make use of a further advantage of video based learning – e.g. to allow for realistically modeling complex behavior (Gagne et al., 2003).

Dodge, K.A. (1986). A social information processing model of social competence in children. In M. Perlmutter (Ed.) Eighteenth Annual Minnesota Symposium on Child Psychology (pp. 77-125). Hillsdale: Erlbaum.

Gagne, R. M., Wager, W. W., Golas, K. C., Keller, J. M. and Russell, J. D. (2005), Principles of instructional design. Performance Improvement, (44), 44–46.

Gartmeier, M., Bauer, J., Gruber, H. & Heid, H. (2008). Negative knowledge: Understanding professional learning and expertise. *Vocations and Learning: Studies in Vocational and Professional Education*, 1, 87-103.

Graham-Clay, S. (2005). Communicating with parents: Strategies for teachers. *The School Community Journal*, 16(1), 117-130.

Piskurich, G. (Ed.). (2003). *The AMA handbook of e-learning: Effective design, implementation, and technology solutions*. New York: American Management Association.

ICT DEMONSTRATION

Raising awareness and improving task performance of e-moderators using visualization and machine-learning

Astrid Wichmann, rub, Germany; Bruce McLaren, Carnegie Mellon University, United States; Rupert Wegerif, University of Exeter, United Kingdom; Ulrich Hoppe, University Duisburg Essen, Germany

Moderating e-discussions is a demanding activity. A teacher needs to keep track of the argumentation process in different sessions to be able to provide just-in-time feedback and scaffolding questions. Two studies were conducted to investigate the added value of support features in an e-moderation system. The first study focused on awareness support, whereas the second study investigated the effect of an alerting mechanism to facilitate moderation. Results from both studies showed that teachers who were provided with awareness support and alert support, performed better on tasks as compared to moderating without those types of support. The findings suggest that in order to enable effective e-moderation of multiple parallel e-discussions, teachers need to be supported with respect to awareness and just-in-time information.

Introduction

Supporting the learner during e-discussions has been a major focus in education (cf., e.g., Andriessen, Baker, Suthers, 2003) yet investigating the role of the teacher in e-discussions has not been fully investigated. The role of the teacher in e-discussions is important: On the one hand, a moderator needs to give learners opportunities for self-directed and autonomous learning (e.g., Zimmerman, 2000). On the other hand, a moderator should keep learners on track by asking questions. Findings in the area of tutoring have shown that scaffolding questions are important to engage learners in active knowledge construction (Chi, et al, 2001). Even for a single discussion, e-moderation is a complex task. If teachers need to moderate several e-discussions simultaneously, they quickly lose track and are unable to provide just-in-time feedback because of lacking awareness (Dourish & Bellotti, 1992). For teachers to effectively intervene, additional support is required, in particular, providing content, process, and social behavior information. One research project in this direction is the ARGUNAUT Project which developed and researched a moderation component called the "Moderator's Interface". The Moderator's Interface combines a display of students' graphical arguments with SNA-visualization techniques, machine learning and just-in-time alerts to pre-select relevant information avoiding mental overload. The Moderator's Interface displays actual discussion graphs as they are generated over time by students collaborating in different sessions. In addition, awareness support, alerts and a tool for sending messages are offered. Awareness support displays characteristics of a discussion in terms of content, process, and social aspects. Goal of StudyThe study presented investigates the additional value of awareness support for teachers while moderating several e-discussions simultaneously. Specifically, we compare moderation with a view of the discussion graphs and awareness support (With-Awareness) with moderation using a view of the discussion graphs only (No-Awareness). Study Methodology In a counterbalanced lab study, two teachers were asked to moderate discussions carried out by their students. Each teacher moderated three synchronous e-discussion sessions simultaneously, with 4 students in each session. In the With-Awareness condition, the teacher moderated the discussions using the Moderator's Interface including the discussion graph and awareness support. In the No-

Awareness condition, the moderator could only view the discussion graph; no awareness support was available. Ten tasks were carried out by each teacher during and after moderation for all three sessions, in every condition, resulting in 60 tasks. Findings Study I Results showed that in the With-Awareness condition both teachers performed better on the given tasks (e.g., who is the strongest collaborator in the discussion?) than in the No-Awareness condition. Particularly tasks that cannot be answered through first glance at the Discussion Graph display have been conducted not at all or incorrectly if awareness support was not available. In the No-Awareness condition, several tasks were not conducted at all or incorrectly. For instance, in the With-Awareness condition, the teachers could easily determine strong collaborators, which they were not able to determine in the No-Awareness condition. In a second study, we concentrated on the additional value of machine-learned alerts that were learned from prior discussions and that provide local, just-in time information with respect to students reasoning behavior, for instance, whether the students are on topic and whether they have made reasoned claims. Findings Study II The same study design was deployed but this time with only a single pre-service teacher moderating a discussion with two sessions, each consisting of three students, and with machine-learned indicators also provided to the With-Alert condition (McLaren, Scheuer, & Miksatko, in press). While knowledge-gain and task-performance dependent measures did not vary across conditions, the teacher did spend less time accomplishing tasks in the With-Alert condition. This is important, since quick, real-time moderation is a fundamental goal of ARGUNAUT and just-in-time feedback is necessary to provide effective support for the learner. An additional illuminating observation was that in the With-Alert condition, the teacher initially insisted that students had not engaged in off-topic conversation, even though they had; it was not until the teacher saw the results of the Topic-Focus alert, one of the machine-learned awareness indicators, that he realized off-task conversation had, in fact, occurred. Theoretical and educational significance Taken together, findings suggest that in order to enable effective e-moderation of multiple parallel e-discussions, teachers need to be supported with respect to awareness and just-in-time information. Procedures The authors will present the project itself and the principles behind the ARGUNAUT system. Particularly the role of the teacher in e-discussions and approaches to e-moderation will be presented, with an emphasis on how awareness indicators can support teachers. Subsequently, participants will be invited to explore the ARGUNAUT system. Participants can either take the role of a learner or the role of the moderator using the Moderator's Interface. Finally the challenges of moderating e-discussions will be discussed. Specifically the challenges of moderating multiple discussions at the same time as well as e-moderation styles in general will be emphasized. Technical Aspects At least three computers (running java) and a router and connection to a network are necessary. In the worst case we could bring those with us.

References

- Andriessen, J., Baker, M., & Suthers, D. (2003). Argumentation, Computer Support, and the Educational Context of confronting cognitions. In Andriessen, J., Baker, M., & Suthers, D. (Eds.), *Arguing to Learn: Confronting*
- Chi, M. T. H., Siler, S. A., Jeong, H., Yamauchi, T., & Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive Science*, 25(4), 471-533. Cognitions in Computer-Supported Collaborative Learning environments (pp. 1-25). Dordrecht: Kluwer.
- De Groot, R., Drachman, R., Hever, R., Schwarz, B., Hoppe, H.U., Harrer, A., De Laat, M., Wegerif, R., McLaren, B. M., & Baurens, B. (2007). Computer Supported Moderation of E-discussions: the ARGUNAUT Approach. In C. Chinn, G. Erkens and S. Puntambekar (Eds.), In C. Chinn, G. Erkens, & S. Puntambekar (Eds.) *Mice, Minds, and Society. Proceedings of the Seventh International Computer Supported Collaborative Learning Conference* (pp.165-167). Mahwah: Lawrence Erlbaum Associates.
- Dourish, P., & Bellotti, V. (1992). Awareness and Coordination in Shared Workspaces. *Proceedings of the ACM Conference on Computer-Supported Cooperative Work* (pp.107-114). New York: ACM.
- McLaren, B.M., Scheuer, O., & Miksatko, J. (in press). Supporting collaborative learning and e-Discussions using artificial intelligence techniques. To appear in the *International Journal of Artificial Intelligence in Education (IJAIED)* 20(1).
- Wichmann, A., Harrer, A. & Hoppe, U. (2008, June). The e-moderation challenge: Teachers' styles and strategies during e-discussions. Symposium paper presented at the 8th International Conference of the Learning Sciences ICLS Proceedings 2008, Utrecht, Netherlands.
- Zimmerman, B., J. (2000). Attaining Self-Regulation: A Social Cognitive Perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner, *Handbook of Self-Regulation*. (pp 13- 35). San Diego: Academic Press.

ICT DEMONSTRATION

Study skills and plagiarism: developing on-line learning resources in a multicultural context

Tine Wirenfeldt Jensen, Aarhus University, Denmark; Gina Bay, Library of Social Sciences, Aarhus University, Denmark

In this demonstration we present and discuss two interrelated on-line learning resources aimed at supporting international students at Danish universities in building study skills (the Study Metro) and avoiding plagiarism (Stop plagiarism). We emphasize the necessity of designing online learning resources about these topics which take aesthetic aspects into account in order to create an engaging and supportive learning climate (Biggs, 2007) in which discourse and design strategies are employed to construct the student as "trustworthy" (MacGregor, 1960). Finally we point to the need for and challenges associated with making tacit knowledge about these topics explicit in a multicultural educational context, and we share our experiences with using cross-disciplinary/institutional collaboration as a method to overcome these challenges.

Stop plagiarism and the Study Metro

'Stop plagiarism' is a web tutorial about plagiarism and how to avoid it for international students in Denmark.

[Illustration: Stop plagiarism']

The tutorial consists of several components. The introduction provides a definition of plagiarism and examples of plagiarism. An explanation of why plagiarism is unacceptable is provided, along with information about the consequences students can expect if they do plagiarize. The second section presents the basic tools for ensuring academic integrity by introducing the basic concepts necessary to avoid plagiarism: quotations, in-text citations and summarizing. A quiz allows students to test their knowledge about plagiarism and gives them an idea of how and where they might improve. The tutorial also presents six videos in which experts discuss plagiarism from their particular viewpoints. Finally, the site offers students links to additional resources, and educators are offered suggestions on how to teach and talk about plagiarism.

'Stop plagiarism' is a collaboration between four Danish universities and the Danish Research Library Association's Forum for Library User Education, and the English version is funded by the Conference of Directors of Research Libraries.

The Study Metro is a digital learning resource designed to support international students in building the study skills necessary to succeed in a Danish educational context. The Study Metro is shaped like a subway map with four routes: Standards for Academic Papers, Writing an Academic Paper, Studying and Information Literacy. Each route has several stations with material in the form of texts (including advice, lists and guides), exercises, tasks, links to relevant external material and literature. The metaphor of the subway map provides students with a mind map of the key skills they need to build in order to be able to study at university level and to visualize the interconnectedness of these skills.

[Illustration: The Study Metro]

The Study Metro is designed and run by the Centre for Educational Development, Faculty of Arts, Aarhus University and the material on information literacy is based on the work of Søren Elle (Library for Language, Literature and Culture) and Jette Bohn (Library of Aesthetic Studies), Aarhus University.

The two learning resources described above are intertwined in several ways. The Study Metro situates the 'Stop plagiarism' material in a broader context, showing that the topic is an essential study skill and closely related to other skills such as writing, oral presentation etc., and the designer of the Study Metro shares an educational developer's perspective on the concept of plagiarism in a podcast in 'Stop Plagiarism'. Both learning resources reflect a holistic understanding of the academic learning process which views finding information, handling sources, choosing a topic, formulating a research problem as well as writing techniques as deeply integrated elements of the academic work process.

The importance of creating an engaging and supportive learning environment

When teaching subjects such as plagiarism and study skills, the student can easily be constructed as a cheater and a poor student by discourse that emphasizes rule-breaking or which highlights poor study skills rather than focusing on knowledge building. This view of the student as "untrustworthy" (McGregor, 1960) can be communicated not only through explicit discourse; it can be implicit in the design of learning materials (for example, a list of rules). A learning climate that does not construct the student as trustworthy will not inspire students to want to learn how to become

better students. Therefore both Stopplagiarism and the Study Metro are designed to create an engaging, inviting learning environment where the student is offered the role as a learner who can be trusted to make independent, constructive decisions about how to engage with the learning material.

The need for and challenges associated with teaching study skills and how to avoid plagiarism in a multicultural educational context.

Both learning resources were originally designed for Danish students, and Danish versions of both are available. Both resources received positive feedback, and both tools seemed to fill a gap in available materials. But 75 percent of the feedback was: 'Does this exist in English?' It became clear that there was a need to teach the concepts of study skills and plagiarism in a local academic culture to international students in Denmark. Recent years have seen an apparent increase in the incidence of plagiarism among international students in Denmark, which points to a need to make aspects of Danish academic culture, which is primarily monocultural, more accessible to students from diverse cultural backgrounds. It is a challenge for educators to make such culturally bound expectations and practices explicit, as they exist primarily as tacit knowledge. One means to reaching this goal is for educators from different fields and institutions to work together. Even when they come from the same cultural context, the situation requires them to make expectations, rules and desired behavior explicit for one another, a process which may act as a bridge to making such tacit knowledge explicit for students with a non-Danish cultural background. Part of both the Study Metro and Stop plagiarism were developed in interdisciplinary collaborations between university educators, librarians and others.

Demonstration format

As a part of this demonstration we will use student personas with specific needs connected to completing specific tasks. We also invite the participants to share their own experiences with related learning materials as well as their institution's approach to preventing plagiarism and building study skills in a multicultural educational context.

Abasi, A.R.; Graves, B. (2008) Academic literacy and plagiarism: Conversations with international graduate students and disciplinary professors. *Journal of English for Academic Purposes*. 7, 4, Oct, 221-233

Carroll, Jude: A handbook for deterring plagiarism in higher education. Oxford : Oxford Centre for Staff and Learning Development, 2007

Biggs, J. & C. Tang (2007): Teaching for Quality Learning at University. Open University Press, McGraw- Hill Education.

Gu, Q.; Brooks, J. (2008). Beyond the accusation of plagiarism. *System* vol. 36, Issue 3, pp. 337-352

<http://www.en.stopplagiat.nu/>

http://studiometro.au.dk/autogen_eng/index.html

Jensen, T.W., Hansen, L.K. 2003, "Next Stop in the Study Metro", i Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2003, AACE, Chesapeake, VA, s. 1291-1296.

McGregor, D. 1960. The Human Side of Enterprise. New York: McGraw-Hill.

Pennycook, A. (1996). Borrowing Others' Words: Text, Ownership, Memory, and Plagiarism. *TESOL Quarterly*. Vol. 30, No. 2, pp. 201-230

ICT DEMONSTRATION

Dialogue, Social Media and the New Education Practises

Harri Jurvela, University of Tampere, Finland; Teemu Mikkonen, University of Tampere, Finland; Mikko Vuorinen, University of Tampere, Finland

In the present paper we introduce the interactive conference assistant application which aim is to enrich the interaction and learning in the context of conference and lectures. We have developed a new interaction tool to improve the communication between speakers and audience. The application enables to send questions to the speaker and to make references via Twitter or via our specific web page. The idea is to add some useful properties (like question tags, video stream etc.) to make the social media tools more suitable and more useful to use in the conferences and lectures. We have also designed an ethnographic research setting to test how the chosen social media tools with our additions work in real-life. The research and application development is emphasizing the ideas of dialogue and learning. The dialogic approach in the conference presentations, lectures etc. expands the (possible) learning activity from the one-way communication to the multi-directional communication. This means that the learning situation becomes more active, more open and more respectful. Harri Jurvela harri.jurvela@uta.fi University of Tampere Teemu Mikkonen, teemu.mikkonen@uta.fi University of Tampere Mikko Vuorinen, mikko.vuorinen@uta.fi University of Tampere

Our ICT demonstration is based on the results of CoEx (Communal Activity Supporting Spaces in Sharing Experiences)-research project. The primary objectives in the CoEx -project are to diversify and deepen the conference experiences, increase the interactivity between the participants and the performers, bring the new networking opportunities to the conference participants and to observe the applicable educational potentials in general. In our research and application development we are emphasizing the ideas of dialogue and learning (see e.g. Burbules, 1993; Bakhtin, 1981; Enqvist & Aarnio, 2003). More specifically this means the dialogue and the learning affordances in the conference and lecture context. We think that the dialogic approach in the conference presentations, lectures etc. expands the (possible) learning activity from the one-way communication to the multi-directional communication. This means that the learning situation becomes more active, more open and more respectful. The practical solution that we are suggesting is based on one of the most popular social media tool, Twitter. The idea is to add some useful properties (like question tags, video stream etc.) to make it more suitable and more useful to use in conferences and lectures. We have designed an ethnographic research settings to test how the chosen social media tools with our additions works in real-life. The first experiment was implemented at ITK -conference in April 2010, another one was implemented at MindTrek -conference in October 2010 and the next experiment will be carried out again at ITK# -conference in April 2011. The Conference Assistant Application in MindTrek 2010 In autumn 2010 we've made a conference application to MindTrek 2010# -conference consisting of session based Twitter -hashtag channels, bambuser videostreaming and an application that aggregates and integrates tweets, videostreaming and parts of conversations together. The application can be found in the MindTrek website <http://www.mindtrek.org/2010/coex/>. The main purpose of this conference application was to support the virtual collaboration in the communal activity space (e.g. the physical conference). The main view of the application is illustrated in the following picture (Picture 1.).

Picture 1. MindTrek -conference assistant: the main view. First users see the main view where they can tweet using their Twitter account or using anonymous chatting space in the website (Picture 1 & 2). Users can follow Bambuser video streams from the presentation, panels and competitions and at the same time comment, make questions or give a short summaries about the presentations.

Picture 2. MindTrek Conference Assistant: Following view If a user wants to concentrate to only one presentation, she/he can choose the proper session which opens the session view. In the session view it is possible see more detailed information about the speaker and the present subject. It is also possible to see what questions people have left to the speaker by using proper tag (q:) and what speaker have answered. One extra function is an automatic reference monitor, which gathers the referred topics, comments etc. of the speakers. It helps people inside and outside the conference concentrate to the major issues. Roadmapping to the Conference and Lecture Assistant Application in ITK 2011

Our previous development has been mainly focused on the conference perspective. The next step is to bring in a new version of application, which supports more an everyday lecture use. At the end of the year 2010 and the beginning of the year 2011 we will be testing the settings for the lecture use to develop the user interface further. There has been some positive feedback for using Twitter in educational settings. For example Monica Ranklin has used Twitter to activate students in the class room discussions at the university of Dallas (Ranklin, 2009). By using the virtual communication space people who normally won't dare to ask or comment the presentation, may do it easier. Many educators would agree that large classes set in the auditorium-style classrooms limit teaching options just to lecture and that is not the most effective way to teach. Even so, lots of mass lectures are held, because of the financial matters or small group situations and more active learning methods are not possible to organize. In the proper learning context, it is possible to increase the interactivity of the speaker and audience. This will bring new pedagogical opportunities to achieve more active and open learning practises.

References

- Bakhtin, M. (1981). *The dialogic imagination: Four essays*. Austin: University of Texas Press.
- Burbules, N., C. 1993. *Dialogue in teaching : theory and practice*. New York : Teachers College Press.
- Enqvist, J. & Aarnio, H. (2003). DIANA Model - Dialogical Authentic Learning on the Net. In D. Lassner & C. McNaught (Eds.), *Proceedings of World Conference on Education*
- Ranklin, M. 2009. Some general comments on the "Twitter Experiment". Available: <http://www.utdallas.edu/~mrankin/usweb/twitterconclusions.htm>. (26.10.2010)

ICT DEMONSTRATION

EuroCAT, a Collaboration Awareness Tool aiming to enhance organisation in collaborative learning act

Margarida Romero, Esade, Spain; Cyril Todeschini, Ouak.net, France; Niki Lambropoulos, London South Bank University, United Kingdom

In long term Computer Supported Collaborative Learning (CSCL) tasks, the students' face organizational difficulties that could hinder the knowledge construction and convergence activity. The reduction of the Group Awareness (GA) cues in the Computer Learning Environments (CLE) is one of the factors that hinders the GA development and the subsequent difficulties to coordinate the group activity in the collective level. Considering these difficulties we analyzed the organisation and collaboration awareness challenges the students face in the context of CSCL and the GA cues that could be introduced in the CLE to foster the organization of the group. Once these concepts are described we introduce the way EuroCAT tool supports the GA in CSCL. We finalize discussing the EuroCAT tool impact in the students' organisational activity.

This ICT Demonstration introduces the Collaboration Awareness Tool EuroCAT developed under the FP7 Marie Curie project Euro-CAT-CSCL. For this objective, we start introducing the organisation and collaboration awareness challenges the students face in the context of CSCL. Then we introduce the concept of Group Awareness (GA) in the context of long term CSCL tasks and design a Collaboration Awareness Tool (EuroCAT) to support group awareness in CSCL. EuroCAT includes organizational awareness cues by displaying the progressions on the subtasks and the group responsibilities. It also supports implicit peer evaluation in a dynamic and constantly updated environment. The EuroCAT tool is discussed at the end considering its impact on the overall organizational activity.

1. Students' organisation in CSCL

When engaging in CSCL activities some negative results show low participation rates and performances and/or varying degrees of disappointing collaboration that can lead to social and learning difficulties (Lakkala et al., 2000; Kreijns et al., 2002; Kirschner, 2009). Examples of such difficulties are the different time zones of cooperation, collaboration awareness, interaction difficulties (Sproull & Kiesler, 1991), time tracking and coordination (Lakkala et al, 2000; Dillenbourg, 2002). Such difficulties have an effect on communication and interaction patterns (Liu & Tsai, 2008) as they create problems on sharing roles in tasks and tools (Bourguin & Derycke, 2000). We consider GA as a common factor in several organizational difficulties in distance CSCL situations.

2. Group Awareness in long term CSCL tasks

Awareness is the understanding of the activities of others, which provides a context for own activity (Dourish & Bly, 1992). GA is essential for collaboration as it allows peers to understand their team-mates' intention and so coordinate their own task coordination within the group activity (Kalika, Boukef & Isaac, 2007).

In CSCL, group awareness considers the intersubjective perception of the way students have to collaborate: task distribution, roles, turn taking rules, work phases, deliverables, etc. The aim is to coordinate the individuals' as well as the group's activities in order to achieve convergence (Lambropoulos, 2010). In distance CSCL situations, the students' organizational difficulties are augmented by the low level of group awareness cues reflected in the CLE. Trying to compensate the lack of group awareness cues, Buder and Bodemar (2008) considers augmenting collaboration GA by increasing the CLE reflective properties. Such GA Tools provide contextual cues in their construction of a situation (Bazerman et al. 2000), by informing learners with respect to what their group thinks. In this way collaboration awareness is increased and in turn, participation and group engagement. According to McCarthy and Garavan (2008), enhancing GA supports group coordination and facilitates learning activities regulation.

3. Impact of collaboration group awareness in learners' organisation

GA is enhanced by the CLE mirroring capabilities (Soller et al., 2005). The CLE awareness cues can facilitate collaboration even before collaboration starts. Structuring and mirroring can create favourable conditions for learning by designing. For example, structuring approaches aim to create favourable conditions for learning by designing or scripting the situation even before the interaction begins (Dillenbourg, 2002). Mirroring and structuring not only facilitate proactiveness in activities organisation but also support meta-activities organisation based on reflection and self- and group- regulation. System regulation functionalities support collaboration by taking actions and support a pattern of collective arrangement once the interaction has begun (Soller et al., 2005; Tchounikine, 2008). In this way group self organisation and organic guidance is enhanced.

4. EuroCAT, a Collaboration Awareness Tool

A few CSCL systems have been employed to support collaboration and GA. They mostly targeted on internal group feedback (Kimmerle & Cress, 2008); for example, Janssen et al. (2007) uses the augmented GA tool Shared Space for feeding back information about cognitive and social variables in a group. Buder and Bodemar, (2008) focus on conflicting information in a group based on explicit ratings from learners. Within the European context IntelLEO (Devedzic et al., 2010) is a tool to support collaboration GA; the pedagogical experts define activities and processes that take these factors into account and equally consider individual as well as the organisational needs.

Considering the learners' needs in CSCL long term task, the Collaboration Awareness Tool EuroCAT has been designed to enhance the development of the organization GA in order to facilitate the students' organization in the CSCL task. Integrating different information visualisation and communication tools, EuroCAT supports sharing the specific learning objectives and shared activities described by the tutors, their sequencing as well as role distribution, peer evaluation. EuroCAT supports the organisation of task- and sub-task related information by displaying the progressions on the subtasks and group responsibilities. It also supports the peer evaluation process in a dynamic and constantly updated environment. As for monitoring group progression and effectiveness, EuroCAT is anchored on peer's performance ratings on all three social, cognitive and team activities to support self- and group- regulation. The main EuroCAT screen allows all three types of activities to be coordinated with an automatic display of team-members' availabilities and synchronous time. The relational social interactions within the team by subjective ratings of team-members' tasks and team skills. Learning objectives displayed on EuroCAT provide an overview toward the 'correct' direction of the learning tasks and activities. The tool can increase the GA by supporting the group coordination via collaboration and organisational awareness. EuroCAT functionalities support the overall collaboration convergence in small group activities by offering a support for collective planning and time regulation, by displaying and monitoring group activities.

The impact of the Collaboration Awareness Tool EuroCAT tool is currently studied in the context of 5 European countries involving more than 1100 students in authentic collaborative learning tasks. The first results of the impact of the EuroCAT will be analyzed in the forthcoming months.

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ICT DEMONSTRATION

How an eTeaching-Portfolio Supports Development as Teacher in Higher Education

Marianne Merkt, Centre for Higher and Further Education, Germany

The Centre for Higher Education at the University of Hamburg offers a two years study programme called "Master of Higher Education" to improve academic teaching quality. Since 2009 an eTeaching-Portfolio concept is implemented to enable participants to document their ongoing individual development as university teacher. The web-environment includes learning diaries structured as blogs, the drop-box - a folder for related documents - and textboxes. Programme participants are introduced to the eTeaching-Portfolio concept at the very beginning of the master-programme. The portfolio work is supported by peer groups, tutors and teacher feedback throughout the whole study programme and will lead to the master thesis.

A longitudinal research project accompanies eight participants of the Master of Higher Education over two years and explores their development as university teachers. Participants are interviewed, their teaching practice is observed and eTeaching-Portfolios are documented at different stages. Next to areas of development in teaching practice participants' beliefs about teaching and learning in higher education are under investigation. First outcomes indicate that teachers need to become aware of and altercate with different aspects regarding their teaching in order to develop. The eTeaching-Portfolio stimulates this growing awareness and reflection. Consequently we regard the eTeaching-Portfolio-concept a highly valuable method in fostering development in teaching individually, which leads to an improved teaching quality in higher education. Furthermore a fruitful transfer of the ePortfolio concept into other disciplinary fields is expected.

We would like to present an eTeaching-Portfolio concept supporting growth as university teacher individually. It is imbedded into the curriculum of a Masters programme for academic teaching development offered by the Centre for Higher Education at the University of Hamburg. The syllabus consists of four modules: planning teaching and learning processes, leading and managing communication and group processes, methods of teaching and learning and handling e-learning and digital media. Interdisciplinary exchange, a hands-on practical course and practical peer-reviews are important features of the master-programme.

Since 2009 a teaching portfolio concept supported by an electronic portfolio environment (Jafari & Kaufman, 2006) is implemented. The platform gives the possibility to create a variation of layouts by integrating different multimedia and internet formats like audio files, pictures, films or blog postings. It supports the exchange and feedback processes on individual chosen parts of an individual e-portfolio by "view" features. It enables peer group work by an integrated group and message system (Merkt, 2009).

Starting their study programme with a kick-off workshop the participants are introduced to the e-teaching portfolio work. Based on theoretical and practical input on e-teaching portfolio work they work out their own criteria of portfolio work as guidelines for their further studies. They get a guided instruction to different structures within the portfolio environment. The first element are learning diaries structured as blogs. Participants are recommended to blog about theories and literature they read as well as their teaching and its development. The second element called "drop box" is a folder to collect relevant documents, such as innovative didactical concepts, evaluation questionnaires and results, observation reports, theoretical elaborations on teaching and learning or PodCasts of performed teaching. The third element are text boxes holding participants' biography and documents reflecting different aspects of being an academic teacher, such as personal educational philosophy and concept of science, concept of students' learning processes, ones image of man (=learners), description of ones teaching and managing personality, a repertoire of adequate teaching and learning methods, didactical concepts, documented teaching practice and aims of further development, description of an individual quality concept and considerations of the university as teaching context. As master thesis participants submit an individual teaching portfolio with scientific background (Merkt, 2009).

The eTeaching-Portfolios is embedded into the hands on practical course, which runs alongside the whole study programme. The course offers time slots for writing on the portfolio and for receiving advice and feedback from peers and teachers. During the kick-off workshop also peer groups are build. These groups aim at supporting participants in their portfolio work through feedback, exchange of ideas and social support. In the long run they also aim at creating communities of teaching in which participants get to know significant others who support their development in teaching after completing the programme (Boud & Middleton, 2003; Roxå & Mårtensson, 2009; Warhurst, 2006). Furthermore tutors are available to give advice and technical support.

A longitudinal research project accompanies eight participants of the Master of Higher Education over two years and explores how they develop as university teachers during the programme. Participants are interviewed, their teaching practice is observed and their eTeaching-Portfolios are documented at different stages.

Next to areas of development in teaching practice participants' beliefs about academic teaching and learning are under investigation. First outcomes indicate that teachers need to become aware of and altercate with different aspects of their teaching in order to develop. The eTeaching-Portfolio stimulates this growing awareness and reflection. First outcomes indicate that teachers need to become aware of different aspects regarding their teaching in order to develop. They need to become aware and reflect on their beliefs concerning these areas in order to professionalize as teachers in higher education. The eTeaching-Portfolio stimulates this growing awareness and reflection. Establishing a habit of reflection is also seen as necessary condition for lifelong improvement of professional practice (Schßn, 1983).

Additionally we believe that development as academic teacher is a highly individualized process depending on the personality of the teacher, the subject, the discipline and its scientific culture, context conditions of teaching, the target group of learners and others. Therefore it can only be fostered and later assessed in a highly individualized manner. The eTeaching-Portfolio-concept can manage both, which makes it a highly valuable method contributing to the improvement of teaching quality in higher education. Apart from that we assume portfolios a helpful tool to stimulate professionalization processes in more than the teaching profession. And we consider the e-environment with its web 2.0 characteristics attractive for the current generation of students.

In our ICT demonstration we would like to share our experience with:

- the integration of the eTeaching-Portfolio into an existing curriculum,
- designing assignments which support participants in developing their own structure rather than passively using an existing one which may lead to defensive reflection,
- developing a support-structure of teachers, tutors and peer students and
- different e-environments.

Also we want to discuss with participants changes and pitfalls of our concept and possible transfer into other disciplinary fields.

References

- Boud, D., & Middleton, H. (2003). Learning from others at work: communities of practice and informal learning. *Journal of Workplace Learning*, 15(5), 194-202.
- Jafari, A., & Kaufman, C. (2006). *Handbook of Research on ePortfolios* (N/A). IGI Publishing Hershey, PA, USA.
- Merkt, M. (2009). A competence oriented e-teaching portfolio concept for academic staff development.

Roxå, T., & Mårtensson, K. (2009). Significant conversations and significant networks—exploring the backstage of the teaching arena. *Studies in Higher Education*, 34(5), 547-559.

Schön, D. A. (1983). *The reflective practitioner*. Basic books New York.

Warhurst, R. P. (2006). "We really felt part of something": Participatory learning among peers within a university teaching-development community of practice. *International Journal for Academic Development*, 11(2), 111-122.

WORKSHOP

Didactic Sequences (DS): a socioconstructivist model for literature education at secondary school

Xavier Fontich, UAB - Universitat Autònoma de Barcelona, Spain

In this work we present three experiences of literature education carried out in secondary school classrooms (15-16 years old) in Barcelona. The experiences focus on the compulsory novels and poems of the curriculum and search to broaden students' interpretative repertoire. The model adopted is that of Didactic Sequence (DS). It helps the teacher to create a dynamic, collaborative and rich context and to define explicitly the objectives, the content and how to solve the tasks. It overcomes a purely transmissive vision of literature education and promotes an active and constructive role of the students, which are meant to write, to talk, to interact, to explain the project, to observe models, etc. in order to assimilate the key elements of the literature interpretation. The model of DS organizes activities in three phases. Phase 1 is focused on reading the text collaboratively while establishing a frame of joint interpretation; in this phase the teacher proposes the goals of the DS and the written task. In Phase 2 the task is solved through the joint action and the teacher scaffolds the writing process. Phase 3 promotes a metacognitive activity, with a written final report and a formal oral exposition about the experience carried out. All along the experience the students describe the activities and give their opinion on the whole project both in their learning log and in a blog. The results show that such a way of working increases not only students' interpretative repertoire but also their motivation to study literature.

In this work we present three experiences of literature education carried out in secondary school classrooms (15-16 years old) in Barcelona in 2009 and 2010. The experiences focus on the compulsory texts of the curricula and search to broaden students' interpretative repertoire. A teacher attempts to create a rich context through collaborative settings in which students talk, read and write to assimilate the key elements of the literature interpretation (Mercer, 2008; Chambers, 2003; Colomer, 2005). He integrates in this process the use of ICT (PC projector, blog and video) as instruments of metacognitive reflection. However research explores the important potential of ICT to modify educational practices some studies highlight the fact that ICT do not guarantee by themselves a significant learning (Mercer & Littleton, 2007). According to Coll (2008), a basic condition should be the teacher's action, guided by socioconstructivist models. The model adopted in the experiences that we will describe here is that of Didactic Sequence (DS) (Camps, 2003; Bordons & Ferrer, 2009). This model overcomes a purely transmissive vision of literature education and promotes an active and constructive role of the students. It is inspired in the project work tradition and is influenced by different disciplines and theories such as sociocultural psychology, theory of the activity-CHAT, cognitive psychology, action-research perspectives and research on literature didactics. The model of DS organizes activities in three phases. Phase 1 is focused on reading the text (partially in the classroom and at home) and discussing and sharing opinions on difficult issues, in which the students are guided and in which a frame of joint interpretation is progressively established. In this phase the teacher proposes the goals of the DS and the task; it is an initial and dynamic phase, with preponderance of oral interaction. In Phase 2 the task is solved through the joint action, it is a synoptic phase with preponderance of written activity. The teacher models the writing process with a PC projector and a "thinking aloud" protocol. Phase 3 promotes a metacognitive activity, with a written final report that will be published in a blog, a formal oral exposition and the elaboration of a video about the experience carried out. All along the experience the students describe the activities and give their opinion on the whole project both in their learning log and in the blog.

Next, we describe three examples of DS.

Didactic Sequence 1. In Phase 1 the students and the teacher altogether read Fred Uhlman's *Reunion*. They work the literature topic of the war, exploring fiction and non-fiction texts of different length, difficulty and genre (novel, study, report, biography and comic). Each one takes one of these perspectives on the topic: the concentration camps, the roots of the conflict and the survivors. In Phase 2 the students have to solve a specific task: an interview to a character. Different aspects of the interview are worked and the teacher writes his own interview "live" through a "thinking aloud protocol" and the use of a PC projector. In Phase 3 the texts are published in a blog: <http://demicaenmicasomplelapica.blogspot.com/>.

Didactic Sequence 2. In Phase 1 students read the novel *Cold skin* by A. S. Pióol and see a movie based on D. Trumbo's novel *Johnny got his gun*. In Phase 2 they work on symbolic and narrative aspects of both the novel and the movie. In Phase 3 the results of the work are published in a blog (www.quart20092010.blogspot.com). Students also go to the Universitat Autònoma de Barcelona to present the work carried out to students of the Faculty of Education, who are

currently studying Literature Education. Finally the students take part in a 20 minutes video report in which they explain the experience: http://mickey2.uab.es/CR-APED/Produccions_SAE/temporals/versio-anglesa.wmv.

Didactic Sequence 3. In Phase 1 a romantic poem is read, *La pàtria* (The homeland) (1833) by B. C. Aribau, and the students have to work on the references to the History of the Catalan Literature since the Middle Ages. In Phase 2 the teacher proposes a task: the information gathered has to be adapted for 5th graders (9-10 years old). This makes students transform the knowledge in accordance with the addressee and it leads them to higher understanding of some of the notions of the History of Literature studied. This also makes them aware of the complexity of written composition. In Phase 3 an oral exposition for the 5th graders is made and the students explain the experience in a 7 minutes video:

http://mickey2.uab.es/CR-APED/Produccions_SAE/temporals/historia-anglesa.wmv.

In these three experiences we can observe a new way of getting the students involved while studying literature, beyond a transmissive setting. Students are meant to write, to talk, to interact, to explain the project, to observe models, etc. The model of DS has helped the teacher to create this dynamic context and to define explicitly the objectives, the content and how to solve the tasks. Regarding the use of ICT, we think that it has helped to create these significant contexts of learning and it has promoted the metacognitive reflection of the students. Several authors defend such a role for the ICT (Zayas, 2008; Hernández Ramos, 2005; Ferreiro, 2007). The PC projector has been useful to observe the process of modeling by an expert writer (the teacher) and to contrast it with their own practices. The blog has been useful to publish the texts elaborated by the students and to write their learning log, as well as to communicate with the University students. Finally, the video has promoted a global metacognitive reflection on the sequence carried out: the students work in groups and describe the experience, and it also helps to share it with other students (of the same school and of the University). The experiences we have described integrate oral interaction, writing, reading and use of ICT for the literature education as well as increases students' motivation (Bergen, 1999).

References: Xavier.Fontich@uab.cat

THEMATIC POSTER

New Modes of Assessment

Competence Assessment programme as an instrument for self-evaluation

Asha Dijkstra, Avans University of applied science, Netherlands; Han Blankert, Avans Unveristy of Applied Science, Netherlands; Liesbeth Baartman, Eindhoven University of Technology, Netherlands

Self-evaluation has become a topic of debate in the Netherlands since vocational institutions have to demonstrate the quality of their assessments to an external quality board in order to retain their accreditation. In 2011, a new accreditation system for Bachelor and Master education will implemented in the Netherlands and Belgium. In this new system, assessment is no longer a subcategory but become one of the main subjects besides program and goals. Institutions for higher education have to thoroughly prepare themselves for this accreditation and collect evidence to demonstrate assessment quality. In this poster, we discuss if self-evaluation is a way to do this. However, the trustworthiness of self-evaluations is highly debated, for example showing differences between the outcomes of self-evaluations and external evaluations. Therefore, an online self-evaluation method for assessment quality was developed, to prepare institutions for their external accreditation. This study compares the self-evaluations of five faculties of a University of Applied Sciences to the outcomes of their external accreditation. Research questions are: (1) in what way can self-evaluation prepare institutions for the external evaluation of assessment quality, (2) are there any differences between the outcomes of the self-evaluation and the external evaluation?

Self-evaluations will be carried out in Spring 2011. Participants are 7 teachers, 5 students and 2 coordinators per faculty. Evaluation is based on 12 quality criteria and quantitative ratings and qualitative examples are collected. Better self-evaluations – in terms of collected evidence - are expected to better prepare for external evaluation.

Theory and aims

Higher vocational education is undergoing fundamental changes in many European countries. In the Netherlands, new qualification structures for vocational education have been developed which are based on competences and work-related experiences. The rationale behind this innovations is to better link educational programs to job requirements (Tillema, Kessels, & Meijers, 2000).

Also, the role of assessment is becoming more and more important since vocational institutions have to demonstrate the quality of their assessments to an external quality board in order to retain their accreditation. In the new accreditation system (2011) for Bachelor and Master education in the Netherlands and Belgium, assessment is no longer a subcategory but one of the main criteria besides program and goals. Institutions have to thoroughly prepare for this accreditation by collecting evidence to demonstrate assessment quality. One way to do this is self-evaluation. Thus, self-evaluation is used as a preparation for external evaluation (McNamara & O'Hara, 2005).

However, the trustworthiness of self-evaluations is highly debated. It is questionable whether self-evaluation can be used for internal improvement and external accountability at the same time (Vanhoof & Petegem, 2007). Also, self-report studies have been criticised for showing only reported behaviour, instead of actual behaviour (Falchikov & Boud, 1989). Therefore, this study focuses on the merits of self-evaluation as a preparation for external evaluation and accreditation. Research questions are: (1) in what way can self-evaluation prepare institutions for the external evaluation of assessment quality, (2) are there any differences between the outcomes of the self-evaluation and the external evaluation?

A self-evaluation method was developed, based on earlier work (Baartman et al., 2007), which helps institutions to evaluate online the quality of their Competence Assessment Programme (CAP). The focus is on CAPs – combinations of both traditional and new assessment methods – because single assessment are seldom used and not fit to assess competence (Baartman et al., 2007).

Data and methods

Participants

This study will be carried out at a large University of Professional Education in the Netherlands, a type of higher vocational education. In Spring, when the new accreditation system has been implemented, five faculties will carry out a self-evaluation of the quality of their CAP: In each faculty, the evaluators are 7 teachers, 5 students and 2 coordinators. They are selected on their familiarity with the CAP and provide input from different perspectives.

Self-Evaluation Method

The self-evaluation uses 12 quality criteria including ideas of validity and reliability, complemented by criteria deemed important in competence-based education specifically, for example authenticity, meaningfulness and self-regulated learning. A self-evaluation method was chosen it is assumed to stimulate reflection and internal school improvement (McNamara & O'Hara, 2005). The self-evaluation consisted of three phases. First, the evaluators receive a short training on the 12 quality criteria and the CAP to be evaluated was defined. Second, all evaluators rate their CAP on a numerical scale. For each criterion, they are asked to provide evidence of the quality of their CAP. This evidence is considered important for the external evaluation, as it can be used to demonstrate assessment quality. Third, all individual evaluations are collected and summarised by the researchers in a short powerpoint-presentation, to be discussed in a two-hour group interview. The goal of the group interview is twofold: formulate concrete points for improvement (school improvement) and review the available evidence for external evaluation (accreditation).

Questionnaire

All evaluators are asked to fill out a questionnaire on the usefulness of the self-evaluation for external accreditation. This will be done twice: immediately after the self-evaluation, and after the external accreditation has been carried out.

Data analyses

To answer the first research question, group interviews will be recorded. The evidence collected in the self-evaluation will be summarised in a data display, and compared across cases (Miles & Huberman, 2003). Analyses of the quality of the evidence will be based on previous research (Baartman et al., 2007). For the second research question, we will compare all self-evaluation reports with the external accreditation reports

Anticipated results

We expect the self-evaluation to better prepare the faculties for external evaluation, as suggested by the literature (Nevo, 2001; McNamara & O'Hara, 2005). The more and better evidence is collected during the self-evaluation, the better we expect the faculties to be able to demonstrate assessment quality during the accreditation. With regard to the differences between the self-evaluations and the external evaluations, we expect small differences, as the faculties know the self-evaluation is meant to prepare for the accreditation, so a realistic picture of assessment quality is most valuable.

References

- Baartman, L.K.J., Bastiaens, T.J., Kirschner, P.A., & Van der Vleuten, C.P.M. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review*, 2, 114-129.
- Baartman, L.K.J., Prins, F.J., Kirschner, P.A., & Van der Vleuten, C.P.M. (2007). Determining the quality of Competence Assessment Programs: A self-evaluation procedure. *Studies in Educational Evaluation*, 33, 258-281.
- Falchikov, N., & Boud, D. (1989). Student self-assessment in higher education: A meta-analysis. *Review of Educational Research*, 59, 395-430.
- McNamara, G., & O'Hara, J. (2005). Internal review and self-evaluation – The chosen route to school improvement in Ireland? *Studies in Educational Evaluation*, 31, 267-282.
- Miles, M.B., & Huberman, A.M. (1984). *Qualitative data analysis. A sourcebook of new methods*. Beverly Hills, CA: Sage.
- Tillema, H.H., Kessels, J.W.M., & Meijers, F. (2000). Competencies as building blocks for integrating assessment with instruction in vocational education: A case from the Netherlands. *Assessment & Evaluation in Higher Education*, 25, 265-278.
- Vanhoof, J., & Van Petegem, P. (2007). Matching internal and external evaluation in an era of accountability and school development: Lessons from a Flemish perspective. *Studies in Educational Evaluation*, 33, 101-119.

A method to assess the modifications of mathematics pre-service teachers in their learning portfolio

Jose Chamoso, Facultad de Educacion, Spain; Maria Jose Caceres, Universidad de Salamanca, Spain; Pilar Azcarate, Universidad de Cadiz, Spain

During the last few years, many changes have taken place not only regarding learning but also teaching. To foster this change, the training of mathematics teachers should involve pre-service teachers in a variety of interesting activities. Reflection about how to solve situations and problems linked to their future educational practice is what allows ideas and forms of understanding Mathematics Education to be put into practice. This means that assessment needs to involve using a selection of instruments that provide evidence about learning. Portfolio can include several of these aspects. In this study we focus on the use of the learning portfolio. There has been little systematic attention given to the ways in which the learning portfolio it is being used in teacher-training classrooms. Our work has focused

specifically on how pre-service teachers reconstruct the initial ideas they set out in a project that was included in their learning portfolio at the beginning of their teacher-education program and based on the instruction received during this program. This system was used in the studies within a university teacher-education program. The project consisted of designing a lesson plan for teaching mathematical knowledge taking into account Content, Activities, Methodology and Reflection. The outcomes showed significant differences in the revisions carried out in all categories except Activities. The training received during the teacher-education program had limited influence on these four categories.

Theoretical framework

Reflection on teaching practice is one of the main objectives of teachers' professional work. Much has been written about the importance of reflective practice, scarce attention has been given to the reflective process which future teachers have to experience in making a learning portfolio (Tillema, 1998). However, there are hardly any empirical studies about the use of reflective thinking when pre-service teachers try to improve their own work as a result of the training developed in the teacher-education program.

In the last few years, the use of portfolios has become commonplace internationally in teacher education for different purposes (e.g. Farr Darling, 2001). Although great expectations have been placed on the use of the portfolio, research studies on the efficiency of the instrument have been few and far between (Imhof & Picard, 2009). We need to learn more about the nature and quality of reflection that emerges under different conditions of portfolio use (Zeichner & Wray, 2001). Empirical research is still needed to determine what effect portfolios have made on pre-service teachers' individual thinking (Wade & Yarbrough, 1996). Concretely, Xu (2003) recommended extending the use of portfolios during the pre-service years to promote teachers' future professional development.

This study was set within the context of a proposal for innovation that linked a teaching-learning process with an assessment process that included the construction of a learning portfolio. In this context, the main specific research question was: What kind of changes did pre-service teachers of primary mathematics make in one of the projects included in their learning portfolios after receiving instruction in the university teacher-education program?

Method

30 pre-service teachers, at one Faculty of Education of Spain, took part in the experiment. The instruments used for the collection of the data were the papers referred to the following project that the pre-service teachers included in their learning portfolio. At the beginning of the course the contents of the syllabus were distributed among the pre-service teachers and they were given a week to design individually how to teach them at the primary level (IP), taking into account: (a) Content, (b) Activities, (c) Methodology, and (d) Reflection. At the end of the module each pre-service teacher revised his/her own work based on the training received during the module (FP). To evaluate the process, we considered the following:

1. The differences in the assessment of each pre-service teacher's IP and FP overall and in each of the categories Content, Activities, Methodology and Reflection.
2. The modifications made in the FP with respect to the IP of each pre-service teacher, analysing both the level of depth and the aspects to which they refer in their work.

To evaluate the work carried out, we established three general levels for classifying each pre-service teacher's degree of learning: participation in the process as a spectator, active participation in the process, and, involvement in the process by taking his/her own decisions. These general criteria were adapted to evaluate each of the elements identified in the project in question in the four categories above mentioned. An assessment template was drawn up for each of them.

The first step in analysing the work of each pre-service teacher was to identify complete units of information. Next, the corresponding assessment was applied to the work of each pre-service teacher. The results for each aspect were collected in tables in which each section 1, 2 or 3 reflected the amount of complete information units of each pre-service teacher. The sum of the outcomes of each pre-service teacher multiplied, respectively, by the factor of the corresponding category and, the final outcome, divided by the sum of all the complete information units, was considered the score in each of the aspects considered.

Secondly, to study the depth of the modifications made in the FP, we established the following 5 levels according to the reflection process each pre-service teacher made in each case in order to improve their IP: The IP was completely revised, the IP was completely reorganized and perhaps some things were added, only some parts of the IP were reorganized or modified, new knowledge was added without modifying or reorganizing the IP, the IP was not modified.

For the analysis of the quantitative data, related samples t-test and Pearson's chi-square test were used.

4. Results

In the first place, a related samples t-test showed that the overall assessment of each pre-service teacher considering the 4 categories increased significantly in the FP after revision of the IP as a result of the reflection carried out owing to the training received [$t(29)=5.820$, $p<.001$]. Content, Activities, Methodology and Reflection, related samples t-test showed significant differences between the scores obtained by the pre-service teachers in the IP and FP in all the categories except Activities.

Secondly, the number of pre-service teachers who made a completely new FP in all the categories was greater than the number who made another type of modification except in the case of Activities. Most of the pre-service teachers improved their score in the FP with respect to the IP in all the categories except Content and Activities, where 4 (13% of the total) and 6 (20% of the total) pre-service teachers obtained a lower score in the FP, 3 of whom coincided in both cases. Then, based on the analysis of the pre-service teachers' work, we compared the aspects of the knowledge to which they referred both in the IP and the FP.

Conclusions

This study allows us to conclude on the effect that continuous revisions of their work can have on future teachers' ideas and on personal reflections development on the decisions taken. On the other hand, this study provides a method to assess the work of pre-service teachers and the modifications they make in their written reports that could be used in future research. This method can also be helpful to teacher educators working both in the context of teacher training and in lifelong professional education.

Gender Analysis of Czech General Reasoning Tests

Jiri Dvorak, SCIO, Czech Republic; Denisa Denglerova, SCIO, Czech Republic; Petr Gilar, SCIO, Czech Republic

This article is focused on the gender analysis of Czech General Reasoning (CGR) tests. Tests similar to the other reasoning tests like tests of GRE, SAT, Cambridge Assessment and other. Using such tests suggests a question whether there are any measureable differences between reasoning of males and females. And more specifically, whether the tests themselves respect such differences and in this sense of meaning provides a fair measurement. We have analyzed more than 3400 items and every item was answered by a few hundred to a few thousand highly motivated persons. The analysis shows interesting differences between responses of males and females. And moreover offers a good base to other research and future test makers.

This article is focused on the gender analysis of Czech General Reasoning (CGR) tests. In the Czech republic there is a system of so-called Comparative Exams organized every school year. A main part of these exams are General Reasoning tests similar to the other reasoning tests like tests of GRE, SAT, Cambridge Assessment and other. Using such tests suggests a question whether there are any measureable differences between reasoning of males and females. And more specifically, whether the tests themselves respect such differences and in this sense of meaning provides a fair measurement. Thank to the number of persons performing CGR test each year and the number of test items used we have a good base to answer these questions. An essential precondition of this kind of research is an appropriate data base. We have analyzed more than 3400 items (two tests every testing day, 17 testing days in three years). Every item was answered by a few hundred to a few thousand persons. Persons were highly motivated because results of CGR test are recognized as the entrance exams by many Czech universities. Because of the number of various Czech universities recognizing CGR tests and the number of persons performing the tests we assume that the sets of males and females answering items of the test is a random sample. Therefore we could make general conclusions required by the research questions we have asked. Similarly we are assuming that the large set of various items is also random enough to avoid the influence of items answered better by either males or females because of reasons other than a reasoning of a person (for example because of a vocabulary used in an item). The method of analysis had to follow some particular characteristics of CGR tests. Items in the CGR tests are multiple-choice items organized into nine groups of similar items. Therefore we have decided to make an analysis for each group of items separately. A three types of answer are recognized: correct answer, incorrect answer and no answer. Incorrect answers are evaluated as a worse results than no answers, so people are motivated to rather not answer at all if they are unsure about the correctness of their answer. To respect this characteristics of CGR we are computing four variables for each item (separately for males and females): the rate of correct responses to the total number of possible responses (V1), the rate of incorrect responses to the total number of possible responses (V2), the rate of no responses to the total number of possible responses (V3) and finally the rate of correct responses to the number of responses (ie total number of possible responses minus number of no responses) (V4). After that the average rates are computed within various groups of items: groups of similar items (as mentioned before) within each test, groups of

similar items within each test day, groups of similar items within each year and finally groups of similar items overall. Performed analysis brings a couple of interesting results. We have discovered significant differences between responses of males and females to the particular groups of items. Moreover we have discovered that the difference between reasoning of males and females is more clearly seen on the variables V3 and V4 than on the other two rates. For example in some item groups items are left unanswered by males significantly less than by females, but in some groups items are answered by females as much as by males. There is also one group answered by females more than males, but the difference is quite small. An analysis of the variable V4 says that there is no significant difference in reasoning between males and females. Once a person decided to answer an item the probability of correct response is almost the same regardless of gender. Results of the analysis brings on a couple of important conclusions. At first the main difference between males and females in reasoning tests is made by the unanswered items not by the items answered correctly or incorrectly. The second conclusion is very important for the test makers: there are big differences in responses to items even if the items are very similar. In particular: inappropriate setting of an item could dramatically influence the rate of not answering by either males or females and therefore influence the success of either group. This result of the analysis makes a good basement for making a fair tests which will avoid unintentional influence of external factors (ie factors we do not want to measure).The presented also analysis opens some interesting new directions of future research. Especially we should identify and describe items which make inappropriate difference between males and females. Also the analysis itself could be improved by checking up claimed assumptions, especially the assumption of random samples.

A cross-national comparative study on reading achievements:data from PIRLS2006

Jen Jang Sheu, Center of Teacher Education, Taiwan, Province of China

The aim of this study is to progress a cross-national comparative study on the relations among reading abilities, reading attitudes, and reading achievement, based on the published results from Progress in International Reading Literacy Study (PIRLS 2006) by the Association for the Evaluation of Educational Achievement (IEA). Subjects selected in this study are Russia, Hong Kong, Canada (Alberta), Singapore, the top four countries of the reading achievement in PIRL 2006, and Taiwan, which ranked 22nd. Hierarchical Linear Modelling will be applied to the modelling building process with level-1 being students' attributions (including reading abilities, reading attitudes, and students' gender) and level-2 being ways of teaching strategies adopted in the top four countries and Taiwan to examine the different efficacy in reading instruction. Research findings in this study can be offered to the domestic educational authorities, schools and practicing teachers in each countries in reading instruction as reference resources to improve and adjust their teaching strategies to help lifting students' reading literacy, then consequentially national competitiveness can be enhanced.

The aim of this study is to progress a cross-national comparative study on the relations among reading abilities, reading attitudes, and reading achievement, based on the published results from Progress in International Reading Literacy Study (PIRLS 2006) by the Association for the Evaluation of Educational Achievement (IEA). There were 45 countries and area as benchmark participated in the study of PIRLS 2006, Subjects selected in this study are Russia(students' average score 565), Hong Kong(students' average score 564), Canada (Alberta) (students' average score 560), Singapore(students' average score 558), the top four countries of the reading achievement in PIRL 2006, and Taiwan(students' average score 535), first time to join in PIRLS study, which ranked 22nd. Hierarchical Linear Modeling, the second generation statistical tool, with high efficiency for the contextual data, will be applied to the modeling building process. There level-1 in the research framework being students' attributions (including reading abilities, reading attitudes), students' reading achievements as the outcome variable, reading abilities and reading attitudes as predictors, students' gender as the moderator. Level-2 being ways of teaching strategies as predictors adopted in the top four countries and Taiwan to examine the different efficacy in reading instruction(including direct understand process and explanatory process in students' reading comprehension). Another important reason to use Hierarchical Linear Modelling method in this study is because when PIRLS reported each country's students' reading achievements, there included five plausible values which were gained by an imputation procedure, and Hierarchical Linear Modelling can get standardized estimated error form these five plausible value directly.

The research framework was defined as follows (Insert fig 1 here)Two research questions will be explored:

1. How do students' reading ability, reading attitude and teachers' teaching strategy affect the reading achievements on fourth graders in each country? Do they have between-school differences?
2. What are the differences among these countries on the above issues.

According to the research questions, we will use HLM 6.08 software to analysis the data given, and starting with the null model whether there is cross schools difference in each country, then exploring the effect when add students' reading abilities and reading attitudes as predictors (including fixed effect and random effect), after that teachers'

teaching strategies will be added as predictor to see what kind of effects will appear. Reside, the gender variable as moderator and there interaction will be discussed too. When make the cross-national comparison steps, the adjusted class mean should be considered, there will be four models to be processed step by step:

Model 1: one-way ANOVA with random effects The aim of model 1 is to test if there are between-group and within-group variation in students' reading achievements, because in doing multilevel analysis we need to divide students' reading achievements into two parts, between-group and within-group variation, and according to the rule the between-group variation can't be zero in significant level.

Model 2: random coefficients regression model The aim of model 2 is to test if students' reading abilities and reading attitudes can predict or explain students' reading achievement.

Model 3: intercept -as-outcomes model The aim of model 3 is to test if students' reading abilities and reading attitudes can predict students' reading achievement.

Model 4: slopes-as-outcomes model The aim of model 4 is to test if teachers' teaching strategies as moderators on students' reading abilities, reading attitudes and students' reading achievement. Research findings in this cross-national comparative study can be offered to the domestic educational authorities, schools and practicing teachers for each country in reading instruction as reference resources to improve and adjust their teaching strategies to help lifting students' reading literacy, then consequentially national competitiveness can be enhanced.

Online Curriculum-Based Measurement for First-Graders in Mathematics

Martin Salaschek, University of Muenster, Germany; Natalie Foerster, University of Muenster, Germany; Elmar Souvignier, University of Muenster, Germany

Developing basic numeracy skills for all children is one of the main goals in elementary school. Curriculum-Based Measurement (CBM) offers ways to continually monitor students' improvement and identify children that do not benefit from regular classroom work. The aim of this study was to analyse the adequacy and statistical quality of a newly developed, internet-based CBM concept for first-graders in mathematics.

Nine first-grade classrooms with 205 students participated in the study. After a standardized maths test for first-graders (DEMAT 1+) was conducted, classes worked on three parallel versions of the CBM test in 3-weeks-intervals. Additionally, teachers completed a questionnaire concerning the usability of the program, the usefulness of the diagnostic information, and the usage of the data for classroom work.

The test results show that students were able to improve significantly from test to test. The results underline that online CBM tasks in maths can be conducted as early as in first grade, and that the results are useful for forming classroom work. Further studies will show whether this positively affects learning outcomes of classes that use CBM tasks.

Theoretical background

One of the main goals of education in elementary school is to develop numeracy: Establishing a sound understanding of the numeric system and basic mathematical operations. However, there are precursors which have high predictive value of mathematical achievements at the end of fourth grade. These precursors - such as early quantity-number competencies - already start to develop before school enrolment (Krajewski & Schneider, 2009). One method of monitoring students' competency progress that has received much recognition particularly in special education is Curriculum-Based Measurement (CBM) which monitors student progress over time with periodic measurements of contents from the curriculum (Deno, 2003; Foegen, Jiban, & Deno, 2007; Stecker, L. Fuchs, & D. Fuchs, 2005). The CBM concept seems particularly suitable for mathematics, since curricular goals are well-defined.

Aims

The main aim of the study was to analyse the adequacy of the newly developed internet-based CBM test concept for first-grade maths students. More specifically, it was examined (a) if the developed CBM tasks showed satisfactory sensitivity, reliability, and construct validity; and (b) if the children were able to use the internet-based testing software with a computer at this young age.

Moreover, since CBM is a young research field in Germany - especially in regular education settings -, teachers' general acceptance and usage of the results was under review.

Methodology

The CBM test was constructed of tasks from the curriculum sampling as well as from the robust indicators approach. It consisted of 52 items in 11 different tasks, measuring four basic competencies: (a) calculation skills, (b) understanding of quantities, (c) digit knowledge, and (d) working memory skills. The first competency sampled the curriculum with exercises such as addition and subtraction tasks in the range of 1-20. The second and third competencies served as specific robust indicators for basic mathematical understanding, based on the triple code model (Dehaene & Cohen, 1995) and Krajewski and Schneider's model of early mathematical development (Krajewski & Schneider, 2009). The assessment of the children's working memory skills served as a general risk indicator for overall school performance.

Nine first-grade classrooms with 205 students participated in the study. Three parallel versions of the test were conducted from May to July 2010 in intervals of approximately 3 weeks. Testing order of the three tests was randomized for each participating class. The children worked on the tests autonomously; instructions for the tasks were given via headphones. The results of the CBM tests for all four competencies could be separately reviewed by the teachers online directly after the test on student- and class-level; comparative data from all participating classes were given. The CBM tests were preceded by a standardized paper pencil test for first-graders (DEMAT 1+). After the last CBM test, teachers were asked to complete a short questionnaire concerning the usability and adequacy of the test, the acceptance of the program, and the usage of the results for teaching and individual fostering.

Findings

Firstly, measures for sensitivity, reliability and validity of the CBM test were evaluated. The test showed adequate difficulty levels with mean overall scores ranging from 73% in the first test to 79% in the last test. The test was sensitive to students' learning outcomes, resulting in increased performance from test to test ($p < .05$). The test appeared to be significant ($p < .05$) as a measure of parallel forms reliability ranged from $r = .53^{**}$ to $r = .55^{**}$. Overall correlation of the three tests with DEMAT 1+ scores ranged from $r = .36^{**}$ to $r = .48^{**}$. However, due to randomization effects, not all tests were conducted by the same amount of students at the same testing time. The results should therefore be interpreted with caution.

Secondly, usability and usefulness were assessed. The majority of the teachers stated that they used the CBM test results for adjusting their teaching (87% agreement) as well as that the children were able to conduct the tests independently and had fun doing so throughout all tests (100%, 83% agreement, respectively).

Theoretical and educational significance of the research

The statistical findings suggest that the newly developed CBM test is sensitive to changes in students' skills. Reliability and validity measures are not fully satisfying; indications for task modifications were obtained, and a revised test is being conducted in the school year 2010/2011 with additional parallel tests as well as with more participating classrooms.

Furthermore, teachers' ratings for the adequacy and usability as well as for the usefulness for general classroom work and individual fostering were remarkably high. Against the background of the successful implementation of CBM tasks with older students in special education settings, the newly developed internet-based concept proved the CBM concept to be valuable in regular education settings as early as in first grade.

References

- Dehaene, S., & Cohen, L. (1995). Towards an Anatomical and Functional Model of Number Processing. *Mathematical Cognition*, 1 (1), 83-120.
- Deno, S. L. (2003). Developments in Curriculum-Based Measurement. *The Journal of Special Education*, 37 (3), 184-192.
- Foegen, A., Jiban, C., & Deno, S. L. (2007). Progress Monitoring Measures in Mathematics: A Review of the Literature. *The Journal of Special Education*, 41 (2), 121-139.
- Krajewski, K., & Schneider, W. (2009). Early development of quantity to number-word linkage as a precursor of mathematical school achievement and mathematical difficulties: Findings from a four-year longitudinal study. *Learning and Instruction*, 19 (6), 513-526.
- Stecker, P., Fuchs, L., & Fuchs, D. (2005). Using Curriculum-Based Measurement to Improve Student Achievement: Review of Research. *Psychology in the Schools*, 42 (8), 795-819.

Effects of reading progress assessment in regular education

Natalie Foerster, University of Muenster, Germany; Elmar Souvignier, University of Muenster, Germany

Providing teachers with diagnostic information on the reading progress of each student should lead to better individual support and higher learning gains. The method of curriculum-based measurement (CBM) was designed to

describe the progress in learning. This concept stands in clear contrast to standardized tests and traditional measures of achievement in the classroom which do not focus on the documentation of change. CBM has proven to be eligible to document and improve reading progress, especially for students with special educational needs. Hence, the aim of our study was to investigate the efficacy of reading progress assessment compared to providing teachers with diagnostic (state) information from a standardized test in regular education. Using a pre- and post-test design, learning gains were assessed with two standardized reading tests (ELFE; SLS) at the beginning and the end of the school year. A total of 1491 third- and fourth-graders (996 CBM vs. 495 control) participated in the study. CBM-students completed eight parallel forms of a 10-minute reading test in intervals of two weeks. While all teachers obtained information about reading achievement at the beginning of the school-year, teachers of the CBM-students additionally obtained information about the reading progress of each student. Overall, students of the CBM-group showed higher improvement in reading achievement than control students ($d = .26$ (ELFE) and $d = .20$ (SLS) for third-graders, and $d = .68$ (ELFE) and $d = .22$ (SLS) for fourth-graders. Thus, information on learning progress seems to be helpful for teachers to foster reading achievement.

Aims

The aim of our study was to investigate the efficacy of reading progress assessment compared to providing teachers with diagnostic (state) information from a standardized test in regular education. Diagnostic information is needed to adapt instructions to children's individual needs. The more often teachers have information about achievement and progress of their students, the better they can select individual aid. Thus, providing teachers with diagnostic information on the reading progress of each student beyond state information about reading achievement should lead to better individual support and higher learning gains of the students.

The method of curriculum-based measurement (CBM) was designed to describe the progress in learning in contrast to standardized tests and traditional measures of achievement in the classroom which do not focus on the documentation of change. CBM has proven to be eligible to document and improve reading progress, especially for students with special educational needs (Deno, 1985; Fuchs & Fuchs, 1998). We developed an internet-based measurement tool with an automated routine for data analysis to apply the assessment of reading progress in regular education classrooms.

Methodology

A total of 68 third- and fourth-grade-classes (1491 students) participated in the study. Classes were assigned to either a CBM-group (46 classes with 996 students) or a control group (22 classes with 495 students). All students completed two standardized reading tests (ELFE and SLS) at the beginning (pretest) and at the end of the school year (posttest). In addition, CBM-students completed eight parallel forms of a 10-minute internet-based reading test in intervals of two weeks during the school year. While in CBM reading competence is usually assessed by tasks such as one-minute oral reading or a maze task, we developed short internet-based reading tests consisting of a maze task and comprehensive questions. While all teachers obtained information about reading achievement at the beginning of the school-year, teachers of the CBM-students additionally obtained information about the reading progress of each student. Feedback of the pretest results of two standardized reading tests (ELFE 1-6 and SLS) was provided not later than six weeks after testing and at least 16 weeks before the posttest.

Findings

Overall, students of the CBM-group showed higher improvement of reading achievement than students of the control group indicating that teachers really made use of the diagnostic information for instructional decisions. For third-graders effect sizes are $d = .26$ (ELFE) and $d = .20$ (SLS). Effect sizes for fourth-graders appeared to be slightly higher ($d = .68$ (ELFE) and $d = .22$ (SLS)). All differences proved to be statistically significant.

Theoretical and educational significance of the research

Assessment of individual difficulties and individual progress provides the basis for adapting instructions to individual needs. The computer-based CBM method facilitates the collection of progress data for each student in regular educational settings. Moreover, teachers have proven to be successful in using the information for planning adaptive teaching, which led to higher achievement gains for their students. Hence, our findings are in line with research in special educational contexts.

The results of this study underline that providing teachers with diagnostic information on the learning progress of their students is – as a first step – sufficient to bring about higher learning gains (Stecker, Fuchs & Fuchs, 2005).

References

Deno, S. L. (1985). Curriculum-based measurement: The emerging alternative. *Exceptional Children*, 52(3), 219-232.

Fuchs, L. S., & Fuchs, D. (1998). Treatment validity: A unifying concept for reconceptualizing the identification of learning disabilities. *Learning Disabilities Research & Practice*, 13, 204-219.

Stecker, P. M., Fuchs, L. S., & Fuchs, D. (2005). Using curriculum-based measurement to improve student achievement: Review of research. *Psychology in the Schools*, 42, 795-819.

THEMATIC POSTER

Cognitive Development

Number sense in kindergarten children and its relationship with calculation fluency in later grades

Manuel Aguilar-Villagran, University of Cadiz, Spain

In this poster an early math longitudinal study of a group of children from kindergarten to the third year of Primary is presented. All children were assessed with the Early Numeracy Test (Van Luit et al., 1994) at 5 years old. The different ENT components were used to predict fluency in basic math operations at the end of the first, second and third grades of Primary Education. We also used a longitudinal study to identify the differences between initial high and low ENT achievers. The participants were a group of 87 children (49 boys and 38 girls) aged between 60 and 70 months old (mean 66 months). They were evaluated when they were in the third year of kindergarten (Fall 2006) with UENT (Van Luit, Van de Rijt, & Pennings, 1994). We calculated the correlation between UENT and the different measurements of math fluency in the first three grades of Primary education. A statistically significant correlation was found between counting sub-tests (verbal counting, resultative counting, structural counting and general number knowledge) and addition, subtraction, multiplication and division fluency measures (range .36 - .62). No statistically significant correlations were found between the relation sub-tests and fluency measurements. A hierarchical regression calculation showed that verbal counting and resulting counting explained the maximum variance in basic math operations.

Students start school with differing levels of number sense development. Low early number sense development may be one of the variables explaining math learning disabilities in older children (Gersten et al., 2005; Mazzocco & Thompson, 2005). For example, Aunio et al., (2005), Kavkler, et al., (2003) consider that between 5 and 10 % of children have severe counting skill difficulties. This skill could be an important precursor for later math abilities (Aunola et al., 2004; Aunio & Niemivirta, 2010). Fluency refers to the ease and precision with which an activity is performed. Calculation fluency is a tool for solving the majority of math problems. For example, solving multi-digit calculations depends on knowledge of basic combinations, number facts, and recovery fluency. Poor number fact skills reduce the necessary attentional resources (i.e. attention, working memory) for decoding and solving more complex tasks. (Dehaene, 1997). Some research has shown that low calculation fluency characterises students with math learning difficulties. (Hanich, et al., 2003; Barnes et al., 2006). The main aims of the study were, on the one hand, to identify the importance of number sense development, evaluated in kindergarten, on calculation fluency in the first three years of Primary education. In addition, we aimed to assess and analyse fluency differences between high and low early math performers. The participants were a group of 87 children (49 boys and 38 girls) aged between 60 and 70 months old (mean 66 months). They were evaluated when they were in the third year of kindergarten (Fall 2006) with UENT (Van Luit, Van de Rijt, & Pennings, 1994). We assessed their early math competence with 8 ENT sub-tests: (a) relational or Piagetian concepts: comparison, classification, 1:1 correspondence and seriation (b) numerical concepts: verbal counting, resultative counting, structural counting and general number knowledge. All children were assessed on calculation fluency (addition [$8 + 9 = ?$], and subtraction, $8 - 3 = ?$) at the end of the first grade of Primary education (June 2008). Then they were evaluated at the end of the second grade of Primary education on addition, subtraction and multiplication fluency ($7 \times 5 = ?$) (June 2009) and finally at the end of the third grade they were assessed on addition, subtraction, multiplication and division fluency ($24 : 8 = ?$) (June 2010). We calculated the correlation between UENT and the different measurements of math fluency in the first three grades of Primary education. A statistically significant correlation was found between counting sub-tests (verbal counting, resultative counting, structural counting and general number knowledge) and addition, subtraction, multiplication and division fluency measures (range .36 - .62). No statistically significant correlations were found between the relational sub-tests and fluency measurements. A hierarchical regression calculation for each measurement year showed that verbal counting, structured counting and resulting counting explained the maximum variance in basic math operations (table 1). Table 1. Hierarchical regression calculation for additions, subtractions, multiplications and divisions assessed in 2008, 2009 and 2010

Models

In addition, we compared the low and high ENT achievers. We selected children with a standard deviation below ($N = 10$) and above ($N = 14$) the total ENT average (21.76). Significant differences were found for high ENT achievers

The fact that these differences were maintained for three years suggests the importance of early instructional programs for counting in order to reduce the gap between low and high early math achievers. This study also has some implications for educational practice. It should be understood that counting fluency is an important early math skill which may require specific support in order to provide a firmer basis for future learning of math in primary school. This is particularly relevant for early childhood education, and it may be critical in preventing future learning difficulties or lower early math performance. Our results call for all children to be provided with possibilities for training their potential math skills in early childhood education.

Personal Epistemology, Critical Thinking, and Moral Reasoning: Keys to Active Citizenship

Lisa D. Bendixen, University of Nevada, Las Vegas, United States; Lori Olafson, University of Nevada Las Vegas, United States; Raelynn Frazier Lee, UNLV, United States; Cristina Salinas, University of Nevada, Las Vegas, United States

With citizenship as its context, the current study examines the relationships among what we think are key components of effective ill-defined problem solving: epistemic beliefs, critical thinking, and moral reasoning. Participants included 149 (107 females, 42 males) undergraduate ($n = 103$) and graduate ($n = 46$) education students. We hypothesized that views of citizenship would be significantly related to our main variables (i.e., epistemic beliefs, critical thinking, and moral reasoning). Findings indicated that graduate-level education students had more advanced moral reasoning and viewed themselves as more capable in citizenship skills. In addition, critical thinking and epistemological beliefs significantly predicted principled moral reasoning. Implications such as providing more opportunities for students to actively engage in citizenship problem solving are discussed.

Aims

Informed and active participation of citizens is a hallmark of democratic societies. Education's role in training its citizens is also a key aspect of most Western cultures. Currently, there is debate regarding whether or not the educational system in the U.S. is doing an adequate job of preparing its future citizens for some of the complex tasks required of them (Torney-Purta, Hahn, & Amadeo, 2001). Some of the problems required of citizens to solve would be considered ill-defined problems (i.e., problems with no single correct answer or way to achieve the answer). For example, active and effective participation in political campaigns and juror decision-making require critical thinking skills, sound moral reasoning, and epistemic competence. The goal of the current study is to examine the relationships among moral reasoning, epistemic beliefs/competence, and critical thinking in undergraduate and graduate students. The more we can understand key components of the problem solving required of future citizens the more we can address their educational needs.

Epistemic Beliefs

The study of epistemic beliefs (i.e., about knowledge and knowing) has been a focal point of educational research over the last forty years (Hofer & Pintrich, 1997). Viewing personal epistemology as a set of beliefs originated with the work of Schommer-Aikins. Schommer (1990) proposed that there are five dimensions of epistemological beliefs and these epistemological dimensions have also been shown to develop and advance over time as age and education levels increase (Schommer, 1993).

Moral Reasoning

The moral reasoning of adults has also been a major focus in developmental and educational psychology for a number of years. Based on the moral development theory of Kohlberg (1981) research using The Defining Issues Test (DIT) (Rest, 1987) has been widely used and has yielded consistent and useful results in terms of how individuals reason about open-ended moral situations typically found in society.

Critical Thinking

Encouraging critical thinking in students has been a main focus in terms of learning and instruction (Ennis, 2003). Critical thinking and its importance in more everyday situations has also been pursued (Halpern, 2006).

Methodology

Participants

There were 149 (107 females, 42 males) undergraduate ($n = 103$) and graduate students ($n = 46$) who completed the study as part of their educational psychology course requirement. The mean age was 24.57.

Materials

All participants completed 5 surveys and one essay online. Three dimensions of the 28-item Epistemic Belief Inventory (Schraw, Bendixen, & Dunkle, 2002) were used. The naïve end of the dimensions include: 1) simple

knowledge (i.e., knowledge consists of discrete facts), 2) certain knowledge (i.e., absolute knowledge exists), and 3) omniscient authority (i.e., all authorities have access to otherwise inaccessible knowledge).

The Halpern Critical Thinking Assessment Using Everyday Situations was also given (Halpern, 2006). This measure includes 25 everyday situations with open-ended and Likert scale items designed to assess participants critical thinking.

The short-form of the Defining Issues Test (Rest, 1987) was also administered in this study. The short form includes 3 moral dilemmas that participants were asked to rate in terms of their judgments about the dilemmas in order to give an indication of their level of moral reasoning.

Two surveys about citizenship were also administered: 1) The Citizenship Questionnaire (10 items, 4-point Likert scale) is designed to measure individuals' view of community involvement and other aspects of participatory citizenship (Westheimer & Kahne, 2004). 2) The Project Citizen Survey (10 items, 4-point Likert scale) adapted from Root & Northup (2007) was also used and asks participants to rate how good they are at various activities related to citizenship.

An open-ended essay question about citizenship was also given and is currently being analyzed using the Westheimer & Kahne (2004) framework.

Findings

Independent - Samples t Tests

When comparing means for the undergraduate and graduate students, the P Score (Undergrad Mean = 29.06, SD = 16.27, Graduate Mean = 33.33) and ProjectCitizen (Undergrad Mean = 24.86, SD = 3.86, Graduate Mean = 26.89, SD = 4.20) variables were significantly different

Gender was also significant on the CitizenshipQuest

Multiple Regression

To examine the relationship between Moral Reasoning (DV) and our other variables (predictors), multiple regression was performed. Results indicate that critical thinking (Beta = .24) and epistemological beliefs (Beta = .31) significantly predicted principled moral reasoning. The model accounted for 21% of the variance ($R = .46$, $R^2 = .21$).

THEORETICAL/EDUCATIONAL SIGNIFICANCE

Critical Thinking and Citizenship

Consistent with the results of the current study, links have been established between moral reasoning and epistemological beliefs (e.g., Bendixen, Schraw, & Dunkle, 1998, Olafson, 2003). We think that an important addition to this association is critical thinking as our findings indicate that this type of reasoning also plays a role in moral decision making.

This study illuminates the possibility of addressing both the epistemological beliefs (Bendixen & Feucht, 2010) and critical thinking (Kuhn, 2005) of students in the classroom to aid in moral reasoning within the context of participatory citizenship. For example, more critical thinking activities in the arena of citizenship could have many short- and long-term benefits for students in and out of the classroom (Torney-Purta et al., 2001).

Level of Education and Citizenship Graduate-level education students in the current study had more advanced moral reasoning and viewed themselves as more capable in citizenship skills. Although a solid educational trend in moral reasoning is apparent in the literature (e.g., Thoma & Davison, 1983), views of citizenship becoming more advanced with education is a relatively new finding. One reason for this could be that graduate students have had more time and experience being a citizen and thus gain more self-efficacy in this arena than their undergraduate counterparts. More opportunities for reasoning in citizenship situations may better prepare high school and undergraduate students for what's to come in terms of their responsibilities as citizens.

The Epistemology of Counseling: Inroads to More Effective Counselor Education

Lisa D. Bendixen, University of Nevada, Las Vegas, United States; Wendy Hoskins, University of Nevada, Las Vegas, United States; Randall Astramovich, University of Nevada, Las Vegas, United States

Graduate level counselor education involves a variety of learning experiences and instructional methods designed to help new counselors integrate theory and practice. In particular, understanding the beliefs that counselors-in-training hold in regard to counseling theory, skills, and knowledge (i.e., counseling epistemology) helps to better prepare them for working effectively with students/clients. The aim of the current study is to explore the development of beliefs about counseling epistemology among beginning master's students enrolled in a theory-based Counselor Education course. Forty-seven students participated (Females = 37, Males = 10, Mean Age = 28.65) in the study during their first semester of entering a Master's level Counselor Education Program in the U.S. Paired-samples t tests results indicate that students' at the end of the entry-level course viewed counseling knowledge as more complex and integrated (rather than made up of simple, unrelated facts). This may be due, in part, to being exposed to the course content that includes a number of theories and skills associated with counseling. Additional implications for learning and instruction are also discussed.

Aims

Graduate level counselor education involves a variety of learning experiences and instructional methods designed to help new counselors integrate theory and practice. In particular, understanding the beliefs that counselors-in-training hold in regard to counseling theory, skills, and knowledge (i.e., counseling epistemology) helps to better prepare them for working effectively with students/clients. The aim of the current study is to explore the development of beliefs about counseling epistemology among beginning master's students enrolled in a theory-based Counselor Education course.

Framework

A growing body of research literature supports that counseling students' general beliefs about knowledge and knowing can change over the course of their training (e.g., Fong, Borders, Ethington, & Pitts, 1998). One framework used to consider this growth is based on the work of Perry's (1970) theory of general epistemological development that includes three broad levels: 1) Dualist (i.e., knowledge is seen as right/wrong), 2) Multiplist (i.e., knowledge is considered completely relative and based on personal views), and 3) Evaluativist (i.e., knowledge is viewed as relative but certain within contexts based on evidence) (see also Kuhn & Weinstock, 2002).

Using Perry's scheme, Granello (2002) found longitudinal evidence to support this developmental view over the course of counseling students' training and that shifts in beliefs were most associated with interaction with clients later in their educational experience (e.g., counseling students close to completing their programs had more advanced or evaluativist views).

Epistemological development can also be examined in terms of specific and interrelated dimensions of epistemological beliefs (Schommer, 2004) and research supports that these beliefs can be domain-specific (Muis, Bendixen, & Harle, 2006) and/or topic-specific (Braten & Stromso, 2005). To gain a more nuanced view of student counselors' epistemic beliefs we adapted and used a measure developed by Braten and colleagues (Braten, 2006) that assesses four dimensions of counseling knowledge and knowing. Each dimension is based on a continuum of beliefs ranging from more naïve views to more advanced beliefs and includes: 1) Certainty of knowledge about counseling (i.e., absolute truth exists – knowledge is tentative and evolving), 2) Simplicity of knowledge about counseling (i.e., knowledge is based on simple, discrete facts – knowledge is complex and highly integrated), 3) Source of knowledge about counseling (i.e., knowledge resides outside the self – knowledge is constructed), and 4) Justification of knowing about counseling (i.e., knowledge can be justified by what feels right or from authority – knowledge is based on critical thinking and evaluation).

Methodology

Participants. Forty-seven students participated (Females = 37, Males = 10, Mean Age = 28.65) in the study during their first semester of entering a Master's level Counselor Education Program in the U.S. Theory-Based Practice for use in the counseling setting is a fundamental entry course in a Counselor Education Program. The curriculum and instructional methods are developed to incorporate knowledge components including: an understanding of basic theories of counseling, a better understanding of the student's own views of counseling, and to understand the process of building collaborative relationships within the counseling experience. In addition to knowledge, there is a skills-based curriculum that focuses on student's ability to: incorporate methods of theory-based interventions in the counseling setting, to incorporate the core skills of attending and responding in the counseling experience, and to better understand their own personal philosophy of counseling.

Measures. As was described previously, we adapted and used a version of a topic-specific measure of epistemological beliefs developed by Braten (2006). This measure contains 49 items based on a 10-point Likert scale and includes four

dimensions of epistemological beliefs related to counseling: 1) Certainty of counseling knowledge, 2) Simplicity of counseling knowledge, 3) Source of counseling knowledge, and 4) Justification for knowing about counseling.

In addition, students were asked to identify one of three theoretical umbrellas (pre and post) that seemed to fit their personhood best. The three theoretical umbrellas include: 1) Psychoanalytic/Psychodynamic, 2) Behavioral/Cognitive Behavioral, and 3) Humanistic/Transpersonal (Nye, 1992). We were interested in student selection as an indicator of personal and professional growth, insight to self, and level of personal autonomy as indicated by the Spectrum Model of Counseling Theories (Astramovich, 2002).

Procedure.

The two questionnaires, along with a demographic sheet, were administered at the beginning and the end of the course.

Findings

To investigate if there were shifts in students beliefs about counseling over the course of the semester, means on each of the four dimensions of epistemological beliefs were compared (pre and post) using paired-samples t tests.

The Simple Knowledge dimension showed a significant increase in mean from pre ($M = 78.11$) and post ($M = 83.14$) at the Interestingly, the Justification of Knowledge dimension slightly decreased for the pre ($M = 87.15$) and post ($M = 86.58$). In addition, preliminary analyses indicate that 30% of the counseling students changed their theoretical umbrella at the end of the course.

Theoretical/Educational Significance

The findings of the current study offer a number of important implications for counselor education. To begin with, we see the more topic-specific view of counseling epistemology (Braten, 2006) explored in this study to be an important addition to the more general view of how counseling students view may change over the course of their training (Granello, 2002). Obtaining information on students' beliefs along the lines of the four epistemic dimensions may offer counselor educators a better chance to more effectively reach their students. For example, students' at the end of the entry-level course viewed counseling knowledge as more complex and integrated (rather than made up of simple, unrelated facts). This may be due, in part, to being exposed to the course content that includes a number of theories and skills associated with counseling. Also encouraging is the fact that other shifts to a more sophisticated view of counseling knowledge were apparent at the end of the course.

Critical analys of models of adult cognitive development and implications for higher education

Eeva Kallio, University of Jyväskylä, Finland

Post-formal relativistic-dialectical thinking has been widely claimed to be a new developmental stage of intellectual development in adulthood. Some other theoretical models come very close to post-formal thinking with overlapping features, such as the study of wisdom and epistemic understanding, as well as models of expertise and critical thinking. No coherent theory exists in fields of post-formal and relativistic-dialectical thinking or in the other fields mentioned, though scholars have claimed that there is some similarity between the models. While some empirical evidence of interconnectedness between them exists, a major difficulty lies in the theoretical definition of concepts. Concept of integrative thinking is suggested to be used as substitute for mentioned terms. Implications for teaching integrative thinking will be discussed especially in the field of higher education.

Relativistic-dialectical postformal thinking in adulthood Research on adult thinking has aroused keen interest in the topic in different fields of research during the last few decades. Indeed, scholars from separate traditions of thought have introduced different conceptualizations. There seems to be at least some consensus as to the basic characteristics as shown in meta-theoretical analyses (Gurba, 2005; Hoare 2006; Kramer, 1983; Marchand, 2001). These numerous adult thinking models have been defined as focus to relativistic-dialectical thinking (Kramer, *ibid.*). Three features are thus included: the realization of the relativistic nature of knowledge, an acceptance of contradiction, and integration of contradiction into whole. Adult cognitive development is thus described with the concept of post-formal thinking (Bassett, 2006). Wisdom, epistemic understanding and expertise knowledge. The word wisdom has many meanings: it is a complex phenomenon and several different conceptualizations have been made (Bassett, *ibid.*). According to Baltes and Staudinger (2000) concept of relativistic-dialectical post-formal thinking is a cognitive sub-component of wisdom, indicating that the relationship between these constructs is supposed to be close. Wise action is defined to include integration of will, emotion and thinking. Research on epistemic understanding is understood as the study of assumptions about the certainty of knowledge claims, argumentation, and the limits of knowledge (Kitchener, King & DeLuca, 2006; Baxter-Magolda, 2004). The traditions in the study of critical thinking

(Phillips & Bond, 2004) is also related variations on the theme. Also, the study of expertise in adulthood is an established branch of research (Merriam & Clark, 2006). According to a brief definition of expertise, one is able to make judgements with practical experience in complex situations based on tacit knowledge (Bereiter & Scardamalia, 1993). Preliminary empirical research on the interconnectedness between the mentioned models (post-formal relativistic-dialectical thinking, wisdom, and epistemic understanding) suggests that they indeed share common features and, thus, gives us reason to assume that they deal, at least partially, with the same phenomenon (e.g. Baltes & Staudinger, 2000; Kitchener, King, DeLuca 2006). As an example, scholars have identified a connection between wisdom and relativistic-dialectical beliefs (Lyster, 1996; Kramer, 2003). Theoretical analysis also indicate common features between models (Kallio, in press). Integrative thinking as alternative term and its' pedagogical implications However, clarification the nomenclature of mentioned models shows that there are major problems in using philosophical terminology in psychological theorization (Kallio, *ibid.*). Also, overlapping features of mentioned models should be taken seriously, as assumption of epistemic relativism and synthetizing knowledge. It is suggested that the most apt candidate as a common core of models would be the term 'integrative thinking' (*ibid.*). The integration of mental actions seem to be the 'hard core' in different models. For example, in the field of the development of epistemic understanding, it refers to coordination of the different sources of knowledge, as expert knowledge and one's subjective experiences (Limon, 2006), and in another case, several subcomponents of the psyche are integrated (e.g. emotion, thinking, and conation) in wise action (Yang, 2008). Implications for training of integrative thinking in higher education are of importance as it is question of adult cognitive development. Model of integrative pedagogy (Tynjälä & Kallio, 2010) will be thus discussed, especially in connection to university pedagogy and training of scientific thinking.

References

- Baltes, P. & Staudinger, E. (2000). Wisdom. A metaheuristic (pragmatic) to orchestrate mind and virtue towards excellence. *American Psychologist*, 55(1), 122-136.
- Bassett, C. (2006). Laughing at gilded butterflies: integrating wisdom, development and learning. In C. Hoare (Ed.), *Oxford handbook of adult development and learning* (pp. 281-306). New York: Oxford University Press.
- Baxter-Magolda, M. (2004). Evolution of a constructivist conceptualization of epistemological reflection. *Educational Psychologist*, 39(1), 31-42.
- Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves: an inquiry into the nature and implications of expertise*. Chicago: Open Court.
- Gurba, E. (2005). On the specific character of adult thought: controversies over post-formal operations. *Polish Psychological Bulletin*, 36(3), 175-185.
- Hoare, C. (2006). *Handbook of adult development and learning*. New York: Oxford University Press.
- Kallio, E. (in press) Integrative thinking is the key: an evaluation of current research into the development of thinking in adults (Theory & Psychology)
- Kitchener, K., King, P., & DeLuca (2006). Development of reflective judgement in adulthood. In Hoare, C. (Ed.), *Handbook of adult development and learning* (pp. 73-98). New York, NY: Oxford University Press.
- Kramer, D. (1983). Post-formal operations? A need for further conceptualization. *Human Development*, 26, 91-105.
- Kramer, D. (2003). The ontogeny of wisdom in its variations. In J. Demick & C. Andreoletti (Eds.), *Handbook of adult development* (pp. 131-152). New York, NY: Kluwer.
- Limon, M. (2006). The domain generality-specificity of epistemological beliefs: A theoretical problem, a methodological problem or both? *International Journal of Educational Research*, 45(1-2), 7-27.
- Lyster, T. (1996). A nomination approach to the study of wisdom in old age. PhD dissertation. Concordia University, Montreal, Quebec, Canada.
- Marchand, H. (2001). Some reflections on post-formal thought. *The Genetic Epistemologist*, 29(3). Retrieved 2010-04-01 from <http://www.piaget.org/GE/2001/GE-29-3.html>
- Merriam, S. & Clark, M. (2006). Learning and development: the connection in adulthood. In C. Hoare (Ed.), *Handbook of adult development and learning* (pp. 27-51). New York, NY: Oxford University Press.
- Phillips, V. & Bond, C. (2004). Undergraduates' experiences of critical thinking. *Higher Education & Development*, 23(3), 277-294.
- Tynjälä, P. & Kallio, E. (2011). Integrative Pedagogy for Developing Professional Expertise in Higher Education. Submitted manuscript.
- Yang, S-Y. (2008). A process view of wisdom. *Journal of Adult Development*, 15(2), 62-75.

Mental Representations of the Magnitude of Fractions

Florence Gabriel, University of Cambridge, United Kingdom; Denes Szucs, University of Cambridge, United Kingdom; Alain Content, Universite Libre de Bruxelles, Belgium

This research investigated the mental representations of the magnitude of fractions and their development. There is an on-going debate in the literature about the nature of fractions processing in adults. Some authors argue that fractions processing is componential, that is, based on the magnitude of numerators and denominators. Others argue that fractions processing is hybrid that is, based on the magnitude of components and the global magnitude of fractions. Experiment 1 examined the mental representations of the magnitude of fractions in adults. Participants carried out two experiments: a Same/Different task and a Numerical Comparison task. In the Same/Different task, participants were asked to answer same when a pair of fractions shared the same global magnitude and different when global magnitudes were different. In the Numerical Comparison task, participants had to determine which one of two fractions was larger. Results showed different strategies in both tasks. In the Same/Different task, participants based their judgments on the magnitude of components only. In the Numerical Comparison task, they used hybrid strategies. Experiment 2 explored the development of those mental representations. 5th-, 6th- and 7th-graders were tested with the same paradigms as in Experiment 1. Results showed that from 6th-grade, children develop the same strategies as the ones used by adults. This finding could have implications for teaching fractions.

Introduction

Although fractions have interested psychologists for a long time, little is known about their processing and representations. The aim of this research was to determine how fractions are processed and represented in numerate adults (Experiment 1) and how they develop with education (Experiment 2). Previous studies in adults showed that fractions processing can be whether based on the magnitude of the numerators and denominators (componential) [1,2] or based on the global magnitude of fractions and the magnitude of their components (hybrid) [3,4].

Experiment 1

Experiment 1 contrasted the evaluation of fractions in a semantic Same/Different task (participants decided whether two fractions were numerically equivalent) and in a Numerical Comparison task (participants decided which of two fractions was larger). We hypothesized that the magnitude of the components would always be activated, but the global magnitude of fraction would be optional. The objective of Experiment 1 was to examine participants' magnitude decision strategies in two different experimental contexts, both requiring making judgments on the magnitude of fractions.

Method

Participants were 15 graduate students.

Fractions with denominators up to 9 were used. The magnitude of fractions was always less than 1. In the Same/Different task, there were three conditions: Identical (e.g. $1/2_1/2$), Equivalent (e.g. $1/2_2/4$) and Different (e.g. $1/2_2/3$). In the Numerical Comparison task, we used the same fractions as in the Different condition of the Same/Different task.

Results

Task \times Global Distance repeated measures ANOVA was run on response times. There was a significant task \times global distance interaction: $F(2,28) = 15.974$, $p = 0.000$. Tukey post hoc tests showed a global distance effect in the Numerical Comparison task, but not in the Same/Different task.

In the Numerical Comparison task, a linear regression analysis was run showing a global distance effect ($R^2 = 0.404$, $b = -0.635$, $F(1,89) = 60.236$, $p = 0.000$).

In the Same/Different task, regression analysis showed no global distance effect ($R^2 = 0.036$, $b = -0.190$, $F(1,89) = 3.335$, $p = 0.071$) for different pairs of fractions, but a significant distance effect between denominators was observed ($R^2 = 0.069$, $b = 0.263$, $F(1,89) = 6.636$, $p = 0.012$).

Discussion

Our results showed that different strategies were used in both tasks. There were only distance effects between components in the Same/Different task. In contrast, in the numerical comparison task, there was a global distance effect determined by global fraction magnitudes and componential distance effects. Subjects used hybrid processing strategies. Thus, even when the same stimuli were used in both tasks, and even when both tasks required accessing the magnitude of the fractions, participants applied different heuristics to perform both experiments.

Experiment 2

We also investigated the development of fractions processing in children. 5th-, 6th- and 7th-graders were tested with the same tasks as in Experiment 1, a Same/Different task and a Numerical Comparison task. Our main research

question was to determine if younger children who are still learning fractions use the same kind of strategies as adults and if so, at what point in the learning process those different strategies appear.

Method

Forty 5th-, 6th- and 7th-graders were tested. The procedure and stimuli were the same as in Experiment 1. Results A repeated measures ANOVA was run on response times with tasks and distance as within-subjects factors, and grade as between-subjects factors, revealing a significant interaction between task and distance, $F(2, 64) = 7.95$, $\eta^2_p = 0.181$, $p = 0.001$. Tukey post hoc tests showed a global distance effect in the Numerical Comparison task and not in the Same/Different task.

Regression analyses were run in the Numerical Comparison task, revealing no global distance effect in 5th-grade, but a global distance effect and a distance effect between denominators in 6th-grade ($R^2 = 0.05$, $b = 0.223$, $p = 0.035$) and 7th-grade ($R^2 = 0.052$, $b = 0.228$, $p = 0.030$). They also showed a significant distance effect between denominators in 6th-grade ($R^2 = 0.112$, $b = -0.334$, $p = 0.001$) and 7th-grade ($R^2 = 0.156$, $b = -0.395$,

Regression analyses showed no global distance effect in the Same/Different task, but a distance effect between denominators in 6th-grade ($R^2 = 0.047$, $b = 0.216$, $p = 0.040$) and 7th-grade ($R^2 = 0.035$, $b = 0.188$, $p = 0.05$). Discussion Results showed that pupils used different strategies in both tasks. In the Same/Different tasks, they used componential strategies. In the Numerical Comparison task 6th- and 7th-graders used hybrid strategies, suggesting that pupils start developing mental representations of the magnitude of fractions from 6th-grade. In 5th-grade, correct responses rates were low and results showed no evidence of holistic representations of the magnitude of fractions.

Conclusion

This research investigated how the magnitudes of fractions are mentally represented and how they develop. Experiment 1 examined the representations of the magnitudes of fractions in adults, and Experiment 2 the representations in children. Two paradigms were used: a Same/Different task and a Numerical Comparison task. Adults used different strategies in both tasks. Componential strategies were used in the Same/Different task, and hybrid strategies were used in the Numerical Comparison task. As it has been shown with adults, children are able to flexibly use different strategies to process the magnitude of fractions from 6th-grade. Further research should investigate how the global magnitude of fraction can be accessed. A better understanding of the nature of the mental representations of fractions could lead to the development of more adequate teaching methods.

References

- [1] Bonato M. et al. (2007). The mental Representation of Numerical Fractions: Real or Integer? *Journal of Experimental Psychology: Human Perception and Performance*, 33 (6), 1410-1419
- [2] Kallai, A. & Tzelgov, J. (2009). A Generalized Fraction: An Entity Smaller Than One on the Mental Number Line. *Journal of Experimental Psychology : Human Perception and Performance*, 35(6):1845-64
- [3] Meert, G. et al. (2008). Rational numbers: Componential versus holistic representation of fractions in a magnitude comparison task, *The Quarterly Journal of Experimental Psychology*, DOI:10.1080/17470210802511162
- [4] Ischebeck, A. et al. (2009). The processing and representation of fractions within the brain. An fMRI investigation. *NeuroImage*, 47, 403–413

Early quantity-number- competencies in three year old children

Christina Balke, University of Hildesheim, Germany; Kirsten Schuchardt, Institute for Psychology, Germany; Claudia Maehler, Institute of Psychology, Germany; Dietmar Grube, University of Oldenburg, Germany

In the present work, we investigated the psychometric assessability and factorial structure of basic numerical competences in children at the age of 3;6 years. For this purpose, we created eight numerical tasks, while for each task we referred to one of the four categories of basic numerical competences as distinguished by Krajewski (2003). Krajewski worked out a dimensional structure of numerical basis competencies in preschool children one year before their school enrolment. This structure comprised of two basic dimensions, (pre-) knowledge of quantities and of Arabic numbers, while the latter is further subdivided into Arabic number knowledge, counting ability and arithmetic competencies.

Using AMOS, we conducted a Confirmatory Factor Analysis (CFA) based on the maximum likelihood estimation principle in order to test the factorial validity of the Krajewski model in the investigated age group. Basically, the CFA revealed a good model fit with coefficients that all met the standard criterion. Thereby, sub-tasks (i.e. the associated

latent variables) related to number knowledge yielded an especially good representation while corresponding factor loadings were slightly reduced for quantity knowledge, but still in a fully satisfactory range.

Our findings strongly suggest that children already at the age of 3;6 possess a differentiated set of numerical and quantity competencies which can be reliably measured. The structure of numerical competencies appeared to correspond to the one which has been repeatedly defined for later developmental stages.

Gathering knowledge about the development of basic (phonological and numerical) competencies at preschool age and creating psychometric instruments to quantify them provides the basis for the early detection of children at risk for later developmental disorders and the consequent initiation of adequate therapeutic-preventive interventions. This specifically concerns numerical competencies and it is, hence, a question of high importance and relevance from which age on such competencies can be found and reliably measured. A series of studies, which used habituation paradigms (e.g. Starkey & Cooper, 1980), strongly suggests the existence and measurability of basic numerical competencies already in infancy. Wynn (1992) even found evidence for a primitive concept of addition and subtraction already in 4-5 month old children. Most importantly, these early numerical or quantity competencies appear to have a relevant predictive value. For instance, in a four-year longitudinal study, Krajewski und Schneider (2006) could show that quantity and number competencies in preschool children can efficiently predict later school performance in mathematics.

In the present work, we investigated the psychometric assessability and factorial structure of basic numerical competences in children at the age of 3;6 years. For this purpose, we created eight numerical tasks, while for each task we referred to one of the four categories of basic numerical competences as distinguished by Krajewski (2003). More specifically, Krajewski worked out a dimensional structure of basic numerical competencies in preschool children one year before their school enrolment. This structure comprised of two basic dimensions, quantity (pre-) knowledge and (pre-) knowledge of Arabic numbers, while the latter is further subdivided into Arabic number knowledge, counting ability and arithmetic competencies. This leads us to a total of four relevant dimensions in the present work - one dimension representing quantity (pre-) knowledge and three dimensions representing pre-knowledge of Arabic numbers - for which we created tasks (see below).

Thereby, our basic aim was to confirm the factorial structure of numerical competence as postulated by Krajewski (2003) for our younger age group. For our purpose, we created three tasks to represent the category "Arabic number knowledge", wherein one task comprising 17 items involved number naming (German label: "Benennen arabischer Zahlen", abbreviated as BAZ) and a second task comprising 6 items required transcoding of verbal number information into a number symbol (by means of a choice selection) (German label: "Transkodieren", abbreviated as T). The third task of this category was called "knowledge of number in everyday life" (German label: "Zahlenwissen im Alltag", abbreviated as ZA) and comprised 10 items in form of questions like "how many fingers are on one hand" or "how many wheels has a car". The category "counting ability" was operationalized by two tasks, one task requiring children to verbalize (i.e. to follow up) the number sequence beginning from 1 going as far as they know (German label: "Aufsagen der Zahlenreihe", abbreviated as AZ) and a second task of 11 items requiring counting of visually presented objects (German label: "Abzählen von Objekten", abbreviated as AO). Krajewski's "computational abilities" were implemented in two further tasks. In one task comprising 7 items, children were to add two simultaneously presented amounts of geometric objects (i.e. cubes) (German label: "Addition zweier sichtbarer Mengen", abbreviated as AzsM) while in the second task 8 items required to add objects which were presented successively and that thus had to be mentally maintained (i.e. a varying number of cars that successively vanished in a garage) (German label: "mentales Operieren mit Objekten", abbreviated as MOO). The category "amount or number pre-knowledge" was assessed in one task referred to as "amount or number comparison" (German label: "Mengenvergleich", abbreviated as MV) including 24 items in which children had to make a "more or less" decision with regard to two simultaneously presented amounts of objects (e.g. balls).

The tasks were administered during the morning hours to a total of 170 children (93 boys /77 girls) in 15 different kindergardens of the city of Hildesheim. The mean age of the investigated children was 3;6. We expected to confirm the basic factorial structure of numerical competence as postulated by Krajewski (2003), which so far has only been demonstrated for later developmental stages.

Using AMOS (Analysis of Moment Structures), we conducted a Confirmatory Factor Analysis (CFA) based on the maximum likelihood estimation principle in order to test the factorial validity of the Krajewski model in the investigated age group. Basically, the CFA revealed a good model fit with coefficients that all met the standard criterion (e.g. CFI>.95; Hu & Bentler, 1999). Thereby, sub-tasks (i.e. the associated latent variables) related to number

knowledge yielded an especially good representation while corresponding factor loadings were slightly reduced for quantity knowledge, but still in a fully satisfactory range.

Our findings have a significant practical relevance. They strongly suggest that children already at the age of 3;6 possess a differentiated set of numerical and quantity competencies which can be reliably measured. The structure of numerical competencies appeared to correspond to the one which has been repeatedly defined for later developmental stages (cf. Krajewski, 2003).

References:

- Fuson, K.C. (1988). *Children's counting and concepts of number*. New York: Springer.
- Hu, L. & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling*, 6 (1), 1-55.
- Krajewski, K. (2003). *Vorhersage von Rechenschwäche in der Grundschule*. Hamburg: Dr. Kovac.
- Krajewski, K. & Schneider, W. (2006). Mathematische Vorläuferfertigkeiten im Vorschulalter und ihre Vorhersagekraft für die Mathematikleistungen bis zum Ende der Grundschulzeit. *Psychologie in Erziehung und Unterricht*, 53, 246-262.
- Krajewski, K., & Schneider, W. (2009). Early development of quantity to number-word linkage as a precursor of mathematical school achievement and mathematical difficulties: Findings from a four-year longitudinal study. *Learning and Instruction*, 19, 513-526.
- Starkey, P. & Cooper, R.G. (1980). Perception of numbers by human infants. *Science*, 210, 1033-1035.
- Wynn, K. (1992). Issues concerning a nativist theory of numerical knowledge. *Mind & Language*, 7, 367-381.

THEMATIC POSTER

Beliefs

Reformed Mindset and Knowledge: An Analysis of Teachers Beliefs and Knowledge

Margareta Pop, NC State University, United States; John Nietfeld, NC State University, United States

The purpose of this study was to investigate Elementary Education (ELM) and Mathematics, Science and Technology Education (MSTE) preservice teachers' beliefs about reformed science teaching and learning as related to self-efficacy, monitoring accuracy and content knowledge. ELM students reported a higher level of reformed thinking and were less apt to support a realist framework for science teaching than their MSTE peers. However, MSTE students exhibited higher levels of content knowledge, more confidence and more accurate monitoring of that knowledge, and higher levels of self-efficacy for teaching science than ELM students. These discrepancies in preservice teacher knowledge and beliefs have important implications for preservice teacher education and classroom learning.

Purpose

The purpose of this study was to investigate Elementary Education (ELM) and Mathematics, Science and Technology Education (MSTE) preservice teachers' (PT) beliefs about reformed science teaching and learning. Learner characteristics such as content knowledge and self-efficacy were explored in relation to science reformed beliefs and beliefs about learning in general.

Theoretical Framework

The National Research Council (NRC, 1996) claims that "to teach science as portrayed by the Standards, teachers must have theoretical and practical knowledge and abilities about science." However, elementary teachers' difficulties in presenting science content are well documented, and many studies have found that elementary teachers do not have basic mathematics and science content knowledge and often hold negative attitudes toward science (Huinker & Madison, 1997; Hill, Rowan, & Ball, 2005). Studies demonstrate a direct relationship between beliefs and innovative instructional practices (Lee, Hart, Cueves, & Enders, 2004; Richardson & Liang, 2008).

In science education it is not uncommon for pre-service teachers to come to their teacher preparation programs with traditional beliefs about these subjects: a belief that science is a fixed body of knowledge to be delivered to students usually through lectures. Thus, the need to examine the complex relationship between teacher preparation programs, preservice teacher knowledge, and professional practice (Cochran-Smith & Zeichner, 2005) continues to be great and researchers are calling for enlisting the support of multiple disciplines and methods (Borko, & Whitcomb, 2008; Wilson, Floden, & Ferrini-Mundy, 2002) to evaluate teacher education in order to deliver better instruction. In light of this need to examine the nature of knowledge and beliefs more fully across program areas we addressed the following research questions in this study:

1. How do ELM preservice teachers differ from MSTE teachers with respect to their beliefs about reformed science, teaching science as inquiry, self-efficacy and science content knowledge?

2. What are the relationships in general, between preservice teachers' beliefs about reformed science, teaching science as inquiry self-efficacy and science content knowledge? Methodology

Participants included 202 PTs. Of these 103 were ELM students, 18 were MSTE Science Education students, and 81 were MSTE Math & Science Education students (dual specialization). Most students were juniors ($N = 85$) and seniors ($N = 71$); also four freshmen, 29 sophomores, and 13 other.

Participants completed a 20 min survey in one session, measuring: Beliefs About Reformed Science Teaching and Learning Questionnaire (BARSTL, Sampson & Benton, 2006), Science Teaching Efficacy Beliefs (STEBI, Enochs & Riggs, 1990), Epistemic Beliefs Inventory (EBI, Schraw, Bendixen, & Dunkle, 2002), Epistemological World View scale (Schraw & Olafson, 2002), Science Knowledge Test (Praxis II), Monitoring Accuracy (Schiffman, Reynolds, & Young, 1981; Schraw & Roedel, 1994).

Results

A number of significant differences emerged between groups on the science content and beliefs inventories using ANOVA procedures. With regard to science knowledge ELM students ($M = 11.45$, $SD = 2.55$) scored significantly lower, $F(2, 191) = 5.46$, $p = .005$, than the MSTE Math& Science ($M = 12.51$, $SD = 2.76$) and the MSTE Science students ($M = 13.17$, $SD = 2.26$). MSTE Science students ($M = 67.49$, $SD = 14.84$) were more confident, $F(2, 190) = 5.00$, $p = .008$, in their answers than either the ELM ($M = 54.50$, $SD = 15.30$) or MSTE Math&Science students ($M = 55.13$, $SD = 17.72$), were more accurate ($M = .31$, $SD = .09$) in their judgments, $F(2, 188) = 4.47$, $p = .013$, than the MSTE Math& Science students ($M = .37$, $SD = .08$), and were nearly perfect in their overall bias ($M = .02$, $SD = .13$, where .00 is complete lack of bias) for over or underconfidence.

With regard to beliefs about teaching and learning, ELM students ($M = 2.75$, $SD = 1.08$) were significantly less apt to subscribe to the realist teaching model, $F(2, 199) = 6.90$, $p = .001$, in comparison to the MSTE Math & Science students ($M = 3.30$, $SD = 1.03$) with borderline significant differences ($p = .056$) with MSTE Science students ($M = 3.39$, $SD = 1.33$). Scores on the EBI revealed only one significant difference between groups, on omniscient authority $F(2, 198) = 3.39$, $p = .036$, where ELM students ($M = 17.23$, $SD = 2.90$) subscribed more highly than MSTE Math & Science students ($M = 16.09$, $SD = 3.07$). MSTE Science students ($M = 53.72$, $SD = 5.72$) reported significantly higher levels of perceived self-efficacy for teaching science, $F(2, 197) = 33.30$, $p = .000$, $M = 41.96$, $SD = 8.33$ and with borderline ($p = .06$) higher levels than the ELM students ($M = 49.50$, $SD = 6.48$). On the BARSTL, $F(2, 197) = 33.73$, $p = .000$, $M = 85.29$, $SD = 7.19$ students scored significantly higher than their MSTE Science ($M = 76.83$, $SD = 6.59$) and MSTE Math& Science ($M = 78.22$, $SD = 4.99$) peers indicated stronger beliefs aligned with current reform movement in science education.

Results from the bivariate correlations of the major study variables reveal that higher scores on the BARSTL relate significantly to more complex views of knowledge (negative correlations with simplex knowledge, complex knowledge, quick learning, and fixed ability). BARSTL scores also show positive correlations with science teaching efficacy however no relationship with science knowledge. In addition, BARSTL scores correlate negatively with the realist stance and positive with the contextualist and relativist stance.

Findings and Theoretical Implications

In sum, MSTE Science Education students exhibited higher levels of content knowledge, more confidence and more accurate monitoring of that knowledge, and higher levels of self-efficacy for teaching science than ELM students. However, ELM students reported a higher level of science reform and were less apt to support a realist framework for science teaching than their MSTE peers. Interestingly, there was no correlation between science knowledge and scores on the BARSTL nor did the groups differ in their EBI scores. The discrepancy between the ELM and MSTE students in knowledge and beliefs is an important finding for PTs education. It is reasonable to assume that MSTE students would score higher in content knowledge but why would they not subscribe to reformed mindset as much as the ELM students? This is critical for teacher education programs because beliefs and knowledge should be aligned.

Math Exam-Related Anticipatory Joy and its Proximal and Distal Personal Antecedents

Iris Dinkelmann, Zurich University of Teacher Education (PHZH), Switzerland; Alex Buff, University of Teacher Education, Switzerland

Emotions are considered an integral component of practically all school-related activities of students, and it is assumed that they play a central role in learning processes, upon which they have a long-lasting influence (cf., for example, Linnenbrink, 2006; Pekrun & Schutz, 2007; Schutz, Hong, Cross, & Osbon, 2006). For several years, the focus of interest has not been solely on negative emotions, particularly test anxiety, but rather also on positive emotions such as joy (cf. for example Buff, Reusser, Rakoczy, & Pauli, in press; Goetz, Frenzel, Stoecker, & Hall, 2010). This forms the focus of the current contribution.

Against the background of the Control-Value Theory of Achievement Emotions (cf. Pekrun, 2006; Pekrun, Frenzel, Goetz, & Perry, 2007), the contribution examines the cause-and-effect relationships of subjective control and subjective value, as well as anticipatory joy, in terms of two real-life math exams, taking into account long-lasting mathematics-related beliefs and joy.

Data will be analysed of approximately 200 children, who are participating in the longitudinal study "TRANSITION: Parental support and motivational-affective development in the transition to lower secondary level" (Buff & Reusser, 2008). In line with theory, first path analyses regarding the two math exams show main effects of subjective control and subjective value on anticipatory joy, but no reciprocal effects of anticipatory joy on subjective control in the first exam and on value in the second exam.

Theoretical and educational significance

Emotions are considered an integral component of practically all school-related activities of students, and are assumed to play a central role in learning processes, upon which they have a long-lasting influence (Linnenbrink, 2006; Maehr, 2004; Meyer & Turner, 2002; Pekrun, 2000; Pekrun & Schutz, 2007; Schutz & DeCuir, 2002; Schutz, Hong, Cross, & Osbon, 2006; Schutz & Lanehart, 2002). Although it has been repeatedly mentioned that in terms of their emotional experience in learning and achievement situations, school and university students report positive emotions just as frequently as negative ones, little is known in particular about positive emotions (cf. Goetz, Frenzel, Hall, & Pekrun, 2008; Pekrun, 1992; Pekrun, Goetz, Titz & Perry, 2002a, b; Schutz & Pekrun, 2007). Accordingly, for several years, interest has increasingly turned to positive emotions such as joy (cf. Buff, Reusser, Rakoczy, & Pauli, in press; Goetz, Frenzel, Stoeger, & Hall, 2010; Pekrun et al., 2002b). This forms the focus of the current contribution. Central in this regard is the question of individual proximal and distal antecedents of the experience of anticipatory joy regarding two upcoming math exams.

The Control-Value Theory of Achievement Emotions (CVTAE) (cf. Pekrun, 2000; Pekrun, 2006; Pekrun, Frenzel, Goetz, & Perry, 2007) deems cognitive appraisals of control (subjective control) and value (subjective value) and their interaction, respectively, as central proximal antecedents of exam-related anticipatory joy, whereby "antecedents, emotions, and their effects are thought to be linked by reciprocal causation over time" (Pekrun et al., 2007, p. 16). Considered as central distal antecedents are, on the one hand, long-lasting, domain-specific control and value beliefs, which influence the situation-specific appraisals of control and value (Pekrun et al., 2007; cf. also Boekaerts, 2001; Op't Eynde & Turner, 2006; Schutz et al., 2006), and should thus indirectly unfold an effect regarding situation-specific, exam-related anticipatory joy. On the other hand, it can be assumed that the habitualised enjoyment of a subject exerts an influence on the math-exam-related anticipatory joy (cf. Pekrun et al., 2007).

The theoretically postulated main effects of control and value on joy have been confirmed in several studies (cf. Goetz et al., 2010; Goetz, Pekrun, Hall, & Haag, 2006; Jullien, 2006; Pekrun, 2000; Pekrun & Hofmann, 1999). Moreover, Barrera (2001, cited following Pekrun et al., 2002b, p. 166) and Goetz et al. (2010) were able to prove the theoretically postulated interaction effect of control and value on joy. Regarding the question of the importance of distal antecedents in terms of the interaction both of situation-specific appraisals and situation-specific emotional experience, Seegers and Boekaerts (1993) and Boekaerts (1999; cf. also Boekaerts, 2001) showed that control appraisals mediate the influence of constructs relating to control beliefs on emotional state.

Aims

Research gaps in educational psychology as a whole concern the consideration both of appraisals and emotions in real-life situations and of their distal personal antecedents (cf. Boekaerts, 2001). Specifically with regard to the CVTAE, it can be established that in addition to main effects, interaction effects of subjective control and value on emotions should also be tested, and reciprocal cause-and-effect relationships should be modelled (cf. Goetz et al., 2010; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010).

Against the background of the theoretically postulated cause-and-effect relationships, the available empirical findings, and the research gaps outlined, the poster focuses on

1. examining (reciprocal) cause-and-effect relationships of subjective control, subjective value and anticipatory joy regarding two successive math exams (in a first step without, and in a second step with, consideration of potential interaction effects), and
2. examining the cause-and-effect relationships in these situations, taking into account mathematics-related control and value beliefs and mathematics-related joy measured at an earlier time point.

Methods

The analyses are based on information from approx. 200 12-year-old boys and girls who are participating in the study "TRANSITION: Parental support and motivational-affective development in the transition to lower secondary level" (Buff & Reusser, 2008). Questionnaires were completed on three separate occasions: first relating to mathematics generally (control beliefs, value beliefs, joy), and then following each of two math exams (subjective control 1st/2nd math exam, subjective value 1st/2nd math exam; anticipatory joy 1st/2nd math exam). The whole measurement period spanned from mid-November 2008 to mid-March 2009. The longitudinal design refers to the three measurement time points – within the individual measurement time points, the concern is effectively with cross-sectional data.

Due to the rather small sample size, data analyses are ensuing through path models with manifest variables using Mplus 5.2.

Preliminary Results

Analyses conducted so far are related to the (reciprocal) cause-and-effect relationships of the variables of interest in the two math exams. Examined in this respect were main effects of subjective control and value on anticipatory joy, and main effects of the constructs measured in the first math exam on their manifestations in the second math exam (in the case of anticipatory joy also the reciprocal effects on subjective control and value). As presented in figure 1, the main effects of subjective control and of value on anticipatory joy can be modelled in the postulated manner. A reciprocal effect of anticipatory joy (first math exam) on subjective control or subjective value (second math exam) is not shown by the current data. By contrast, students appear to evaluate the second exam against the background of the first (positive effects of subjective control and value appraisal first exam on the corresponding appraisals second exam), and also experience it against this background (positive effect of anticipatory joy first exam on anticipatory joy second exam).

Fig. 1 First results

In a next step, it is being analysed whether, in addition to main effect, also possible interaction effects of subjective control and value on anticipatory joy exist. Finally, a model will be tested which takes into account the cause-and-effect relationships of the situation-specific constructs when considering the mathematics-related beliefs and mathematics-related joy, as well as indirect effects on anticipatory joy.

Gender differences in the effects of mathematics anxiety on mathematics performance

Amy Devine, Centre for Neuroscience in Education, University of Cambridge, United Kingdom; Kayleigh Fawcett, University of Cambridge, United Kingdom; Denes Szucs, University of Cambridge, United Kingdom; Fruzsina Soltesz, University of Cambridge, United Kingdom

Mathematics anxiety (MA), a state of discomfort associated with performing mathematical tasks, is thought to affect a notable proportion of the school age population. Some research has indicated that MA negatively affects mathematics performance and that girls may report higher levels of MA than boys. The current study compared the MA, test anxiety (TA) and mathematics performance of 433 secondary school children. No gender differences emerged for mathematics performance but levels of MA and TA were higher for girls than for boys. Both genders showed a positive correlation between MA and TA and a negative correlation between MA and mathematics performance. TA was also negatively correlated with mathematics performance, but this relationship was stronger for girls than for boys. When controlling for TA, the negative correlation between MA and performance remained for girls only. Furthermore regression analyses revealed that MA was a significant predictor of performance for girls but not for boys. These results have clear implications for mathematics teaching practices; efforts should be made to reduce MA in the classroom, especially in girls, for which MA appears to have a significant detrimental effect on performance.

Mathematics anxiety (MA) is typically defined as a state of discomfort caused by performing mathematical tasks (Cemen, 1987, as cited in Ma & Xu, 2004). MA can be manifested as feelings of apprehension, dislike, tension, worry, frustration, and fear (Ashcraft & Ridley, 2007; Ma & Xu, 2004; Wigfield & Meece, 1988). MA is related to general anxiety associated with taking tests (test anxiety; TA) however it is regarded as a distinct construct (Ashcraft, Kirk & Hopko, 1998)

Importantly, MA has several negative effects on the learning of mathematics, for example, withdrawal from mathematics classes, avoidance of mathematics courses and careers, and the development of negative attitudes towards tasks involving mathematics (Ho et al., 2000; Ma & Xu, 2004). The relationship between MA and mathematics performance has been studied extensively. Past studies have shown small negative correlations between mathematics performance and MA (Hembree, 1990; Ma, 1999), indicating that those with high mathematics anxiety show poorer mathematics achievement.

Two of the most important, though still not adequately responded questions are whether a gender difference exists in MA and whether MA affects the mathematics performance of girls and boys differently. Hembree's 1990 meta-analysis revealed that females reported higher levels of mathematics anxiety than males (Hembree, 1990). More recent studies investigating MA in school children have not consistently shown gender differences, with some studies replicating Hembree's finding (e.g., Baya'a, 1990; Jain & Dowson, 2009; Ma & Cartwright, 2003; Ma & Xu, 2004; Yuksel-Sahin, 2008) whereas others have not found any difference in reported levels of MA with gender (e.g., Birgin et al.; Chinn, 2009; Gierl & Bisanz, 1995; Newstead, 1998).

Similarly, evidence for gender differences in the effects of MA on mathematics performance is inconclusive. Some studies have shown that MA affects males' and females' mathematics performance differently (e.g., Betz, 1978; Ma and Xu, 2004; Wahl, 1987) whereas other studies have failed to find gender differences in the relationship between MA and performance, (e.g., Ma, 1999; Meece, Wigfield and Eccles 1990; and Sepie and Keeling, 1978).

Given that the findings reported in the literature are contradictory, the current study sought to investigate whether gender differences occur in overall levels of MA and whether MA affects girls' and boys' mathematics performance differently. Furthermore, the current study controlled for the children's levels of TA.

Method

482 pupils in Year 7, 8 and 10 were studied in total. 49 pupils were excluded from the investigation because they did not give at least one correct response in the mathematics test. The remaining 433 children were included in the data analysis.

The Abbreviated Math Anxiety Scale (AMAS; Hopko et al, 2003) was used to measure levels of maths anxiety. This is the shortest valid maths anxiety scale; it contains only 9 items, uses a 5-point scale and has been shown to be just as effective as longer MA questionnaires (e.g., MARS, sMARS; Richardson & Suinn, 1972; Suinn & Winston, 2003). A modified version of Sarason's Test Anxiety Scale (Sarason, 1978) was used to measure general TA. This was a 36-item questionnaire, with 'True/False' response options.

Standardised mental mathematics tests were used in order to assess mathematical performance. Each year group was given a specific mathematics test suitable for their age range.

Results

- A MANOVA was run on MA, TA and performance scores with factors Gender and Year.
 - o The main effect of Gender was significant
 - o Year was marginally significant ($p=0.053$).
- Univariate ANOVAs were run on each dependent variable with factors and Gender and Year.
 - o MA was higher in girls than in boys
 - o TA was also higher in girls than in boys
 - o Maths performance did not differ by gender, but differed by Year ($p=0.039$). The performance difference was marginally significant between Years 7 and 8 (Tukey $p=0.052$).
- Pearson correlations were computed with age, Year, MA, TA and performance.
 - o Girls: MA positively correlated with TA ($r=.363$;
 - o Boys: MA was positively correlated with TA ($r=.457$;
- Partial correlations were used to control for the effect of TA.
 - o Girls: MA remained strongly negatively correlated with performance ($r=-.301$;
 - o Boys: the correlation of MA and performance was not significant ($r=-.104$;
- Stepwise multiple linear regression was used to assess the relationship of mathematics performance, MA and TA. MA and TA were used as predictors of mathematics performance.
 - o Girls: the regression model was highly significant ($p2$). MA was a significant predictor variable of performance (p
 - o Boys: the overall model reached significance

Conclusions

In line with past research, the results of the current study suggest that cognitive and affective variables impact the mathematics performance of secondary school children. Overall, girls showed higher levels of MA than boys, however this may be because females are more willing to report anxiety than males. Nonetheless, girls showed a strong negative relationship between MA and mathematics performance, which remained even when TA was controlled for. On the contrary, boys only experienced marginal effects of general TA on performance and when TA was controlled for, did not show a relationship between MA and performance. These results suggest that teaching practices need to

take into account anxiety associated with performing mathematics tasks and efforts should be made to address anxiety in the mathematics classroom. The results suggest attention should be directed towards reducing MA in girls, whose performance may be more susceptible to the negative effects of MA; however further research is needed to ascertain the direction of this relationship.

Patterns in the relationship between Conceptions of Learning and Epistemic Beliefs

Walter Terrazas, Universidad Catolica del Norte, Chile; Mariane Frenay, Universite catholique de Louvain (U.C.L.), Belgium

Traditionally research about examining Conceptions of learning and Epistemic beliefs suggests a consonance relationships between them. However, several methodological and theoretical issues must be considered to evaluate the scope of this claim. The main goal of this paper is to analyze the relationship between Conceptions of learning and Epistemic beliefs in the light of perceptions about learning demands. Based on comparative method (Rihoux & Grimm, 2006), a particular combination of elements from both representations was used to analyze each individual case. Participants were thirty eight undergraduate students from several programs from Universidad Católica del Norte at Antofagasta, Chile. Data were collected by individual interviews, using open questions about (1) conceptions of learning, and (2) perception about learning demands; also the dilemma about the construction of the Egyptian Pyramids was used to identify (3) epistemic beliefs. To analyze relationships among these 3 elements, individual profiles were used as a main methodological strategy.

Results indicate two types of relations between Conceptions of Learning and Epistemic Beliefs. A Consonance relationship, when those two elements go in the same direction. A Non-Consonance relationship when those elements go in a different direction. Additionally, both types of relationships seem to be associated with their particular level of correspondence with the perception about learning demands. The implications of the analysis of individual profiles as a methodological strategy to study this relationship are examined.

The manner on which students represent their academic work has an important effect on the approach and strategies used to learn, but also on their academic performance (Boulton-Lewis et al., 2003; Cano, 2005; Debacker et al., 2008; Trigwell & Ashwin, 2006). To examine these representations, two different theoretical frameworks have been developed. The first is called Conceptions of Learning and it refers to representations related to learning experiences. The second one, it is called Epistemic Beliefs and it refers to representations relate with the nature of knowledge and with act to know (Hofer & Pintrich, 1997; Marton et al., 1993). Even when both frameworks have been developed in an independent way, it is possible to observe some similarities between them in the following areas: the importance of knowledge in the process, the degree of complexity that can be captured by these representations, the role that individuals play in their learning process and in their knowledge generating, and also on the role played by educational experiences changing those representations. Based on these similarities, some studies have focused on identifying relations between both types of representations. These studies postulate that representations imply different degrees of complexity, and also that the variation on complexity explains the unequal distribution of resources used by students to face their academic challenges (Cano & Cardelle-Elawar, 2004; Lonka & Lindlom-Yläne, 1996). Although the results of these studies suggest a consonance relationship between conceptions of learning and epistemic beliefs, several conceptual and methodological issues must be taking into account to evaluate validity and scope of those previous claims. In that sense, Lonka and Lindlom-Yläne (1996) emphasizes the role that individuals profile could be played there. Similarly, Cano and Cardelle-Elawar (2004) suggest using a qualitative method and including controls by contextual variables. The main goal of this paper is to analyze the relationship between conceptions of learning and epistemic beliefs, including perceptions about demands of learning. To achieve that, some elements from the comparative method proposed by Rihoux and Grimm (2006) are used. A sample of students was selected, and a particular combination of elements from both representations was used to analyze each individual. The sample was composed by thirty eight undergraduate students from several programs (physics, engineering, psychology, and journalism) from Universidad Católica del Norte at Antofagasta, Chile. Data were collected by individual interviews, using open questions about conceptions of learning, and perception of demands of learning (Klatte et al., 2001; Marton et al., 1993; Tynjälä, 1997); also the dilemma about the construction of the Egyptian Pyramids was used to identify epistemic beliefs (Kitchener & King 1994). In methodological terms, the researcher establishes for each participant a profile of conceptions of learning, epistemic beliefs and perception of demands of learning, using a set of categories identified in previous studies (Terrazas & Frenay, 2008, 2009). Particularly, to determine conceptions of learning two categories were used: the Knowledge Restitution and the Knowledge Reorganization. The first one establishes that knowledge is acquired by simple assimilation and the second that, during the learning process, the knowledge is acquired by reorganizing and integrating new elements with previous knowledge. To operationalize epistemic beliefs, both empiricism and relativism categories were used. Empiricism supposes that knowledge is to discover a univocal reality; on the other hand, relativism implies that knowledge is an interpretation of reality, in the

last case many possible interpretations can co-exist about a particular phenomenon. To operationalize perception of demands of learning, a set of two categories were used: reproductive and elaborative demands. Reproductive demands include memorization and accurate reproduction of learning material on test. Elaborative demands include analysis and decision making process using different points of view. The results indicate two types of relations between conceptions of learning and epistemic beliefs. 1) A Consonance relationship, it is when those two elements go in the same direction; in other words it means that two cases are possible: a. Knowledge Restitution and Empiricism, or b. Knowledge Reorganization and Relativism. 2) A Non-Consonance relationship, it is when those two elements go in a different direction. For example: Knowledge Restitution and Relativism. Moreover, both consonance and non-consonance relationship between conceptions of learning and epistemic beliefs are related to a third element, it is the particular experience of learning that is represented by the specific perception of demands of learning. Usually, mismatch occurs between the epistemic beliefs and the perception of demands of learning. In conclusion, those results are partially supporting previous investigations, given that the relationship between epistemic beliefs and conceptions of learning is not always located in the consonance case. Results suggest reconsidering the issue concerning relationship between them focusing on the analysis of the coexistence of consonance/non-consonance cases. Furthermore, those results imply that the consonance scenario requires also the existence of a specific congruence with experience of learning that is taking place into each particular undergraduate program. On the other hand, the congruence between conceptions of learning and perception of demands of learning seems to be more important than the congruence between perception of demands of learning and epistemic beliefs. These results are in line with previous research emphasizing the contextual nature of conceptions of learning (Elen & Clarebout, 2001; Trigwell & Ashwin, 2006). Finally, the research about individual profiles and their configurations appears to be a next step to understand the co-existence of those cases of concordance / non-concordance. Future research should include larger samples and additional contextual controls, such as academic discipline, teaching practices and its link with the conceptions of learning and epistemic beliefs.

How teachers' daily attributions and perceptions predict children's success and performance?

Katja Natale Upadaya, University of Michigan, United States; Yi-Miau Tsai , University of Michigan, United States; Kaisa Aunola, University of Jyväskylä, Finland

Previous research has shown that among the most typical causes to which teachers attribute children's academic success are ability, effort, task difficulty and help from others. Previously it has been found that when children's performance at school is high teachers tend to attribute children's success to their abilities, whereas when children's performance is poor teachers tend to attribute their success to effort or others' help. However, less is known about how teachers' daily attributions and perceptions of success contribute to children's academic success and performance during the children's first year of primary school. Consequently, the present study aimed at investigating the associations between teachers' daily attributions, perceptions of success and children's performance in math during the children's 1st grade. In the present study, 160 children and their teachers were followed up for one school week once during the fall (Time1) and once during the spring (Time 2) of children's first year of primary school. Each day of the week teachers filled in a questionnaire concerning their daily interaction and causal attributions for children's daily success and failure. Children's performance in math was examined once during the fall (Time 1) and once during the spring (Time 2) of their 1st grade. The results were analyzed by using multiple regression. The results showed, first, that when teachers perceived children's success during the fall term of their 1st grade (Time 1) was due to their ability, the children is more likely to experience more success later on during the spring (Time 2). Similarly, when teachers attributed children's success to effort (Time 1), they also perceived children as being more successful later on (Time 2).

Previous research has shown that among the most typical causes to which teachers attribute children's academic success are ability, effort, task difficulty and help from others (Clark & Artiles, 1990; Georgiou, Christou, Stavrindes, Panaoura, 2002; Weiner, 1994). Teachers' causal attributions vary also by the internal-external dimension: ability and effort are typically considered as internal characteristics of a child, whereas task difficulty and teachers' help are external properties for a child (Weiner, 1985, 1986). Previously it has been found that when children's performance at school is high teachers tend to attribute children's success to their abilities, whereas when children's performance is poor teachers tend to attribute their success to effort or others' help (Holloway & Hess, 1985; Natale, Viljaranta, Lerkkanen, Poikkeus, & Nurmi, 2009). It has also been found that teachers' causal attributions contribute to children's performance: when teachers attribute children's success to internal causes, such as ability and effort, children's subsequent performance and motivation increases (Natale et al., 2009). Some studies have also found gender differences in teachers' causal attributions. Especially when explaining children's success in math, teachers may think that boys succeed because of their abilities, whereas girls succeed because of effort (Fennema, Peterson, Carpener, & Lubinski, 1990). However, less is known about how teachers' daily attributions and perceptions of success contribute to children's academic success and performance during the children's first year of primary school. Consequently, the

present study aimed at investigating the associations between teachers' daily attributions, perceptions of success and children's performance in math during the children's 1st grade. Moreover, the possible gender differences related to teachers and children were also controlled for in the analyses. The present study is a part of a larger Development of Motivation and Academic Skills in Family and School Environments study, in which 160 children and their teachers were followed up for one school week once during the fall (Time1) and once during the spring (Time 2) of children's first year of primary school. Each day of the week teachers filled in a questionnaire concerning their daily interaction, perceptions of children's success, and causal attributions (e.g. ability, effort, task difficulty and others' help) for children's daily achievement. Children's performance in math was examined once during the fall (Time 1) and once during the spring (Time 2) of their 1st grade. The results were analyzed by using multiple regressions by using the STATA program. To investigate the unique predictive effect of teacher' attribution, other variables of achievement and earlier school success were controlled. The results showed, first, that when teachers perceived children's success was due to their abilities during the fall term of their 1st grade (Time 1), they also perceived children as being more successful later on during the spring (Time 2). Similarly, when teachers attributed children's success to effort (Time 1), they also perceived children as being more successful later on (Time 2). The results showed further that teachers' daily causal attributions predicted rather the perception of children's success than children's actual performance at school. The results of the present study suggest that teachers' internal attributions (e.g. ability and effort) impact how successful teachers perceive children to be later on during the school year. No such predictions were found for teachers' external attributions. On the one hand, this may be due to the accuracy in teachers' causal attributions, and on the other hand may reflect bias between perceived success and teachers' internal attributions. Moreover, no gender differences related to teachers or children were found in the present study. This may be due to children's age, and cultural differences. These results also suggest that teachers perceive the success of first grade boys and girls in a similar way. However, more gender differences in teachers' perceptions may emerge when the children grow older.

The Relationship between Epistemic Beliefs and Goal Orientation: Changes across Adolescence

Amber Harris, Middlebury College, United States; Barbara Hofer, Middlebury College, United States

As part of a larger four year, cross-sectional and longitudinal examination of students' epistemological development, this study examines the relationship between adolescents' epistemic beliefs (beliefs about knowledge and knowing) and motivational goals. Students from New England rural public schools (6th- 12th grades) participated in a think-aloud online search task, a retrospective interview, an epistemic stance interview, and a follow-up survey at two time points, one year apart. Results suggest that students' epistemic beliefs, motivational goals, and academic achievement are part of an inter-related system, and that the relationships between these variables may change throughout the course of adolescence. Results of this research could allow teachers to more effectively design instruction to meet the needs of students at all developmental levels.

In recent years, psychologists have increasingly turned their attention to the field of personal epistemology (Hofer & Pintrich, 2002) or epistemic cognition (Greene et al, 2008), the system of beliefs that individuals hold about knowledge and knowing (Hofer & Pintrich, 1997). Researchers have also begun to explore the link between epistemic beliefs and motivation (Hofer, 1999; Paulsen & Feldman, 1999; Cano, 2005; Buehl & Alexander, 2005). Studies that provide support for the link between epistemic beliefs and motivation have not fully considered the potential influence of domain differences or developmental patterns of epistemology and motivation during adolescence. The current study was designed to address the following research questions:

Research Question 1: Do epistemic beliefs and motivational goals change during the course of adolescence?

RQ2: What is the relationship between epistemic beliefs and motivation?

RQ3: Does the relationship between epistemic beliefs and motivation change throughout adolescence?

RQ4: Will students' epistemic beliefs be related to academic achievement, as measured by students' grade point averages?

RQ5: In addition to these between subject questions, we were also interested in within-subject changes from the first to the second interview and survey administration. How do these relationships change within subjects?

Method

Participants

Initially, participants were 106 students in 6th (n=25) 8th, (n=31) 10th, (n=28) and 12th (n=22) grades; 56% were males. Participants were randomly selected from school rosters and compensated for time and transportation.

Procedure

Following a warm-up task, students were asked to think-aloud while completing an online search on a science topic. Students participated in a retrospective interview, as well an epistemic stance interview. Students later completed a

web-based survey that included epistemic beliefs measures (general and domain specific) and motivational measures, among other assessments. One year later, students returned to the lab to complete a similar set of tasks.

Results

RQ1: We first ran a one-way MANOVA to determine effect of year in school (6th, 8th, 12th) on the five dependent measures of motivation. Results of post hoc analyses revealed that scores on the performance approach subscale differed significantly between eighth ($M = .88$, $SD = 0.89$) and twelfth grade ($M = 2.74$, $SD = 0.89$), and between sixth ($M = 2.04$, $SD = 0.91$) and twelfth grade ($M = 2.74$, $SD = 0.89$). Additionally, scores on the interest subscale differed significantly between sixth ($M = 3.69$, $SD = 0.95$) and eighth grade ($M = 2.88$, $SD = 1.19$).

RQ2: We found a negative correlation between students' scores on the performance avoidance sub-scale of and both the general epistemic belief scale, $r(74) = -.295$, $p = .011$, and science epistemic belief scale, $r(74) = -.243$, $p = .037$. Conversely, a significant positive correlation was found between students' scores on the general epistemic belief scale and the mastery sub-scale, $r(74) = .308$, $p = .008$.

RQ3: Performance approach goals and epistemic beliefs. In sixth grade, a significant negative correlation was found between science epistemic beliefs and performance approach, $r(25) = -.455$, $p = .022$. However, by twelfth grade a significant positive correlation existed, $r(19) = .561$, $p = .013$.

Performance avoidance goals and epistemic beliefs. Within the sixth grade cohort, science epistemic beliefs were significantly negatively correlated with performance avoidance, $r(24) = -.573$, $p = .003$. Eighth graders' scores on the general epistemic belief scale and the performance avoidance sub-scale were also negatively correlated, $r(31) = -.395$, $p = .028$.

However, by twelfth grade, the opposite relationship can be seen. Although no significant relationship was found between these variables, the correlation between the science epistemic belief scale and the performance avoidance sub-scale has become positive, $r(19) = .192$, $p = .431$. Furthermore, this correlation differs significantly at the .05 level from the correlation between these variables in sixth grade.

Mastery goals and epistemic beliefs. At the sixth grade level, a significant positive correlation existed between history epistemic beliefs and mastery, $r(24) = .481$, $p = .017$. Although the correlation between eighth graders' scores on general epistemic beliefs and mastery was not significant, it did approach significance, $r(31) = .337$, $p = .064$. Similarly, the correlation between history epistemic beliefs and mastery also approached significance in twelfth grade, $r(18) = .459$, $p = .056$. Students with more sophisticated epistemic beliefs regarding the certainty of knowledge were more likely to adopt mastery goal orientations, regardless of year in school.

Research Question 4

General beliefs and academic achievement. Significant positive correlations were found between general epistemic beliefs and all three measures of academic achievement: overall grade point average, $r(70) = .430$, $p = .000$, grades in science, $r(68) = .343$, $p = .004$, and grades in history, $r(67) = .364$, $p = .002$. Thus, students with more sophisticated beliefs about knowledge were more likely to obtain higher grades in school, both overall and in science and history.

Domain specific beliefs and academic achievement. No significant correlation was found between science beliefs and grades in science, $r(68) = .224$, $p = .066$, but this correlation was approaching significance. Similarly, no significant correlation was found between history beliefs and grades in history, $r(65) = .223$, $p = .075$, but this correlation also approached significance. However, students' overall grade point averages were positively correlated with both the history epistemic belief scale, $r(68) = .286$, $p = .018$, and score on the science epistemic belief scale, $r(70) = .303$, $p = .011$. General epistemic beliefs seemed to be more strongly correlated with both overall grade point average and achievement in science and history.

Research Question 5

We have begun coding data from the second round of interviews and survey administration and will be examining the within-subject changes in the next few months.

Discussion

Results of our study provide support for a connection between epistemic beliefs and motivational goals during adolescence. Across all grades, students who had more sophisticated beliefs about the certainty of knowledge were more likely to hold adaptive motivational goals, such as mastery goals, interest, and utility. Additionally, students with less sophisticated beliefs were more likely to adopt less adaptive motivational goals in their learning, such as

performance goals. The current research also suggests that the relationship between these variables may change during adolescence. Consistent with previous research (Pintrich & Schunk, 2002), the results of our study indicate that students' rely more frequently on mastery goals earlier in their education, and then begin to adopt performance goals more frequently later in their education.

THEMATIC POSTER

Reading

The effects of familiarization with oral expository text on listening and reading comprehension level

Irene-Anna Diakidoy, University of Cyprus, Cyprus

This study explored the effects of text type (narrative vs. expository) and early familiarization with oral expository text structures on second graders' listening and reading comprehension levels. Early listening comprehension skill is hypothesized to facilitate and predict reading development after mastery of decoding skills (Hoover & Gough, 1990; Sticht & James, 1984; Vellutino et al., 2007), with important implications for early reading assessment and instruction. However, this hypothesis has found support only with narrative texts, as expository listening and reading comprehension levels have been found to be comparable even in the early elementary grades (Diakidoy et al., 2005). Therefore, this study examined the extent to which differential results can be attributed to lack of early familiarization to oral expository texts or to particular text characteristics. Two hundred second grade students read and listened to a set of narrative and expository texts, and their comprehension was assessed with a sentence verification task. Half of the students had participated in an intensive nine-week-long intervention designed to familiarize them with oral expository structures in the previous year while in Grade 1. Preliminary results indicated that expository listening and reading comprehension levels remained comparable in the intervention group, indicating that simple lack of early exposure is not a viable explanation for the results obtained with narrative and expository texts. These findings have implications for the generalizability of the main hypothesis advanced by contemporary reading models (Hoover & Gough, 1990; Vellutino et al., 2007) as well as conceptualizations of comprehension as a unitary process construct.

The purpose of the present study was to explore the effects of text type (narrative vs. expository) and early familiarization with oral expository text structures on second graders' listening and reading comprehension levels. According to a unitary process view, early listening comprehension skill facilitates reading acquisition and predicts the level of skill that is achieved in reading after decoding skills have been mastered (Sticht & James, 1984). This unitary process view has provided the main theoretical framework for contemporary models such as the Simple View of Reading (Hoover & Gough, 1990) and the Convergent Skills Model (Vellutino et al., 2007). In both models, the implicit assumption is that learning to read involves decoding plus language comprehension skill, with comprehension conceptualized as a unitary process applicable across stimuli and tasks. Therefore, listening comprehension is hypothesized to precede, relate to, and predict reading development. In addition, listening comprehension levels are hypothesized to be higher than reading comprehension levels in the early elementary grades when decoding skills have not been fully mastered. Although, the hypotheses originating from a unitary process view have found general support in research, there are indications that this may not be the case across language stimuli and tasks. Specifically, Diakidoy et al. (2005) found differences in favour of listening comprehension in the second grade, but only with narrative texts. In contrast, oral and written expository comprehension performance was comparable regardless of grade level. These diverging results may be attributable to either the particular characteristics of expository texts (unfamiliar and abstract content and variable structures) or to simple lack of early exposure to oral expository text. Therefore, this study sought to examine (a) the extent to which previous findings in relation to oral and written expository text comprehension can be replicated and (b) the extent to which differential results can be attributed to lack of early familiarization to oral expository texts or to particular text characteristics. The sample included 200 second-grade students representing a range of oral and written language comprehension ability as indicated by their teachers' ratings. All students read and listened to two narratives and two expository texts, and their comprehension was assessed with a sentence verification task. However, half of the students had participated in an intensive nine-week-long intervention designed to familiarize them with oral expository structures in the previous year, while still in Grade 1. The intervention involved teachers reading aloud a selection of age-appropriate expository texts and posing key questions designed to facilitate class discussion and text comprehension. Repeated measures analyses with Presentation Mode (oral vs. written text) and Text Type (narrative vs. expository) as the within-subject variables, Group (intervention vs. control) as the between-subject variable and General Language Comprehension ability as the covariate indicated significant main effects of the covariate and the Presentation Mode and a significant Mode X Group interaction (p < .05). These findings replicate previous results and further suggest that the differential pattern of results obtained with oral and written expository texts cannot be attributed to simple lack of early exposure and familiarity. These findings have both theoretical and practical implications. First, they indicate that the main hypotheses advanced by current reading models may not generalize across language stimuli, texts, and tasks.

Although narrative listening comprehension skill may precede and provide the basis for the development of reading comprehension skill, this is not the case with expository listening comprehension. These findings leave open the possibility that the demands posed by expository texts and other text types and stimuli may require the application of different comprehension mechanisms or strategies. Second, the present findings suggest that language comprehension as a construct is far too complex to be captured by a single score obtained in a single assessment context. Therefore, the assessment of listening comprehension skill is more properly thought of as an indicator of the ability to process a particular type of text when presented orally than as a predictor of overall reading potential. Finally, these findings also imply that early reading instruction needs to extend beyond decoding to familiarize students with the content and the structures of different text types and to provide a context for the development of more effective comprehension strategies.

Beliefs about Explanation Moderates the Effects of Explaining Expectancy on Text Comprehension

Tatsushi Fukaya, The University of Tokyo, Japan

Although previous research investigated whether explaining expectancy promotes text understanding, their results were inconsistent with some research reporting positive effects and others reporting no effects. The present study examined that beliefs about explanation (i.e. tutors' role perception) moderate the effects of explaining expectancy on text comprehension. An experiment was conducted with 51 8th grade students. Participants in the experimental condition were all given the explaining expectancy before studying the text. On the other hand, participants in the control condition were not. Results showed that the effects of explaining expectancy differed depending on their knowledge-transforming tendency. With explaining expectancy, knowledge-transforming tendency predicted the scores of text comprehension. But, without explaining expectancy, knowledge-transforming tendency did not. Results suggested that explaining expectancy exercise an influence only if the learners have the beliefs that they need to elaborate or organize the materials for explanation.

Introduction

In peer-tutorial programs, tutors could benefit from explaining learning materials even more than tutees (e.g., Cohen, Kulik, & Kulik, 1982). One of factors causing this learning is the explaining expectancy. Several studies compared an experimental group, in which subjects expected to explain the content of a text to another person, with a control group, in which subjects did not have such an expectation. Although some of them reported the positive effects (e.g., Bargh & Schul, 1980), some also reported there were no effects of the explaining expectancy (e.g., Renkl, 1995).

A major problem of the cited studies is that moderational impacts of the explaining expectancy were not investigated. That is, the explaining expectancy might promote effective ways of studying for some students, but might result in a superficial processing of learning for some. Roscoe & Chi (2007) argued there are two types of explanation, knowledge-telling and knowledge-transforming. If students perceive their role to paraphrase the materials with elaborations (knowledge-transforming tendency), explaining expectancy might promote the learning outcomes. On the other hand, if students perceive their role to just summarize the materials without any elaborations (knowledge-telling tendency), explaining expectancy might deteriorate the learning outcomes. So, this research investigated whether the beliefs about explanation moderates the impact of explaining expectancy on text comprehension.

Method

Participants

Participants were 51 Japanese 8th grade students (22 male, 29 female). They voluntarily participated the 5-days learning seminar held in the University of Tokyo. Participants were randomly assigned to one of the two conditions. Half of the participants were expected to explain the content after learning (n=25), and half were not (n=26).

Procedure

About 1 month before the learning seminar, a questionnaire about participants' achievements and beliefs about explanation was mailed out to them. Items of beliefs about explanation were created based on Roscoe & Chi (2007, 2008). The items consisted of the 3 items asking their knowledge-telling tendency (Cronbach's alphas = .77) (e.g., "An important thing in explanation is to recall exactly what the author said or wrote in the text.") and 4 items asking their knowledge-transforming tendency (Cronbach's alphas = .81) (e.g., "An important thing in explanation is to paraphrase difficult concept to be easily understood.") on their daily classroom lessons.

On the first day of the learning seminar, a booklet including the instructions, a question about motivation for learning the following text, the learning materials, and the post-tests were given to the participants. Instructions differed for the two groups. Subjects in the experimental condition were informed that after studying the material, they will write the expository text to explain the learned content to an imaginary 6th grade student. Subjects in the control condition

were not. Then, they studied a 1000-words article arguing "how art impresses human" or an 1100-words article arguing "technical development since Edo-era" for 20 minutes. Then, participants took the two-part post-tests for 25 minutes, which were designed to tap the memory, with the cued-recall task (8 items), and the comprehension, with the multiple-choice task requiring the elaborative inferences from texts (6 items). The overall sessions took about 50 minutes.

Results

A question of interest for this study is that explaining expectancy promote deep learning, not just rote learning, so the analysis focused on the scores of the multiple-choice questions which require inferences for understanding texts (i.e. text comprehension scores).

To check the manipulation, scores of a question about motivation for learning the following text were analyzed by ANCOVA with achievement scores as a covariate. The score in the experimental group was better than that in the control group ($F(1, 45) = 3.99, p = .052$), and was not moderated with the beliefs about explanation. Thus, the explaining expectancy was adequately manipulated.

Although comprehension scores were nearly equal in both groups (experimental group, mean = 2.60, SD = 1.19; control group, mean = 2.96, SD = 1.46), the focus of this study was to investigate whether beliefs about explanation moderate the effects of the explaining expectancy. According to Baron & Kenny (1986), moderational effects were analyzed by multiple regression analysis. The interaction term of explaining expectancy and knowledge-transforming tendency reached marginally significant ($t(45) = 1.92, p = .06$), and except this variable, all variables were not significant (Table 1). This interaction is illustrated in Figure 1, which shows that the simple slope of knowledge-transforming tendency is significantly different from zero when given the explaining expectancy ($t(23) = 3.23, p = .004$), whereas the slope is not significantly different when not given expectancy ($t(24) = -0.17, n.s.$).

Discussion

The primary goal of this study is to analyze the moderation by comparing the impacts of beliefs about explanation on text comprehension with or without explaining expectancy. The data supported the hypothesis. The results of this study suggested that inconsistent results of earlier research might be attributed from ignoring the different effects of explaining expectancy for different students.

But, how did explanation expectancy enhance the understanding with participants having knowledge-transforming tendency? Knowledge-transforming tendency reflects a learner's belief that they need to elaborate and organize the materials for the explanation so that they employ deep learning strategies. This tendency seems activate under the explaining expectancy, because scores of knowledge-transforming tendency did not predict the comprehension scores without the explaining expectancy.

Thus, for the tutorial-program to be effective, the administrators and classroom teachers need to focus on what kind of beliefs their students have. Their beliefs about explanation might not only lead to their bad explanation for the tutees, but hinder their own learning by explaining. Considering their important roles in the process of peer-tutoring, a line of research examining teaching methods to promote the learners' knowledge-transforming tendency would be promising for a future direction.

The depth of secondary school students' German (L2) word knowledge

Olga S. Hrebik, University of Szeged, Hungary

The depth of vocabulary is the qualitative characteristic of word knowledge referring to the internal structure of the sets of word meanings learnt and their different connections to other words (Meara and Wolter, 2004; Read 2000, 2007). This study investigated the depth of Hungarian secondary school students' German L2 word knowledge. The analysis focused on (1) the response patterns of a word association test, (2) the similarities and deviations between the response patterns of students at various German proficiency levels and (3) the correlations between the depth of lexical knowledge and reading comprehension, as well as between word knowledge and background factors (motivation and parental education). Three instruments were used: a German word association test, an adaptation of a Hungarian (L1) original, a German reading comprehension test (Cronbach's $\alpha=0.83$) developed by the author, and a questionnaire of language learning motivation (Cronbach's $\alpha=0.94$) and social background (Józsa, 2007). The sample comprised 205 students (grade 12, 18-year-olds) studying German (L2) and consisted of three sub-samples, based on the intensity of their language studies. The qualitative analysis of the response patterns of the word association test revealed that the structure of the bilingual students was more stable than that of the other two

groups, therefore difference in the intensity of language learning seems likely to result in different internal semantic structuring. The correlations between vocabulary depth, text comprehension and background factors were significant.

Theoretical background

Learning words is a traditionally privileged area in learning and teaching foreign languages. Experience has shown that the specific levels and qualities of vocabulary are important conditions for the development of language skills, reading comprehension among them (Qian, 1999; Zareva et al., 2005). Research has traditionally targeted two main dimensions of lexical knowledge: vocabulary width and depth. The width of vocabulary comprises all the words one knows, while the depth of vocabulary characterises the quality of the smaller or larger sets of words learnt, that is, their internal structure and semantic links to other lexical elements (Meara and Wolter, 2004; Read 2000, 2007). Word knowledge develops through a long learning process; it is enriched through learning experiences and is transformed by recurrent restructuring processes. In its complexity the acquisition of words resembles the development of skills and abilities (Vidákovich and Cs. Czachesz, 2006). For measuring vocabulary knowledge, various instruments are available (Read and Chapelle, 2001; Schoonen and Verhallen, 2008).

Aims

This study investigated the depth of secondary school students' German (L2) word knowledge. The analysis focused on (1) the response patterns of a word association test, (2) the similarities and deviations between the response patterns of students at various proficiency of learning German, and (3) the correlations between the depth of lexical knowledge and reading comprehension, as well as between the deep word knowledge and the background variables of motivation and parental education.

Methods

In 2009, a sample of 205 students studying German (L2) in grade 12 (18-year-olds) from ten secondary schools participated in the study. Based on the intensity of learning the language, the sample contained three sub-samples: group A studying German in the standard curriculum, (n=65, 3 or 4 hours/week); group B, taking a high number of German classes (n=71, >4 hours/week); and group C, studying German in a bilingual programme (n=69).

Three instruments were administered. The word association test was a German adapted version of Schoonen and Verhallen's Word Association Task (WAT). The test (14 tasks) examined the meaning subjects attributed to targeted words by asking them to select three of the six presented words in different semantic relationships (paradigmatic, partonomic, syntagmatic etc.) with the target word.

The students' L2 reading comprehension performance was assessed by a 40 item reading test, based on three newspaper articles and developed by the author (Cronbach's $\alpha=0.83$). Information on language learning motivation was collected with a separate questionnaire (Cronbach's $\alpha=0.94$) used in earlier research (Józsa, 2007).

Results and discussion

(1) The qualitative analysis of the data from the word association test revealed a high variety of response patterns in all three sub-samples. In order to analyse the internal structures of response patterns, the frequencies of individual response alternatives were identified in all three samples, and cluster analyses were performed for each task. It seems that, although the most frequent response patterns are mostly composed of the most frequent response alternatives, the students selected these three components with differing frequencies. The structures of response patterns are not stable and the choice of neither component determines the selection of the other two.

(2) In order to compare the samples and to describe the distances between the characteristic response patterns for each sample, a proximity index was created by calculating the differences between the shortest and the longest distances, the values of which show the degree of the proximities of the response patterns in the samples on a given task. In several cases, the differences are considerable, occurring more frequently between groups A and C, and less frequently between groups B and C.

Despite these differences, it is obvious that the students in the bilingual program (group C) had more stable structures to their word patterns, as their choices are less diverse than those of the other groups. Students in group A (standard curriculum) had the least stable response patterns, and of the whole sample, they are the most likely to have had the least experience in studying German. In general, it may be said that the decontextualised syntagmatic (definition-type) response patterns were more frequent in group C and the least frequent in group A. The different intensities of language learning thus seem likely to result in different internal semantic structuring. The variety within the sub-samples may be due to individual characteristics in word acquisition.

(3) As regards the results of the reading comprehension test, the performance of group A (55%) was significantly (p

The correlations between vocabulary depth and motivation (0.171,)

Methodological and educational significance

The adaptation and piloting of the word association test to German (L2) yielded important methodological experience. On the one hand, the study provided evidence that the instrument and the process are suitable for the identification of the similarities and deviations in the qualitative characteristics of students' vocabulary depth; on the other hand, it also provided information on, and confirmed the correlation between, vocabulary and reading comprehension.

The nature and composition of word knowledge and the role it has in foreign language acquisition and comprehension are areas barely studied in Hungary when learning foreign languages is concerned. The better understanding of the nature of word acquisition in a foreign language and its correlations with the different factors of language learning and language knowledge requires further investigations.

The Role of Interest and Concreteness on Reading Time and Recall of Expository Text

Gregory Schraw, University of Nevada, United States; Lori Olafson, University of Nevada Las Vegas, United States; Ivan Ivanov, University of Nevada, United States; Kendall Hartley, University of Nevada, United States

We investigated the effects of interest and concreteness on reading time and recall of sentences in an expository text. 66 participants read the text on a computer and recalled the text afterwards. High-interest sentences were read faster, while high-concreteness sentences were read slower. High-interest and high-concreteness sentences were remembered better. In addition, interest and concreteness produced an interaction on recall such that sentences high on both dimensions were recalled better than those high on only one. Results were discussed in terms of Dual Coding Theory, which postulates separate verbal and imaginal systems in memory that draw on different pools of cognitive resources and yield additive effects on recall, or the Integrative Model of Text and Picture Comprehension, which postulates separate verbal and imaginal systems in memory that draw on a single pool of resources and yield interactive effects on recall. Our findings were more consistent with the Integrative Model.

Purpose and Hypotheses

This study investigated the effects of interest and concreteness on reading time and recall of sentences in an expository text. Previous studies have investigated the effects of interest and concreteness separately on text processing; however, none of these studies examined their conjoint reading time and recall in expository text. We parsed a 50-sentence expository text into four categories based on whether sentences were above or below the mean on interest and concreteness. 66 participants read the text on a computer and recalled the text afterwards. We hypothesized significant main effects for interest and concreteness on both the reading time and recall outcome measures. In addition, we predicted a significant interaction between interest and concreteness variables such that the combined effects of high interest and concreteness would significantly improve reading and recall compared to high interest or high concreteness alone.

Theoretical Framework

Previous research shows that interest and concreteness increase memory for expository text (Ainley, Hidi, & Berndorff, 2006; Alexander & Jetton, 1996; Durik & Harackiewicz, 2007; Hidi & Renninger, 2006; Sadoski, 2001; Schraw & Lehman, 2001). The majority of studies investigated interest and concreteness separately. However, several studies examined the relationships between interest and concreteness when used simultaneously to predict learning (Sadoski, Goetz & Fritz, 1993; Sadoski, Goetz & Rodriguez, 2000; Sadoski, Goetz, Stricker, & Burdinski, 2003), reporting significant positive correlations between the two. In these studies, the effects of interest and concreteness have been explained using either Dual Coding Theory (Sadoski, 2001), which postulates separate verbal and imaginal systems in memory that draw on different pools of cognitive resources and yield additive effects on recall, or the Integrative Model of Text and Picture Comprehension (Schnitz, 2002), which postulates separate verbal and imaginal systems in memory that draw on a single pool of resources and yield interactive effects on recall. In terms of the current research, Dual Coding Theory predicts a significant main effect for interest and concreteness, but no interaction between them. It also predicts faster reading times for high-interest and high-concrete sentences. In contrast, the Integrative Model predicts a significant interaction effect for interest and concreteness due to interactive, conjoint processing. It also predicts faster reading times for segments that are high-interest and high-concreteness than segments that are high on only one dimension. Methods30 undergraduates read the text from a computer sentence by sentence without being timed and then rated the interestingness and concreteness of each of the 50 sentences in the text. The text was 1,200 words long and described the formation and potential dangers of lightning (Harp & Mayer, 1998). Ratings were made on a 4-point Likert scale. These ratings were used to partition the sentences into four categories: 14 high-interest, high-concreteness (HIHC), 4 high-interest, low-concreteness (HILC) sentences, 3 Low-interest, high-concreteness (LIHC) sentences, and 29 low-interest-low concreteness (LILC)

sentences). 66 different participants from the same pool then read the text sentence by sentence on the computer and were timed.

Results

Sentences were scored for total recall by two judges with 96% agreement. Reading times are reported in milliseconds per word to equate the four categories. The analysis consisted of a 2 X 2 repeated-measures ANOVA in which each variable was treated as a within-subjects variable. There were significant main effects for interest $F(1, 65) = 21.29, p < .001$. Recall scores were converted to proportions. The findings were significant main effects for interest $F(1, 65) = 19.67, p < .001$.

Discussion

Our results suggest several findings. One is that high-interest segments are read faster than low-interest sentences. High-interest sentences also were recalled better than low-interest sentences. These findings are consistent with a variety of previous studies and are consistent with both the Dual Coding Theory and Integrative Model frameworks, which predict that high interest facilitates engagement and enables readers to integrate this information into a mental representation of the text with greater ease. A second finding is that concreteness affects reading differently than interest. Although high-concrete sentences were recalled better than low-concrete sentences, they took significantly longer to read. This finding is inconsistent with Dual Coding Theory which predicts faster reading times for high-concreteness sentences because they facilitate processing in imaginal memory. In contrast, longer reading times are consistent with the Integrative Model which predicts that verbal and imaginal systems engage in conjoint processing to establish a more elaborate representation in memory. Processing in two systems simultaneously may increase the amount of time and effort needed to process these sentences. A third finding was that interest and concreteness interacted to yield significantly better recall than either interest or concreteness alone. This finding supported the Integrative Model, which predicts conjoint processing between verbal and imaginal memory systems in a manner that integrates multiple facets of meaning into a single representation in memory. In contrast, the Dual Coding Theory perspective predicts additive effects for interest and concreteness due to separate processing in verbal and imaginal memory, but not interactions due to conjoint processing.

Beyond vocabulary and memory: Inference skills contributes to the development of listening comprehension

Riikka Roman, University of Turku, Finland; Julie Lynch, Saginaw Valley State Univ., MI, U.S., United States; Janne Lepola, Univ. of Turku, Finland

The aims of the present study were to analyze the concurrent and longitudinal contributions of inference making, vocabulary, memory and phonological skills to narrative listening comprehension. One hundred thirty Finnish-speaking children participated in a longitudinal study. The participants' narrative listening comprehension, inference skills, memory of sentences, vocabulary and phonological awareness were assessed individually at time 1 (4-year-olds), time 2 (5-year-olds) and time 3 (6-year-olds). Narrative listening comprehension was assessed by free recall task and prompted literal comprehension questions. Inference making skills were evaluated by implicit comprehension questions (Paris & Paris, 2003) in the context of narrative picture-book reading. The results show that among younger children vocabulary and memory for sentences played a more fundamental role in concurrent listening comprehension. The results also show that inference making skills at the age of 4 and 5 years had a significant contribution to later listening comprehension over and above the effects of the autoregressor and language skills. The present study contributes to previous research on text comprehension by identifying both language-related and higher-order skills that underlie the development of listening comprehension among young children.

Summary

Aims

The aim of the present study was to analyze the concurrent contributions of inference making, vocabulary, memory and phonological skills to narrative listening comprehension. An additional interest was to examine the unique role of inference making skills in predicting the development of narrative listening comprehension from the age of 4 to 6 years.

Methodology

Despite the large body of research on early reading skills (see, e.g., Lyytinen et al., 2004), and the progress made in supporting children's reading difficulties (Vellutino & Scanlon, 2002), less attention has been paid to the development of comprehension skills (Paris & Paris, 2003) among nonreaders. As a consequence, there is a serious gap in our knowledge about the development of listening comprehension before children have become fluent readers.

To understand a narrative through listening, the child not only needs to segment the spoken message to word units and derive and integrate the meanings of individual words and sentences, but s/he also needs to make inferences in order to identify characters and their motives, the plot of the story, and to make links between the text elements (van den Broek et al., 2005).

A longitudinal study by Sénéchal, Oullette, & Rodney (2006) showed that when controlling for prior listening comprehension, literacy skills and SES, vocabulary at kindergarten made a unique contribution to grade 1 listening comprehension. What is more, only a few studies have examined the relationship between memory and listening comprehension among young children (Dufva, Niemi, & Voeten, 2001). A study by Florit et al. (2009) showed that both forward and backward word span tasks were unique predictors of listening comprehension over and above language skills among the 4- and 5-year-olds. In addition, the ability to make inferences is shown to be an important source of individual differences in text comprehension. A study by Cain, Oakhill and Bryant (2004) showed that inference making skill was a significant predictor of concurrent reading comprehension (children aged 8, 9 and 11 years) even after the contribution of working memory, vocabulary, and word reading skills were controlled for. Moreover, the study by Kendou et al. (2008) showed that inference making had a unique contribution to narrative comprehension over and above vocabulary and phonological skills both at the age of 4 and 6 years, and, the predictive power of inference making increased with age. The present study contributes to previous work by examining the role of inference making, vocabulary and memory skills in predicting the development of listening comprehension.

Method.

130 Finnish-speaking children participated in longitudinal study. The participants' narrative listening comprehension, inference skills, memory, vocabulary and phonological awareness were assessed individually at time 1 (4-year-olds), time 2 (5-year-olds) and time 3 (6-year-olds) by trained experimenters. Parallel narrative texts describing the behaviour of a cat in specific setting (91 words) were used in the assessment of listening comprehension. Listening comprehension was assessed by retelling task scored according to story grammar framework (Mandler & Johnson, 1977), and by four prompted comprehension questions. Inference making skills were evaluated by five implicit comprehension questions (e.g. feeling, causal relation, prediction) in the context of narrative picture book reading (Paris & Paris, 2003). The subtest of sentence repetition (Korkman et al., 1997) was used to assess children's memory of progressively longer sentences. The word definition task was used to assess children's skill in analyzing knowledge of word meanings (WISC—III; Wechsler, 1999). Phonological awareness was evaluated by 10 rhyme and 10 alliteration tasks (Silvén et al., 2002).

Results demonstrate that the scores were normally distributed in listening comprehension (LC), inference making and language-related variables. Floor effect was observed to some extent only in retelling task at time 1 and time 2. To determine whether inference making skills make a unique contribution to the prediction of concurrent and later LC over and above vocabulary, memory of sentence and phonological awareness, a series of fixed-order hierarchical regression analyses was performed. The findings are reported in tables 1 and 2. As shown in table 1, both vocabulary and memory of sentence were significant concurrent predictors of LC at time 1, and vocabulary predicted unique variance in LC at each time point. Inference making skills started to account, from time 2 onwards, for a significant amount of variance in LC over and above vocabulary and memory skills. Table 2 displays that inference making explained a unique variance in later listening comprehension after the effects of prior LC, vocabulary and memory were controlled for.

The present study extends our knowledge about the role of higher-order skills such as inference making in the acquisition of narrative listening comprehension skills, and that listening comprehension is based on the same skills that have been shown to underpin reading comprehension. Educational implications include the value of early instructional practices to enhance not only children's knowledge of word meaning but also inference making skills that are shown amenable to training as well (Paris & Paris, 2007).

THEMATIC POSTER

Computer-supported Learning Environments

The Impact of Self-regulated Feedback on Learning Outcome in Computer-based Learning Environments

Antje Schatta, University of Erfurt, Germany; Helmut M. Niegemann, University of Erfurt, Germany

The requests of this study were to develop and evaluate self-regulated feedback for complex learning tasks. The principles for the design of self-regulated feedback are the attempt to find a simple technical solution for multimedia learning. The effects of these feedback forms on learning were examined in a computer-based learning environment. We suppose that feedback, including typical sources of error will be more useful than sample solutions.

Need for the Study

Why is it necessary to pay attention to self-regulated feedback? One problem is the high complexity of technical solutions for giving feedback for complex learning tasks in computer-based learning. We want to find out if the design of self-regulated feedback can be an adequate solution to substitute personal feedback for complex learning tasks in computer-based learning environments.

Theoretical background

Feedback is considered as an important framework in many theories of learning and instruction.

The cognitive view of feedback is important for this research project. From this point of view feedback is a source of information that is necessary to correct false responses of learners (Kulhavy & Stock, 1989).

Self-regulated feedback

Studies (e.g. Mory, 1992) turn the focus to feedback models that view feedback in the context of self-regulated learning (Butler & Winne, 1995). If we talk about self-regulated feedback we have to distinguish between internal and external feedback. For self-regulated learning the most important function of feedback is tutoring or guiding the learner to regulate their own learning process successfully. Elaborated feedback should support self-regulated feedback (e.g. sample solutions).

Research question and hypotheses

This paper deals with one of our research questions concerning the learning outcome: Are there differences in consideration of learning outcome between the treatments? We hypothesized that learners following the feedbacks, including typical errors conditions of this study will reach higher learning outcomes compared to those with only sample solutions. We also suppose students with feedback including typical errors will reach higher learning outcomes in the ten tasks including typical errors as distractors.

Method Participants and design

The participants were 307 college students (267 women, 40 men) majoring in education. They were randomly assigned to one of the five conditions: feedback as personalized sample solutions (Mayer, 2005) referring to typical sources of error (n=63), sample solutions referring to typical errors (n=64), feedback as guidelines referring to typical errors (n=51), feedback as personalized guidelines referring to typical errors (n=66) and a control group with sample solutions (n=63).

Procedure

The field experiment was carried out within the lecture "Learning and Instruction". The lecture was presented online at a computer-based learning environment (CBLE). According to the five conditions there were five learning rooms in which students worked with the materials and feedback. The same mini lectures, materials from the textbook, complex learning tasks were presented to the students in each of the rooms. The complex learning tasks requested students to name and explain certain processes in learning and instruction (e. g. "Explain 'schema', 'mental model', 'script' and find an example for each one."). Every week students were asked to listen to one or two mini lectures, read the relevant pages in the textbook and answer five or six learning tasks. At the end of every week students had to load the solutions of their complex learning tasks onto the learning platform. On Mondays, we loaded the different feedback forms onto the platform. Then students should compare their own solutions for the learning tasks with the feedback given. While working with the feedback, students were asked to compare the typical errors given with their own solutions of the complex learning tasks (e. g. "Attention: This is a typical source of error in this task: the mix-up of examples for mental model and script"). In the personalized forms of feedback, we showed students how to use the feedback ("Now you can compare your own solution with the sample solution. You can go back to the lesson if you found errors and repeat again") and motivated them ("If you have got the same solution, you are well prepared for the exam at the end of the term").

Learning outcome was measured at the end of the term by an exam consisting of 60 items. Students had to choose the correct answer out of four answers given. Ten items included typical errors as distractors.

Analyses and expected results

At the moment we test our hypothesis with MANOVAs.

We suppose that learners following the feedbacks including typical errors (experimental group) will reach higher learning outcomes compared to those with only sample solutions (control group). We also suppose the experimental group to gain better learning outcomes in the ten tasks including typical errors as distractors compared to the control

group. This is because comparing the feedback with typical errors with their own solutions should be able to relate to errors (learning from mistakes) and thus, lead to a higher learning outcome.

Scientific significance

If at least one of the formats of self-regulated feedback turns out to be effective, instructional designers will have a strong argument to use more complex learning tasks in multimedia learning environments.

References

- Butler, D.L. & Winne, P.H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281
- Kulhavy, R.W., & Stock, W.A. (1989). Feedback in written instruction: The place of response certitude. *Educational Psychology Review*, 1, 279-308.
- Mayer, R. E. (2005): Principles of Multimedia Learning Based on Social Cues: Personalization, Voice, and Image Principles. In R. E. Mayer (Ed.), *The Cambridge Handbook of multimedia learning*. (201 -212) Cambridge: Cambridge Univ. Press.
- Mory, E. (1992). The use of informational feedback in instruction: Implications for future research. *Educational Training Research and Development*, 40(3), 5-20.
- Niegemann, H. M., Hessel, S., Aslanski, K. & Deimann, M. (2003). Sample Solutions and Guidelines as Feedback for Self-Managed Comparison with Learners' Outcomes. Paper presented at the International Conference on Computers in Education (ICCE), Hongkong, China.

The impact of competition in a game-based learning environment on motivation and language learning.

Sylke Vandercruysse, Katholieke Universiteit Leuven, Belgium; Mieke Vandewaetere, University of Leuven - Campus Kortrijk, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium

Although games are recently quite popular in education, not much empirical studies have focused on the effectiveness of games in educational settings. Of the studies that examined this, many contain flaws resulting in unclear conclusions. As proposed by Aldrich (2005), focusing on gaming elements rather than on games as such may be a possible solution for these shortcomings. In the current effectiveness study, the competition element, more specifically the competition against others, will be investigated. The game based learning environments used in the experiments are developed according to the principles of the 4C/ID-model (van Merriënboer, Clark, & Croock, 2002). The presumed results are that the students confronted with the competition element will be less intrinsically motivated and they are expected to improve less on the posttests than the students playing in a non-competitive learning environment.

Introduction

Notwithstanding the large amount of recent research on (educational) games and the promising claims that are spread into the world about them (see for example Gee 2003; Prensky, 2001), there is only sparse empirical research available on the educational effectiveness of these games. Consequently, drawing general conclusions about the effectiveness of educational games is difficult, if not impossible. Therefore, it is more interesting to focus on gaming elements rather than on games as such to find the crucial elements for defining the successful implementation of a game in educational settings (Aldrich, 2005; Vandercruysse et al., 2010). Games consist of different gaming elements. Some gaming elements are inherently present in a game environment (e.g., story, goals and rules) others are not, depending on the definition the authors give to 'educational games', for example competition. This element has already been defined in different ways and can take several forms, e.g., competition between the user and the computer, against oneself, chance, time, etc. or a combination of these elements (Alessi & Trollip, 2001). According to Cheng, Wu, Liao, and Chan (2009) competition is a well-structured activity with a clearly defined goal for students which can be a motivator for excelling themselves. Competition may thus provide an additional challenge to the learner in educational settings, which may result in greater attention and excitement, which in turn indirectly influences students' performances. Next to this, competitive game design can encourage students' belief that investing effort will obtain the harvest and encourage them to work (Wu, Liao, Chen, & Chan, 2010). However, implementing competition also seems to have drawbacks (Cheng et al., 2009). When applying competitive elements in the game-environment, especially external rewards are given to the students which can lead to lower sense of control and subsequently to lower intrinsic motivation (Deci, Koestner, & Ryan, 1999). Also, confronted with competition, students are exposed to social comparison which can influence their self-concept or emotions. Especially students with low self-concept may suffer from this and undermine their performance (Bandura & Locke, 2003), feel more depressed, frustrated or inferior (Cheng et al., 2009). In sum, no univocal results on effectiveness of games for learning seem to occur. Some studies support the positive effects (e.g., the motivational aspect) of competition as a separate variable in a game on performance, others show no or negative effects (e.g., too much extrinsic motivation). Consequently, the following research questions are examined: (1) Is competition as gaming element more motivating

and engaging than a game-based environment without this gaming element? (2) Does competition affects students' performance in comparison with students playing in a non-competitive game-based learning environment?

Method

Learning environments

Two different game-based language learning environments have been developed. These environments were based on the four-component instructional design model (4C/ID). This is an instructional design model that supports and enables educational developers to construct learning materials for complex tasks (van Merriënboer, et al., 2002), here English language learning, more specific English conversation skills. The two environments differed only with respect to the inclusion of the competition element. Participants were randomly distributed over both learning environments/conditions.

Participants

Hundred first year-university students participated in this experiment. All students already received English courses in general secondary education. Nowadays they receive no English language courses, however some of their study content is presented in English.

Competition element

In the competitive game-base learning environment, different competitive elements are included. It should be noted that we exclude competition against oneself as a study object, since it can be argued that overcoming a problem or learning new things can also be called competition and hence this is present (or at least is expected to be) in all learning environments. Competition against others is included since the score of the player is compared with a mean score during the game. The students are told this is the mean score of the other players in the classroom, in fact this score is measured during a pilot-study. In this pilot study, students received the questions as a traditional paper-and-pencil test. The mean score on this test was calculated and afterwards implemented in the environment. This was done because of technical limitations: calculating the mean score during the game-play of the students was impossible. Next to this, after finishing a task (class) students see a high ranking list. In this list, students can find their position in comparison to the other players. Also in this case, the scores were measured before-hand and are equal for all players, only the position of the students differed, depending on their own individual score.

Procedure

The participants received a pretest to measure their prior English language knowledge related to the content that is taught in the game (i.e. the difference between formal and informal language). Based on this test, the prior knowledge level of the participants concerning English language could be determined. If differences occurred, correction for the prior knowledge was made during the analyses. Next to the pretest, participants also received a motivation questionnaire. After completing both, the students were introduced in the learning-environment and the goals were explained. During the gameplay the players practiced their English language knowledge, more specific the difference in language use in formal or informal contexts. After playing the game, students received a posttest and two questionnaires. The posttest measures again their performances. The first questionnaire measures motivation after game-playing. By means of this survey the hypotheses concerning motivation are investigated. Next to this, also their competition experience is questioned to be sure that the intended competition feeling is realized. Tracking and logging data were stored on an external SQL-server from which information was extracted such as the score during game-playing, their end-score, time-spent during learning phase, etc.

Results

Because this is a work in progress and the data-analysis is still ongoing, only the presumed results are mentioned. The hypotheses we pose, based on the literature, is that students learning in a competitive game-based learning environment will show a decrease in intrinsic motivation and lower improvement on the posttests than students playing in a non-competitive game-based learning environment. For a graphical representation of the hypothesized effects, see Figure 1.

Self-reported and observed attention behaviour

Mandy Hommel, University of Technology, Germany

Observing attention behaviour is impeded by feigning and covert aspects. The difficulty to conclude cognitive engagement via observing attention is obvious. In a research project (sample size N = 100) with the aim to compare the attention and learning performance in different kinds of teaching and learning situations, this problem was addressed. In line with the test of the validity of the developed observing instrument the self-reported attention

behaviour of five randomly selected students was compared with the coding of two independent observers. The results show possibilities and limits of observing attention behaviour of students in classroom situations.

Attention is the first cradle in the learning process. Processes of attention are mediators (HELMKE, 2009) between individual conditions and situation features. Thus, questions how to get and hold attention and how attention influences learning, are important for teachers as well as for students.

The aim of the research project is the comparison of attention behaviour and its courses in more traditional and more activity oriented lessons (business game and case study instruction). Starting with the assumption of a better level of attention in activity oriented lessons caused by real complex problems and orientation towards prior experiences of the students, the courses of attention behaviour within the lessons and influences on learning results will be investigated. In this context, critical phases of attention and the features of these situations will be identified.

Based on the well tested "Mýnchner Aufmerksamkeitsinventar" (Munich attention inventory, HELMKE & RENKL, 1992) an extended and modified observing instrument was developed. Attention was determined by observable behaviour relating to time the students spent on-task (SLAVIN, 2000; KARWEIT & SLAVIN, 1981). Each class was videotaped by four cameras. In a first step the observing instrument was tested in a business game lesson. The degree of observer agreement between three independent observers reached Spearman's $\rho = .847$. In a second step the agreement between self-reported attention behaviour of students and the coded categories of the observers was determined to proof the validity of the coding scheme. Therefore, five students were randomly selected from the whole sample. During a retrospective interview the students were asked to describe their attention behaviour and thoughts in the learning situation. Out of the videotaped lessons sequences of 10 minutes were randomly selected to be the basis for the stimulated recalls. With the help of 30 seconds time intervals the students reported and valued their own behaviour by coding it appropriate to the given coding categories. The retrospective interviews were videotaped as well. Afterwards, two independent observers coded the behaviour of these students in the same lesson sequence to enable the determination of the agreement. Additionally the interviews were transcribed and analyzed.

The percentage agreement between the two observers was 0,863, between the self-reported attention of all learners and the first observer 0,876, and the second observer 0,863. Counted with the more cautious measure Spearman's ρ ; the agreement between self-reported attention of all students and observed attention reached values between $\rho = .743$ (observer 1) and $\rho = .765$ (observer 2). The differences in the agreement rates showed the lowest value for student 11 ($\rho = .264$ observer 1, $\rho = -.081$ observer 2) and the highest for student 43 ($\rho = .944$ observer 1, $\rho = .948$ observer 2). To figure out the reasons for the low agreement the transcript of the retrospective interview with student 11 was analyzed. Surprisingly the student reported insightful about her strategies of feigning attention while preparing a presentation for another subject. The engagement in another topic was not observable for certain. The resultant uncertainty concerning the valuation of the behaviour is reflected in the low agreement rates. The content of the poster will especially report and highlight the detailed results of this part of the project.

The investigation and its results are a vividly example for possibilities and limits of observing attention behaviour in context of classrooms.

References:

- Helmke, A. (2009). Unterrichtsqualität und Lehrerprofessionalität. Diagnose, Evaluation und Verbesserung des Unterrichts. Seelze-Velber: Klett und Kallmeyer.
- Helmke, A. & Renkl, A. (1992). Das Mýnchener Aufmerksamkeitsinventar (MAI): Ein Instrument zur systematischen Verhaltensbeobachtung Der Schýleraufmerksamkeit Im Unterricht. Diagnostica, 38, Heft 2, S. 130-141.
- Karweit, N. & Slavin, R. E. (1982). Time-On-Task: Issues of Timing, Sampling and Definition. Journal of Educational Psychology, 74 (6), 844 – 851.
- Slavin, R. E. (2010). Educational Psychology: theory and practice. Boston: Allyn & Bacon.

Interactive learning tasks – useful learning tools or senseless time wasting?

Felix Kapp, TU Dresden, Germany; Susanne Narciss, TU Dresden, Germany; Hermann Koerndle, TU Dresden, Germany; Antje Proske, TU Dresden, Germany

One possibility to support learners in computer-based learning situations is to provide them with interactive learning tasks. Working on learning tasks can facilitate the learner's retention and understanding of learning material, the learner's knowledge organization and application, as well as the learner's assessment of his progress of knowledge and skill acquisition (Proske, Kßrndle & Narciss 2004).

Learning tasks have been proved to be an effective support for learners (Hamaker, 1986). The present study reports findings on the use of interactive learning tasks in six different learning environments. The learning environments were based on the same content management system but deal with different domains.

The number of participants ranged between 23 and 26 students for the different web-based learning environments. Students were randomly assigned to the control-group (learning environment without interactive learning tasks) or experimental-group (learning environment with interactive learning tasks). A significant learning effect for the experimental group was found for two domains. Results are discussed regarding the different learning activities.

Introduction

One possibility to support learners in computer-based learning situations is to provide them with interactive learning tasks. Working on learning tasks can facilitate the learner's retention and understanding of learning material, the learner's knowledge organization and application, as well as the learner's assessment of his progress of knowledge and skill acquisition (Proske, Kördle & Narciss 2004). In contrast to test exercises, interactive learning tasks offer the possibility to solve tasks interactively by providing multiple-try strategies and informative tutoring feedback (Narciss, 2008). Interactive learning tasks have the explicit goal of promoting learning by stimulating and guiding desired learning activities (Proske, Koerndle & Narciss, 2010).

Based on a review Hamaker (1986) reported that learning tasks have an effect on learning achievement. This review excluded learning tasks with informative feedback and studies from the field of computer-based instruction. Yet, it is a widely acknowledged assumption in educational research that learning tasks are useful in CBLs as well. The purpose of the present study was to investigate learning outcome effects of interactive learning tasks in different domains, to identify relevant characteristics of interactive learning tasks and processes which are responsible for those effects.

Method

Material and Participants.

The six learning environments, the corresponding interactive learning tasks and the knowledge tests were constructed by six groups of students during a psychology class at the Dresden University of Technology, Germany. Each group of students (consisting of five to six students) designed one learning environment and then served as participants by working on the learning material of the other five groups. Participants ranged between 23 and 26 persons. Topics of the learning environment that were chosen by the students themselves were "surviving in the wild", "Psychodrama", "didgeridoo", "pygmies", "emission trading" and "chameleon". Material in the six learning environments contained between 1050 and 1651 words and 0 to 15 content related pictures. All learning environments were based on the same content management system. The experimental group received access to 12 interactive learning tasks with informative tutoring feedback (Narciss, 2008). Each interactive learning task was constructed based on the content of the particular environment. All 12 interactive learning tasks were multiple choice questions in a single-best choice format. The informative tutoring feedback consisted of knowledge of result, specific information about why it was correct or wrong and in case of a wrong answer additional information which supports the learner to find the correct solution on his/her own. After the second incorrect trial the learning environment presents the correct solution.

Design and Procedure.

An experimental-control group design with just one posttest was used. Each participant worked on the learning material either with interactive learning tasks (experimental-group) or without (control-group). Participants started with studying the learning material after login on the web-based learning environment. They were randomly assigned to the experimental conditions. After finishing the study period they were asked to answer a multiple choice knowledge test consisting of 15 test items. The learning environments were accessed via the internet. Participants were free to choose the time and place of studying during a period of one week as long as they worked on the material and the knowledge test without interruptions.

Achievement measures.

Learner's achievement in the post-test was assessed by a post-knowledge test consisting of 15 multiple choice items.

Learning activities.

To gain information about the learning process the logfiles were analysed with regard to the use of interactive learning tasks and study time. Time on tasks and the correct and incorrect attempts of answering the interactive learning tasks were also recorded in the data base.

Results and conclusion

Achievement and learning activities.

The results of the knowledge tests for each learning environment and the learning activities are presented in table 1. [table 1 - appendix]

Data analysis of the post-tests revealed a significant effect only for the learning environment "surviving in the wild" ($t(22) = 2.60$, $pd = .91$) and "pygmies" ($t(24) = 3.78$, $pd = 1.22$). In those two learning environments students using interactive learning tasks performed significantly better than the control-group without interactive learning tasks. It should be emphasized that in both learning environments experimental- and control-group do not differ in study time. Data of the other four learning environments show that interactive learning tasks were used and sometimes lead to more learning time compared to the control-group (e.g. learning environment "Emission trading") but had no effect on the learning achievement.

The conclusion of the present study is that interactive learning tasks can promote learning. They serve as a useful tool which can support learners in achieving better learning effects even without investing more study time. On the other hand results show that providing learning tasks to learners is not per se useful. They should be constructed based on psychological findings (e.g. Klauer, 1987). Further research should consider aspects like the cognitive operations, different formats, the domain and the dimension interactivity especially in computer-based learning environments. Due to the limitations of the study further research with an experimental paradigm in a controlled setting is necessary. A special focus should be on the variety of interactive learning tasks and the question of how the learning process is affected by different types of learning tasks.

References

- Hamaker, C. (1986). The effects of adjunct questions on prose learning. *Review of Educational Research*, 56, 212-242.
- Klauer, K. (1987). *Kriteriumsorientierte Tests*. Göttingen.: Hogrefe.
- Narciss, S. (2008). Feedback strategies for interactive learning tasks. In J.M. Spector, M.D. Merrill, J.J.G. van Merriënboer, & M.P. Driscoll (Eds.), *Handbook of Research on Educational Communications and Technology* (3rd ed., pp. 125-144). Mahwah, NJ: Lawrence Erlbaum Associates.
- Proske, A., Kärndle, H. & Narciss, S. (2004). The Exercise Format Editor: A multimedia tool for the design of multiple learning tasks. In H. Niegemann, D. Leutner, & R. Brünken (Eds.), *Instructional design for multimedia learning* (pp. 149-164). Münster: Waxmann.
- Proske, A., Kärndle, H. & Narciss, S. (in press). Interactive learning tasks. In N. Seel (Ed.), *Encyclopedia of the Learning Sciences*. New York: Springer Science & Business Media, LLC.

Ways of Contributing to a Knowledge-Building Dialogue in Elementary Classrooms

Maria Chuy, OISE/University of Toronto, Canada; Monica Resendes, OISE/University of Toronto, Canada; Bodong Chen, OISE/University of Toronto, Canada; Christian Tarchi, University of Florence, Italy; Marlene Scardamalia, OISE/University of Toronto, Canada

This paper addresses new ways for education to strengthen society's capacity to produce new knowledge. Collaborative knowledge creation is a "self-organizing process" fostered by idea diversity and continual improvement of ideas. An important challenge is to understand how different contributing roles might increase levels of knowledge creation. The current research aims: (1) to develop an empirically grounded list of ways of contributing to knowledge building dialogue, (2) to examine the extent to which these are present and evolve during the first years of elementary school, (3) to explore how various contributions support each other in a dialogue, and finally, (4) to probe ways of contributing to conceptual breakthroughs. The participants were 61 students from grades 1-3 from a school, where "knowledge-building discourse" is integral to day-to-day work. The dataset analyzed in this research covers 4 months of online science discourse archived in Knowledge Forum (Author, 2004), an online environment designed to support knowledge-building dialogue. Early analyses of results have revealed that the majority of students' contributions focused on two ways of contributing—*theorizing* and *working with evidence*. This suggests a powerful influence of teacher and technology supports, enabling young students to propose and improve explanations to scientific phenomena. Correlations further suggest different contribution types operate in tandem, with advances in one type supporting advances of another type. Follow-up path analyses will focus on the course of contributions leading to conceptual breakthroughs, developmental changes in contributor roles, and discourse dynamics to engage processes of collaborative knowledge creation.

Introduction

Innovation is increasingly important in determining the health and wealth of societies, and from this perspective, a citizenry's capacity for knowledge creation represents an important challenge for education. Collaborative knowledge creation is a "self-organizing process" (Resnick, 1996) fostered by idea diversity and continual improvement of ideas. Different contributing, complementary roles are believed to foster knowledge creation, and collaborative knowledge

creation has been explored through assigned roles. For instance, Edward de Bono (1985) distinguishes 6 different thinking strategies (e.g., critical thinking, idea generation, providing information, etc.) Similarly, Hogan (1999), observing student interactions in science discourse, identified 8 naturally occurring roles: promoter of reflection, contributor of content, creative model builder, and mediator of group interactions and ideas. The current research fosters different types of contribution through engaging students in use of an online environment with supporting scaffolds. Pedagogical work and analyses focus on (1) developing an empirically grounded list of ways of contributing of finer grain than the above, (2) examining the extent to which these are present and evolve during the first years of elementary school, (3) exploring how various contributions support each other in a dialogue, and finally, (4) probing which ways of contributing lead to conceptual breakthroughs. Toward this end, we selected an elementary school site where "knowledge-building discourse" (Author et al., 2003) is integral to the day-to-day work of classes. Evolving practices at the Institute of Child Study, University of Toronto, are aimed at improving collective responsibility for knowledge advancement in students (Author et al., 2007). More precisely, students reference, evaluate, build on, and work to continually improve ideas—their own and those of community members. In addition to face-to-face discussions, students work in an online environment—Knowledge Forum (Author, 2004)—that provides a community space for collaborative work with ideas, with stored records providing data for this study. Teachers and students are experienced in Knowledge Building pedagogy and technology, so the situation represents what Fischer and Bidell (1997) call "optimal conditions" for identifying cognitive developmental goals.

Method

Participants and Dataset

The participants were 61 primary school students from the Institute of Child Study (notably, 10 girls and 10 boys from Grade 1; 9 girls and 11 boys from Grade 2; and 11 girls and 10 boys from Grade 3). Their teachers have been committed to Knowledge Building and have used Knowledge Forum for several years. The dataset analyzed in this research covers 4 months of online discourse on one study unit of each grade: water cycles (Grade 1), salmon (Grade 2) and fungus (Grade 3). Knowledge Forum scaffolds were available to support students' discussion around scientific objects. The total 679 notes that were posted in the Knowledge Forum space during this period constitute the dataset of this research.

List of Ways of Contributing

On the basis of informal observation as well as knowledge creation literature, a provisional list of contribution types was created. Then, using well-recognized iterative procedures of "Grounded Theory" (Glaser & Strauss, 1967), this list was revised and extended. Six major categories with 20 sub-categories have been identified: I—Formulating thought-provoking questions (i.e., explanatory, design and factual questions); II—Theorizing (i.e. proposing, supporting, improving explanations, or seeking an alternative explanation); III—Designing an experiment (i.e., proposing or describing an experiment; identifying a design problem; thinking of design improvements); IV—Working with evidence (i.e. asking or looking for evidence; providing evidence or reference to support or discard a particular idea; identifying new facts); V—Creating syntheses and analogies (i.e. summarizing previous ideas by integrating multiple notes into a rise-above note); VI—Supporting discussion (i.e. using diagrams to communicate or support ideas; giving an opinion; acting as a mediator). Four independent raters participated in the analysis. A quarter of the notes were scored by all four coders, and the remaining three-quarters were equally distributed among four raters for individual coding.

Preliminary Results

Results reveal that the majority of students' contributions were dedicated to theorizing and working with evidence. One of the possible interpretations is related to the use of scaffolds that are available within Knowledge Forum: most of these scaffolds intended to support young students with creating new explanations and justifying them with evidence (e.g., scaffolds such as "My theory," "A better theory," "This theory does not explain," "New information," etc.). These scaffolds, supported by teachers in classroom and online discussion, seem to have had a powerful influence on the discourse forms in evidence in each of the classes under investigation. Correlation analyses further suggest that different contribution types operate in tandem, with advances in one type supporting advances of another type. For instance, the interest in explanatory questions was closely related to the ability to propose explanations and synthesize ideas, and interest in factual questions led to the search in authoritative sources for new facts that could be used to support theories. Other analyses in progress focus on the developmental changes of contributor roles (i.e., do some contribution types appear earlier or later in the discourse, and to what extent is this influenced by use of scaffolds?) and conceptual breakthroughs (i.e., are particular types of contributions associated with conceptual breakthroughs or "aha!" expressions?). Follow-up research underway will allow us to determine the extent to which giving priority to different discourse forms, especially those most directly related to conceptual breakthroughs, will serve to better engage processes of collaborative knowledge creation.

References

de Bono, E. (1985). *Six thinking hats*. Boston: Little, Brown.

Fischer, K. W., & Bidell, T. R. (1997). Dynamic development of psychological structures in action and thought. In R. M. Lerner (Ed.) & W. Damon (Series Ed.), *Handbook of child psychology: Vol 1. Theoretical models of human development* (5th ed., pp. 467–561). New York: Wiley.

Glaser, B.G. & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New York: Aldine.

Hogan, K. (1999). Sociocognitive roles in science group discourse. *International Journal of Science Education*, 21(8), 855-882.

Resnick, M. (1996). Beyond the centralized mindset. *Journal of the Learning Sciences*, 5(1), 1-22.

Author (2004). Author et al. (2003). Author et al. (2007).

Learning in blended environment - face-to-face with social media and Mahara

Terhi-Maija Itkonen-Isakov, Metropolia University of Applied Sciences, Finland

The aim of the study is to research the changes of learning strategies in a global, networked learning environment, including also online environments and social media. In particular, the changes of educational practices are regarding the changing roles of teachers, the students and the the learning environments, including technology use in learning and instruction. The instruction combined face-to-face with online offerings, blended learning, and the pedagogical approach was inquiry and collaborative learning. The pedagogical frameworks also included shared expertise with the interaction of higher education and working life. The research questions were:- How learners build a shared understanding in social media environment? - What exactly sharing means in social media environment?- What kind of learning strategies support learning in social media environment? The participants were students and teachers of Helsinki Metropolia University of Applied Sciences Faculty of Culture. The data was collected in autumn 2010. The procedure was made with the server tools an a questionnaire and the data was reduced with content analysis and compared with learning outcomes. There is a methodological challenge to explain precisely the role of social media on all phases of blended learning and to explore the distinctions between individually and socially shared learning. Although, there seems to be some strategies supporting learning in social media learning environment: - combination of individual and group perspectives- target-orientation- working both online and in real life and openness for new ideas. The findings indicate that blended social media learning environments support collaborative inquiry learning.

The aim of the study is to research the changes of learning strategies in a global, networked learning environment, including also online environments and social media. In particular, the changes of educational practices are regarding the changing roles of teachers, the changing role of students and the changing role of the learning environments, including technology use in learning and instruction. The study is part of piloting project of open e-portfolio system Mahara in Helsinki University of Applied Sciences. Mahara itself features a weblog, resume builder and social networking system, connecting users and creating online learner communities, groups, blogs and forums, but also other open internet based tools were used. Wiki was used as a co-operative online learning tool, Moodle was used as CMS and new continent to the personal Mahara pages was updated with RSS feeds from e.g. Twitter, Youtube, Facebook, Slideshare and LinkedIn. The instruction combined face-to-face with online offerings, and the pedagogical approach was inquiry and collaborative learning. Inquiry-based learning is a constructivist approach, in which students have ownership of their learning. It starts with exploration and questioning and leads to investigation into a worthy question, issue, problem or idea. Collaborative learning is based on the model that knowledge can be created within a population where members actively interact by sharing experiences and take on asymmetry roles. Collaborative learning is heavily rooted in Vygotsky's views that there exists an inherent social nature of learning which is shown through his theory of zone of proximal development. The pedagogical frameworks also included shared expertise with the interaction of higher education and working life (Eteläpelto & Tynjälä, 1999). Using local experts and expert organisations as sources of information and as learning partners, the learning networks will be created, and the members of the network share knowledge and expertise as a form of human capital. Combining face-to-face with online instruction is also called blended learning. The goal of blended learning should be to unite the best features of oncampus and workplace learning with the best features of online learning, to promote active, self-directed learning opportunities for students. Although, learning in community is not a new idea. John Dewey suggested in his book *Democracy in Education* (1916) that the development of community is essential to a successful educational experience and that community is created through meaningful association, which is based on common interest and endeavor. The research questions were:- How learners build a shared understanding in social media environment? - What exactly sharing means in social media environment?- What kind of learning strategies support learning in social media environment? The context of the study was Helsinki Metropolia University of Applied Sciences. The participants were students and teachers of the Faculty of Culture. There were 230 students enrolled in Mahara e-portfolio environment during the piloting project, and they were allowed to form their own groups and use the social media environments as they liked. Data was collected from general activity, from number of discussion and social activities, from connections

("friends"), from group memberships, from the number of shared updates and from the number of comments to others' updates. The data was collected in autumn period 2010, from the beginning of August until the end of December 2010. The procedure was made with the server tools, including also graphical pictures of the development, and a questionnaire. The server data was analysed by quantity, and the questionnaire was reduced and analysed qualitatively with content analysis method. Finally, the results will be compared together with learning outcomes during spring 2011.

There is a methodological challenge to explain precisely the role of social media on all phases of blended learning and to explore the distinctions between individually and socially shared learning. Although, there seems to be some strategies supporting learning in social media learning environment: - combination of individual and group perspectives- target-orientation- working both online and in real life and openness for new ideas

The findings indicate that blended social media learning environments support collaborative inquiry learning. Also wiki as a tool supports learners building online communities of learning (Wikipedia, Wikiversity, and other wikis and social media). The members of the communities share their learning, support and help each other to learn even without realizing it (see also Suoranta, 2011). This not surprising, but what will happen in learning, if the learning environments change more and more towards online or blended environments in social media, and the conservative or preventing features are not at all supported by this kind of new learning environment? Also there is a question, if there will appear any problems of transformation when transferring learning from social media environment into real life environment?

Sources:

- Bonk, C. & Graham, C. (Eds.) 2006. The Handbook of Blended Learning - Global Perspectives, Local Designs. John Wiley & Sons, Inc. Pfeiffer publishing. San Francisco, CA.
- Dewey, J. (1916). Democracy and education. New York: Macmillan.
- Eteläpelto, A. & Tynjälä, P. (Eds.) (1999). Oppiminen ja asiantuntijuus. Työelämän ja koulutuksen näkökulmia (Learning and expertise. Viewpoints of working life and education). Helsinki: WSOY.
- Hakkarainen, K., Lonka, K. & Lipponen, L. 2004. Tutkiva oppiminen. Järki, tunteet ja kulttuuri oppimisen sytyttäjinä. Helsinki, WSOY.
- Hakkarainen, K. & Sintonen, M. (2002) The Interrogative Model of Inquiry and Computer-Supported Collaborative Learning, Science & Education 11: 25.
- Järvelä, S. & Häkkinen, S. (2002). Web-based cases in teaching and learning – the quality of discussions and a stage of perspective taking in asynchronous communication. Interactive Learning Environments 10 (1), 1–22.
- Lipponen, L., Rahikainen, M., Lallimo, J., & Hakkarainen, K. 2001. Analyzing patterns of participation and discourse in elementary students' online science discussion. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen, (Eds.), European perspectives on computer-supported collaborative learning. Proceedings of the First European Conference on CSCL, (pp. 421-428). University of Maastricht, The Netherlands.
- Suoranta, J. & Vadéén, T. (2011). Wikilearning as Radical Equality. In Trifonas, Peter (ed.). Learning in the Virtual: Public Pedagogy in the Digital Age. London & New York: Routledge.

THEMATIC POSTER

Technology in Education and Training

Learning to organize digital information

Jaap Walhout, Open Universiteit, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Rob Martens, Open University, Netherlands

The skill to search, find, evaluate, select, process, organize and present information in order to acquire new knowledge is defined as information-problem solving (IPS). For two reasons instruction in IPS is needed. First, the information environment changed considerably. With the emergence of the internet, people have nearly unlimited access to information. But this information is not filtered or organized and the question of reliability is of importance. Secondly, students often get assignments which require searching for information. However, research reveals that many students are not able to solve information-based problems successfully, and that they have especially problems with the ability to organize found information.

The skill to organize information during web searches is determined by several factors. Prior knowledge functions as an ontology in order to structure the newly found information. Also meta-textual knowledge is of importance. This refers to explicit knowledge of the role and function of organizers and also knowledge of the relevance of a document as a function of its source.

Instruction in organizing web-based information should foster the use of a non-hierarchical tagging approach, make use of ontological schemes, should be embedded in schools curricula, and should be adaptive. It is expected that instruction in organizing information with the tagging technique will improve students' organization of information, the ability to select relevant and reliable information and will have a positive result on overall task performance. Moreover, adaptive instruction concerning the used ontological schemes will lead to better results for especially intermediates and novices.

In our democratic information societies, learners conduct searches through a variety of sources when informing oneself about a specific topic of interest. Being able to search, find, evaluate, select, process, organize and present information in order to acquire new knowledge is an important skill. This skill is defined as information-problem solving (IPS) (Brand-Gruwel, Wopereis, & Walraven, 2008). The Internet is today's primary resource for information searchers, offering an unprecedented access to an enormous amounts of information. However, research reveals that many students are not able to solve information-based problems successfully (Walraven, Brand-Gruwel & Boshuizen, 2008), and that they have especially problems with the ability to organize found information (Stadtler and Bromme, 2008). In this paper we will analyze the skill of organizing information. The main question to be answered is; 'How can instruction improve students' ability of organizing information?'

Organizing information in a proper way is not easy. Before the internet, information was in books which were stored in libraries. A book cannot be on two shelves. The main subject of a book was therefore used to classify the book into a certain category. Adopting the library way of organizing information, web directories were created to bring order in the available content. Because people are used to such a hierarchical system, it seemed natural to categorize information in classes and subclasses (Shirky, 2005). But problems can raise when unusual or new pieces of information are difficult to classify because they do not fit properly to the classification rules. Another problem is encountered when an information object fits in more than one (sub)class. Which one to chose? The more information is created, the bigger this problem gets. Although hierarchical classification systems are a good way of bringing order in a collection of physical objects, with the use of virtual information objects it becomes possible to organize the information with labels or 'tags'. Consequently, information can be attributed to different classes. With the emergence of social bookmarking, which lets people define their own tags (folksonomy), users are given more control over organizing the contents of the web using own rules and categories. This means that information is not structured in advance but afterwards (Wichowski, 2009).

The skill to organize information during web searches is determined by several factors. The first important factor is students' prior knowledge. Ones' prior knowledge influences the search process (e.g. Fidel et al., 1999; Hirsch, 1999) and also seems to influence evaluation behavior. Studies by Britt and Aglinskias (2002), Nievelstein (2008), Rouet, Britt, Mason and Perfetti (1996) and Wineburg (1991) revealed that, compared to novices, experts used better strategies for evaluating and selecting information than novices. This indicates that people use prior knowledge as a sort of ontology in order to structure the newly found information.

Meta-textual knowledge is another important factor for the ability to locate and organize information. In order to determine whether a piece of information is useful, it is important to be able to quickly determine what the contents are. Text organizers as headings, introductions or tables of contents can be used for this purpose. As Rouet and Bigot (2007) discovered, using text organizers results in selecting more relevant information and a better understanding of the information. As a result it can be assumed that people with better meta-textual knowledge will also be better in organizing information.

The third important factor when organizing web-based information concerns feelings and motivation. According to Kuhlthau (2004) feelings play an important role in the IPS-process. The feelings of uncertainty, confusion and frustration are associated with vague, unclear thoughts about a certain topic (Kuhlthau, 2004). When people develop more clearer thoughts, they start to feel more certain and confident. When you find something interesting or fun, the possibility that you learn something is quite high. Ryan and Deci (2000) explained this with their self determination theory (SDT). They identified three basic psychological needs as the basis of self-motivation: the need for competence, the need for autonomy and the need for relatedness. When the feelings of competence autonomy and relatedness are well developed, it can be expected that people are more motivated and thus better able to organize their information. Instruction in IPS or more specific in organizing information can help students to feel more competent in solving information-based problems and can help students to regulate their emotions and become more motivated. That instruction in IPS is important and necessary is widely accepted (Brand-Gruwel & Gerjets, 2008).

Instruction in organizing web-based information should foster the use of a non-hierarchical tagging approach and make use of ontological schemes. Moreover this instruction should be embedded in the schools curricula and should be adaptive. For instance the amount of guidance in learning to organize will be adapted to the learners needs. Students with more prior knowledge should be able to use own categories and adapt the existing or given ontological schemes. It is expected that instruction in organizing information with the tagging technique will improve students' organization of information, the ability to select relevant and reliable information and will have a positive result on overall task performance. Moreover, adaptive instruction concerning the used ontological schemes will lead to better results for especially intermediates and novices and will have a positive effect on motivation.

This paper will present a theoretical framework to address the problems encountered when people organize web-based information and the mechanisms that should be taken into account when organizing web-based information. Furthermore, instructional solutions will be addressed, with a special attention of the design of adaptive embedded instruction.

Is Touching Better Than Watching? – The Effects of Modalities on Motivation and Performance

Tahmine Tozman, Goethe-Universität Frankfurt am Main, Germany; Mona Seikel, University of Frankfurt, Germany; Marc Grahmann, University of Frankfurt, Germany; Regina Vollmeyer, Goethe-Universität, Germany; Paul W. Dierkes, University of Frankfurt, Germany

Most theories in the field of multimedia learning suppose positive effect of including more modalities during learning. Mayer's cognitive theory of multimedia learning assumes that an active engagement with the learning media leads to a coherent mental representation of the existing knowledge. As media affects motivation, we include Vollmeyer and Rheinberg's cognitive-motivational process model that describes how initial motivation affects flow during learning which then influences performance. According to these theories, we assume that more modalities increase motivation and consequently performance. We examined six elementary school classes ($N = 161$; 78 male) at the age of 9 -11 years. In eight different learning-units students learned the mechanism of respiration. At the third unit we split up the classes into three groups (media). One group watched a film, one worked on a worksheet and the third group constructed a lung-balloon-model. Via questionnaires we tested the students' prior knowledge and their initial motivation. At the end of the unit, the students filled out a flow-scale and a knowledge posttest. We calculated a path analysis with the predictor variable media and considered their effects on flow as a mediator between media and performance. There is a significant effect from media to flow, $b = .18$, $p = .021$, but there is no significant effect from flow to performance, $b = 1.83$, $p = .69$. As expected, using more modalities increased motivation and flow, but did not increase performance. Our results could not support hypotheses from multimedia theories regarding performance.

Aim:

In our study we investigate the influence of different learning material (media) on the motivation and performance of students. According to multimedia theories, we assume that using more modalities increase motivation and in consequence performance.

Theory:

Most theories in the field of multimedia learning suppose positive effects of increasing the number of modalities during learning. Mayer's (1999) cognitive theory of multimedia learning (CTML) assumes a two channel system (visual and auditory) for information processing. Further, Mayer differentiates between a presenting modus of the learning media (spoken text or printed text) and a sensory modality – the perception of the presented media and their representation in the working memory. The aim of designing or using learning media is to activate both channels for the information processing. Mayer assumes that an active engagement with the learning material leads to a more coherent mental representation. Similar to CTML, the cognitive-affective theory of learning with media (CATLM) includes more sensory memories like tactile, olfactory and gustatory (Moreno, 2005). The authors also assume that motivational factors indirectly influence the learning process by increasing the students' cognitive engagement (see Pintrich, 2003). Focusing on motivational aspects of learning, the cognitive-motivational process model (Vollmeyer & Rheinberg, 1999) describes how initial motivation affects strategies and flow during learning which in turn influences performance. Vollmeyer and Rheinberg emphasize the importance of understanding the learning process as well as its outcome. Hypotheses: According to these theories we assume that including more modalities leads to an increased motivation and consequently to a better performance. Further we hypothesize that a more positive initial motivation facilitates flow (initial motivation includes: interest, challenge, probability of success and anxiety). In addition, motivation and flow-experiences can explain performance differences.

Methods:

In the context of a student-lab day at the department of biology didactics at the University of Frankfurt, we examined six elementary school classes (N = 161; 78 male) at the age of 9 -11 years (Mage = 10.31, SD = .50). They were presented with eight units about respiration. Each group got the same information about respiration, but presented with different media. We split up the classes into three groups and labeled this manipulation media. Each group consisted of two classes. All groups completed the same learning units with the exception of the third one. In the third unit each group worked with different learning media. That is our manipulation. One group watched a film about respiration. To understand the contents of the film the students needed to process visual and auditory information. The second group worked on a worksheet about the same topic. To understand the text and the pictures on the worksheet, visual information processing was needed. The third group constructed a lung-balloon-model. The students in this group had to listen to the instructions and information (auditory Information). At the same time they also had to look at their model (visual information) so that they could finally construct their own model (tactile information). We controlled prior knowledge with a pretest. Before starting with the third unit, the students were given an instruction about the upcoming learning unit and they were required to fill out the questionnaire on current motivation (FAM, Rheinberg, Vollmeyer & Burns, 2001). After finishing the unit (film, worksheet or lung-model) flow was measured with the flow-short scale (FKS, Rheinberg & Vollmeyer, 2001). After completing all eight units each student was asked to fill out a posttest. Results: First we tested whether the groups differ in motivation and flow. They differ on interest, $F(2, 158) = 6.46$, $p = .002$, probability of success, $F(2, 158) = 5.42$, $p = .05$, anxiety, $F(2, 158) = 3.43$, $p = .035$. There were no significant differences on challenge, $F(2, 158) = .19$, $p = .83$. We also found a significant difference between the groups on flow, $F(2, 158) = 5.53$, $p = .005$. There were no significant differences in knowledge between the groups on the pretest, $F(2, 158) = 1.76$, $p = .18$ and on the posttest, $F(2, 158) = 1.17$, $p = .31$. There were also no significant differences in knowledge between the groups when we consider the discrepancy between pre- and posttest, $F(2, 158) = .75$, $p = .48$.

Means are presented in Table 1. We calculated a path analysis with the predictor variable media and considered their effects on flow as a mediator between media and performance (dependent variable). There is a significant effect from media to flow, $b = .18$, $p = .021$, but there is no significant effect from flow to performance, $b = 1.8$, $p = .69$.

Discussion:

In our study we investigated that including more modalities leads to increased motivation and flow, but did not increase performance. Therefore, we could not support hypotheses from multimedia theories regarding performance. However, if students are not motivated to learn, it is helpful to increase their motivation through using media with more modalities. Then they might have more fun during learning. Although there is no immediate increase in performance, still their knowledge may grow on the long-term.

A meta-analysis on the influence of spatial ability on learning with visualizations

Tim Hoeffler, IPN - University of Kiel, Germany

This meta-analysis focuses on the role of spatial ability when learning with pictorial visualizations. Regarding 27 different experiments from 19 studies, several sub-factors of spatial ability are considered as well as dynamic and non-dynamic, interactive and non-interactive visualizations. An overall effect of $r = .34$ (95%-CI .28 to .39) demonstrating a medium advantage for high-spatial ability learners when working with visualizations is calculated. More importantly, two moderators could be identified: Learners with low spatial ability can be significantly supported by a dynamic instead of a non-dynamic visualization as well as by 3d- instead of 2d-illustrations. Results are discussed in consideration of contemporary theories of multimedia learning.

Introduction

In educational practice, non-dynamic and, increasingly, dynamic visualizations are a common tool to support the learning process. While the positive influence of visualizations in general seems undisputed and well-documented (cf. Mayer, 2005), there is more skepticism as to dynamic visualizations. What is more, the role of individual differences increasingly shifts in focus: Do all learners profit equally from visualizations? And if not, how can those learners be supported? In this sense, the role of spatial ability on learning with visualizations is still rather unclear. Though, at first glance, an obvious moderator variable, previous studies did not find consistent results as to its role. Hence, the present meta-analysis aims at revealing if and in which way spatial ability influences learning with visualizations. While the meta-analysis itself is quite narrowly focused, the overall goal to demonstrate the importance of considering individual differences in learning is not.

Theoretical Background

While it seems to be beyond dispute that spatial ability plays a crucial role in multimedia learning (e.g., Hays, 1996) there are, for example, disagreements as to possible aptitude-treatment interactions. Hegarty (2005) offers the

hypothesis that, in learning with dynamic visualizations (in contrast to non-dynamic visualizations), spatial ability might play the role of an enhancer (ability-as-enhancer hypothesis).

On the other hand, some authors (e.g., Hßffler & Leutner, 2010) point out the possibility of a compensating effect for low spatial ability in that animations might act as a "cognitive prosthetic" (Hegarty & Kriz, 2008) for learners with low spatial ability, because the visualization provides the learners with an external representation of a process or procedure that helps them to build an adequate mental model. It should be unequally more difficult to construct such a model by using static pictures.

Moreover, many questions concerning possible moderating effects of the role of spatial ability are still open: If learner's spatial ability is low, how should the format of instruction be designed to support the learning process? For example, Huk (2006) found the role of 3d- versus 2d-visualizations important as to this question. Garg, Norman, and Sperotable (2001) indicated a possible compensating effect of self-paced versus system-paced visualizations.

On the whole, the role of spatial ability on learning with visualizations is still rather unclear and superficially defined; therefore, the present, narrowly focused meta-analysis is warranted and aims at examining the relations between spatial ability and different characteristics of visualizations more closely.

Method

To identify relevant studies on the learning effects of spatial ability, the computerized databases SSCI (1993-2009) and ERIC (1966-2009) were searched. Apart from the articles found in databases, cross-references from identified articles helped to find some additional studies. However, for being able to include them in the meta-analysis, several criteria had to be fulfilled, for example the provision of the basic statistics needed for computing effect sizes. In the end, 19 articles (with 27 different experiments) remained.

Results

The overall effect of high-spatial ability learners versus low-spatial ability learners when using visualizations, disregarding all other variables, was calculated to be $r=.34$ (95%-confidence interval .28 to .39). This can be classified as a medium effect.

An overall homogeneity test indicated the overall effect size to be conditioned by one or more moderators: $Q_{total}=99.05$, $df=58$, p When comparing high-spatial ability subjects and low-spatial ability subjects, a significant difference could be found between dynamic ($r=.25$, $CI=.10$ to .39) and non-dynamic ($r=.41$, $CI=.28$ to .52) visualizations ($z_{contrast}=1.67$, p Another significant difference was found for the comparison of 2d- ($r=.35$, $CI=.27$ to .43) and 3d-visualizations ($r=.23$, $CI=.09$ to .36): $z_{contrast}=1.68$, p As to the level of realism of the visualization, no significant differences were found. Concerning the role of interactivity, the comparisons between system-paced, self-paced, and highly interactive visualizations were not statistically significant.

Discussion and Conclusions

To summarize the results of the meta-analysis in one sentence: Spatial ability plays an important role in learning from visualizations (mean effect size $r=.34$), but is moderated by – at least – two compensating factors; learners with low spatial ability can be significantly supported by a dynamic visualization as well as a 3d-visualization.

Thus, it has been confirmed that spatial ability is a factor which should be considered when designing visualization experiments. Learners with low spatial ability can be supported by some design modifications of visualizations. The suggestion of the usage of 3d-visualizations (which leads directly to the controversial question of an "appropriate" level of realism) stands in contrast to other results (cp. Huk, 2006) and certainly warrants further examination. Other established notions about multimedia design (e.g., the use of a secondary modality) could not be supported – which in no way contradicts those notions.

The suggestion to use dynamic visualizations for learners with low spatial ability, on the other hand, may sound controversial at first – but this finding could be one perfectly good reason for the many different findings concerning static pictures versus animations in the past (e.g., Hßffler & Leutner, 2007; Tversky, Morrison, & Béêtrancourt, 2002): Some learners (in this case, learners with high spatial ability) learn better when provided with non-transient static pictures which give them the opportunity to build their own mental model thanks to their highly developed spatial ability. And other learners (e.g., those with low spatial ability) seemingly learn better with animations; possibly because animations provide them with a ready-made dynamic mental model of the process shown.

Therefore, the present paper underlines the importance of the consideration of individual differences when learning with visualizations but also makes some contributions regarding design issues of learning environments.

Developments in interactive media practices of young people

Antoine van den Beemt, Fontys University of Applied Science, Netherlands

This paper presents a cross-sectional analysis of interactive media practices of young people, in perspective of consequences for education. Contemporary youth moves in a range of physical and virtual spaces, which together form their 'learning ecology'. In these learning ecologies, youths engage in activities that allow for the development of expertise, identity and interest. However, individual learning ecologies will develop over time. In order to understand this development, the following research question was formulated: How do patterns of interactive media participation develop among students?

The measurements were done, respectively, among 2138 youths, aged 9 to 23, in 2009, and among 350 first year students in higher education, aged 17 to 23, in 2010. The data analysis consisted of factor analysis and cluster analysis. The results of the first measurement showed a diversity in interactive media practices. The preliminary results of the second measurement showed a shift in both membership of usergroups as well as in specific activities. The results of this study indicate the importance for educators to acknowledge diversity in experiences and preferences among students. Considering consequences for education of this diversity, it is important to acknowledge the development in diversity and to address students' interactive media experiences and preferences with tailor made assignments, regardless of the application of interactive media.

Introduction

This paper presents the results of a cross-sectional analysis of interactive media practices of young people in perspective of consequences for education. It extends and builds on the results of a survey study analysing diversity in young people's use of interactive media, consisting of internet applications and games (Van den Beemt, Akkerman, & Simons, 2010a).

Aims

Contemporary youth moves in a range of physical and virtual spaces. These movements involve connections and actions in relation to others, which in turn bring forward opportunities to learn. Barron (2006) speaks in this respect of a 'learning ecology', which helps to conceptualise the development of expertise and experiences across the spaces of home, school, work, and community. In this learning ecology, young people engage in activities, such as playing games, maintaining a webpage or explaining the use of social software to peers. These activities allow for the development of expertise, while simultaneously supporting the development of identity and interest.

Barron (2006) argues that to understand the relation between technology use and learning, it is important to analyse pathways of participation, by looking at events, activities, and processes that spark interest in learning. Subsequently, the changes in a person's learning ecology should be charted for advancing theories of learning and assessing educational interventions.

An analysis of students' pathways of participation showed the importance of peers and informal networks of likeminded people in developing expertise in interactive media (Van den Beemt, et al., 2010b). More profound analysis of the interactive media practices of young people showed a diversity in both activities and related opinions and preferences (Van den Beemt, et al., 2010a). This diversity has been described in terms of patterns of participation.

The next step in understanding young people's learning ecology should be describing the development of patterns of participation over time. This leads to the following research question: how do patterns of interactive media participation develop among students? By answering this research question, this paper aims to reach a more profound understanding of the position of interactive media in young people's learning ecologies.

Methodology

The research question for this paper will be answered by means of a cross-sectional analysis. The first measurement was done among 2138 Dutch youths, aged 9 to 23, in 2009. Among this sample were 323 first-year students in higher education. The second measurement was done in 2010, among 350 Dutch first-year students in higher education, aged 17 to 23.

The survey was conducted online and consisted of 25 questions. The questions covered three main topics: media use, opinions about specific media and preferent media for specific activities.

The results of the first measurement were used as a jump-off for analysing data from the second measurement. The data analysis consisted of exploratory factor analysis and cluster analysis. Factor analysis allowed to describe differences between groups in terms of interactive media activities, while cluster analysis allowed to describe group membership.

Findings

The results of the first measurement showed a diversity in young people's interactive media use and in corresponding preferences and opinions. This diversity in experience, preferences and opinions gave rise to a description in patterns of participation. The results of the second measurement showed a shift in patterns over time.

In both measurements a categorisation of activities was found. Four categories were discerned, each representing a specific type of activity: interacting, performing, interchanging and authoring. The category interacting consists of traditional internet activities, focused on the consumption and exchange of information, such as e-mail, surfing the web, searching for information and MSN. The category 'performing', consists of gaming activities where users play a certain role on a virtual stage. The category 'interchanging' consists of all kinds of social networking activities. The last category, labelled 'authoring' consists of a larger number of activities, all of them comprising some form of interactive content production.

Furthermore a categorisation of users was found. There is a group of relatively low-end technology users, that mainly engage in the traditional Internet activities. This group was labelled Traditionalists. There is a small group of high-end technology users, which was labelled Producers. Furthermore, two groups of intermediate technology users are defined by mid-level technology use. One group, labelled Gamers, shows an emphasis on playing games, and the other, labelled Networkers, shows an emphasis on using all kinds of social software. The Networkers and Producers are relatively intensive users of the more traditional interactive media as well.

The preliminary results of the second measurement showed 1) a shift from Traditionalists towards the group of Networkers, and 2) as a shift in specific activities.

Relevance

Although learning is traditionally associated with schools and schooling it is increasingly recognised that children learn in everyday life by using interactive media. In terms of a learning ecology, it is important to avoid the binary opposition between in school and out of school, especially when the use of interactive media is concerned.

The results of this study indicate the importance for educators to acknowledge diversity in interactive media skills and preferences among students. However, the diversity itself should not be seen as a new truth, but rather as a developing process. In the consideration of consequences for education of this diversity, it is important to a) acknowledge the development in this diversity among students and b) address students' interactive media experiences and preferences with tailor made assignments, or broad learning contexts, regardless of the application of interaction media.

In this manner, this study aims at contributing to educational insights in how to organise learning so that it is in line with daily practice and interests of students.

References

- Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecologies perspective. *Human Development*, 49: 193–224.
- Van den Beemt, A., Akkerman, S., & Simons, P.R.J. (2010a). Patterns of interactive media use among contemporary youth. *Journal of Computer Assisted Learning*, DOI: 10.1111/j.1365-2729.2010.00384.x
- Van den Beemt, A., Akkerman, S., & Simons, P.R.J. (2010b). Pathways in interactive media practices among young people. *Learning, Media and Technology*. Accepted manuscript.

Computer use in second language learning: A developmental model

Florian Feucht, The University of Toledo, United States; Nathan Ziegler, The University of Toledo, United States

With the growing demand for computer-based technology in the classroom, teachers are continually challenged with the task of integrating technology into their curricula in a manner that supports their theoretical and pedagogical orientation. The second language classroom is no different in this respect, and even though there is a plethora of technology that can be used in a second language classroom, teachers may find that some of the technology is not helpful for their students because of the language and cognitive development of the learners. Despite this demand,

the existing literature often does not bridge the fields of technology, second language learning and instruction, and cognitive development in childhood. Therefore, the goal of this paper is to establish a theoretical framework for technology in second language classrooms that stems from a critical literature review of conceptual and empirical works as they pertain to technology, second language learning and instruction, and cognitive development. Furthermore, this framework is used to describe conceptual issues and to identify educational implications for the use of technology in the second language classroom.

Introduction

In order for children to participate in an increasingly networked global ecology, it is imperative that children begin to study second languages at an early age. With the importance of second language learning and the prevalence of technology in the global landscape and in education, we have established a theoretical framework that looks at the relationship between cognitive development, second language teaching methods, and technology. More specifically, this framework aligns the different teaching methods and technology with Piaget's four levels of cognitive development. Thus, this conceptual framework is designed to assist second language teachers in designing developmentally appropriate lesson plans with technology.

Assumptions of language

Traditional theories of language assume that language is a real-world construct that people use to communicate. In this view, language consists of grammar (i.e., nouns, verbs) and words. Yngve (1996) shows that language and grammar are abstractions that are not scientifically observable, but rather logical constructs that lie in the minds of the people communicating. Therefore, it is important to look at the real-world properties of the communicative event when studying human communication. In Yngve's (1996) scientific framework for studying human communication in the real world, he defined the communicative event as a linkage that consists of participants (i.e., the people), props (i.e., the objects used in communication and that are referred to), settings (i.e., the places where the communication is occurring), and channels of communication (i.e., the energy flows—sounds, light waves, text). In this framework, sounds and texts are correlated with participants' behaviors, the props, the setting, and the outcome of the communicative event. Because Yngve's framework shows that language and grammar are abstractions, it has become the foundation for our integrated framework of second language teaching methods, technology, and cognitive development. Cognitive Development and Language LearningIt is important to consider the cognitive development of learners to ensure the success of the teaching method and to select the appropriate technology for each method. Some methods require more abstract thought and some technology requires more complex skills than children at certain stages of their cognitive development are able to understand and/or carry out. Piaget described four stages of thought that are qualitatively different from each other: Sensorimotor, preoperational, concrete operational and formal operational stages (Piaget, 1952; Sigelman & Rider, 2008). Children progress through these four stages in the same order but may differ in the timely occurrence of the stages. Towards the end of the sensorimotor stage (i.e., birth to 2 years), children develop the ability to develop mental representations or symbols of people, objects, and events in their immediate and concrete environment. They can communicate with and about them by pointing, gesturing, and using words or forming very basic sentences. During the preoperational level (i.e., 2 to 7 years), children learn language about people and objects that are not present and past or future events of their life. They can verbalize and solve simple, concrete problems that do not require any form of logical thought. During the concrete operational stage (i.e., 7 to 11 years), children master the ability to effectively think and talk about concrete objects and events. At the formal operational stage (i.e., 11 years and older), older children learn to think and talk at a more abstract level of thought, and are able to solve hypothetical problems with an increasing number of components and solutions to them.

Second Language Teaching Methods and Technology

In this section, second language teaching methods and computer-based technology used in a language classroom will be aligned with Piaget's stages of cognitive development based on the theoretical framework of Yngve (see Table 1). First, we will provide a brief overview of a selection of second language teaching methods such as the Grammar-Translation method, the Audio-Lingual method, the Audio-Visual-Lingual method, the Content-Based Instruction method, the Communicative Language Teaching method, and the Hard Science Linguistic method. An overview of each method will justify our juxtaposition with Piaget's cognitive development model and Yngve framework for studying communication. For example, because the Grammar-Translation method focuses on translating words from one language to another (Brown, 2007) and students learn and apply grammatical rules of the target language (Oller, 1979; Purpura, 2004), learners must be able to perform at an advanced level of cognitive development (i.e., formal operations) to be able to think about abstract constructs such as grammar and translating words.

Second, computer-based technology will be looked at from a cognitive development perspective to enhance the instructional practices of teachers of a second language and the learning for the second language learners. Therefore,

technological tools such as digital video recording, simulated learning environments, internet based chat programs (both written and verbal), email, and computer-based concept mapping are placed in juxtaposition to the different developmental stages of cognitive development and will be addressed from the different methodological perspectives. For example, we suggest that email is most suitable for learners at the concrete and formal operation levels because they are increasingly able to communicate in writing about events in their immediate life (i.e., concrete operations) and more abstract concepts (i.e., formal operations). Further, Table 1 shows how it would correspond with the different teaching methods.

Conclusion

Due to the changing landscape of this technologically interconnected global society, it is crucial that we begin to teach second languages to children as they start early-childhood education. However, it is important that we consider the cognitive level of the language learners when choosing teaching methods and technology to assist in instruction. Second language learners at the sensorimotor, preoperational, and concrete level of cognitive development should be taught with teaching methods and technology that present communication in a second language in real-world contexts. As second language learners develop, they are able to understand more abstract aspects of communication and can use technology that facilitates their second language abilities at the formal operations and meta-cognitive level.

References

- Brown, H. D. (2007). *Teaching by Principles: An Interactive Approach to Language Pedagogy*, 3rd ed. White Plains, NY: Pearson Longman.
- Oller, J.W. Jr. (1979). *Language Testing at School*. London: Methuen.
- Piaget, J. (1952). *The origins of intelligence in children*. New York: International University Press.
- Purpura, J. E. (2004). *Assessing Grammar*. Cambridge: Cambridge University Press.
- Sigelman, C. K., & Rider, E. A. (2008). *Life-Span Human Development*. (6th ed.) U.S.: Thomson/Wadsworth.
- Yngve, V.H. (1996). *From Grammar to Science: New Foundations for General Linguistics*. Philadelphia: John Benjamins Publishing Co.

Ethics, social media and teacher education

Brita Bjorkelo, University of Bergen, Norway; Aslaug Almas, Stord/Haugesund University College, Norway

Research has shown that the role of the teacher is one of the most vital contributors to student academic outcomes (see e.g. Hattie, 2009). The Norwegian school system places great emphasis on the use of information and communication technologies (ICT) (Almås & Krumsvik, 2008) and digital competence is an essential part of teacher education (Krumsvik, 2008, 2009a). Teachers may also act as role models in their use of social media, and it is important that they conduct themselves in an ethical manner. Preliminary findings are presented from a Norwegian study from a larger, international project. The aim of the study is to understand the role of ethics in the decision to participate in social media as a teacher education student. The context of teacher education in Norway will be outlined and media cases related to teachers and their use of social media will be presented. Data from a survey of Norwegian pre-service secondary teachers will also be outlined. The survey investigated professional interactions and behaviours (PIBS; Morris, Richardson & Watt, 2010) and their relation to the amount of ethical training received to date. Demographic comparisons (e.g., age, gender) are discussed.

Research Context

The project has its background in the role of digital competence as one of the five basic competencies in the "Knowledge Promotion" (Kunnskapsløftet) (see e.g., Krumsvik, 2009b). The Knowledge Promotion is the ongoing reform within the Norwegian 10-year compulsory school and upper secondary education and training. The reform introduces changes in how digital competencies should be a part of the substance, structure and organization of teaching from the first grade of 10-year compulsory schooling to the last grade of upper secondary education and training. Research has shown that the role of the teacher is one of the most vital parts of student academic outcomes (see e.g. Hattie, 2009). Simultaneously, the Norwegian school system prioritises information and communication technologies (ICT) (Almås & Krumsvik, 2008). Digital competence is therefore an essential element of teacher education, as illustrated in the Digital literacy model (Krumsvik, 2008, 2009a). Teachers are role models in the application of ICT, such as teaching students ritual versus academic use. In the same way, teachers are also role models for the use of social media in an ethical manner. Some studies have suggested students evaluate the participation of teachers in social media and their level of motivation, affective learning and classroom climate (see e.g., Mazer, Murphy, & Simonds, 2009). Few, if any studies have investigated the role of ethical reasoning among teacher students and their actual participation in social media. A pilot study recently conducted in Australia among teacher education students (Morris, 2010) investigated the ethical implications of SNS for pre-service teachers. This project "Ethics, Social media and Teacher Education" has developed as a result of international collaboration with

Monash University, Melbourne, Australia (<http://www.monash.edu.au/>). Therefore the current study parallels the research of Morris (2010) and provides information from a Norwegian context with aim to increase understanding of the role of ethics in the decision to participate in social media as a teacher student.

Method

The sample consisted of Norwegian pre-service secondary teachers in their third and fourth years of study. The survey investigated the attitudes towards acceptable behaviour for student-teacher interactions as in Morris' (2010) study, the perceived adequacy of ethical and professional training in the degree and the current usage of social media (e.g. Facebook).

Results and Discussion

Media reports indicate that teacher use/misuse of social media is of public interest. The results of the current study provide an interesting insight into the issues and ethical implications for pre-service teachers in Norway who are soon to become teachers themselves. The adequacy of ethical training and the degree to which teacher education students employ privacy and security settings for their personal profiles are outlined. Recommendations for the inclusion of training on the ethical use of social media in the pre-service teacher curriculum are made. Future directions of the study include a more detailed cross-cultural comparison with an Australian sample of pre-service teachers.

References

- Almås, A. G., & Krumsvik, R. (2008). Teaching in technology-rich classrooms: Is there a gap between teachers' intentions and ICT practices? *Research in Comparative and International Education*, 3(2), 103-121. doi:<http://dx.doi.org/10.2304/rcie.2008.3.2.103>
- Krumsvik, R. (2008). Situated learning and teachers' digital competence. *Educational and Information Technology*, 4(13), 279-290. doi: 10.1007/s10639-008-9069-5.
- Krumsvik, R. (2009a). Digital didaktikk. In H. Otnes (Ed.), *Å være digital i alle fag* (pp. 227-254). Oslo: Universitetsforl.
- Krumsvik, R. (2009b). Situated learning in the network society and the digitised school. *European Journal of Teacher Education*, 32(2), 167-185. Doi 10.1080/02619760802457224.
- Mazer, J. P., Murphy, R. E., & Simonds, C. J. (2009). The effects of teacher self-disclosure via Facebook on teacher credibility. *Learning Media and Technology*, 34(2), 175-183. doi:10.1080/17439880902923655.
- Morris, Z. A. (2010, July). Usage of social networking sites among prospective teachers – Ethical implications for fitness to practice. Paper presented in Symposium 'Teaching in an Era of Accountability'. ICAP Conference, Melbourne, July 11-16.

THEMATIC POSTER

Cooperative learning

To be open and committed - Forming a model of mission education

Elina Kuusisto, University of Helsinki, Finland

The purpose of this study is to explore the structure, goals and methods of mission education in order to educate people to be openly committed to one's own religion and to be open to encounter religious otherness. Mission education is examined within the main religion in Finland. The research context is a Lutheran student association. The empirical data consists of the interviews of the all 25 former chairpersons. The data is analysed by qualitative and quantitative content analysis. Situational learning (Lave & Wenger 1991) and the criteria of meaningful learning (Jonassen 1995) are utilized as theoretical frameworks. Definitions of intentionality and purposiveness (Kansanen et al.'s 2000) are applied as complimentary tools to examine educational goals.

The key result of the study is a model of mission education. The model has three educational components: values, goals and methods. The gist of the model is formed by the goals. The main goal is to arouse and strengthen of the mission interest. Four subgoals create the horizontal, societal, and vertical, religious, dimensions of the model. The subgoals are goals in their own right but their role is also to support the realisation of the main goal. Therefore mission education seems to have explicitly multidisciplinary nature. The model can be utilized as an evaluative instrument in reflecting the focuses of the religion education.

In order to realise the criteria of meaningful learning better more conscious efforts are needed to attain intentional and reflective learning.

This study examines the problem of how to be openly committed to one's own religion and to be open to encounter religious otherness at the same time. This question has long been in the focus of the missionary workers (see Franz  n 1986). However, in the globalizing world every representative of any religion faces this challenge in everyday life. For these reasons this study combines two disciplines: religious education and missiology. Mission education is applied as a linking concept. The purpose of this study is to explore the structure, goals and methods of mission education.

Mission education is examined within the main religion in Finland, Lutheran Christianity. The research context is a Lutheran student association *Opiskelijain L  hetysliitto* (OL), which is Finnish successor of the Student Volunteer Movement. The OL was chosen, because the activities of the OL are reminiscent of the activities of the mission of the congregations of the Finnish Evangelical Lutheran Church. However, the biggest difference is that all OL participants are young adults, the age group that is the greatest challenge to the Church.

The study is empirical despite having a historical and retrospective view since the OL is explored during the period 1972–2000. The data consists of the interviews of all 25 former chairpersons. The data is analysed by qualitative and quantitative content analysis in a partly inductive and partly deductive manner. *Atlas.ti* and *Excel*-programme are utilised.

Lave and Wenger's (1991) theory of situated learning is applied to understand the holistic nature of learning through participation in a community of practice. Kansanen et al.'s (2000) definitions of intentionality and purposiveness are utilised as complimentary tools to examine educational goals within the community of practice. Jonassen's (1995) criteria for meaningful learning are applied as a deductive guideline to evaluate the methods.

The key result of the study is a model of mission education. The model has three educational components: values, goals and methods. The OL's values are described in terms of a postmodern ethos, which appears as ecumenical Christianity and a holistic idea of mission.

The gist of the model is formed by the goals. The main goal is to arouse and strengthen of the mission interest, which has affective, cognitive and practical aspects. The main goal has four subgoals that create the horizontal and vertical dimensions of the model. The horizontal subgoals include socialisation into one's own community of practice as well as into the global world. The vertical subgoals include developing Christian spirituality and learning to encounter other religious traditions such as learning to be ecumenical and to practice religious dialog.

It is noticed that the subgoals are goals in their own right but their role is also to support the realisation of the main goal. Mission education seems to have therefore explicitly multidisciplinary nature, which reflects the structure of missiology (see Jongeneel 1995). The hierarchy of the goals can be seen as empirical examples of missionary dimension and intention, which are mostly discussed within the discipline of systematic theology and mission theology (see Ott 2001; Bosch 1984, Gensichen 1971; Newbigin 1958). Empirical findings suggest that different societal and religious themes can contain mission dimension, when these are understood as preparatory elements to fulfil the mission intention.

Authenticity and transfer were found to be the most exploited criteria of meaningful learning. Authenticity refers for example to supporting missionary work in many concrete ways. Learning about mission in different cultures and religious contexts was reported to take place mainly through lectures by experts who were mostly missionaries. In order to better execute the criteria it is needed to develop a better awareness of the goals of mission education among OL participants, volunteer workers and visiting experts, and also more conscious efforts are needed to scaffold the reflection of the studied topics.

The model is proposed to describe the characteristics of mission education more generally than in the OL only. The study suggests that the model can be utilised as an evaluative instrument in reflecting the focuses of the religion education especially within Finnish Evangelical Lutheran Church. Still, the model is to be tested in other contexts in order to develop it more and find out its broader relevance in theorizing mission education as part of the discipline of religious education.

References of the extended summary

Bosch, D. J. 1984. Mission in theological education. In H. M. Conn & S. F. Rowen (ed.) *Missions & theological education in world perspective*. Farmington, Michigan: Associates of Urbanus, xiv–xli.

- Franzéén, A. 1986. Missionärsutbildning i Norden sedd i relation till missionssituation och organisationsidentitet. [Missionary training models in Scandinavia as related to the missions situation and the organizational identity] Diss. Helsingfors: Missiologian ja ekumeniikan seura.
- Gensichen, H.-W. 1971. Glaube für die Welt. Theologische Aspekte der Mission. Germany: Göttersloch.
- Lave, J. & Wenger, E. 1991. Situated learning. Legitimate peripheral participation. Cambridge university press.
- Kansanen, P., Tirri, K., Meri, M., Klokfors, L., Husu, J. & Jyrhämä, R. 2000. Teachers' pedagogical thinking. Theoretical landscapes, practical challenges. New York: Peter Lang Publishing.
- Jonassen, D. 1995. Supporting communities of learners with technology: A vision for integrating technology with learning in schools. Educational Technology 35 (4), 60–63.
- Jongeneel, J. A. B. 1995. Philosophy, Science, and Theology of Mission in the 19th and 20th Centuries. A Missiological Encyclopedia. Part I: The Philosophy and Science of Mission. Frankfurt am Main: Peter Lang.
- Newbigin, L. 1958. One Body, One Gospel, One World. The Christian mission today. London: International Missionary Council.
- Ott, B. 2001. Mission and Theological Education. Transformation 18 (2), 87–98.

Prediction of cooperative teamwork success in secondary students

J. Reinaldo Martinez-Fernandez, Universidad Autonoma De Barcelona, Spain; Carles Monereo, Universitat Autonoma de Barcelona, Spain; Montserrat Castello, Universitat Ramon Llull, Spain; Calixto Gutierrez-Braojos, Facultad de Ciencias de la Educacion. Universidad de Granada, Spain

In this work we analyzed the effect of a set of social learning variables related to teamwork in a specific learning task (integration of ideas in a writing task) in a sample of secondary students. Our aim was to analyze the effect of group gender composition, group skills organization, interaction, group task goal, social support inside the group, and the perception of effective work time at a level of success in a specific learning writing task. The relevance of our research is that we concluded in an approach model to know the effects of these variables in a best integration of ideas in a writing task with interesting results regarding theoretical, methodological and practical implications. In this sense, we found that the atmosphere of the group and the perception of the effective use of time are the factors that better explain success in the final task. Likewise, some interesting results on differences according group gender composition are discussed.

Overall quality and scientific originality

The study is original for the form of compilation of the information because it has been developed across a task and in an authentic classroom context. The procedure followed allows observing the students during the whole work process, their form of interaction, the conversations, decision making, and the sequence followed in the composition of the final text. From the point of view of the analyses, in this study an analysis of equation structural model is applied that puts as a whole a series of variables defined theoretically relevant for the collaborative work.

Nutrition as prerequisite for optimal school performance

Renate de Groot, Open University of the Netherlands, Netherlands; Carolijn Ouweland, VU University, Netherlands; Jelle Jolles, VU University, Netherlands

Nutrition might play a role in cognitive functioning and school performance. Fish consumption has shown its benefits for cognitive functioning in the elderly or children with disorders (e.g., autism, ADHD), but has rarely been investigated in relation to cognitive performance and school performance of adolescents.

Therefore we executed an observational study in 700 healthy Dutch high school students aged 12-18 years. Data with respect to fish consumption were collected, as well as end term grades to determine school performance, scores on the Amsterdam Vocabulary Test, and scores on the Youth Self-Report.

Results revealed that 13.6% of the Dutch adolescents never ate fish, 6.4% met national guidelines, 16.9% reached half of the norm, and 63.1% did eat fish but too little to meet at least half of the norm. Analysis of variance, controlled for age, gender, educational track, and LPE, showed significant differences between the four fish consumption groups in vocabulary ($p = 0.05$). A trend for significance was found for end term grades ($p = 0.07$). Contrast analyses demonstrated significant quadratic associations between fish consumption and vocabulary ($p = 0.01$) and end term grades ($p = 0.01$), respectively, indicating that higher fish intake was associated with more advanced vocabulary as well as higher end term grades. However, eating more fish than the described norm seemed no longer beneficial.

In conclusion, fish intake among adolescents may provide benefits in vocabulary and school performance. We advise to consume fish twice a week, but not more than that.

Introduction

Nutrition might play an important role in brain function. Fish consumption is often associated with better cognitive performance in the elderly. Up till now it was almost neglected what the role of fish consumption is in the period of adolescence. To our knowledge, there are only two studies, which highlight the effect of fish intake on cognitive functioning during adolescence. Kim (2010) showed that 15-years old adolescents who consumed regularly fish had significant better school performance than their non- or less fish consuming counterparts. Aberg (2009) et al. demonstrated in boys that high fish consumption at age 15 was associated with better cognitive performance at age 18.

In the current study, we endeavor to extend these recent findings in a Dutch high school population with a broader age range, including boys and girls! In addition to school performance, it is our aim to investigate whether fish consumption is associated with current cognitive performance measured with a vocabulary test and self-report attention. By means of this study, we add information about the role of fish consumption for cognitive development during healthy adolescence, a developmental period seldom studied in this field up till now.

Methods

Design and participants

An observational study, approved by the Ethical Committee of the VU University Amsterdam, in 700 healthy Dutch high school students (grade 7-12) was executed. Exclusion criteria: suffering from any learning, psychiatric or developmental disorders, using cognitive function influencing medication, skipping school regularly, and/or taking fish oil supplements.

Measures

Fish consumption was measured by a validated self-report questionnaire (De Groot et al., 2009). According to the Dutch 'guidelines for healthy food', the participants were divided in four groups: (1) never eats fish, (2) fish intake of less than half of the norm, (3) more than half of the norm, but less than the norm, and (4) norm or more.

Vocabulary of four types of words was assessed with the Amsterdam Vocabulary Test.

Regarding attention, adolescents filled in the attention subscale of the Dutch version of the Youth Self-Report (Verhulst & Van der Ende, 2004).

End of term grades for the three core school subjects Dutch, English and Mathematics were used as proxy for school performance. Since schools may have differed in grading policies, standardized z-scores were used.

Gender, age, and level of parental education were included as background variables.

Statistical analyses

To examine whether the four fish consumption groups differed in attention, vocabulary and/or school performance while controlling for age, sex, educational track, and LPE, Analyses of covariance (ANCOVA) were used. Covariates were tested for the assumption of linearity with the dependent variables. Assumptions of normality were tested within each fish consumption group for each dependent variable separately. Since the four fish consumption groups differed in sample sizes, we corrected for unequal cell sizes while analyzing. P-value was set at p-values <0.05.

Results

Participants

The final sample consisted of 700 adolescents (394 girls, 306 boys) with a mean age of 15.0 (SD=1.8).

Fish consumption

13.7% of the Dutch adolescents never ate any fish, only 6.4% met the national guidelines. In addition, 16.9% reached at least half of the norm, while the majority of the adolescents (63.0%) did eat fish, but rather irregularly or too little to meet at least half of the norm. Fish consumption did not differ between boys and girls, $\chi^2(3)=2.95$, ns, and educational track, $\chi^2(3)=1.00$, ns, neither was it associated with age, $F(3,696)=.39$, ns, nor with parental level of education, $F(3,694)=.96$, ns.

Attention

No significant differences between the fish consumption groups regarding attention problems, $F(3,681)=0.94$, $p=.42$. Of the covariates, only age was significant, $F(1,681)=6.49$, $p=.01$, $\eta^2=.01$. With increasing age more attention problems were reported.

Vocabulary

Significant differences were found between the four fish consumption groups, $F(3,624)=2.50$, $p=.05$, $\eta^2=.02$, even after controlling for the significant effects of the covariates age, $F(1,624)=329.65$, $p<.001$, $\eta^2=.35$, sex, $F(1,624)=3.75$,

$p=.05$, $\eta^2=.01$, and educational track, $F(1,624)=55.54$, $p<.001$, $\eta^2=.08$. Polynomial contrast analyses were performed and showed that the relation between fish consumption and vocabulary was quadratic, contrast $=-0.59$, $p=.01$. A higher average DHA/EPA intake per week was associated with more advanced vocabulary. However, eating more fish than the described norm seemed no longer to be beneficial. The model explained 40% of the variance in vocabulary.

School performance

Similar differences between the four fish consumption groups were found regarding school performance, $F(3,639)=2.35$, $p=.07$, $\eta^2=.01$. In this model, the covariates sex, $F(1,639)=11.39$, $p=.001$, $\eta^2=.02$, educational track, $F(1,639)=41.08$, $p<.001$, $\eta^2=.06$, and LPE, $F(1,639)=11.57$, $p=.001$, $\eta^2=.02$, were significant, whereas age was not, $F(1,639)=2.43$, $p=.12$. Polynomial contrast analyses demonstrated a significant quadratic association between fish consumption and school performance, contrast $=-0.20$, $p=.01$. School performance increased with a higher DHA/EPA intake, but it did no longer for the group with the highest fish consumption. The model explained 12% of the variance in school performance.

Discussion

Higher fish intake was proposed as being associated with higher cognitive performance as well as higher school performance. Our results demonstrated that after correction for age, sex, and educational track higher fish intake was associated with higher scores on the Amsterdam vocabulary Test. In addition, also school performance, measured as the average end term scores of the subjects Dutch, English, and mathematics, was higher when more fish was consumed. This implicates that the more fish was consumed by the adolescents, the better school performance, as well as vocabulary scores were. However, we did find quadratic associations, meaning that as soon as the adolescents in our population consumed more fish than the recommended amount this was associated with significantly lower scores on school performance and vocabulary.

Although fish consumption is only a proxy for the actual fatty acid status, our observations indicate that the association between fish consumption and school performance as well as vocabulary scores consists of an inverted U-shape in adolescents aged 12-18 years. Further prospective observational studies are required to confirm our findings, but ultimately intervention studies are required to proof the causality of this association. In the meantime, it seems prudent to advise adolescents to consume fish twice a week, but no more than that.

Can Buying Make a Difference? – Consumer's Responsibility from Adolescents' Perspective

Silke Speidel, University of Leipzig, Germany

Education for Sustainable Development (ESD), an important part of education in the global networked society, aims to enable pupils to recognise and accept the challenge of their personal responsibility for humankind and the environment, which also concerns their patterns of consumption. Therefore this study seeks to find out how pupils handle sustainable consumption decisions: Do pupils recognise any personal responsibility for humankind and the environment when asked about consumption decisions and if so, which consequences do they draw from this? Do they consider diverse interests and frameworks in their reasoning and if yes, which and to which extent? How do pupils deal with the competing logics of economy and moral? Do pupils' self-efficacy and belief in a just world influence the way they handle decisions on sustainable consumption and if yes, in which way? Using a qualitative approach, pupils of Year 10 and 11 were interviewed individually with a hypothetical decision situation and a set of predefined questions. Preliminary results indicate that although pupils recognise personal responsibilities for humankind and the environment, they also find reasons not to accept the challenge of this responsibility. Different structures of making a sustainable consumption decision become apparent. The result of these analyses shall be used to deduce implications for the design of lessons on sustainable decision-making.

Education for Sustainable Development (ESD) is an important part of education in the global networked society of the 21st century, underlined by the "UN Decade of Education for Sustainable Development" (2005-2014). One focus of ESD is sustainable consumption. Although sustainable consumption has been studied from different perspectives, including marketing, political sciences and sociology, an educational perspective with a sound theoretical foundation is lacking and would be a necessary complement the existing practical resources. Pupils' decision-making competencies with regards to sustainable development have been studied from a didactical perspective (e.g. Eggert & Bßgeholz 2009), but pupils' competencies in moral reasoning have been studied mostly separately from that (e.g. Lind 2008). Decisions of sustainable consumption are influenced by the competing logics of economy and moral. Whereas (neoclassical) economic logic dictates that consumers should look for their own advantage and maximize their own utility, moral expectations are that people do not only decide egoistically but comprise other perspectives and/or universal principles in their decisions.

According to the German Cross-Curricular Framework in the Context of Education for Sustainable Development (Appelt & Siege 2007), pupils are expected to "recognise areas of personal responsibility for humankind and the environment" on the basis of "critical reflection on globalisation and development issues" and the personal evaluation of development aid measures "taking diverse interests and frameworks into account" (Appelt & Siege 2007, 61). It thus aims at making pupils able to integrate the competing logics. As sustainability issues usually are highly complex due to interrelated variables on which no comprehensive reliable basis of information can be obtained, pupils have to reduce the complexity of the situation to remain capable of decision-making. On the other hand, they have to avoid over-simplifications that lead to misunderstandings and wrong predictions. How well pupils manage to integrate the competing logics in decision situations of sustainable consumption might depend on the efficacy they ascribe to the actions in question and thus also on their self-efficacy. Furthermore their belief in a just world can probably influence the decision in two directions: Whereas in situations of lower complexity, it can promote pro-social behaviour, it leads to justifying judgments in situations of higher complexity which renders pro-social behaviour unlikely (Hallitzky 2008). This study tries to answer how pupils handle the task of making sustainable consumption decisions: Do pupils recognise any personal responsibility for humankind and the environment when asked about consumption decisions and if so, which consequences do they draw from this? Do they consider diverse interests and frameworks and if yes, which and to which extent? How do pupils deal with the competing logics of economy and moral? Do pupils' self-efficacy and belief in a just world influence the way in which they handle decisions on sustainable consumption and if yes, in which way?

To answer these questions, pupils of Year 10 and 11 (aged 16 and 17) are interviewed individually with a hypothetical decision situation concerning sustainable consumption and a set of predefined questions. The interview is similar to a classic dilemma interview yet more open as the different possibilities of action have to be developed by the interviewee. The protagonist in the described situation desires a product which to his/her knowledge has been or could have been produced in a problematic way. The problems addressed include child labour, working conditions in Least-Developed Countries, and endangered species as well as precarious working conditions in Germany. The situation was presented by orally explaining the circumstances of the decision situation and handing out cards with information the protagonist was said to possess. After the initial advice to the protagonist, for which the pupils had to give reasons, they were asked about the assumed perspectives of different stakeholders mentioned on the cards, on hypothetical situations of every consumer acting the same way and on possible solutions for the addressed problems. As a qualitative approach is used, the number of pupils interviewed and of interviews analysed depends on when theoretical saturation is reached. The analysis draws on the balance theory of wisdom by Sternberg (1998), research on prosocial moral reasoning as well as complex problem solving and the influence of self-efficacy and belief in a just world on sustainable judgments and behaviour by Hallitzky (2008).

Preliminary results indicate that although pupils recognise personal responsibilities for humankind and the environment, they also find reasons not to take up the challenge of this responsibility. Different structures of making a sustainable consumption decision become apparent. So might e.g. the disregard of human rights be an issue of its own or only perceived as moral cost of the consumer. Different rights as well as their disregard seem either to be seen as negotiable and thus a field of trade-offs or to be seen as absolute, a disregard thus leading to a cut-off.

The result of these analyses shall be used to define different levels of competence in the field of sustainable decision-making and to deduce implications for the design of lessons on sustainable decision-making.

References

- Appelt, D. & Siege, H. (Eds.) (2007). *Global Development Education - A Cross-Curricular Framework in the Context of Education for Sustainable Development*. Bonn: BMZ & KMK. Retrieved from http://www.globaleslernen.de/coremedia/generator/ewik/de/Downloads/Dokumente/Orientierungsrahmen_20f_C3_BCr_20Globales_20Lernen_20-_20englisch.pdf (2010-10-27).
- Eggert, S., & Bßgeholz, S. (2009). Students' use of decision-making strategies with regard to socioscientific issues: An application of the Rasch partial credit model. *Science Education*, (94), 230-258.
- Hallitzky, M. (2008). Forschendes und selbstreflexives Lernen im Umgang mit Komplexität. In I. Bormann & G. de Haan, *Kompetenzen der Bildung für nachhaltige Entwicklung: Operationalisierung, Messung, Rahmenbedingungen, Befunde* (pp. 159-178). Wiesbaden: VS Verlag für Sozialwissenschaften.
- Lind, G. (2008). Teaching Students to Speak Up and Listen to Others: Fostering Moral-Democratic Competencies. In D. E. Lund & P. R. Carr (Eds.), *Doing democracy: striving for political literacy and social justice* (pp. 319-335). New York: Peter Lang.
- Sternberg, R. J. (1998). A balance theory of wisdom. *Review of General Psychology*, 2 (4), 347-365.

Cooperative learning and student preferences

Michal Nachshon, Ministry Of Education; Technion, Israel; Amira Rom, the Open University of Israel, Israel

The basic premise in co-operative learning is that it motivates active learning by students, encourages group processing of information, and strengthens meta-cognitive. The present research examines the preferences of "Science for All" students for co-operative learning as opposed to individual learning, and their perception of the co-operative learning process. The research sampling consisted of 283 11th–12th grade students. They created a portfolio reflecting two school years, which invited individual and co-operative learning and included an educational game based on scientific knowledge. The research tools in this study were: (a) A structured model of planning stages for developing the educational game; (b) A Questionnaire of personal achievements, filled by students at the end of the process. The research findings indicate a preference for group work, mainly due to its experiential nature and deeper learning of the collaborative process. Those who favored individual learning, indicate its lack of dependence on other person, and its simpler organization. These reasons related particularly to its level of feasibility, and emphasized individuality. Analysis of the findings indicates more diverse reasons and higher thinking levels amongst students preferring group work than those preferring individual work. Possibly the reservations against group work can be explained by a lack of ability or desire to contend with conflicting opinions. Apparently students capable of coping with conflicts of opinion, prefer group work, while students incapable of coping with conflicting opinions and lack of equality prevalent in group work, emphasize the disadvantages of group work.

Cooperative learning and student preferences

Cooperative learning in instructional and learning processes has some advantages: it provides in-depth learning, leads to diverse learning methods and social interaction. This integrative method increases interest in learning, leading to comprehension of content and successful learning. The basic premise in cooperative learning is that it motivates active learning by students, encourages group processing of information, and strengthens meta-cognitive activities (Lazarowitz & Hertz-Lazarowitz, 1998). The present research examines the preferences of "Science for All" students for cooperative learning as opposed to individual learning, and their perception of the cooperative learning process. "Science for All" is a multidisciplinary approach, a combination of scientific, technological and social aspects. Its purpose is to instill scientific literacy integrated with basic scientific knowledge, thinking skills necessary for the future, and standpoints on science and technology (Shwartz, Stern, 2006). Its educational aim is to acquire knowledge and understanding, in order to make informative decisions on social issues involving scientific and technological aspects (Hofstein & Yager, 1982). The study goals were:

to examine the methods students prefer using – cooperative or individual learning and to identify the reasons for their preferences.

to characterize the cooperative learning advantages and disadvantages expressed by students.

Procedure

The research sampling consisted of 283 11th–12th grade students. They created a portfolio reflecting two school years, which invited individual and cooperative learning and included an educational game based on scientific knowledge. The research tools used in this study were: (a) A structured model of planning stages for developing the educational game (Rom & Nachshon, 2009); (b) A Questionnaire of personal achievements, filled by students at the end of the process. The research approach is ethnographic –characterized by the assumption that a quality environment is inclusive, and that examining it will open a window on the social and learning world of the students.

Findings

Data were treated with qualitative and quantitative analysis. Most of the students preferred cooperative learning, while 39% preferred individual work. Three clusters of reasons reflecting preferences for cooperative learning were identified (see Figure 1): (1) The main preferences stemmed from the experiential aspect of group work. (2) The second group included these criteria: division of work, multiplicity of opinions for enrichment of knowledge and enriching each other (3). The group with the lowest frequency included criteria such as level of activity, greater efficiency in learning and paying more attention to opinions of others. In test a-parametric (Chi-Square=160.5, d.f=6, p=0.000) significant differences were found amongst the criteria. Two distinct clusters of reasons reflecting a preference for individual learning (see Figure 2): (1) The Main preferences include two equivalent aspects: Non-dependence on opinions of others and simpler organization; (2) The group of reasons included the criteria: gaining satisfaction, high level of activity and efficiency of learning. In test a-parametric (p=0.000, d.f=4, Chi-Square=56.5) (significant differences were found amongst the criteria. The students raised 481 reasons for the advantages of group work. In order to identify main trends, the reasons were grouped into 3 main categories (with significant differences amongst them). It was found that about half the criteria for choosing cooperative learning related to cooperation, 1/3 to the value of in-depth learning during cooperative learning, and 1/5 to the enjoyment aspect. The students raised

307 reasons indicating disadvantages of cooperative learning. The students' reasons were grouped into categories (whose differences were significant): more than half of the reasons for reservations to group work related to conflicts of opinion, 40% related to inequality within the groups, and a few related to technical problems.

Discussion and conclusions

The basic assumption of cooperative learning is that it motivates students to active learning, encourages group processing of information and reinforces meta-cognitive activity. "Science for All" adopted the method of cooperative learning as a unique tool to express the abovementioned components. During their studies, students experienced various individual and cooperative instruction methods. We assume that cooperative activities may contribute to the development of academic achievement when carried out in a suitable learning environment, (Lazarowitz, Hertz-Lazarowitz, 1998). The findings support researches that show a significant connection between the degree of satisfaction and the division of labor in groups, and the amount of work load imposed on the individual, and indicate that students who prefer cooperative learning identify the experiential advantages as well as the instructional/learning processes (Burdett & Hastie, 2009). This model of learning reinforces interest in studying, leads to understanding of the content and to success. An analysis of the reasons presented by students' preferring individual work indicates the individualistic aspects which were expressed. These conclusions relating to advantages and disadvantages raise the assumption that students who are capable of coping with conflicts of opinion prefer group work, while those who are not able to cope with conflicting opinions and inequality in cooperative activity overemphasize the disadvantages of cooperative learning. The importance of this research lies in the development of a teaching/learning method, which integrates multidisciplinary scientific content knowledge with modes of learning which together may foster academic achievement. This approach is likely to increase public awareness to the ways of training the future citizens in different ways of work (individual and cooperative) in respect to their future needs.

References

- Burdett, J. & Hastie, B. (2009). Predicting satisfaction with group work assignments. *Journal of University Teaching & Learning Practice*, 6, 1, 61-71.
- Hofstein, A., Yager, R.E. (1982). Societal Issues as organizers for Science Education in the 80's.. *School Science and Mathematics*, 7, 539-547.
- Lazarowitz, R. & Hertz-Lazarowitz, R. (1998). Cooperative learning in science curriculum. In: B.J. Fraser & K.G. Tobin (Eds.). *International Handbook of Science Education*. Netherlands: Kluwer Academic Publishers. pp. 449-471.
- Rom, A. & Nachshon, M. (2009). The curricular reform of science for all in Israel. Paper presented at the ESERA 2009 Conference.
- Shwarz, Y. & Stern, L. (2006). Scientific Literacy – Changing perceptions and approaches to science teaching. From: Supervisory Circular about Mutav, 3, Ministry of Education, Pedagogic Secretariat, Supervision of Mutav teaching. Jerusalem (in Hebrew).

Figure 1: Distribution of criteria and preferences for cooperative learning

Figure 2: Distribution of criteria and preferences for individual learning.

Fostering Gifted Students - A Pilot Project at the interface between School and University

Jutta Moehringer, Technische Universität München, Germany; Manfred Prenzel, TUM School of Education, Germany

In the whole of Europe the promotion of young talent in the field of natural sciences is in the focus of interest. Since 2009 the Technical University of Munich (TUM) has been running a pilot project on special tuition for students interested in and talented for mathematics, IT, sciences and technology (MINT). In a distinct upper secondary level track at the Otto-von-Taube-Gymnasium (ordinary state grammar school) 30 selected students, both male and female, are involved in a demanding advancement program based on the principles of acceleration and enrichment. The program itself differs from others in that it enhances the interconnection between school and university by taking into account whatever the institutions may require in terms of organisation, personnel and contents. The study aims at the evaluation of the special tuition regarding its processes and effects upon students, teachers, and university lecturers. The evaluation concept is based on the CIPP model with its focus on context, input, process, and product. The study-design is that of an explorative study collecting process data, thus using qualitative methods. At the same time and despite small samples only, quantitative methods are applied and set against data derived from large-scale studies such as PISA. First findings show that the TUMKolleg students are capable of handling scientific methods and that neither their performance motivation nor their extra-curricular activities are affected by the heavy workload they are facing. Teachers and university lecturers profit from this interexchange.

Background

The shortage of qualified young people talented for mathematics, IT, sciences and technology (MINT) not only in Germany, but all over Europe, gave rise to frequent initiatives aiming at sparking the young students' interest in the sciences (Ley, 2002). This is why the TUM started a pilot project together with a grammar school, focusing on MINT and directed at highly gifted students. At the beginning of the school year 2009/10 the Otto-von-Taube-Gymnasium (OvTG), an ordinary state grammar school not far from Munich, started introducing a distinct upper secondary level track. 30 students at the TUMKolleg are given the chance to take part in a special tuition program developed exclusively for their purposes. The tuition program itself is based on the principles of both enrichment and acceleration. Enrichment implies widening the curriculum by adding learning facilities. Acceleration means providing measures to achieve utmost efficiency by shortening the learning process (Southern et al, 1993). In the TUMKolleg enrichment comprises school and university. The school provides curricular contents in an all-encompassing and more profound manner and offers a way of teaching that leaves enough flexibility for inductive and independent acquisition. At the university the students are made acquainted with scientific work and given the opportunity to specialise in individual small research projects. Acceleration in this case implies that the students are given some ECTS credits for their future studies, provided they have succeeded in working on their tasks. They are equally enabled to minimise their phase of orientation, once they are immatriculated. The independence of TUMKolleg in terms of structure and organisation allows students to be weekly guaranteed a whole day reserved for getting used to doing their research on campus. Unlike other initiatives aiming at the tuition given to the students in the field of MINT, the TUMKolleg pilot project has the advantage of resting upon two institutions, the grammar school on the one hand and the university on the other. This helps to smoothen the processes at school and university and helps to alleviate the interconnection between lessons at school and research at university.

Aims

The study aims at the evaluation of the special tuition regarding its processes and effects upon students, teacher and university lecturers. The evaluation concept is based on the CIPP model as developed by Stufflebeam (2007) with its focus on context, input, process, and product. The leading questions are: 1. To what extent can students acquire scientific methods? 2. How have the students improved their command of mathematics, natural sciences and problem solving approaches? 3. Which development concerning non-cognitive personal attributes (achievement motivation, coping with stress and interests) can be recognised? 4. What effect does the interexchange between teachers and university lecturers have upon teachers' professional development and upon lecturers' awareness and accessibility to school students.

Methodology

The study-design is that of an explorative study and therefore comprises various qualitative methods including the individual steps of learning and process data. As the CIPP-model demands, the elements of evaluation are the following: The context is represented by the regular state grammar school OvTG and the particular target group of gifted students. The decisive elements regarding the particular target group are the following: A questionnaire with questions regarding the respective students' biographical background, motivation and interest. Furthermore there is a written pre-test assessing competence in mathematics, natural sciences and problem solving (Prenzel et al, 2004). The input implies the special tuition program with its particular offers at both grammar school and university. For the evaluation of the process the students are asked to keep structured diaries in which questions like those on achievement motivation, interest, and coping with stress must be answered. Apart from that, standardised questionnaires help to make explicit how lesson plans and teaching are experienced by teachers and lecturers and how students perceive their lessons (Seidel & Prenzel et al, 2006). The product evaluation at the end of the TUMKolleg is done by means of semi-structured interviews directed at lecturers, students, teachers, parents and student mentors. The results achieved through individual research projects reflect how well science methods have been learned and dealt with. A written post-test measures the progress regarding competence in mathematics, natural sciences and problem solving (Prenzel et al, 2004).

Findings

A part of the data collection has already been made and interpreted. The data collection of the first group of students will be finished in June 2011. Its results will be available in August 2011 at the latest. First findings show that the students of the TUMKolleg are capable of handling scientific methods and that neither their performance motivation nor their extra-curricular activities have been affected by the heavy workload they are facing. Teachers and university lecturers profit from this interexchange. Significance for theory, policy, and practice Research on highly gifted students has shown that only a minor part of tuition programs offered to students has been evaluated (Vock, 2007). At this stage the TUMKolleg is the only tuition project regarding MINT in Germany and therefore the only one with special attention to the institutionalisation of the co-operation between school and university. The unique significance of this project given, there is an unquestionable value of the evaluation results for theory and education, the more so, when it comes to applying the model of TUMKolleg to other schools.

Heller, K. (2002). Untersuchungsauftrag f r die wissenschaftliche Begleitforschung. In: Heller, K. (Hrsg.) Begabtenf rderung im Gymnasium. Opladen
 Ley, M. (2002). Uebergang Schule-Hochschule.
 BonnPrenzel, M. et al. (2004). PISA 2003 – Der Bildungsstand der Jugendlichen in Deutschland.
 M nster Seidel, T. , Prenzel, M., et al. (2006). Unterrichtsmuster und ihre Wirkungen. MuensterSouthern, W. Th., Jones, E. D. & Stanley, J. C. (1993). Acceleration and enrichment: The context and development of program, in K. Heller, F.J. Moenks, A. H. Passow (eds.), International Handbook of Research and Development of Giftedness and Talent, Oxford, UK: Pergamon, pp. 387-410
 Stufflebeam, D., Thinkfield, A. (2007). Evaluation, Theory, Models & Applications. San Fransisco
 Vock, M. et al (2007). Foerderung Hochbegabter in der Schule. Goettingen

THEMATIC POSTER SESSION

Educational Attainment and Effectiveness

Multitasking: does autonomous vs controlled motivation influence performance?

Marie-Paul Senecaut, K.U.Leuven Campus Kortrijk, Belgium; Joke Coens, Katholieke Universiteit Leuven, Belgium; Geraldine Clarebout, Katholieke Universiteit Leuven, Belgium

Mobile learning is gaining importance in education. Learning no longer binds students to one place. Studying 'anytime and anywhere' (Maag, 2006; Motiwalla, 2007) allows students to learn while performing another activity (Laing & Wootton, 2007), which leads to multitasking. Psychological research done mainly in artificial settings, suggests that performance will decline. Results in recent more ecological tests, where learning with a mobile device is secondary to another task, do not always follow this pattern (Doolittle & Mariano, 2008; Clarebout, Coens, & Elen, 2008; Coens, Clarebout & Reynvoet, 2009b). Among several possible explanations motivation could possibly influence performance. Checking this is the aim of this experiment.

We will determine participants' autonomous vs controlled motivation (Self-Determination Theory, Deci & Ryan, 1985) for learning Spanish words and for driving in a simulator using an adaptation of the Academic Regulation Scale (Ryan & Connell, 1989) as found in Vansteenkiste, Sierens, Soenens, Luyckx, & Lens (2009). We expect that participants who are highly autonomously motivated and lowly controlled motivated will show the best performance. Tests are scheduled for November till December 2010, so results will be available by Spring of 2011.

As young people multitask more and more, it would be of great value if we could find what influences their performance when multitasking. This knowledge may help educators in their search for more efficient learning.

Multitasking: does autonomous vs controlled motivation influence performance?

Marie-Paul Senecaut, Joke Coens, Geraldine Clarebout, K.U.Leuven Campus Kortrijk, Belgium;

Mobile learning leads to multitasking.

The "mobile revolution" with people increasingly connected, using mobile technologies in social practice and education is still in full expansion (Wagner, 2005, Alexander, 2004, Rideout, Foehr, & Roberts, 2010). Some even claim that within five years all K12 students in the United States will be using a mobile learning device (Norris & Soloway, 2010). The use of mobile phones and other portable devices is definitely putting its stamp on how learning takes place in many disciplines (Kukulka-Hulme, 2009). Typically mobile learning can be done "anywhere and anytime", meaning students can use the time spent waiting for a bus or riding a train to study (Maag, 2006, Motiwalla, 2007). In doing so, people are often multitasking. Multitasking has been studied elaborately in psychology, yet few researchers report on studies done in a more ecological setting. So far, most results show that multitasking leads to a lesser performance.

Results & expected pattern.

Doolittle and Mariano (2008) reported on learning with a mobile device while performing a second task and they found that stationary students watching an instructional podcast outperformed their colleagues watching the same instructional video on an iPod while walking down a hallway. Theory of divided attention (Craik, Govoni, Naveh-Benjamin & Anderson, 1996; Baddeley, Lewis, Eldridge & Thomson, 1984) explains this effect: when attention is divided during the learning phase of a task (walking down the hallway and watching the video), performance declines. Results of Doolittle's research were confirmed in Clarebout's (Clarebout, Coens & Elen, 2008) study where participants were asked to watch some study material on an iPod while cycling on an exercise bike at a speed of over 10 km/h. Cycling participants scored significantly lower than their friends watching the same movie on an iPod, sitting at a desk.

However, Coens, Clarebout & Reynvoet (2009b) asked participants to screw nuts on bolts while studying with an iPod. Some students were told studying was more important, for others screwing the bolts was to be given priority. Results were not completely as expected. Only one significant difference was found: students in the control group (not multitasking) did significantly better than students who had been told to combine the learning with the screwing of the bolts giving priority to the screwing of the bolts. Although the other groups showed a difference in result, it was not significant.

Several explanations are possible. We could mention among others: perception of importance (Levy & Pashler, 2008, Coens, 2008), working memory capacity (Doolittle & Mariano, 2008) and difficulty level of task (Cherng, Liang, Hwang & Chen, 2007). In this experiment we want to check whether maybe motivation for one of the tasks lies at the core of the differences in results.

A possible explanation

The multidimensional view of motivation, used in Self-Determination Theory (Deci & Ryan, 1985), distinguishes the quantity from the quality of motivation. SDT suggests that higher levels of motivation do not necessarily yield more desirable outcomes if the motivation is of a poor quality. Motivation of a poor quality means controlled rather than autonomous motivation (Ryan & Deci, 2000; Vansteenkiste, Lens, & Deci, 2006).

SDT divides motivation in autonomous vs controlled motivation. Autonomous motivation being an experience of volition and choice, such as in intrinsic motivation and identified extrinsic motivation as opposed to controlled motivation, which involves the experience of being pressured or coerced, corresponding with poorly internalized forms of extrinsic motivation (Deci & Ryan, 1985). When mobile learning, motivation could play a role. Applied to Doolittle & Mariano's experiment, we could suggest that students could have been highly autonomously motivated to walk down the hall and not so highly autonomously or highly controlled motivated to watch the instructional video, obviously resulting in a lesser performance. For Clarebout's study we might say that students could have been highly autonomously motivated to ride the bike and lowly autonomously motivated or highly controlled motivated to watch the study material on an iPod, explaining their poor performance. In Coens' experiment it could have been that learners were more or less as motivated to screw the bolts and nuts as they were to study the educational podcast, showing only slight non-significant differences in performance.

Does motivation play a part, does motivation influence performance?

The experiment

We will invite about 120 university students to learn Spanish vocabulary using an iPod, while driving in a simulator. We will ask them, for each task, to fill out an adapted version of the Academic Self-Regulation Scale (Ryan & Connell, 1989), which has been successfully used in previous work (e.g., Vansteenkiste, Zhou, et al., 2005). The 16-item scale, contains 4 items per regulation (intrinsic, identified, introjected and extrinsic motivation). This Dutch version, used by e.g. Vansteenkiste, Sierens, Soenens, Luyckx, & Lens (2009) has been validated.

As done in previous studies (e.g. Vansteenkiste, Lens, De Witte & Deci, 2004; Vansteenkiste, Zhou, Lens & Soenens, 2005; Vansteenkiste et al., 2009) we will create an autonomous motivation composite by averaging the scores for identified and intrinsic motivation and a controlled motivation composite by averaging the scores for external and introjected regulation. We expect four clusters to emerge: a high quantity motivation group (high autonomous, high controlled), a low quantity motivation group (low autonomous, low controlled), a good quality motivation group (high autonomous, low controlled), and a poor quality motivation group (low autonomous, high controlled).

If motivation (autonomous or controlled) is at the basis of the results of the experiment, then we should find the following pattern for each of the tasks. The experiments are scheduled to take place in November and December 2010, so results will be available by Spring 2011. As young people multitask more and more, it would be of great value if we could find what influences their performance when multitasking. This knowledge may help educators in their search for more efficient learning.

Associations Between Classroom Environment and Affective Outcomes in Queensland Secondary Schools

Jeffrey Dorman, Monash University, Australia

This research investigated associations between classroom environment and student affective outcomes in Australian secondary schools. The What Is Happening In this Class (WIHIC) questionnaire was used to assess 7 classroom environment dimensions: student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity. Three student outcomes were also assessed: academic efficacy, attitude to subject, and attitude to computer use. The sample consisted of 1,256 year 11 and 12 students nested in 61 classes from 10

secondary schools in Queensland, Australia. Multilevel analyses with the 7 WIHIC scales as explanatory variables and the 3 outcome scales as response variables were conducted. The one significant classroom environment dimension that was common to all three models was task orientation. Keeping students engaged in the specific tasks at hand and completing meaningful activities is important to affective outcomes. Overall, this study has shown that students' perceptions of the classroom environment are related significantly and positively to affective outcomes. Teachers should ensure that positive environments exist in all classrooms.

Research on the psychosocial dimensions of classroom environments has made substantial progress during the past 40 years (Fraser, 2007). This research has focused mainly the atmosphere or climate that pervades the classroom. The strong tradition of classroom environment research has been to conceptualise environments in terms of Murray's (1938) beta press – the perceptions of the milieu inhabitants – with instruments assessing particular dimensions of the environment (e.g. teacher support).

The focus of much classroom environment research has been on associations between classroom environment and cognitive and affective outcomes. Ex post facto research designs with correlational data techniques have been the most common approach to environment – outcome studies. Most studies have used either the student as the unit of analysis and ignored class membership or aggregated at the class level and used the class as the unit of analysis. The present study preserves the nested nature of the data by employing multilevel analysis. It has three affective outcomes: academic efficacy, attitude to subject, and attitude to computer use.

Aims

- To validate scales of the What Is Happening In this Class (WIHIC) questionnaire;
- To validate scales to assess academic efficacy, attitude to subject, and attitude to computer use; and
- To use multilevel analysis to identify classroom environment dimensions that predict academic efficacy, attitude to subject, and attitude to computer use.

Methodology

Sample

The sample consisted of 1256 year 11 and 12 students nested in 61 classes from 10 secondary schools in Queensland, Australia. Of these students, 656 were male and 606 female.

Instrumentation

The WIHIC was used to assess 7 classroom environment dimensions: student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity. Three student outcomes were also assessed: academic efficacy, attitude to the subject, and attitude to computer use.

Data Analysis

WIHIC and outcomes scales were validated using confirmatory factor analysis (CFA) and classical test theory procedures. Multilevel analyses with the 7 WIHIC scales as explanatory variables and the three outcome scales as response variables were conducted.

Findings

Reliability coefficients (Cronbach coefficient alpha) were computed for each scale. These results show that all scales had very good internal consistency reliability. Indices ranged from .88 for involvement to .94 for equity. CFA supported the WIHIC's structure.

Initial variance components models were used to partition variance in all variables across student, class and school. Results indicated only a small amount of variance in response and explanatory variables at the school level.

Subsequent regression modelling with backward elimination was conducted with variance partitioned at two levels: student and class (see Table 1). For example, academic efficacy was predicted by student cohesiveness, involvement, task orientation, investigation and cooperation. The -2loglikelihood ratio test statistic was used to report whether differences between null and regression models were statistically significant. From Table 1, the Δ -2loglikelihood statistic for academic efficacy is 1046.1. As $\chi^2(7, N = 1256) = 20.52, p = .001$, there is a statistically significant difference between the null and regression models.

Educational Significance

This study has demonstrated the use of multilevel analysis in classroom environment research. Because students are nested in classrooms, researchers should employ multilevel analysis when analysing classroom environment data. The above results show that classroom environment is a significant contributor to the sources of academic efficacy. Furthermore, it is possible that academic efficacy influences the environment. Bandura's (1997) triadic reciprocity theorises that personal factors influence, and are influenced by, environment and behaviours. Individuals are

producers and products of their own environment and social systems (Pajares, 1996). The results reveal that classroom environment was a much stronger predictor of attitude to subject than attitude to computer use with only 7.37% of variance in attitude to computer use scores attributed to the three predictor variables (task orientation, investigation and equity). More work is needed in integrating computer into the classroom environment.

The one significant classroom environment dimension that was common to all three models is task orientation. Keeping students engaged in the specific tasks at hand and completing meaningful activities is important to affective outcomes. This accords with much recent research (see, e.g. Dorman, Fisher, & Waldrup, 2006). Accordingly it would seem that the fields of student engagement and classroom psychosocial environment have much in common and research on the relationship between engagement and classroom environment should be undertaken.

Overall, this study has shown that students' perceptions of the classroom environment are related significantly and positively to affective outcomes. Teachers should ensure that positive environments exist in all classrooms.

References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Dorman, J. P., Fisher, D. L. & Waldrup, B. G. (2006). Learning environments, attitudes, efficacy and perceptions of assessment: A LISREL analysis. In D.L. Fisher & M. S. Khine (Eds.), *Contemporary approaches to research on learning environments* (pp. 1-28). Singapore: World Scientific.
- Fraser, B. J. (2007). Classroom learning environments. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 103-124). Mahwah, NJ: Erlbaum.
- Murray, H. A. (1938). *Explorations in personality*. New York: Oxford University Press.
- Pajares, F. (1996). Self-efficacy beliefs in academic Settings. *Review of Educational Research*, 66, 543-578.

Effects of rubric: Focusing on values of test, learning motivation and strategy

Masayuki Suzuki, the university of tokyo, Japan

In the present study, we investigated the effects of instruction about the test's grading standards and purpose by presenting a rubric to students. 101 eighth-grade students were randomly assigned to 1 of 3 classrooms, each of which corresponded to an experimental condition. The participants studied mathematics for 5 sessions: at the end of each session, the teacher gave a test of that day's lecture. The feedback methods of their test results varied according to each classroom's experimental condition: (1) the rubric condition in which participants received the rubric; (2) the rubric plus comment condition in which participants received the rubric and comments by the teacher; or (3) the comment-only condition in which participants received only comments by the teacher and not the rubric. The results showed that students who received the rubric were more likely to regard the test's purpose as improvement, had higher intrinsic motivation, used more deep-processing strategies and fewer surface-processing strategies and achieved higher scores than those who did not receive the rubric. The results also revealed that comments by the teacher had no effect on the dependent variables. In addition, the results of a path analysis suggested that the rubric influenced motivation, strategy and test score via values of test. The results of this study suggested that the rubric is helpful in informing students about the test's purpose of improvement, and the test's effects on students depend on the students' perception of the test's purpose or role.

Background and purpose of study

Considering the decline of scholastic ability in Japan, attention is being paid to tests. For example, an admission system based on recommendation that does not need for an academic achievement test has been reviewed. The expectations from an academic achievement test are that it would promote the zeal for achievement and encourage learning among students; however, it is possible that a test may adversely affect the learning motivation and strategy of students (e.g. Gipps, 1994). Therefore, it is important to examine the procedure of conducting tests. In recent years, researchers have examined students' perspectives on testing or assessment and shown that students' view of the test's values or purposes is related to their learning motivation and strategy (e.g. Brown, et al., 2009; Suzuki, 2009). For example, Suzuki (2009) defined values of test as the students' perception of the test's purposes and roles, and the scale comprises four sub-scales: improvement (e.g. test helps me understand the extent of my own learning), pacemaker (e.g. test supports the creation of a learning programme), comparison (e.g. test's purpose is to select excellent students) and enforcement (e.g. test's purpose is to enforce learning). The aspects of a test that help in improving learning and encouraging planning are related to high learning motivation or deep-processing strategy. On the other hand, the aspects that enforce learning and enable selecting excellent students are related to low learning motivation or surface-processing strategy (Suzuki, 2009). These results suggest that tests have a negative effect on students because they regard the test's purpose as comparison or enforcement. Therefore, as suggested in some studies that it is important to inform students about the test's purpose or grading standards (e.g. Murayama, 2006;

Spratt, 2005), it is considered essential that when teachers conduct tests they emphasise the purpose as improvement or pacemaker. If students understand that teachers do not use tests to enforce learning, but to help students improve, their learning motivation can be positively affected and they can be encouraged to use an effective learning strategy. A rubric can be useful for informing students about the test's purpose or grading standards. Although educators tend to define rubrics in slightly different ways, a commonly accepted definition is that it is a document that articulates the expectations from an assignment by listing the criteria, or aspects that count, and describes the levels of quality (Andrade, et al., 2009). Thus, a rubric enables students to understand the test's grading standards, judge their level of understanding and determine the best approaches for correcting mistakes and improving performance (e.g. Weaver, 2006). Therefore, in the present study, we investigated the effects of instruction about the test's grading standards and purpose by presenting a rubric.

Methods

Participants? The participants were 101 eighth-grade students from public junior high schools in two wards of Tokyo and a junior high school affiliated with the University of Tokyo. They voluntarily participated in the study. They were randomly assigned to 1 of 3 classrooms, each of which corresponded to an experimental condition. **Procedure?** The experimental classes were organised and provided at the University of Tokyo for 5 days during the summer of 2009. **Classes?** Mathematics classes on linear equations with two unknowns were conducted. During days 2–4, lessons consisted of the previous day's test review (10–15 min), a lecture on word problems (25 min) and a test on that day's lecture (10 min). On the first day, a pretest and lecture about methods of calculation were conducted. On the last day, participants reviewed the test that they took on the fourth day, and took post-test. **Feedback methods** The feedback methods of their test results varied according to each classroom's experimental condition: (1) the rubric condition in which participants received the rubric; (2) the rubric plus comment condition in which participants received the rubric and comments by the teacher; or (3) the comment-only condition in which participants received only comments by the teacher and not the rubric. All participants received correctness feedback and model answers. **Dependent variables** Values of test, intrinsic motivation and learning strategies were measured through questionnaires, and performance was measured by the post-test. The post-test consisted of three isomorphic problems and two challenging problems.

Results

Contrast analysis was used to test the effects of the rubric, and two orthogonal contrasts were constructed. The first tested for differences between two rubric conditions and the comment-only condition (rubric contrast: rubric [1], rubric plus comment [1], comment-only [-2]). The second tested for differences between the rubric condition and the rubric plus comment condition (comment in rubric contrast: rubric [-1], rubric plus comment [1], comment-only [0]). The results showed that students who received the rubric were more likely to regard the purpose of the test as improvement, had higher intrinsic motivation, used more deep-processing strategies and fewer surface-processing strategies and achieved higher scores than those who did not receive the rubric. The results also revealed that comments by the teacher had no effect on the dependent variables. In addition, the results of a path analysis suggested that the rubric influenced learning motivation, learning strategy and test score via values of test (Figure 1). The model provided a satisfactory fit to the data: $\chi^2(17) = 17.346$, AGFI = .882, CFI = .998, RMSEA = .017, SRMR = .066.

Discussion

The results of this study suggested that students' view of the test's values or purposes influenced their learning motivation, learning strategy and performance. Therefore, the test's effects on students depend on the students' perception of the test's purpose or role. In addition, the rubric proved to be helpful in informing students about the test's purpose of improvement, possibly because students can understand the test's grading standards and their achievement within those standards; hence, they can determine the best approaches for correcting mistakes and improving performance. However, because there was no difference in their enforcement score among conditions, more effective interventions must be developed.

Evaluation of the Model for Competence-Based Vocational Education

Lidwien Sturing, Wageningen University, Netherlands; Harm Biemans, Wageningen University, Netherlands;
Martin Mulder, Wageningen University, Netherlands; Elly De Bruijn, Utrecht University, Netherlands

The model for competence-based vocational education (CBE-model) consists of eight CBE-principles elaborated for four implementation levels and assess the actual and desired competentiveness of vocational study programmes (Wesselink, Biemans, Mulder and Van den Elsen, 2007a). This article presents the result of a study on the necessary adjustments of the CBE-model according to teachers in order to apply the model as a valid instrument to assess the actual and desired competentiveness of their study programmes. In study A 57 teachers evaluated the model during

group sessions resulting in a revised CBE-model including 10 principles for five levels of implementation. In study B 151 teachers completed a questionnaire to evaluate the comprehensibility of the revised model. The study showed that teachers understood and interpreted the revised model as intended, were able to position their study program by using the revised model and that the content validity and reliability of the revised model was satisfactory.

Introduction

The concept of competence has taken a central position in the curriculum reforms that are currently sweeping across the world (Arguelles & Gonczi, 2000; Brockmann, Clarke, Méehaut & Winch, 2008; Clarke & Winch, 2007; Weigel, Mulder & Collins, 2007). According to Velde (1999) competence-based education (CBE) enables students to prepare themselves to be competent professionals and citizens in this current society. Per August 2011 vocational study programmes in the Netherlands should be completely based upon a competence-based qualification structure following governmental policy.

The transformation to CBE has not gone smoothly. First the underlying principles of CBE were not clear in the first place. Furthermore, there were no sufficient guidelines or instructions provided by the government to implement CBE. Only a competence-based qualification structure is obliged by law. As a consequence of this situation the implementation of CBE resulted in putting new competence-related labels on old practices, as a result of which hardly anything changed in educational practice.

Therefore Dutch researchers constructed the model for competence-based vocational education which consists of eight crucial CBE design principles elaborated for four implementation levels (referred to as 'not', 'starting to be', 'partially' and 'completely' competence-based). It assesses the actual and desired competentiveness of vocational study programmes. Competentiveness refers to the extent to which study programmes are competence-based (Wesselink, Biemans, Mulder & Van den Elsen, 2007a).

Further research on the CBE-model appeared to be necessary. A study of Wesselink, Mulder and Biemans (2007b) showed that the CBE-model was perceived as comprehensive and useful by teachers, but that adjustments were necessary because some parts of the instrument could be interpreted differently. It is also unclear whether the results of Wesselink et al. (2007b) who evaluated this model only in the agricultural sector of vocational education and training (VET) with a small number of teachers can be generalized to other sectors.

The current study was initiated to fulfil two objectives. First to examine which adjustments of the CBE-model were necessary according to teachers in order to apply the model in educational practice. And second to examine the content validity of the revised model.

Methodology

In this study a multi-method approach was used. Two studies were conducted. Enrolled in both studies were teachers who were working in Dutch VET. In study A 57 teachers participated. A group session was held in which teachers in couples systematically examined which adjustments to the model were necessary. Preceding the sessions teachers filled out an individual questionnaire. Content analysis and descriptive statistics were used to analyze the data. Suggestions for adjustments were accepted if 20% or more of the teachers suggested the same adjustment. Based on study A the CBE-model was revised.

In study B 151 teachers completed the questionnaire. The questionnaire was based on the revised CBE-model. Teachers had to indicate for each CBE principle the competentiveness of their own vocational course by selecting a level and had to support their answer by giving an example. The supportive argumentations provided by the teachers were used to investigate whether the teachers understood the content of the model. The teachers were also requested to give their opinion on the importance of the various principles of CBE on a three-point scale (not essential; useful, but not essential; essential). Descriptive statistics were used to analyse the questionnaire. The validity was estimated by using the content validation approach of Lawshe (1975). Content analysis was used to analyze the supportive argumentations.

Results

The individual questionnaire showed that 87% of the teachers agreed with the principles of CBE as defined if they compared them with their own key words of CBE. According to 10% of the teachers 'flexibility of study programmes' missed in the model. The results showed that 40% of the teachers were not satisfied with the levels, because they experienced a gap between the last two levels. Least satisfied were teachers with the readability of the principles. Some definitions, sentences or single words were not always clear to the teachers and some parts of the model could be interpreted differently. During the group sessions teachers gave concrete suggestions to improve the readability. Another remark teachers made concerned principle 6 (self responsibility and self-reflection). Teachers didn't agree to

combine two aspects in one principle. During study B teachers were asked to rate the importance of each CBE-principle. The content validity ratio (CVR) was calculated by means of the percentage essential for each principle. All principles showed high CVRs which indicated that at least more than half of the teachers considered the principle essential. The lowest CVR was ,32 and the highest scored ,81. The model as a whole also had a good content validity (,61). The CBE-model also has a good reliability ($\alpha = 0,83$).

Conclusion and discussion

In the introduction two objectives were formulated for this study. The first objective was to examine which adjustments of the CBE-model were necessary. It can be concluded that several adjustments are necessary. Besides making various detailed semantic adjustments, one new principle (flexibility of study programmes) and a fifth level of implementation were included in the revised CBE-model. Principle 6 was divided into two separate principles. The second objective was to examine the validity of the revised model. The results show that the revised model has a good content validity. The teachers were able to position their study program on the model and they understood and interpreted the model as intended. With the help of the CBE-model teachers can grasp the meaning of the underpinnings of CBE and the way instruction should take place. The revised CBE-model offers teachers in an instrument to assess their own practice and see which aspects they have to work on in order to fully realize the main principles of CBE in actual teaching and learning processes. However more research is needed to investigate whether teacher teams can really work with the CBE-model and to examine whether students and teachers perceive the competiveness of their study programme similarly. This article indicates that so far the CBE-model can be seen as a useful instrument in the process and implementation of CBE by teachers.

To Agree Or Not To Agree: Establishing criteria for expert decisions using the resampling technique

Hendrik Lohse-Bossenz, Goethe-University, Germany; Mareike Kunter, Goethe-University, Institute of Psychology, Germany; Olga Kunina-Habenicht, Goethe-University Frankfurt, Germany; Juergen Daebritz, Humboldt-University Berlin, Germany; Daniel Zschaetzsch, Humboldt-University Berlin, Germany; Hanno Strang, Humboldt-University Berlin, Germany

In educational research and practice, standardized tests are widely used, often in high-stakes situations such as school transition or student admission. However, although expert panels are widely used in the process of test development, particularly in the field of student achievement testing, the quality of expert decisions has rarely been systematically investigated. The aim of this study is to investigate measures describing the quality of expert panels and their decisions, in order to establish guidelines for panel selection procedures. Besides the widely used measure of group agreement, it is argued that tools designed to measure the person-dependence of group decisions add incremental value to inferences about group homogeneity.

Using a resampling approach on two non-interacting expert samples ($N_1=48$ and $N_2=40$) from different contexts (teacher education and quality management), results show that despite agreements in both samples, the degree of person-dependence differs – indicating the sensitivity of the approach to differences in group homogeneity. The results are discussed with respect to practical applications such as estimation of optimal panel size or criteria for expert selection.

Introduction

In educational research and practice, standardized tests are widely used, often in high stakes situations such as school transition or student admission. Given the increasing importance of standardized testing, there is an equally increasing call to report evidence for construct validity of the implemented tests (APA, & NCME, 1999). In order to evaluate the usefulness and interpretability of test scores in a certain domain, researchers often rely on persons with high expertise in the domain of interest. For instance, in high-stakes testing experts are recruited to establish cut-off scores for minimal competence of students in the context of standard-setting procedures, or to evaluate the alignment of test procedures with established educational standards (Hambleton & Pitoniak, 2006; Kane, 1994). However, although expert panels are widely used in the process of test development, particularly in the field of student achievement testing, the quality of expert decisions has rarely been systematically investigated.

What remains unclear is whether decisions are based on a real consensus or whether they are merely a compromise between divergent opinions. Other unanswered aspects are panel size and panel selection criteria. How can researchers be sure to have chosen the "right" experts, or could it be that different people would not have reached a different, possibly contrasting, decision?

The aim of the study is to investigate measures describing the quality of expert panels and their decisions in order to establish guidelines for panel selection procedures. As within-group agreement is problematically influenced by group size (small groups tend to agree more easily), it is argued, that tools to measure the person-dependence of group decisions add incremental value to inferences about the validity of expert ratings. To test the sensitivity of this approach, we examined two different samples – one homogeneous (Sample 1) and one heterogeneous (Sample 2).

Method

Samples

Sample 1 included 48 experts from the field of teacher education who participated in a study aimed at developing a test to measure teacher candidates' educational knowledge. Experts rated 852 of topics on their importance to teaching on a 3-point scale. Sample 2 included 40 experts involved in adolescent talent development in sports, who participated in a study on quality criteria for sport schools. Experts rated 120 items regarding their usefulness for athletic and academic development on a 4-point scale. In each case, experts did not interact.

Procedure of Analysis

Using the empirical data from the expert ratings, subgroups of different size (3-47/39) were randomly formed using a resampling procedure (Efron & Tibshirani, 1993). For each group size the mean of all expert ratings and agreement within the group were calculated for 1000 repetitions (using the statistical software R (Bliese, 2009)).

Agreement

Within-group agreement was measured by the Average Deviation Index (ADM, Burke, Finkelstein, & Dusig, 1999), which was calculated by summing up the amount of distance of each participant from the group center. Lower values are indicative for higher agreement.

Person-dependence

The measure of person-dependence was estimated by calculating the standard deviation of the means for 1000 repetitions within each group size. This measure can be used as an indicator for the variation of groups' decisions depending on the random composition of groups. Higher values are indicative for higher person-dependence of the outcome.

Results

Results show that in both samples small groups – though randomly selected – achieve better agreement values (e.g. $ADM(S1;N=3)=0.31$ vs. $ADM(S1;N=20)=0.47$ for Sample 1 and $ADM(S2;N=3)=0.37$ vs. $ADM(S2;N=20)=0.52$ for Sample 2). The ADM values increase asymptotically with group size, indicating lower agreement in larger groups. However, regarding person-dependence of group decisions a reverse trend was observed, showing the larger the group, the less the decisions were dependent on specific group composition (e.g. $SD(S1;N=3)=0.18$ vs. $SD(S1;N=20)=0.02$ and $SD(S2;N=3)=0.20$ vs. $SD(S2;N=20)=0.06$).

Plots for both samples are presented in figure 1 (see attachment). Whereas in Sample 1 the curves for agreement and person-independence are lower and flatten very fast, Sample 2 shows larger values and only a near-linear decrease of person-dependence.

Discussion

The approach here presented used a resampling procedure to evaluate the quality of decisions in expert groups used in test development procedures. Following the analyses presented, Sample 1 seems to be homogeneous. Statistical procedures for group decision are appropriate. Sample 2, however, revealed a higher degree of person-dependence and despite sufficient agreement values, researchers should be cautious not to simply calculate a mean decision. Efforts should be directed to the identification of subgroups at least for reduction of systematic effects. Furthermore, this case requires an extension of panel size to increase accuracy.

The descriptive approach using within-group agreement and person-dependence measures is a useful tool for post-hoc evaluations of selected expert panels in order to support inferences drawn from experts' judgments. Besides further theoretical foundation, the resampling procedure can be used to answer practical educational questions like criteria for expert selection, size of expert panels or instructional contexts producing optimal expert decisions.

References

American Psychological Association, American Educational Research Association, & National Council on Measurement in Education. (1999). Standards for Educational and Psychological Tests. Washington, D.C.: American Psychological Association.

Bliese (2009). Multilevel Modeling in R (2.3): A Brief Introduction to R, the multilevel package and the nlme package: Unpublished manuscript.

Brennan, & Lockwood, (1980). A Comparison of the Nedelsky and Angoff Cutting Score Procedures Using Generalizability Theory. *Applied Psychological Measurement*, 4(2), 219-240. doi: 10.1177/014662168000400209

Burke, Finkelstein, & Dusig (1999). On Average Deviation Indices for Estimating Interrater Agreement. *Organizational Research Methods*, 2(1), 49–68. doi: 10.1177/109442819921004

Efron, & Tibshirani (1993). *An Introduction to the bootstrap*. New York: Chapman & Hill.

Geist (2010). Using the Delphi method to engage stakeholders: A comparison of two studies. *Evaluation and Program Planning*, 33(2), 147–154. doi: 10.1016/j.evalprogplan.2009.06.006

Hambleton, & Pitoniak (2006). Setting Performance Standards. In R. L. Brennan (Ed.), *Educational Measurement* (4 ed., pp. 433–470). Westport, CT: Praeger.

Kane (1994). Validating the Performance Standards Associated With Passing Scores. *Review of Educational Research*, 64(3), 425-461. doi: 10.3102/00346543064003425

Raymond, & Reid (2001). Who made thee a judge? Selecting and training participants for standard setting. . In G. J. Cizek (Ed.), *Setting Performance Standards: Concepts, Methods, and Perspectives* (pp. 119–157). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Comparison of the Impact of Input and Context Variables on Mathematics Performances in Grade 6 and 8

Sarah Gielen, Katholieke Universiteit Leuven, Belgium; Lien Willem, KULeuven, Belgium; Kaat Van Dessel, K.U.Leuven, Belgium; Daniel Van Nijlen, KULeuven, Belgium; Rianne Janssen, K.U. Leuven, Belgium

This study compares the outcomes of national assessments of mathematics at three different levels: grade 6 (primary education) and the A-track (pre-academic) and B-track (pre-vocational) of grade 8 in secondary education in Flanders-Belgium. It finds substantial differences in the amount of school variation. Furthermore, several pupil characteristics that have a negative effect on mathematics performance in the A-track have a stronger effect in the B-track, and are even more pronounced in grade 6. SES is more advantageous in the A-track, while the cultural capital is more important for B-track pupils, and both have more discriminating power in primary education. Finally, the negative impact found in secondary education of attending schools with more disadvantaged children is remarkably smaller in primary education.

It is common practice in educational effectiveness research to correct for input and context variables, in order to get a clear view on the value added of schools. This practice, however, may hide some parts of our educational system are more effective in leveling out the impact of these background characteristics of pupils than others, and thus realize more equal opportunities for all pupils. We examine the difference between the various educational levels in the amount of school variation and its distribution. Furthermore we compare the effect size of several input and context variables ('net models') on pupil performance in various levels of our educational system, and the amount of school variance explained.

The current study uses the outcomes of three national assessments of mathematics in Flanders, respectively at the end of primary education (grade 6, N=6438) and in the A-track (pre-academic) (N=3184) and B-track (pre-vocational) (N=4044) of grade 8 in secondary education. Both test results for mathematics and information from background questionnaires were used. The distribution of the variance is examined in multilevel null models by means of the intragroup correlation coefficient. Then 'net models' (controlling for gender, age, home language, cultural capital, SES, learning disabilities, educational network and proportion of disadvantaged pupils in the school) are constructed in which the effect sizes and significance of the different covariates are examined and compared across projects, as well as the proportion of explained variance.

The B-track of grade 8 shows the smallest amount of school variation and the largest amount of pupil variation, then comes grade 6 in primary education and then finally the A-track of grade 8. The variables of our net model explain about two third of the variance at the school level for both primary education and the A-track of grade 8. In the B-track, this is only 50%. At the pupil level, only 4 to 5 % of the differences are explained by the net model in grade 8, while in grade 6, these net variables account for on average almost 1/5th of the pupil differences.

A comparison of the effect of the covariates between the two tracks in grade 8 reveals that pupil characteristics (e.g. gender, grade repetition, different home language, learning disabilities) with a negative effect on math performance even have a stronger effect in the B-track. On the other hand, also the effect of two 'advantageous' characteristics differs: the number of books at home (cultural capital) has a more positive effect in the B-track, while the measure for

SES only has a significant (positive) effect in the A-track. Finally, after control for the already mentioned pupil characteristics, pupils in the A-track experience a stronger negative influence of being in a school with more disadvantaged pupils than pupils in the B-track.

A comparison with primary education learns us that most effects are even more pronounced in grade 6. The effect of repeating a year, of a different home language and of learning disabilities is stronger in negative sense. In the opposite direction, also the advantageous variables (SES and cultural capital) have a stronger positive effect in primary education. Finally, and on the contrary, the negative impact found in secondary education of attending schools with more disadvantage children is remarkably smaller in primary education.

With a focus on the (undesirable) school variation after correction for the net model, we conclude that the B-track does a fairly good job (only 5% of differences remain unexplained at the school level), the A-track does somewhat worse (13% remaining) and primary education lies in between (average 7% remaining). On the other hand, the impact of 'disadvantageous' pupil characteristics is the smallest in the A-track, and the largest in primary education. Is here a lesson to take – from the perspective of equal opportunities - for research and policy concerning the use of 'net models' that 'pardon' schools and school systems for the effects of some 'input and context' characteristics of pupils and schools?

THEMATIC POSTER SESSION

Culture and Education

Cultural Capital in the Early Childhood

Katharina Kluczniok, Otto-Friedrich-University of Bamberg, Germany; Michael Mudiappa, Otto-Friedrich-University of Bamberg, Germany

Studies have shown that cultural capital at the parental home is a strong predictor of school success. However there are criticisms in the measurement of cultural capital because focus lies on high cultural capital of the parents. Therefore there is less research concerning cultural capital in the early childhood. To meet the criticism an interdisciplinary approach of the sociological concept of cultural capital from Bourdieu and the educational concept of quality in family settings is suggested. The paper deals with activities in cultural and educational fields (e.g. visiting museums) in the early childhood. Based on these activities cultural capital is imparted by the parents to their children. Furthermore it can be assumed that structural aspects (e.g. socioeconomic status) and belief factors (e.g. aspirations) influence the participation of cultural educational activities. Data base is the German panel study BiKS-3-10 (N=554). The following research questions should be answered: 1. Which cultural educational activities take place in families with preschoolers before school enrolment? 2. Which cultural, structural and belief factors have an impact on the participation of these activities? Results of descriptive and multivariate analyses show a wide range of cultural educational activities which takes place in families with preschoolers. Relevant factors for the participation of cultural educational activities are reading to children, high cultural resources and educational beliefs of the parents. The results will be discussed regarding opportunities of activation and involvement of parents.

Studies have shown that cultural capital in families is a strong predictor of school success and educational chances. Therewith related educational inequality is the result of a conditional class effect. This effect is passed on by allocation, transfer and transformation of cultural capital over the life course. Cultural practices, investments in and accumulation of cultural capital and its transfer are influenced by the priority of education, by the parental educational level as well as by the family as a social context and by economical resources.

However, in the literature there is some criticism on the measurement of cultural capital. The main criticism is that the focus lies on high cultural capital of the parents. Therefore there is less research concerning cultural capital in the early childhood. As a consequence of this in the research is no consideration of social and cultural learning, no integration of home learning environment during preschool and there are less factors of parent-child-interaction. Referring to Pierre Bourdieu the acquirement of cultural capital and skills starts in the early childhood by active and passive transfers. Parent-child-interaction, parental cultural behavior and home learning environment are important for the transfer of cultural praxis and orientation, aspiration, habitus and their impact on the educational career. Encouraging cultural educational activities (e.g. reading to the child, visits of concerts and museums) is particularly relevant in this process. On the one hand, the child will acquire cultural skills and praxis which is assumed to have a positive impact on school success. On the other hand, investments in levels of cultural encouragements are indicators of the parental status achievement and educational aspiration. Indeed, it is this criticism that provides a major motivation for your study. To meet the criticism and to consider the acquirement of cultural capital in the early

childhood an interdisciplinary approach of the educational concept of educational quality in home learning settings and the sociological concept of cultural capital from Pierre Bourdieu is suggested. Against the background of both approaches the paper presents an interdisciplinary access, which combines sociological and educational factors to get more explanatory power for the impact of cultural capital in the early childhood. The integration is also an expansion of the concept of cultural capital and fulfills the criticism of the measurement of cultural capital.

The paper deals with activities in cultural and educational fields (e.g. visiting museums) in the early childhood. These activities take place outside the household by visiting cultural and learning places and are assumed to have an impact on educational success by better competencies, school performance, job training and the position on the labor market. Furthermore it can be assumed that structural aspects (e.g. socioeconomic status) and belief factors (e.g. aspirations) influence the participation of cultural educational activities. Data base is the German panel study BiKS-3-10. The longitudinal study BiKS-3-10 focuses on the formation of educational decisions concerning the transition from preschool to elementary school as well as the development of cognitive competencies. Starting in fall 2005 a random selection of 554 children and their families in two federal states (Bavaria and Hesse) are followed from the beginning of preschool until the end of elementary school.

The following research questions should be answered: 1. Which cultural educational activities take place in families with preschoolers before school enrolment? 2. Which cultural, structural and belief factors have an impact on the participation of these activities?

For the analysis descriptive and multivariate methods were used. Descriptive results show a wide range of cultural educational activities which takes place during the socialization. Multivariate regression analyses come to the result that factors of both theoretical concepts have a significant impact on participation of cultural educational activities. Relevant factors are reading to children, high cultural resources and educational beliefs of parents. Parents who are reading to their children, who have available more cultural resources and who have higher idealistic aspirations, do more frequently activities in cultural and educational fields. Surprisingly activities in cultural and educational fields are independent of the financial situation of the families.

The results will be discussed regarding opportunities of activation and involvement of parents. In praxis parental and institutional consciousness has to be reinforced. Based on the assumption that cultural capital of parents will be imparted from the parents to the children, aspirations and cultural activities will be passed down to the children as well. This means, that there should be more investments in parental education to underline the importance of cultural activities. This investment could be a booster of the starting conditions of the educational career. On the one side institutions such as museums and libraries should offer low-threshold services, which are easily accessible for the families. On the other side institutions have to integrate parents more in their educational program. Especially the preschool as learning environment next to the family has to integrate parents more in their educational program and provide information about cultural and educational activities in the neighborhood.

Relation between learning activities and intercultural competence

Hans Gruber, University of Regensburg, Germany; Regina Mulder, Universitaet Regensburg, Germany

Internationalization and globalization processes increasingly cause multicultural teamwork in several work areas. In consultancies this leads to cultural diverse work teams or work with clients with different cultural backgrounds. Therefore, consultants need to develop intercultural competence to successfully work with members of different cultures. This contribution reports a study which deals with the research question what learning activities are related to intercultural competence. Thereby formal and informal learning aspects are taken into account. In this study intercultural competence is measured through a combination of a video based case analysis and a structured interview. The learning background and demographic aspects are collected through a standardised questionnaire. 50 consultants – partly with formal learning experience, partly with no formal learning experiences – participated in the study.

Results of the study show no significant relation between formal learning and intercultural competence, no significant relation between experience based learning and intercultural competence, but a significant relation between professional experience and the affective dimension of intercultural competence. Internationalization and globalization processes increasingly cause multicultural teamwork in several work areas. In consultancies this leads to cultural diverse work teams. Therefore, consultants need to develop intercultural competence to successfully work with members of different cultures.

Theoretical framework

Dealing with people from different cultures can cause intercultural conflicts. These conflicts are caused by the reason that two or more people with different cultural orientation systems converge and have different expectations on the behavior of their counterpart. The concept of intercultural competence describes the specific ability to interact reflectively and productively with people from different cultures (Stahl, 1998). Intercultural competence is developed as a special skill based on general human communication abilities, acquired knowledge about cultural differences and practical experience in intercultural situations (Thomas, 2003). There has been lots of research in the past decades focusing on the effect of formal learning activities e.g. intercultural trainings on intercultural competence (Littrell, Salas, Hess, Paley & Riedel, 2006; Zakaira, 2000) but almost no research on the relation of informal learning activities. In our study we focused on the relation between formal and informal learning activities and intercultural competence. Concerning informal intercultural learning we distinguished between experience based learning and professional experience. Experience based learning is a special form of informal learning and describes how somebody is able to reflect upon his/her own experiences and how somebody is able to learn from his/her experiences. In contrast, professional experience describes the learning experiences which develop through challenging situations at work (McCauley et al., 1994).

Results of training evaluations indicate that pure knowledge transfer is not enough to prepare the learner for intercultural conflict situations (Kammhuber, 2000). Moreover, it is suggested that different learning aspects are connected with different aspects of intercultural competence. Intercultural competence is defined as a three-dimensional construct (see Figure 1), which consists of a cognitive, an affective and a conative dimension. Each dimension contains several items which describe parts of intercultural competence: e.g. cognitive aspects like cultural awareness, change of perspectives etc., affective aspects like openness and empathy etc. and the conative aspects like tolerance of ambiguity, communication skills etc.. It is assumed that the acquisition of intercultural knowledge can lead to a higher intercultural sensitization on the cognitive dimension of intercultural competence. Further assumptions of our study are that learning from experiences has a positive relation to the affective dimension of intercultural competence and professional experience is positively related to the conative dimension of intercultural competence.

Research questions

The research questions of our study were: Is there a connection between formal learning experiences and intercultural competence? Is there a connection between learning from experiences and intercultural competence? Is there a connection between professional experience and intercultural competence?

Method

Design

To investigate these research questions several research methods were combined: a video based case analysis in combination with a structured interview and a standardized questionnaire.

Sample

50 internationally experienced consultants participated. They were members of consulting companies with different size (big to small). Besides they were working in different consulting domains, such as IT, strategy consulting, HR consulting etc.. 30 of them had participated in intercultural formal learning activities, 20 of them never participated in formal learning activities.

Measures

For the measurement of intercultural competence a video based case analysis in combination with a structured interview was designed. This method has the advantage that the measured results are based on the cognitive behavior of the subjects instead of their self-assessment. The case analysis consists of three different intercultural conflict situations between Germans and members of other cultures (India, Spain, USA). These conflicts are based on training material which was taken out of culture assimilators. The conflict cases were filmed and during the realization of the study the subjects were confronted with all three video clips. After viewing one scene they were asked to analyze the situation. Therefore a standardized interview guideline was used. The interview questions were constructed in a way that the questions were aimed at reflecting the three dimensions of intercultural competence. Examples of the questions were:

"Which behaviours in this situation do you trace back to culture or cultural differences?" (Cognitive dimension)

"Which behaviours of the persons lead to this conflict situation?" (Conative Dimension)

"What do you think, how these persons feel in this situation?" (Affective Dimension)

For the measurement of the learning aspects a standardized questionnaire was used which consisted of scales on formal learning, learning from experiences, professional experience and demographic aspects.

Analysis

For the analysis of the interview data, we used thematic analysis. Here, we used the aspects which were included in the intercultural competence model as categories. All interviews were double coded according to the guidelines in the coding manual. Doublings in the content were only rated once to avoid high scores caused by repetition. To check the interrater-reliability of the coded data, the intra-class coefficient (ICC) was analysed for all categories. For further quantitative analysis with SPSS we combined the quantitative interview data with the quantitative data from the questionnaire and computed Spearman's rank correlation coefficient.

Results

Results are shown in Table 1. They show no significant relation between the learning experience of the subjects and their score in intercultural competence. The correlations are even quite small, except of the correlation between professional experience and intercultural competence. Looking at the correlations between the learning experiences and the dimensions of intercultural competence, only one significant correlation was found: between professional experience and the affective dimension.

Conclusions

It can be concluded that the connection between formal and informal learning experiences and the development of intercultural competence is not that direct then expected. There are several reasons which might have had an influence on the outcomes of our study: small sample size, limited measurement of aspects that influence intercultural competence. Main limitation of our study is, that we could only measure intercultural competence through a cognitive analysis and not "real" intercultural behaviour.

Building mathematics knowledge through blogs in the engineering university classroom

Jazmin Juarez, Escuela Superior de Computo, Mexico; Jose Chamoso, Facultad de Educacion, Spain; Maria Teresa Gonzalez, Universidad de Salamanca, Spain; Laura Hernandez, Universidad de Salamanca, Spain

In recent years, university teachers have experienced alternative methods of teach mathematics, some of them in order to develop classroom activities that incorporate the use of learning environments that contain asynchronous communication tools, to promote the collaborative process in which meaning is negotiated and knowledge is co-constructed. Blogs are often used in educational settings to foster collaboration and enhance interaction between students and teachers; however there is little evidence about the study of collaborative processes developed with the blogs use. The aim of this study was to analyze the knowledge building process carried out when engineering students use blogs as communication tools in a mathematics course.

The participants were 31 systems engineering students, from the Superior School of Computer Sciences in Mexico City. Students organized into 6 groups developed a project that consisted in design a blog to show problems of real phenomena solved by first order ordinary differential equations. Each group used a blog to post proposed problems, and as communication tool to select just two problems considering the representation of dynamic systems by initial value problems.

We analyzed students' messages using a sequential model of knowledge building phases proposed by Gunawardena, Lowe & Anderson (1997). The results showed high incidence in the first phase and low incidence in high phases of the knowledge building process: students just exchange and compare information to develop a task together; however the interaction between students through blogs can be an effective way to achieve results in relation to the acquisition of knowledge.

An important component in the growth and development of teaching and learning mathematics at university level has been the emergence of Web-based applications designed for the creation of spaces for teaching and learning (Engelbrecht & Harding, 2005). Success in learning to use Web-based environments depends on how these resources support collaboration, encourage participation and interaction among students (Fisher, 2000; Lee, 2001). Asynchronous communication transforms the teaching-learning process, enabling a group discussion and access to other participants for socialization and communication (Cabero, 2004; Silva & Gros, 2007; Kim, 2008). By participating in an activity mediated by asynchronous tools, students not only learn mathematical skills and procedures also explain and justify their own thoughts and discuss their findings on the use of mathematics in different problem-solving situations (H yrme & J rvel , 2005).

In the study of asynchronous interactions, some studies have focused on the level of discussion, considering the interactions as opportunities to promote knowledge and learning (Henri, 1991, Gunawardena et al., 1997). Asynchronous communication supports constructivist learning principles because it allows students to articulate, read

and reflect on the concepts (Hara, Bonk & Angeli, 2000). There have been recent attempts to describe the messages in online forums, to study the construction of knowledge in these communication spaces. However, although other asynchronous tools such as blogs can be used in various disciplines in higher education (Williams & Jacobs, 2004), and providing educational opportunities that support the learning process, still have limited use in teaching mathematics at university level.

In this respect, and considering that the communication has the potential to transform education by creating learning environments focused on students, the aim of this paper is analyze the knowledge building that take place when engineering students use blogs as contexts of debate to develop a task in a Mathematics course.

2. Method

We carried out a study in the School of Computing in Mexico City with a group of 31 students enrolled in the course of Differential Equations for the period January to June 2010. This course is taught in the second semester of Computer Systems Engineering and aims to formulate models and to solve engineering problems using ODE. The course was organized through a Web platform in the content management system open educational MOODLE, that the school offers teachers to develop courses. The implementation of the platform on the subject aimed to foster collaboration, reporting on aspects of the course, manage the distribution of documentation and the work to be done by students, and generate an efficient and flexible communication between teacher and students or among students themselves.

In this experience the students developed a project, in the first part of the project students investigated individually and resolved a problem of application of the first order ODE to represent an everyday situation, and then organized into groups, they designed a blog with the proposed problem for each member in the team. Since individual messages, students selected two proposals together, considering criteria identified by the teacher in the theoretical session. Each team restructured his blog including only the selected problems together and presents it in the classroom.

To collect data, we used the students' messages. We categorized the messages according to the model of building knowledge of Gunawardena et al. (1997), in the following phases: Phase I (Exchange and comparison of information), Phase 2 (Discovery and exploration of dissonance or inconsistency among ideas, concepts or statements), Phase III (Negotiation of meaning and / or co -construction of knowledge), Phase IV (Testing and modification of proposed synthesis or co-construction), and Phase V (Declarations of agreements and implementation of newly constructed meaning). The coefficient of reliability of the instrument of Gunawardena et al (1997) has been reported in some studies that have used this coding system (Schellens & Valcke, 2005; Veerman, Veldhuis & Diermanse, 2001).

Taking each complete message as the unit of analysis, 83 messages were classified in some phases of the model, according to the most appropriate description of the processes of building knowledge in the message. The contributions of two or more ideas or comments different phase were categorized into hierarchically superior. Phase 0 was allocated for those comments not related to the topic.

3. Results

By observing the amount of classified messages in each of the phases, it appears that the largest number of contributions (64%) corresponds to Phase I, which indicates that most students delivered remarks showed agreements, and requested or clarifications made. The percentage of messages in Phases II and III, Discover and explore dissonance and inconsistencies of ideas and knowledge to negotiate and build are very similar (14 % and 13 % respectively). An important observation is that the students focused on the development of the task to complete. Students reached agreement to jointly select a problem as indicated by posts categorized in Phase V: State agreements (7%), however, despite reaching an agreement, students rarely tested the foreground, contrasting with the theoretical information and personal experience, as the lower incidence (1%), was detected in stage IV: Evaluate and modify ideas. Only one message was categorized in phase 0.

In relation to the collaborative construction of knowledge, we detected that the knowledge gained by the students were allowed to restructure its initial work and convey their knowledge to classmates to present their work in the classroom. We also observed that the interaction in the discussion groups stays task-oriented, but didn't reflect high levels in knowledge building.

4. Discussion

The study shows that blogs provide new forms of collaborative work and spaces to discuss in which students can express themselves and build learning communities. We concluded that the building of new knowledge process is further developed when students share and compare their observations and understandings with others. The learning process was transformed from a personal activity to a social activity when they compared their own meanings through

interaction with the members of the group. We got new information to understand the knowledge building process when blogs are used and thus exploit their potential in math courses.

Level groups as approach to foster student achievement in a heterogeneous and multicultural context

Jeannette Wick, PHTG, Switzerland; Annelies Kreis, University of Teacher Education Thurgau, Switzerland

An increase in heterogeneity regarding students' cultural and linguistic background has become a widespread condition for teaching. Internal differentiation is asked for but demanding to practice in highly heterogeneous classes. As an approach to this problem two primary schools started to teach two out of six weekly German lessons in level groups with grades 4-6 that are smaller and more homogeneous. However, studies about the relationship between class size and learning gains show that smaller class sizes do not automatically result in higher achievement (e.g. Graue & Rauscher, 2009). In a multi-method comparative panel study we examined differences between teaching activities in level groups and in regular German classes in two intervention schools (8 classes, 145 students). In a comparison school (8 classes, 169 students) with similar conditions, German lessons are taught in regular classes without level groups. The two groups are compared with respect to teaching activities in regular classes gained from the perspective of students and achievements in reading comprehension competencies. For the assessment of content specific teaching activities in German lessons we developed a theory based questionnaire in expert workshops. Reading comprehension competences were assessed with a standardized, computer-based instrument (ELFE, see Lenhard & Schneider, 2006). Comparison of teaching activities in regular classes and level groups indicate that there is less internal differentiation in smaller and more homogeneous level groups than in regular classes. Regarding the achievement in reading comprehension there are no significant differences between the conditions with and without level groups.

Theoretical framework and aims

Multi-culturally constituted classes have become a widespread condition for teaching and a prevalent feature is increased heterogeneity of classes regarding students' cultural and linguistic background. As language competences are crucial for school success (e.g. Ditton et al., 2005) their fostering is essential. From a constructivist perspective, different previous knowledge of learners calls for a differentiation of learning environments. However, in highly heterogeneous multi-cultural classrooms internal differentiation comes to its limits. One way of adapting learning environments is to partly teach students in level groups with respect to linguistic previous knowledge. In 2001 two Swiss primary schools (grades 4-6) started to teach two out of six weekly German lessons in three different level groups. The aim of this shift was to improve the fostering of students' language competences in German under the condition of (a) a high proportion of students who come from non-German speaking families (52.6%, 8 languages, e.g. Albanian, Serbo-Croatian, Turkish) and (b) a large number of students with a German speaking middle-class background who are all taught in the same classes. Level groups are smaller and more homogeneous than regular classes. Several studies show that a reduced class size does not forthrightly result in higher learning gains (e.g. Graue & Rauscher, 2009). One explanation for this seems to be, that teachers do not adapt their activities when they teach smaller groups (Im Brahm, 2006). We therefore examined in a multi-method comparative panel study whether teaching activities in level groups are different from those in regular German classes. We furthermore compared intervention schools with two schools which are similar with respect to multi-cultural and socio-economic variables but in which all German lessons are taught in regular classes. Schools were compared with respect to (a) teaching activities in regular classes from the students' point of view and (b) learning gains of students (reading comprehension). The study firstly aims to evaluate whether there are differences between teaching activities during German lessons taught in smaller and more homogeneous level groups and in regular German classes in the intervention school. Secondly it examines whether there are differences between control and intervention group with respect to teaching activities in regular classes. Thirdly student achievement regarding reading comprehension is compared between conditions with/without level groups.

Methodology and design

We could not draw on proved questionnaire for the assessment of content specific teaching activities in German lessons by students and developed a new instrument. In two expert workshops and based on theory about teaching second languages (Cummins, 2000) we collected items that describe teaching activities and structured scales. These scales were validated with a pilot group of 97 students (grades 4-6). Seven scales (30 items) can be regarded as reliable: use of standard language (4 items, $\alpha=.55$), transparent learning goals (4 items, $\alpha=.73$), internal differentiation (4 items, $\alpha=.52$), stimulating search for information (3 items, $\alpha=.50$), stimulating meta-cognition and feedback (6 items, $\alpha=.80$), stimulating reading on differentiated levels (5 items, $\alpha=.78$) and stimulating reading-motivation and frequency (4 items, $\alpha=.5$). To assess students' reading comprehension competences a computer-based diagnostic program for grades 1-6 called ELFE was used (Lenhard & Schneider, 2006). ELFE analyses reading comprehension competencies on

four levels: word comprehension, velocity of reading, sentence comprehension and text comprehension. The scales for content specific teaching activities and data about reading comprehension competencies have been analyzed using T-Test (2-tailed) for dependent and independent means. Data was collected in 16 classes (NIG = 8, NCG = 8) with 314 students (NIG = 145, NCG = 169) for two different measuring points (t1 = beginning of the 4./5. grade, t2 = end of the 5./6. grade) with the same students. FindingsThe comparison of teaching activities in German lessons between level groups (LG) and regular classes (RC) shows that at the first measuring point (t1) the scale use of standard language was rated significantly higher for level groups than for regular classes ($p = .04$). Four further scales show significant differences with higher values for teaching activities in regular classes: internal differentiation ($p = .003$), stimulating search for information ($p = .006$), stimulating reading on differentiated levels ($p = .007$) and stimulating reading-motivation and frequency ($p = .000$). At t2 only transparent learning goals was rated significantly higher for level groups ($p = .000$). Five other scales differ significantly in favour of regular classes: internal differentiation ($p = .000$), stimulating search for information ($p = .000$), stimulating meta-cognition and feedback ($p = .000$), stimulating reading in differentiated levels ($p = .007$) and stimulation of reading-motivation and frequency ($p = .000$). Regarding differences between intervention und control group there are neither significant differences in the assessment of teaching activities nor regarding students' reading comprehension competencies at the first measuring point (t1) Two years later (t2) one teaching activity scale differs significantly in favour of the control group (stimulating reading-motivation and frequency, $p = .040$). Comparison of students' reading comprehension competencies between t1 and t2 shows a significant increase under both conditions without significant differences between conditions. Theoretical and educational significanceOne outcome of this project is a proved instrument which allows assessing content specific German teaching activities. Results indicate that German language teaching activities in smaller and more homogeneous groups are different to those in regular classes. However, modifications are not in a theoretically desirable direction: in comparison with regular classes internal differentiation is reduced in level groups and they do not result in higher reading comprehension competencies. We conclude that smaller and more heterogeneous level groups can unburden teacher workload but do not result in the desired student achievement.

References

- Cummins, J. (2000). Language, Power and Pedagogy. Bilingual Children in the Crossfire. Clevedon: Multilingual Matter.
- Ditton, H., Krýsken, J. & Schauenberg (2005). Bildungsungleichheit - der Beitrag von Familie und Schule. Zeitschrift fýr Erziehungswissenschaft 8(2), 285-304.
- Graue E. & Rauscher, E. (2009) Researchers Perspectives on Class Size Reduction. Educational Policy Analysis, 17(9), 1-26.
- Im Brahm, G. (2006). Klassengröße: eine wichtige Variable von Schule und Unterricht? Bildungsforschung, 3(1).
- Lenhard, W. & Schneider W. (2006). ELFE 1-6. Ein Leseverständnistest fýr Erst- bis Sechstklässler. Göttingen: Hogrefe.

Exploring reciprocal expectations of academic staff and international students in higher education

Mairin Hennebry, Newcastle University, United Kingdom

Internationalisation of higher education is a fast growing field of interest for research and Higher Education Institutions. In the year 2007/2008 international students contributed over £1.88 billion to the UK economy. However, external competition is increasing and there is an imperative to ensure that the needs of international students are met and that their experience of study in the UK is a positive one. This small scale study aims to contribute to current research on the experience of international students at Higher Education Institutions by examining the relationship between these students and academic staff. The study focuses on the relationship between each party's expectations and understanding of their own role and that of the other, with a key aspect of the study being the exploration of the role that culture has to play in both sets of expectations and understandings. The paper reports findings from two stages- the first being questionnaires and interviews administered to staff and international postgraduate students in an Education Department of a Higher Education Institution in the UK; the second an exploratory session with each set of participants to examine their reactions to the understandings and expectations of the other. Departing from Vygotsky's theoretical tradition of identity formation and Bernstein's framing theory, the data allows for an exploration of the potential for a better understanding of each others' roles and perceptions to influence behaviour and expectations.

Aims

This small scale study aims to contribute to current research on the experience of international students at Higher Education Institutions by examining the relationship between these students and academic staff. Particularly the study focuses on the relationship between each party's expectations and understanding of their own role and that of the other. A key aspect of the study is the exploration of the role that culture has to play in both sets of expectations and understandings.

Methodology

Questionnaires administered to all international postgraduate students in a School of Education at a Higher Education Institution in the United Kingdom. Semi-structured follow-up interviews with five students leading to a deeper exploration of the cultural nature of the students' perceptions and expectations. Semi-structured interviews with five members of the academic staff examining their own understandings of the role of academic staff and international students and the role of culture in these perceptions. Interview data from each set of participants would then be shared anonymously with the other set (student responses shared with teachers; teachers' responses shared with students) in order to explore reactions. This process would provide data as to whether a better understanding of each others' roles and perceptions has the potential of influencing their own behaviour and expectations.

Findings

Data collection is being carried out over the course of this academic year so findings are not yet available. Theoretical and educational significance of the research The internationalisation of higher education is a fast growing field of interest for research and Higher Education Institutions. In the year 2007/2008 international students contributed over £1.88 billion to the UK economy. The widespread recognition of English as a global language is no doubt a contributory factor in the increase of applications from international students to UK institutions, given that North America and Australia have experienced similar rises. However, Whilst English is unlikely to lose its status as a global language, it is not inconceivable that fast expanding economies may question the need for a qualification in an Anglophone country. Indeed universities in China and other Asian countries are actively recruiting international staff and students of their own, and in some cases setting up university courses entirely in English. Thus there is an imperative to ensure that the needs of international students are met and that their experience of study in the UK is a positive one. Research to date has considered various aspects of international students' experience of studying in higher education institutions, such as psychological and social adaptation to living and studying in a foreign country (Spencer-Oatey & Xiong, 2006; Maley & Gu, 2008), linguistic challenges of undertaking study in a second language (Edwards et al., 2007; Low et al., 2008), internationalisation of the curriculum (Clifford, 2009) and students' cultural awareness (Bodenhorn, 2005). The focus of much of the existing research has been on the students, with a handful of studies focussing rather on academic staff. Very few studies, however, have investigated the existence of any common ground among expectations of the two groups or sought to create sharing of understandings. Much of the research on internationalisation implicitly adopts a more simplistic view of identity by either grouping participants in the categories of 'home student' and 'international student' or according to their individual nationalities. Anecdotal evidence suggests that academic staff do similarly, whether consciously or unconsciously. If this is the case then it is conceivable that this cultural categorisation brings with it assumptions about what students might expect, what they may be used to, how they may behave. It is equally conceivable that the same is true in students' thinking about academic staff. The present study will create an opportunity to observe the impact that engagement between students and staff might have on the continuing construction of their respective identities and to examine whether some identities (e.g. cultural, academic, individual etc.) are more flexible than others. By creating channels of communication between staff and students such that misunderstandings or misconceptions can be unpacked and problematized. The findings and process of this study could contribute a valuable insight into ways of making the academic experiences of international students a positive one, while also having a beneficial impact on the professional development of academic staff. The theoretical basis for investigating shared understandings lies in Vygotsky's theoretical tradition and sociocultural theory, which hold that identity is shaped through participation in community, that we hold multiple identities and that these are continually being reconstructed through engagement with others. This study will seek to examine the impact that engagement with the other can have on professional identity formation of both staff and students. By using Bernstein's theory of framing, this study hopes to examine student and staff perceptions of the degree of control they have over the pedagogical relationship and the extent to which the level of framing promotes or inhibits opportunities for the development of identity.

Learning about slavery heritage in multicultural classrooms: students' entrance narratives

Geerte Savenije, Erasmus University Rotterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Maria Grever, Erasmus University Rotterdam, Netherlands

Both in and outside school students learn about heritage related to the history of the country they live in. Heritage education in a multicultural society and a globalising world should offer students of diverse backgrounds and with different frames of reference the opportunity to give meaning to heritage. This study aims at a better understanding of students' entrance narratives on sensitive heritage and the way students transform these narratives during a heritage education project. The entrance narratives we look at comprise interest in the subject and knowledge and opinions about it (Doering & Pekarik 1996). We expect that multicultural classrooms show a variety of entrance

narratives, and that students can enrich their knowledge and ideas on the significance of heritage by sharing and negotiating meanings. We conducted a multiple case-study with two multicultural classrooms in secondary education that participated in a heritage education project on transatlantic slave trade. The project consisted of a preparatory and closing lesson at school and a visit to a museum and a monument. Sources are questionnaires, student interviews (pre- and post), observations, transcribed videotapes of student interactions, and student products. Our preliminary analysis shows that students' entrance narratives comprise different types of significance: historical, societal and personal. Further analysis will focus on students' interest, emotions and first impressions during the museum lesson and the negotiation and appropriation of different perspectives on the significance of slavery heritage.

References

Doering, Z.D. & Pekarik, A.J. (1996). Questioning the entrance narrative, *Journal of Museum Education* 21, 20-22.

Aims and theoretical and educational significance

The last decades attention for cultural heritage, cultural identity and common ground has grown rapidly throughout the Western world. Globalisation and the movement towards increasingly multicultural societies have led to a renewed interest in national identity and a desire for national cohesion. History and heritage education are often thought of as ideal subjects to provide for this common ground in future generations (Symcox & Wilschut 2009). However, it is stated as well that in order to appeal to all students and to do justice to different historical interpretations one needs to address a plurality of narratives (Grever 2007). In line with this, a large part of the Dutch heritage institutions has expressed the need to consider the increasing multicultural character of school classes that attend their programmes. Students enter a learning process with 'entrance narratives', which comprise knowledge, perspectives and personal experiences, memories and feelings (Doering & Pekarik 1996). These may be more or less shared within multicultural classrooms. Previous studies show that students' representations of the past often reflect collective memory and the grand narratives that are part of it (e.g. VanSledright 2008). On the other hand, researchers emphasise that students in multicultural classrooms have different ideas about historical significance (e.g. Seixas 1993) and tell different stories about the past (e.g. Epstein 2000). Especially regarding sensitive heritage we expect students to bring in a diversity of narratives. For a dynamic approach of heritage it is important to stimulate students to express their ideas on its significance (Barton & Levstik 1998). Empirical research on the learning processes and learning outcomes of heritage education is still very scarce. This study aims to explore what occurs in classrooms during heritage education activities in and outside school to add profoundness to the debate on affordances and constraints of heritage education in the history school curriculum. Our research question is: How do students in multicultural classrooms negotiate, generate and share their entrance narratives and ideas on the significance of heritage during a heritage education project on sensitive heritage of topics from the history curriculum?

Method

We conducted a multiple case-study with two multicultural, urban classrooms in secondary education in the Netherlands. We selected a heritage education project that includes a preparatory lesson, a museum lesson and a closing lesson. The project discusses the transatlantic slave trade and includes a visit to the National Institute Dutch Slavery Past and Heritage as well as to the national slavery monument. Both classes engaged in the same project. In each case study we conducted four questionnaires and two interviews, we observed two triads at school and in the museum doing group tasks and we analysed student products. In general, each case covered a period of two weeks, of which the heritage project itself took one. The classes showed a variety of cultural and ethnic backgrounds and included native Dutch students as well. Participants were students aged 13-14 of higher general education which is the mid level preparing for higher vocational education. History was a compulsory subject of two hours per week. We composed two triads of students with diverse entrance narratives based on the results of a questionnaire. These six students we interviewed individually before and after the heritage project. The pre and post questionnaires were used to examine the students' entrance narratives by questioning their knowledge, their interests, their memories and experiences and their ideas on the meaning and significance of heritage and the related history. After each lesson we monitored students' emotions, interests and first impressions with a short questionnaire. For the third lesson this short questionnaire was integrated within the post questionnaire. The interviews focused on clarification of students' answers on the questionnaires as well as on students' experiences in the triads during the heritage project. In the observations of the triads we focused on their negotiation, generation and sharing of their entrance narratives and ideas on the significance of heritage. For the closing lesson we designed a group task on the significance of heritage which provoked student verbalization and student interaction. These conversations are coded for structural patterns, explanatory engagement, content emphasis (Fienberg & Leinhardt 2002), the negotiation of ideas on significance, the use of multiple perspectives, and historical thinking (Van Drie & Van Boxtel 2008).

Results and discussion

Our preliminary analysis shows that students' entrance narratives comprise different types of significance: historical, societal and personal. We expect that multicultural classrooms show a variety of entrance narratives on heritage related to transatlantic slave trade. Further analysis will focus on students' interest, emotions and first impressions during the museum lesson and the negotiation and appropriation of different perspectives on the significance of slavery heritage. We expect that students can enrich their knowledge and ideas on the significance of heritage by sharing and negotiating meanings. We analyse for the reciprocal influence of this process and the students' entrance narratives.

References

- Barton, K.C. & L.S. Levstik (2008). "It wasn't a good part of history". National identity and students' explanations of historical significance. In L.S. Levstik & K.C. Barton (eds.), *Researching history education. Theory, method and context* (pp. 240-272). New York: Routledge.
- Doering, Z.D. & A.J. Pekarik (1996). Questioning the entrance narrative, *Journal of Museum Education* 21, 20-23.
- Drie, J. van & C. van Boxtel (2008). Historical reasoning: Towards a framework for analysing students' reasoning about the past, *Educational Psychology Review* 20, 87-110.
- Epstein, T. (2000). Adolescents' perspectives on racial diversity in U.S. history: case studies from an urban classroom, *American Educational Research Journal* 37, 185-214.
- Fienberg, J. & G. Leinhardt (2002). Looking through the glass: Reflections of identity in conversations as a history museum. In G. Leinhardt, K. Crowley & K. Knutson (eds.), *Learning conversations in museums* (pp. 167-212). Mahwah, NJ: Lawrence Erlbaum.
- Grever, M. (2007). Plurality, narrative and the historical canon. In Grever & Stuurman (eds.), *Beyond the canon* (pp. 31-47). Basingstoke: Palgrave Macmillan.
- Seixas, P. (1993). Historical understanding among adolescents in a multicultural setting, *Curriculum Inquiry* 23, 301-327.
- Symcox, L. & A. Wilschut (2007). Introduction. In Symcox & Wilschut (eds.), *National history standards: the problem of the canon and the future of teaching history* (pp. 1-14). Charlotte, NC: Information Age Publishing.
- VanSledright, B. (2008). Narratives of nation-state, historical knowledge and school history education, *Review of research education* 32, 109-146.

THEMATIC POSTER SESSION

Mathematics Education

Mathematical Word Problem Solving in Children Engaged in Computer-Based Metacognitive Support: A Lon

Hidetsugu Tajika, Kobe Shinwa Women's University, Japan; Narao Nakatsu, Aichi University of Education, Japan; Ewald Neumann, University of Canterbury, New Zealand; Hisae Kato, Hyogo University of Education, Japan; Tomoko Fujitani, Mukogawa Women's University, Japan; Chie Hotta, Aichi Gakusen University, Japan; Hironari Nozaki, Aichi University of Education, Japan

The purpose of the study was to examine how self-explanation known as a metacognitive strategy helps elementary school children solve mathematical word problems through computer-based support over one year. Research on computer-based support for self-explanation has been mainly carried on by using high school students and university students as participants. We developed a computer-based support program that helps elementary school children self-explain solution steps to worked-out examples. One hundred and twelve fifth grade students participated in the study. At the start of the study they were all given a word problem pretest. The students then solved two or three worked-out examples for thirty minutes once a week in a three-week training session. The students had three three-week training sessions up until June 2010. Students had a word problem test a week after each training session. In addition, we used sixty-eight fifth-grade students as the control group who did not self-explain the solution steps. The results show that all of the students gradually solved more word problems correctly than before. We further classified students in the self-explanation group according to their test scores, the upper group, the rising group, and the lower group, respectively. The upper group, whose students had consistently higher scores on the tests, self-explained their solution processes using inferences. The rising group, whose students were not good at the pretest but were gradually increasing their scores on each word problem test, gradually self-explained their solution processes using inferences and elaborated explanations. The lower group, whose students had consistently low scores on the tests, only took notes on the results of their past records about solution steps.

The purpose of the study was to examine how self-explanation known as a metacognitive strategy helps elementary school children solve mathematical word problems through computer-based support over one year. Recent research has shown that self-explanation is an effective metacognitive strategy across a wide range of task domains. Research on self-explanation has shown that most students including undergraduate students do not spontaneously self-

explain. However, it is also known that students start self-explaining when they are supported by guidance or prompts with feedback (e.g., Aleven & Koedinger, 2002; Atkinson, Renkl, & Merrill, 2003). Our framework for self-explanation was designed to provide computer-based support to self-explanation by providing solution steps for worked-out examples.

Within the realm of computer-based self-explanation support systems, for example, Aleven and Koedinger (2002) used geometry problems to compare self-explanations emphasizing computer-based instructional environments to instructional methods that did not emphasize self-explanations. The results showed that 10th grade students who explained their solution steps during problem-solving practice in computer-based instructional environments learned with greater understanding compared with students who did not explain their solution steps (see also Atkinson et al., 2003).

Research on computer-based support for self-explanation has been mainly carried on by using high school students and university students as participants. We developed a computer-based support program that helps elementary school children self-explain solution steps to worked-out examples. Tajika, Nakatsu, Nozaki, Neumann, and Maruno (2007) had sixth grade students self-explain each solution step to the worked-out examples using paper and pencil that showed the effectiveness of support for self-explanation. To develop effective computer-based support for self-explanation, we broke the solution steps into many simpler solution steps, which elementary school students could self-explain more easily. Worked-out examples consisted of six to ten solution steps to worked-out examples. Worked-out examples were word problems which consisted of ratio word problems, elimination problems, decimal problems, and so on. Students self-explained and/or solved each solution step when it was presented by a computer. The students selected the right explanation and/or solution to each solution step from the reference table on the computer. The computer included the provision of feedback for correctness on the students' self-explanations and/or solutions. It displayed error messages in response to the students' errors. It also required that a student got the self-explanation and/or solution right before moving on to the next worked-out problem. The students' correct explanations and/or solutions were exhibited on the display of the computer. After the students solved and/or self-explained all solution steps, they took notes to self-explain their solution processes to the worked-examples.

One hundred and twelve fifth grade students (fifty-four girls and fifty-eight boys with a mean age of 11 years 6 months when the study began) participated in the study. At the start of the study they were all given a word problem pretest. The students then solved two or three worked-out examples for thirty minutes once a week in a three-week training session. The students had three three-week training sessions up until June 2010 (i.e., last November, this February, and this June). Students had a word problem test (which depended on worked-out examples presented on the computer) a week after each training session. In addition, we used sixty-eight fifth-grade students as the control group who did not self-explain the solution steps. They had only the pretest and the word problem tests.

The results of two three-week training sessions (as of February 2010) show that all of the students gradually solved more word problems correctly than before. However, when we compare the Februarys' test scores for the students using computer-based self-explanation support with those of the students in the control group, the students using computer-based self-explanation support solved a little many more word problems compared to those of the control group.

We further classified students in the self-explanation group according to their test scores. The first group is called the upper group, whose students had consistently higher scores on the pretest and each word problem test. The second group was the rising group, whose students were not good at the pretest but were gradually increasing their scores on the word problem tests. The third group was called the lower group, whose students had consistently low scores on the pretest and word problem tests. As a result, many students in the upper group self-explained their solution processes using inferences. It was also shown that some of the students in the rising group gradually self-explained their solution processes using inferences and elaborated explanations. Most students in the lower group only took notes on the results of their past records about solution steps.

The study demonstrates that effective self-explanation can be achieved in a computer-based support approach and that some of the elementary students were gradually better able to solve word problems. The study also shows that support for self-explanation, while solving worked-out examples, can improve learning of domain-specific knowledge for some students.

References

Atkinson, R.K., Renkl, A., & Merrill, M.M. (2003). Transitioning from studying examples to solving problems: Combining fading with prompting fosters learning. *Journal of Educational Psychology*, 95, 774-783.

Aleven, V., & Koedinger, K.R. (2002). An effective metacognitive strategy: Learning by doing and explaining with a computer-based Cognitive Tutor. *Cognitive Science*, 26, 147-179.

Tajika, H., Nakatsu, N., Nozaki, H., Neumann, E., & Maruno, S. (2007). Effects of self-explanation as a metacognitive strategy for solving mathematical word problems. *Japanese Psychological Research*, 49, 222-233.

Authenticity level of mathematic word problems solved by Spanish Primary education students.

Santiago Vicente, University of Salamanca, Spain; Jose Orrantia, University of Salamanca, Spain; Eva Manchado, University of Salamanca, Spain

Children's low achievement in mathematics has usually been related to the existing gap between the problems children are used to solving in the classroom, and the situations in which they are involved in their everyday life (INECSE, 2006). However, the length and the nature of this gap are still undetermined. In order to bridge this gap, a framework was posed by Palm (2001). This model holds that by analyzing certain aspects of word problem solving activity in school, the level of authenticity of this activity can be measured. These aspects are the following: a) event described by the problem; b) question asked by the problem; c) existence, realism and specificity of the data; d) presentation mode (oral, written...); e) availability of external tools; f) solution requirements; and g) purpose of the problem solving activity. In order to know the level of authenticity of the problems that Spanish children usually solve in mathematics classrooms, and considering the theoretical frame posed by Palm, all the word problems included in 1st to 6th grade mathematics textbooks from two Spanish textbook publishers were analyzed. The mathematical structure and the level of challenge involved for children were also analyzed for each problem. Results showed that although most of the aspects from Palm's model were well simulated in a high percentage of the problems analyzed, the aspects "purpose" and "specificity of data" still need further improvement. Furthermore, we found, in line with previous studies, that problems included by textbooks were highly stereotyped. Educational implications are discussed.

Children's low achievement in mathematics has usually been related to the existing gap between the problems children are used to solving in the classroom, and the situations in which they are involved in their everyday life (INECSE, 2006). However, the length and the nature of this gap are still undetermined. In order to bridge the gap, a new framework was posed by Palm (2001). This model holds that by analyzing certain aspects of word problem solving activity in school, the level of authenticity of this activity can be determined. These aspects are the following: a) event described by the problem; b) question asked by the problem; c) existence, realism and specificity of the data; d) presentation mode (oral, written...); e) availability of external tools; f) solution requirements; and g) purpose of the problem solving activity. Taking this theoretical frame into account, a continuum between authentic tasks and non-authentic tasks can be established. Furthermore, the aspects that characterize some tasks as "non-authentic tasks" might be improved to increase the authenticity of these tasks. An example of this issue is the research conducted by Palm and Burman (2009): they analyzed the task-reality concordance in Finnish and Swedish national assessment tests by assigning each problem to a category depending on whether the task simulated the aspects defined by Palm's model or not. Their results showed that: firstly, in most of the problems (more than 90%), only the aspect "event" could be considered as an authentic aspect; and secondly, the rest of the aspects could be considered as authentic aspects in no more than 50% of the problems. However, Depaepe, De Corte and Verschaffel (2009) analyzed how two 6th grade teachers approached word problems in a Flemish school during seven months. They found that certain additional aspects other than those pointed out by Palm and Burman could be considered as authentic in most of the problems (e.g., existence, specificity and realism of the data, solution strategies and requirements). The goal of this study was to analyze every problem included in textbooks and complementary materials of two main textbook publishers. We did so following a categorization based on Palm and Burman's proposal together with some of Depaepe et al's proposals about including an intermediate category between "authentic" and "non-authentic" in some of the aspects. We also wanted to update and extend previous research on this topic, developed by Orrantia, González and Vicente (2005), who found that word problems included in Spanish textbooks were highly stereotyped because the problems belong to the easiest mathematical structures. In addition, they found that challenging problems (i.e., those problems that included irrelevant information, or that lacked the information necessary to solve the problem and consequently the problem solvers had to infer this information) were very scarce. MeasuresAll activities from mathematics textbooks for the 1st to 6th grades belonging to the most recent editions of two of the most important publishers in Spain were classified into routine exercises and word problems. The proportion of word problems related to the whole number of activities was calculated. Then, the analysis focused on word problems, by examining: a) problem type by mathematical structure (additive, multiplicative and their respective sub-categories); b) problems' level of authenticity; and c) proportion of challenging problems (e.g., problems with irrelevant information or missing information that problem solvers must infer from their prior knowledge, problem posing activities, or realistic problems).

Method

The analysis of the word problems included in the textbooks was done by comparing them with the real life situations indicated in their figurative contexts. In order to categorize language use, availability of solution strategies, external tools, guidance, and solution requirements, two categories were defined depending on whether the task reasonably simulated each specific aspect (category 1) or not (category 2). For the aspects Event, Question, Existence, Realism and Specificity of information and Purpose, three classification categories were attached, and they were classified in category 2 when these aspects were partly simulated and in category 3 when it was judged as not being reasonably simulated.

Results

Results showed that only 20.45 percent of the analyzed activities in the Spanish textbooks were word problems. Most of them belonged to the easiest mathematical structure (i.e., in additive word problems only 18 percent could be considered as difficult, following the categorization from Riley, Greeno and Heller, 1983), and only 4.03 percent could be considered as challenging problems. Regarding the authenticity of the problems, results were closer to those of Depaepe et al. than to Palm and Burman's, since the main aspects of the problems (event, question and existence of information) were well simulated in most of the problems (91, 86 and 77 percent, respectively), and other aspects, such as external tools, data realism and language use, were also well simulated in more than 75 percent of the problems. However, the categories "specificity of the data" and, especially, "purpose" might clearly be improved because no more than 50 percent of the problems simulated the first category correctly whereas the second one was simulated in no more than 10 percent of the problems. In fact, according to Palm (2001), roughly 2.26 percent of the word problems could be considered as authentic tasks.

Conclusions and educational implications

Our results show that Spanish textbooks contained many more routine exercises than word problems. Furthermore, word problems were highly stereotyped, easy and non-challenging. In addition, although the main aspects related to the authenticity of the problems were well simulated in most of the problems, aspects like "purpose" and "specificity of information" must be improved. This issue is important because recent research on word problem comprehension (Orrantia et al, in press) showed how tasks with intentional information or goals should be easier to solve. Similarly it is also known that problems with specific information (especially, information related to problem solver) are easier to solve. By improving these two aspects of word problems we can increase the authenticity of the problems and help children to solve them more easily.

Differences in problem solving process and external representations' use at primary school mathematics

Johannes Grosse, University of Koblenz-Landau, Germany

The positive effects of representations on the problem solving process have already been shown in studies. Yet, studies on the configuration of problem solving process and the use of representations on complex story problems are scarce. That is especially unfavourable, because the constructive effects of complex story problems on learners' problem solving competences have already been proven. By closing this gap in research, an effort is made to help students in their struggles with problem solving in mathematics. The underlying study is analyzing the structure of the problem solving processes of primary school students when working on complex story problems and their external representations in the solution process. There are 17 students of 2nd and 10 students of 4th grade participated in the study. Different influencing factors on the processes of problem solving were explored (e.g. cognitive ability, self-efficacy, intelligence). In up to 40 minutes, the students worked on five complex story problems. They were allowed to use different auxiliary material. The students were videotaped individually during the solution process. The problem solving processes were analysed according to a newly developed system of categories for this study. ANOVA is conducted to compare the different class levels. Preliminary findings showed that the ability groups differed in terms of representations they used as well as the time they needed to solve the problems. Also, the quantity of solved word problems differed among the ability groups.

Introduction

The term "complex story problems" specifies a group of tasks that are different from "regular story problems". These tasks are based on very challenging mathematical structures and cannot be solved by arithmetic operation models that students are usually familiar with (Winter, 1992). To convince didacts of complex story problems' advantages, further research on the use of complex story problems in primary schools is needed.

The theoretical framework of this study bases on two models: first, the "student-problem-solver" (Reusser, 1992), second the „cognitive-metacognitive model of mathematical problem solving" (Montague, 1993). The reanalysis of

these two models lead a new system of categories that offers the opportunity to analyse the problem solving processes in primary school mathematics. This system (Groß, Hohn, Telli, Rasch & Schnotz, 2010) consists of 9 categories and 30 facets which can be used to analyse the configuration of the problem solving processes and the use of different external representations while working on complex story problems.

A representation is an object which stands for something else. Yet, studies on the configuration of problem solving process and the use of different external representations on complex story problems are scarce. That is especially unfavourable, because the conductive effects of complex story problems on learners' problem solving competences in primary school classes have already been shown in studies (Rasch, 2001). By closing this gap in research, an effort is made to help students in their struggles with problem solving in mathematics at school in this study.

Questions

- 1) What are the differences in the persistence and the quantity of solved word problems (total word problem score) among the ability groups in both class levels?
- 2) What are the differences in the usage of different external representations among the ability groups in both class levels?
- 3) What are the differences in the connection between the different stages of the problem solving process and the external representations among the ability groups in both class levels?

Methods

A total number of 27 students from a primary school participated in the study in April 2010. There are 17 pupils at 2nd (M=8.53 years, SD=.61) and 10 pupils at 4th grade (M=10.31 years, SD=.60). Different influencing factors on the processes of problem solving were explored: First verbal and visual spatial intelligence were measured by scales from cognitive abilities test (KFT) (Heller & Geisler, 1983; Heller, Schön-Gaedike & Weinläder, 1976). Second, scales from the project for the analysis of learning and achievement in mathematics (Pekrun, Götz, Zirngibl, v. Hofe & Blum, 2002) were used to assess students' mathematical self-efficacy as well as their mathematical self-concept. Lastly, students were asked to solve the complex word problems. In our study, students were successively given five tasks which were arranged in Latin Square Design. Students solved the problems on their own and got auxiliary material. They were videotaped during the solution process.

The participants were divided in both class levels into the two groups' higher math competence (HMC) and lower math competence (LMC) according to their results the KFT. At the 2nd grade, there were 9 students in the LMC-group and 8 students in the HMC-group. At 4th grade there were 5 students in both ability groups. Their solutions were analysed according to the aforementioned category system (Groß, et al., 2010). ANOVA is conducted to compare the different ability groups.

Outcomes

Question 1

Table 1 shows the differences in the persistence and the quantity of solved word problems. On average, students of the HMC-group in both class levels needed less time to solve the story problems than their peers at the LMC-group. At both class levels, students of the HMC-group achieved a higher quantity of solved word problems than students of the LMC-group.

Question 2

Analysis of students' solutions applied in the problem solving process and their external representations were given in Table 2 and 3 for both class levels. At the 2nd grade students of both ability groups did not use the "realistic pictures". Additionally, only members of the HMC-groups used "fingers" and "logical pictures".

At the 4th grade all kinds of external representation were used in the LMC-group. In the HMC-group the external representations "working materials" and "fingers" were not used.

Perspective

The design and development of the system of categories is completed. Using this system the remaining research question will be answered. Results of the analysis will be presented at the 14th Biennial Conference Earli 2011.

References

Groß, J., Hohn, K., Telli, S., Rasch, R. & Schnotz, W. (2010). Analyse des Problemlöseprozesses bei der Bearbeitung von problemhaltigen Textaufgaben durch Grundschulkinder, 74. Tagung der AEPF, Jena, Germany 13.-15.09.2010.

- Heller, K. & Geisler, H. J. (1983). Kognitiver Fähigkeitstest für 1. bis 3. Klassen (KFT 1-3): Manual. Weinheim: Beltz Test GmbH.
- Heller, K. A., Schßn-Gaedike, A.-K. & Weinläder, H. (1976). Kognitiver Fähigkeits-Test für 4. bis 13. Klassen (KFT 4-13+): Manual. Weinheim: Beltz Test GmbH.
- Montague, M. & Applegate, B. (1993). Middle School Students' Mathematical Problem Solving. An Analysis of Thinking-Aloud Protocols. *Learning Disability Quarterly*, 16 (1), 19-32.
- Rasch, R. (2001). Zur Arbeit mit problemhaltigen Textaufgaben im Mathematikunterricht der Grundschule. Hildesheim: Franzbecker.
- Reusser, K. (1992). Kognitive Modellierung von Text- Situationen und mathematischem Verständnis beim Lösen von Textaufgaben. In K. Reiss & M. Reiss (Eds.), *Maschinelles Lernen – Modellierung von Lernen mit Maschinen*. Berlin: Springer.
- Pekrun, R., Gßtz, J., Zirngibl, A., v. Hofe, R. & Blum, W. (2002). *Skalenhandbuch PALMA: 1. Messzeitpunkt* (5. Klassenstufe). München: Universität München: Institut Pädagogische Psychologie.
- Winter, H. (1992). Zur grundsätzlichen Problematik des Sachrechnens. *Sachunterricht und Mathematikunterricht in der Primarstufe*, 8, 350-369.

Investigating the consistency and extraneous effects when solving math word problems

Meng-Lung Lai, National Chiayi University, Taiwan; Meng-Jung Tsai, National Taiwan University of Science & Technology, Taiwan; Fang-Ying Yang, National Taiwan Normal University, Taiwan; Chin-Chung Tsai, National Taiwan University of Science and Technology, Taiwan.

Arithmetic word problems containing relational statements are difficult for students to solve, especially when the arithmetic operation required to solve the problem is inconsistent with the relational term (e.g., subtraction required yet the term more used; consistency effect). Extraneous information provided in problem statements may also have influences on students' problem solving (relevance effect). The authors investigated the consistency effect and relevance effect on students' arithmetic word problem solving process in this study. Thirty two college students participated in this study. They were asked to solve eight arithmetic problems which were designed based on four (2x2) combinations of consistency and relevance effects (consistency v.s. inconsistency; relevance v.s. irrelevance). Students' eye fixations and sequences of fixations on the problem statements were recorded by eye tracker FaceLab 4.5. Accuracy results showed that 9 students correctly answered all the problems while 10 of them made more than two errors. Students performed the worst in the inconsistent problems with extraneous information, followed by the inconsistent-only problems and the extraneous-only problems respectively. The eye movement data showed that the high-accuracy participants spent much more time than the low-accuracy participants in the integration phase but not the translation phase for each problem, especially for the inconsistent problems with extraneous information. Much more mental efforts were needed for students to solve the problems with both negative effects. Finally, high-accuracy participants reread the keywords in problem statements much more carefully than did the low-accuracy participants. More details and discussions will be presented in the conference.

Previous studies (e.g., Hegarty et al., 1992, Schoot, et al., 2009) have consistently demonstrated that mathematics word problems are widely regarded by students as very difficult, especially for those problems containing relational statements comparing the quantities of different variables (i.e., compare problems). The same holds even true when the required arithmetic operation to solve the problem is inconsistent with the relational term (e.g., addition required but the term less is used or subtraction required yet the term more is used; consistency effect). In addition, the existence of irrelevance information also significantly increases the difficulty of solving mathematics word problems (i.e., relevancy effect). Specifically, most students find it difficult to discriminate relevant from irrelevant facts when solving mathematics word problems, probably because they hold the misconception that all the numbers and information in a word problem must be used (e.g., Muth, 1992).

In this study, the authors investigated the consistency effect and relevancy effect on college students' mathematics problem solving process. Our participants were asked to solve eight arithmetic word problems which were designed based on four (2 x 2: consistency vs. inconsistency; non-irrelevancy vs. irrelevancy) combinations of consistency and relevancy effects (i.e., two trials for each combination). The materials were presented using GAZETRACKER 8.0 on a computer, situated approximately 0.70m from the participant. The authors partitioned the participants into three groups based on their accuracy rate on solving these problems. Participants' eye fixations (e.g., numbers of fixations and fixation duration) and sequences of fixations on these problems were recorded using an eye tracker (FaceLab4.5) that sampled the position of the participant's eye fixation every 16ms. The problem solving processes, namely translation (initial reading from the appearance of a problem to last line of the problem for the first time), integration (across-sentence comprehension excluding translation), planning (developing a plan for solving the problem), and

finally selecting an appropriate answer, were used to analyze participants' step-by-step thought and to identify the locus of difficulty on solving mathematics word problems.

Thirty two college students, half science-related majors and the other half, liberal art majors, participated in the study. Nine of them correctly answered all the problems and ten of them made more than two errors. The inconsistent problem with extraneous information was, as predicted, performed the worst, followed by the inconsistent-only one and the one with extraneous information respectively. Interestingly, participants were more bothered by the extraneous information than the inconsistent relational term.

The eye movement data showed that the high-accuracy participants spent much more time than the low-accuracy participants in the integration but not the translation phase for each problem, especially in the inconsistent one with extraneous information. Much more mental efforts needed to put forward to solve the problem with two negative effects presented. High-accuracy participants reread keywords much more carefully than their low-accuracy counterparts.

The major findings are threefold. First, college students, science-related major and non science-related major, performed similarly on the mathematics word problems and some of them even answered incorrectly on more than two problems. The compare problems still bother undergraduate students no matter for those receiving more logical training (science majors) or not (liberal art majors). Second, based on the eye fixations data, after the initial reading, the participants started to read different variables first and read the numbers soon afterwards, in which the former can be seen as the integration phase and the latter, the planning phase. It appears that we can identify the integration and planning phase that were considered difficult to disentangle by previous studies. Third, most higher accuracy participants read the problem from the first word to the last word before trying to solve problems while the pattern is not found for most of lower accuracy participants. More details and discussions will be presented in the conference.

Illusion of linearity in multiple choice problems: magnitude of geometric shape's size change

Vesna Vlahovic-Stetic, Faculty of Philosophy, University of Zagreb, Croatia; Valentin Lapaine, University of Zagreb, Croatia

This study is related to illusion of linearity, the tendency to apply properties of linear or proportional relations even in situations where it is not appropriate. It is investigated whether an offered linear solution affects the success of solving non-linear problems. It is also investigated whether the success of solving non-linear problems is affected by the magnitude of geometric shapes' size change. Finally, the relation between correctness of a solution and participants' degree of certainty is investigated. Pupils of third grades of two high schools participated in the research (N=201). They solved five linear and five non-linear word problems. There were four groups of non-linear problems. The difference between them were in whether a linear solution was among the offered solutions and in the magnitude of geometric shapes' size change (2, 3, 4, or 200, 300, 400) Participants solved linear problems very successfully and non-linear problems much worst. Participants who did not have linear solution offered solved significantly more non-linear problems than other group. Participants whose problems contained lesser magnitudes of geometric shapes' size change solved significantly more non-linear problems than group with greater magnitudes of change. The interaction of mentioned variables was also significant. Participants in all groups were equally certain in their correct solutions of non-linear problems. Participants who did not have linear solution offered were significantly less certain in their incorrect solutions of non-linear problems, and participants whose problems also contained lesser magnitudes of geometric shapes' size change were the least certain.

Student's tendency to use linear reasoning in non-linear problems is described in many areas of mathematics, such as arithmetic, algebra, probability, geometry and measurement. They fail to solve the given non-linear problems because of a very strong tendency to always apply linear solution methods and that error is called „illusion of linearity". This study is related to some aspects of illusion of linearity, the tendency to apply properties of linear or proportional relations even in situations where it is not appropriate. In geometry, illusion of linearity entails thinking that a geometric shape's area or a geometric solid's volume is going to be reduced or enlarged k times if its length is reduced or enlarged k times (in fact, areas are reduced or enlarged k^2 times and volumes k^3 times). It is investigated whether an offered solution which corresponds to the illusion of linearity (i.e. linear solution) affects the success of solving problems for which is it not appropriate to apply the linear model (i.e. non-linear problems). It is also investigated whether the success of solving non-linear problems is affected by the magnitude of geometric shapes' size change. Finally, the relation between correctness of a solution and participants' degree of certainty for groups with and without offered linear solutions and for groups with lesser and greater magnitudes of geometric shapes' size change is investigated.

Pupils of third grades of two high schools participated in the research (N=201). Each of them solved five word problems for which it was appropriate to apply the linear model (i.e. linear problems), each of which had five offered solutions. Each participant also solved five non-linear word problems, each of which also contained five offered solutions.

For the requirements of this study five lists of mathematical problems were constructed. In the Form A there were five classical proportionality problems that did not include any enlargement of areas of volumes, but only a linear enlargement.

Form B and C contained five non-linear problems, and for every problem five answers were offered. Among these five answers, one solution could be obtained if the participant is liable to the illusion of linearity; one was a correct solution, while the remaining answers served to reduce the probability of guessing. In form B were problems with lesser magnitude of geometric shapes' size change (2, 3 or 4 times enlargement or reduction). In form C were problems with greater magnitude of geometric shapes' size change (200, 300 or 400 times enlargement or reduction). Form D and F also contained five non-linear problems, and for every problem five answers were offered but without offered linear solutions. In form D were problems with lesser magnitude of geometric shapes' size change (2, 3 or 4 times enlargement or reduction). In form F were problems with greater magnitude of geometric shapes' size change (200, 300 or 400 times enlargement or reduction).

Distracting solutions in all forms were selected in such a way that they could not be obtained by simple linear combinations nor with the simple multiplication or division of the numbers in the problem.

Participants solved linear problems very successfully and they solved non-linear problems much worst. Participants who did not have linear solution offered solved significantly more non-linear problems than other group (with offered linear solution) ($F(1,177) = 36,18$). In addition, participants whose problems contained lesser magnitudes of geometric shapes' size change solved significantly more non-linear problems than other group (with greater magnitudes of change) ($F(1,177) = 30,100$). The interaction of mentioned variables was also significant ($F(1,177) = 21,34$). Participants without offered linear solutions in nonlinear problems were more successful and that difference was greater between groups with lesser magnitude of geometric shapes' size change.

Participants in all experimental groups were equally certain in their correct solutions of non-linear problems. Participants who did not have linear solution offered were significantly less certain in their incorrect solutions of non-linear problems, and participants whose problems also contained lesser magnitudes of geometric shapes' size change were the least certain.

Stimulating Creativity In Mathematics Classrooms: Increasing Engagement And Understanding

Gaye Williams, Deakin University, Australia

A theoretically developed and empirically grounded framework for considering conditions necessary (but not necessarily sufficient) for nurturing creative thinking in mathematics lessons is presented. This theoretical framework integrates socio-cognitive theory (Schwarz, Dreyfus, & Hershkowitz, 2009), theory linking positive affective with learning (Csikszentmihalyi, 1992), and psychological theory linking orientations to successes and failures to subsequent actions (Seligman, 1995). Flow (Csikszentmihalyi, 1992) is a state of high positive affect during creative activity that can occur during mathematical problem solving where students discover mathematical complexities that were not evident at the start of a task, and spontaneously decide to explore them (Williams, 2009). During the process of discovering complexity, groups spontaneously create 'Zones of Proximal Development' (Vygotsky, 1933/1966) with the potential to support new learning. Students' perceived successes resulting from mathematical insights developed during flow situations can build optimism (Seligman, 1995) (resilience) over time and this can increase student inclination to explore new ideas in the future. The Engaged to Learn Pedagogical Approach (Williams, in press) to mathematical problem solving is based upon this theoretical framework. Using illustrations drawn from elementary and secondary school classes, the complexity of this approach is illuminated by identifying key features that encourage and sustain creative mathematical thinking in mainstream elementary and secondary classes: including situations that theory suggests should build optimism. These illustrations demonstrate the deep mathematical understandings, and student engagement, that the Engaged to Learn Pedagogical Approach can nurture. Implications for teaching and learning associated with using approaches that nurture creative thinking are discussed.

The benefits of drawing upon approaches that encourage creative mathematical thinking in mathematics lessons in mainstream classes are elaborated. The Engaged to Learn Pedagogical Approach is used as a vehicle to discuss complexities associated with teaching and learning intended to achieve this. This approach is based upon a theoretical

framework that illuminates these complexities. This framework (Williams, in press) was developed through synthesis of aspects of several learning models and theories (Schwarz, Dreyfus, & Hershkowitz, 2009; Krutetskii, 1976; Csikszentmihalyi, 1992; Vygotsky, 1933/1966; Seligman, 1995). Within this framework, creative student thinking is represented through the 'observable cognitive elements': 'recognising', 'building-with', 'constructing' and 'consolidating' (Schwarz, Dreyfus, & Hershkowitz, 2009). Building-with and constructing are subcategorised using Krutetskii's (1976) 'mental activities' ('analysis', 'synthetic-analysis', 'evaluative-analysis' within building-with; and 'synthesis' and 'evaluation' within constructing). Social interactions that contribute to the creative development of new mathematical knowledge are represented using Schwarz, Dreyfus, and Hershkowitz's (2009) social elements: control, elaboration, explanation, query, agreement, and attention. Conditions for flow (Csikszentmihalyi, 1992) include: a) spontaneous intellectual mathematical challenges; and b) working beyond present skills level (Csikszentmihalyi, 1992) and conceptual level (Williams, 2009). These conditions are operationalised through students exploring unfamiliar mathematical complexities by spontaneously asking and pursuing questions that assist this exploration (Williams, 2009), and the spontaneously created ZPDs (Vygotsky, 1933/1966) associated with these spontaneous questions that can be examined through the nature of the insights developed. These mathematical insights represent deep and connected mathematical understandings that are articulated by groups as they share their findings with others at intervals during their problem solving activity. High positive affect becomes apparent through student exclamations in groups, excited communication to the class, and body language indicating intense focus on the task and/or communication of these findings to others. Similarly, the disinclination of some students to engage in solving unfamiliar problems is evidenced through their lack of engagement with the task and their group. This disinclination is frequently related to absence of optimism (Seligman, 1995). The Engaged to Learn Approach includes: a) tasks containing many opportunities to discover complexities; b) groups with similar paces of thinking to increase their likelihood of remaining in flow together; c) teacher questioning to elicit more complex student thinking; and d) an organisational structure (small group brainstorming/whole class feedback cycles) that provides opportunities to amplify the successes students achieve as other groups exclaim about group findings, or use them in their subsequent group activity. Developing and sustaining creative student thinking for the purpose of developing deep mathematical understandings is a complex process. This complexity is illustrated through activity within the Engaged to Learn Approach in upper elementary, and upper secondary classes, and through the spontaneous activity of optimistic Year 8 students within the Learners' Perspective Study who manoeuvred the conditions for flow and undertook creative mathematical thinking when such activity was not the explicit intention of their teacher. Lesson video and video-stimulated post-lesson student interviews within and beyond the Learners' Perspective Study (Shimizu, Kaur, Huang, & Clarke, 2010) provided access to the activity illustrated. It is hoped this elaboration of an approach that stimulates frequent creative mathematical thinking by students in diverse mainstream mathematics classroom settings (and the associated theoretical framework), will be of assistance to others exploring this research area. It is also hoped that these illustrations will raise awareness of the need to increase the frequency of such activity in classrooms internationally, and that they will illuminate subtle differences between teacher 'moves' that support and inhibit such activity.

References

- Krutetskii, V. (1976). *Psychology of mathematical abilities in schoolchildren*. (J. Kilpatrick, & I. Wirzup (Eds.), J. Teller, Trans.). Chicago: University of Chicago Press. (Original work published in 1968).
- Shimizu, Y., Kaur, B., Huang, R., & Clarke, D. J. (Eds.). (2010). *Mathematical tasks in classrooms around the world*. The Netherlands: Sense Publications.
- Seligman, M. (with Reivich, K., Jaycox, L., Gillham, J.). (1995). *The Optimistic Child*. Adelaide: Griffin Press.
- Schwarz, B., Dreyfus, T., & Hershkowitz, R. (Eds.). (2009). *Transformation of knowledge through classroom interaction*. New York: Routledge.
- Vygotsky, L. (1933/1966). *Play and its role in the mental development of the child*. (C. Mulholland, Trans.), Online Version: Psychology and Marxism internet archive 2002. Retrieved June 16, 2003, from <http://www.marxists.org/archive/vygotsky/works/1933/play.htm>
- Williams, G. (in press). Building optimism in prospective mathematics teachers: Psychological characteristics enabling flexible pedagogy. In Orit Zavilasky & Peter Sullivan (Eds.), *Constructing knowledge for teaching secondary mathematics: Tasks to enhance prospective and practicing teacher learning*. Springer Publications.

THEMATIC POSTER SESSION

Motivational, Social and Affective Processes

Cooperation, Competition Behaviour of Children between 4-18 and Effect of Parent Resources on Them

Laszlo Kasik, University of Szeged, Hungary; Edit Toth, University of Szeged, Hungary

The aim of the research was to describe the developmental level of cooperation and competition abilities at the age of 4, 8, 12, 15 and 18 (N=945), and to examine mothers' opinion about their financial, intellectual and relationship resources in connection with children's cooperation and competition behaviour (N=855). A factor-wise study of these abilities was assessed with a Likert-type questionnaire. Besides children's own evaluations, teachers and mothers also evaluated the functioning of abilities. The mothers' views were assessed with another questionnaire developed by ourselves.

The relationship between the values of children and parents are the strongest in all age groups, and teachers and parents evaluate the most divergently the functioning of ability factors. Based on the total values, the competition factors show increasing tendency with age, contrary to most of the cooperation factors. Gender differences can be found especially among children between 12 and 18.

In all age groups, parents have different opinions about cooperation and competition abilities according to their age, financial status and level of education. The functioning of factors is influenced by parents' opinions less about relational and the least about financial resources. The parents of 15- and 18-year-old children assign a smaller role to themselves in the development of behaviour forms. The change in the ability factors is not always reinforced by parents' opinions, e.g. the frequency of competition increases with age but the parents of older students find it less important that children should see an appropriate example for competition in their environment.

Background

International surveys agree that the functioning of cooperation and competition abilities is very important for both individuals' inner balance and a satisfactory social co-existence (Fýlþp, 2009). One of the basic conditions of developing abilities in kindergartens and schools is having at the same time many evaluators' opinion about the functioning of psychic components to be developed. It is also crucial to take into consideration the characteristics of families and institutions influencing significantly the functioning of abilities lying behind different behaviour forms (Grusec and Hastings, 2007). Therefore, their improvement is a major task of institutionalized education (Schneider, 1993).

Aims

The aim of the research was to describe the developmental level of cooperation and competition abilities on the basis of children's, teachers' and parents' evaluation; to examine the parents' opinion about cooperation and competition; to describe the parents' views about financial, intellectual and relationship resources in connection with these behaviour forms; and to investigate the correlation between parental resources and the functioning of abilities.

Methods

Sample and data collection

Subjects were 945 children (at the ages of 4, 8, 12, 15 and 18), 855 mothers (only a few fathers sent back the questionnaire) and 46 teachers. The size of subsamples was approximately the same. Data collection took place in Spring 2010.

Instruments

The functioning of cooperation and competition abilities was assessed a Likert-type questionnaire developed by ourselves (Cronbach-a: 0.83–0.92). Besides children's own evaluations, teachers and mothers also evaluated the functioning of abilities. Based on the theoretical background (socio-anthropological, human ethological, social psychological), we had defined some dimensions in the abilities. On the basis of the factor analysis, the dimensions form many factors (e.g. interest, relation between give and take, time of competition, instruments of competition, winner).

The parental questionnaire (Cronbach-a: 0.81–0.95) consists of four sections: the influence of mothers and public education on behaviour forms; the influence of parents' financial, intellectual, relational resources on the development of the behaviour forms. Furthermore, we had a list of background variables about all participants (e.g. mothers' educational level; family type; net income).

Results

Development of cooperation and competition factors

The three raters rate the social factors very differently, the correlation values being between 0.22 and 0.68. In all age groups, the correlation between children and parents are the strongest, and teachers and parents evaluate the functioning of abilities the most divergently.

Based on the total values (mean of the three raters), we found for example that 15- and 18-year-old children want to realise more often their own interest in groups. They think more often that the distribution of awards depends on the work done (there is no equal share). The older children use lots of instruments (positive and negative) to win. The younger children (4, 8, 12) are more impatient if they have to wait for the result of the competition, and they think that they must defeat their partners. Gender differences can be found especially among children between 12 and 18, e.g. boys realise more their own interest in groups; girls exhibit a more dominant tendency toward help in a group.

Cooperation, competition and parental resources

In all age groups, the examined mothers' opinions about the two behaviour forms differ significantly: they think that their children's cooperative behaviour depends mostly on family education while competition should be acquired in schools.

Independently of the age of children, mothers' rejection is significant in the case of competition, it is considered as a really negative behaviour form. The change in the ability factors is not always reinforced by mothers' opinions. It is a very important result that the frequencies of most factors of competition increase with age but the mothers of older students (15, 18) find it less important that children should see an appropriate example for competition in their environment. On the contrary, most of the cooperation factors show decreasing tendency with age and the mothers of older children think that a good example for development of cooperation is very important.

In families where more money are spent on children, behaviour forms are more likely to be awarded by money; however, there is no significant difference between the quantity of money and the behaviour form awarded by money. It is very important for mothers, independently of age, to talk about behaviour forms and that they give examples (the two forms of intellectual resources); however, mothers of 15- and 18-year-old children think more that their influence is smaller than that of peers and media at this point. They think that children should see lots of good examples for cooperation in the family, and not many for competition. On the basis of the analysis of relational resources, mothers uniformly do not ask for help from anyone in order that children should get into situations where they have more possibilities to cooperate and to compete.

Some connections between the examined aspects

From the environment variables, mothers' educational level, family type and mothers' opinions about intellectual resources influence the most the development of social abilities. However, their effects are different by factors, and they are nearly of the same extent at a given factor in the age groups. The net income is the environment variable that has the smallest effect on the assessed factors of abilities.

Conclusion

Results are to be used as the basis for a complex development programme. The results unequivocally strengthen the international research experience that family factors have to be taken into consideration more than so far when elaborating a specific development program. Nevertheless it has to be taken into consideration that respondents were mothers. Numerous surveys show that mothers' opinions about cooperation and competition are different from those of fathers.

References

- Fýlßp, M. (2009) Socialization for cooperative and competitive citizen: a classroom observation study. *Social Science Tribune*. From a national identity to a European one. 55. 59–87.
- Grusec, J. and Hastings, P. (2007, Eds.): *Handbook of Socialization*. Guildford Press, New York.
- Schneider, B. H. (1993): *Childrens' Social Competence in Context*. Pergamon Press, Oxford.

How Young People Respond To Change And Challenge: The Role Of Adaptability

Andrew J Martin, University of Sydney, Australia; Arief Liem, University of Sydney, Australia; Susan Colmar, University of Sydney, Australia; HARRY NEJAD, UNIVERSITY OF SYDNEY, Australia

Abstract

This study focuses on a relatively understudied construct, academic adaptability, defined as students' capacity to adaptively regulate cognition, affective, and behaviour in response to new, changing, and/or challenging conditions. It

seeks to examine the relationships between adaptability and its antecedents (age, gender, language background, literacy and numeracy) and well-being outcomes (general self-esteem, life-satisfaction, and emotional stability) in an integrative structural equation model (SEM), the conceptual scope of adaptability, and the validity and reliability of a set of hypothesised adaptability measures. The data were collected using a set of psycho-educational measures administered to 2,145 Australian high school students (mean age=14.01, 45% females). Preliminary analysis showed that participants' responses to the measures were normally distributed (i.e., relatively low skewness and kurtosis), internally consistent (i.e. $\alpha > .80$), and fit well to the hypothesized measurement models (i.e., excellent fit indices; item factor loadings $> .70$; invariant factor structures across gender and age groups). The SEM indicated that literacy and numeracy achievement scores significantly predicted adaptability (both $bs = .16$, $pb = .55$, $b = .51$, and $b = .31$, respectively, p

Harry G. Nejad, Andrew J. Martin, Gregory Arief D. Liem, and Susan Colmar, Faculty of Education and Social Work University of Sydney

Extended Summary

Background. Both academic and non-academic challenges and changes are a reality of young people's everyday life (Martin & Marsh, 2006, 2008). It is argued that young people who are able to regulate their personal resources can effectively adapt to their challenging and changing circumstances and, further, attain a desirable state of well-being. This study focuses on a relatively understudied construct, adaptability, which is defined as young people's capacity to adaptively regulate cognition, affective, and behaviour in response to new, changing, and/or challenging conditions. Significant components in this research include adaptability, life effectiveness, self-confidence, and engagement – constructs that are all aligned with the National Goals for Schooling outlined in the Adelaide Declaration (1999) which hold implications for social and cultural development in Australia (MCEETYA, 1999) and beyond.

Aims. The present study was set with both measurement and substantive goals. As a measurement goal, the study aims to examine psychometric properties of a recently developed measure, the Adaptability Scale. To this end, we aim to assess the scale's descriptive statistics (mean, standard deviation), distributional properties (skewness, kurtosis), and internal consistency reliability, as well as first- and second-order confirmatory factor structure (CFA) factor structures (fit indices, factor loadings, measurement invariance across gender and age groups). As a substantive goal, the study aims to test a hypothesized model predicting the effects of socio-demographic factors (i.e., age, gender, language background) and academic abilities on adaptability and the effects of adaptability on key well-being outcomes (i.e., general self-esteem, life satisfaction, and emotional stability) in an integrative structural equation modelling (SEM).

Method. Data were collected using a set of psycho-educational measures administered to 2,145 Australian high school students. Of the total sample, 259 (12.1%) students were in grade 7, 567 (26.4%) students in grade 8, 509 (23.7%) students in grade 9, 491 (22.9%) students in grade 10, 267 (12.4%) students in grade 11, and 48 (2.2%) students in grade 12. This sample was drawn from seven schools that are broadly representative of school types in Australia (i.e., independent and government schools; single-sex and co-educational schools). The mean age of the sample is 14.01 years and 45% of them are females.

A set of items probing students' demographic information (e.g., age, gender, and language background), adaptability, and key well-being outcomes were used. As indicators of academic abilities, students' literacy and numeracy scores from nationally standardized achievement tests were used. Students' capacity to adapt in new, changing, and/or challenging situations was assessed by the Adaptability Scale developed for the purpose of this study. The scale is a 21-item self-report instrument that measures three proposed dimensions of adaptability, namely the cognitive dimension (e.g., I am able to change the way I think about new situations to help me deal with them better), the affective dimension (e.g., I am able to reduce negative emotions, such as fear, to help me deal with challenging or uncertain situations), and the behavioural dimension (e.g., I am able to adjust my behaviour e.g., work harder or longer, to help me deal with challenging or difficult situations.). Well-being outcomes were measured by pre-existing instruments, including the Satisfaction with Life Scale (Diener et al., 1985) and the Emotional Stability and General Self-Esteem Scales from the SDQ-II (Marsh et al., 1999). Items of these scales are rated on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Results. Preliminary analysis showed that participants' responses to the measures, including the Adaptability Scale, were normally distributed (i.e., relatively low skewness and kurtosis) and internally consistent (i.e. α s $> .80$). Following recommendations on establishing model fit (e.g., Marsh, Hau, & Wen, 2004), the Comparative Fit Index (CFI), the Non-Normed Fit Index (NNFI), the Root Mean Square Error of Approximation (RMSEA), and an evaluation of

parameter estimates, were used to assess CFA and SEM models. CFA showed that each of the scales used evinced a robust factor structure (CFI>.90, NNFI>.90, RMSEA.60; Marsh et al., 2004) and invariance across gender and age groups (Delta CFI). Although fit indices suggested that responses to the adaptability items can be represented by both first- and higher-order factor models, for parsimony purposes, the higher-order factor model was used in addressing the substantive goal of the study. SEM indicated that students' literacy and numeracy achievement scores significantly predicted adaptability (both β s=.16, p =.55, β =.51, and β =.31, respectively, p

Conclusions. The study provides preliminary psychometric evidence of the Adaptability Scale. The study has also shown adaptability predicts general self-esteem, life satisfaction, and emotional stability – whilst adaptability is predicted by academic ability, but not gender, age, or language background. Taken together, the findings of the present investigation are relevant for school personnel and parents/caregivers seeking to enhance students' well-being that relies very much on the extent to which students are capable to adapt to challenging and changing circumstances. The findings also hold substantive and methodological implications for researchers studying issues related to adaptability in students' academic and non-academic lives.

Changes in Motivational and Self-regulated Learning Components: A multilevel growth curve modeling

Ridwan Maulana, GION - University of Groningen, Netherlands; Marie-Christine Opdenakker, University of Groningen, Netherlands; Roel Bosker, University of Groningen, Netherlands

The present study examined the developmental changes of and the link between motivational and self-regulated learning components of 566 first-year secondary education students from 10 Mathematics and 10 EFL classes in the Netherlands. A set of self-report measures of student motivational and self-regulated learning components was administered in five different occasions across the school year. Multivariate multilevel growth curve modeling (MMGCM) was applied and attention was paid to the general development and the deviation to this development at class and student level. Results revealed differences between classes and students within classes with regard to the level and growth of the motivational and self-regulated learning components. Self-efficacy, intrinsic value and autonomous motivation decreased significantly over time, whilst test anxiety and controlled motivation increased significantly over time. Moreover, self-regulation, delay of gratification, effort regulation and academic engagement decreased significantly over time, while procrastination increased significantly over time. In addition, the link between several motivational and self-regulated learning components over time was found. Class type and student gender could explain developmental differences of several components across the school year. The role of both determinants was discussed.

Introduction and framework

Research suggests that motivational and self-regulated learning components are important factors in education because they play the critical role in students' development, academic performance and behavior (Bandura, 1986; Bembenuddy & Karabenick, 1996; Hoffman & Spataru, 2008). However, positive achievement-related motivational and self-regulated learning components tend to decrease across age of schooling (Opdenakker & Maulana, 2010; Wigfield & Eccles, 2000). Particularly, problems regarding absenteeism, school drop out and misbehavior in the early years of secondary education are often associated with the drastic changes occurring in everyday's life of students during the critical transition from primary to secondary school (Eccles & Midgley, 1989; Hargreaves, Earl & Ryan, 1996).

Students experiencing a transitional year display poor motivation and low engagement in learning because transitions seem to facilitate stressful, yet excited moments for them (Johnstone, 2002). In effect, students' level of anxiety, emotional stability, confusion and disengagement during this transition may boost to a great extent (Howard & Johnson, 2004). In this study, we aimed at investigating the developmental changes of and the link between motivational and self-regulated learning components of the first year secondary students by incorporating expectancy-value and self-determination theories as underlying frameworks.

Research questions

- (1) How do motivational and self-regulated learning components (MSL) of first grade secondary students develop across the school year? What are the role of class type, subject taught, teacher gender and student gender on these changes?
- (2) How are the three motivational components linked with the self-regulated learning components across the school year?

Method

Participants

The sample included 566 students from 20 mathematics and EFL classes of secondary schools in the Netherlands. Surveys were administered five times across the school year.

Measures

Students responded to a questionnaire provided on a 5-point Likert scale. Measures of motivational components were adapted from the existing instruments including self-efficacy, intrinsic value, test anxiety and controlled and autonomous motivation. Self-regulated components included self-regulation, delay of gratification, effort regulation, procrastination and academic engagement. All measures showed satisfactory reliabilities: Cronbach's alpha between .70 and .90.

Data analysis

Multivariate multilevel growth curve modeling (Rasbash et al., 2005) was applied to answer the research questions.

Findings

1. Development of the MSL components over time

Results of multilevel growth curve analyses reveal differences between classes, between students within classes and differences across the school year with respect to changes in motivational components (Table 1). Results show that self-efficacy, intrinsic value and autonomous motivation decline systematically, while test anxiety and autonomous motivation increase over time (see Table 2; Figure 1). Differences in the development of several motivational components between classes over time are found and can be explained partly by class type and student gender (Table 3).

With respect to the self-regulated learning components, results show that differences between classes, between students within classes and differences over time with regard to changes in self-regulation, delay of gratification, effort regulation, procrastination and academic engagement are found (see Table 4). All self-regulated learning components except procrastination decrease over time (Table 5, Figure 2). The results suggest that there are large differences in the growth changes of degree of gratification, effort regulation and academic engagement over time and these differences can be partially explained by class type, student gender and teacher gender (Table 6). Polynomial developmental trends are found for both the motivational and self-regulated learning components.

2. Relations between the MSL components over time

Across the school year, higher degree of self-efficacy, intrinsic value, controlled motivation and autonomous motivation are correlated with higher degree of self-regulation. Similarly, higher levels of self-efficacy, intrinsic value and autonomous motivation are associated with higher levels of degree of gratification. In line with these findings, self-efficacy, intrinsic value and autonomous motivation are positively correlated with effort regulation. Likewise, higher levels of self-efficacy, intrinsic value and autonomous motivation are related with higher levels of academic engagement. In contrast, self-efficacy, intrinsic value and autonomous motivation are negatively correlated with procrastination. Test anxiety is negatively related with effort regulation and is positively associated with procrastination. Interestingly, test anxiety is positively associated with self-regulation (Table 7).

Significance of research

This study provides an empirical base for the elaboration of differences in motivational and self-regulated learning components across the first year of secondary education. The study revealed that all positive motivational and self-regulated learning components decreased significantly over time, while negative components of both constructs increased significantly over time. These findings may verify the problematic nature of the transitional period between primary and secondary education that need further attention.

The present study represents an important movement beyond static assessment of motivational and self-regulated learning components across the first year of secondary school. The results offer ecologically valid empirical evidence to the knowledge base in terms of the developmental changes of and link between various motivational and self-regulated learning elements and suggest cues to pay attention to the transitional context of schooling to enhance the quality of learning and instruction. Moreover, a sophisticated and highly promoted approach was used: The constructs were studied within a longitudinal multilevel design paying attention to changes over time and to differences between classes and students within classes.

References

- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Upper Saddle River, NJ: Prentice Hall Inc.
- Bembenutty, H., & Karabenick, S. A. (1998). Academic delay of gratification. *Learning and Individual Differences*, 10, 329-346.
- Eccles, J. S., & Midgley, C. (1989). Stage-environment fit: Developmentally appropriate classrooms for young adolescents. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (pp. 139-186). San Diego: Academic Press.
- Hargreaves, A., Earl, L & Ryan, J. (1996). *Schooling for change: Reinventing education for early adolescents*, London: the Falmer Press.
- Hoffman, B., & Spataru, A. (2008). The influence of self-efficacy and metacognitive prompting on math problem-solving efficiency. *Contemporary Educational Psychology*, 33, 875–893.
- Johnstone, K. (2002, December). The transition to high school: A journey of uncertainty. Paper published at the Association for Active Educational Researchers, Australia.
- Opdenakker, M-C., & Maulana, R. (2010, April). Teacher-student relationships and academic engagement: How do they develop and link?. Paper presented at the International Conference on Interpersonal Relationships in Education, Boulder, Colorado.
- Rasbash, J., Charlton, C., Browne, W. J., Healy, M., & Cameron, B. (2005). *MLwiN Version 2.0*. Bristol: Bristol University.
- Wigfield, A., & Eccles, J. (2000). Expectancy–Value Theory of Achievement Motivation. *Contemporary Educational Psychology* 25, 68–81.

Comparing self-report and teacher assessment of reading motivation

Jeannette Bergsma, Utrecht University of Applied Sciences, Netherlands; Wim van de Grift, Groningen University, Netherlands; Thonia Houtveen, University of Applied Sciences, Netherlands

There is increasing interest in research on reading motivation, since we know that affective components of reading strongly correlate with reading development. So far, in the Netherlands we failed to develop a reliable instrument to measure reading motivation in very young children. We developed an instrument to measure reading motivation based on two separate and relatively well-established indicators of reading motivation: Competence beliefs and goal orientations. In this paper we present two versions of a questionnaire; a self report scale and a teacher version of the scale.

Background:

There is growing concern about the low level of literacy in the Netherlands (Struiksmā, 2003, Dutch Inspectorate of Education, 2007). The absence of proficient reading skills is a considerable risk factor, associated not only with academic failure and school dropout, but with unemployment and even adjudication (Werner, 1993). Much research on reading has focused on the cognitive processes of reading (Watkins & Coffey Young, 2004) and prevention of reading difficulties (Carnine e.o., 2006). Based on a substantial increase of knowledge about the process of learning to read and the factors influencing this process, researchers are optimistic about the possibilities of teaching almost every pupil basic reading skills. Many reading problems could be prevented by early identification of children at risk of reading failure and more intensive interventions for pupils who do not respond sufficiently to effective classroom instruction alone (Snow, Burns & Griffin, 1998, Simmons & Kameenui, 1998, Pearson, 1999, Rand National Reading Panel, 2000; Collins Block & Pressley (eds.), 2002; Farstrup & Samuels (eds.), 2002). At the same time research results indicate that engagement is essential to long-term achievement. Many more children could attain high levels of reading achievement if efforts are made to increase engagement. To engage young readers, teachers need to offer a coordinated emphasis on competence and motivation in their reading instruction. Both skill and will are important ingredients (Baker, Dreher & Guthrie, 2000; Oka & Paris, 1986). As Guthrie and Wigfield (2000), put it "motivation activates behavior, the most able students will not be able to read if they are not motivated".

There is increasing interest in research on reading motivation, since it is known that affective components of reading strongly correlate with reading development (Guthrie & Wigfield, 1997). Theorists assume a variety of constructs to explain reading motivation and how these constructs may affect reading (Wigfield, Egges & Rodriguez, 1998). So far, in the Netherlands we failed to develop a reliable instrument to measure reading motivation in young children.

Aims:

This study is aimed at the following:

the development of an instrument to measure reading motivation for primary school pupils?

researching the relationship between reading motivation, reading competence and reading achievement

researching the relationship between classroom environment, including teacher behavior and reading motivation, reading competence and reading achievement?
In this paper we answer the first question.

Method:

Based on the study from Morgan and Fuchs (2007) we search for studies, including instruments, for children in primary education based on two relatively distinct and well-established indicators of reading motivation: competency beliefs and goal orientations. These two indicators are increasingly linked within dynamic models of reading motivation (e.g., Lepola et al., 2005; Nurmi & Aunola, 2005). We selected 18 instruments including 565 items. We asked an expert group of 5 teachers to place the items in several categories: competence beliefs and goal orientations (task orientation, social dependence orientation and ego defensive orientation). Items placed in the same category by every teacher were selected for further instrument-construction. We developed a teacher rating scale and a self report scale for children (4-12 year). The 47-item version of the scale was field-tested in May 2009 in 16 schools, by 52 teachers and 861 children. Teachers were asked to score the instrument on reading, math and creativity. Children only rated the items for reading. We also asked teachers to provide pupil information (e.g. age, gender, years of reading, test scores) and information about the reading environment (e.g. text books, children's' books in the classroom, time spend on reading). On the basis of item-test correlations, 27 items were eliminated. We used the 20-item teacher rating scale for 3000 children.

Results:

The reliability of the 20-item version of the teacher rating scale is .92. The subscales were also sufficient reliable (task orientation: Cronbach's alpha = .85, social dependence orientation: Cronbach's alpha = .79, ego-defensive orientation: Cronbach's alpha= .75 and competency beliefs : Cronbach's alpha= .79).

For the construct validity we used a LISREL model (Jöreskog & Sörbom, 1985), which shows the interrelationships of the subscales. We found a positive fit for the model.

We also asked the teachers to rate the motivation for reading of each individual child. We found a high correlation for preschool children (.84) and a bit lower, but still satisfying correlation for older children (.52).

The reliability for the total 20-item self rating scale for children was good (.76), but for the subscales it was insufficient (.62; .76; .66; and .57).

Significant correlations were found between teacher en self report scales.

Educational and theoretical significance:

Theorists assume a variety of constructs to explain reading motivation and how these constructs may affect reading. The results of this study may contribute to the knowledge base on which factors of reading motivation contribute to reading achievement. Educational significance lies in the applicability of the developed instruments in the classroom practice. If the claim that promoting reading engagement requires a coordinated emphasis on competence and motivation in reading instruction is taken seriously, teachers need tests not only for measuring reading achievement, but for motivation as well to design their classroom practice.

Teacher Perceptions and Student Explanations of Engagement in Learning

Andrea Christensen, University of Notre Dame, United States

This study examined the relationship between middle school students' perceptions of the instructional activities in their classrooms and students' self-reported engagement. In addition, this study examined the types of information teachers use to assess students' engagement. Participants were 106 students and eight teachers at a mostly rural middle school in northern Indiana. Findings showed that teachers' engagement predicted teachers' perceptions of their students' engagement, but that there was no relationship between teachers' perception of students' engagement and students' self-reported engagement. Students' reports of meaningfulness during instruction predicted students' engagement. The lack of relationship between students' engagement and teachers' perceptions of students' engagement suggested that students and teachers use different criteria to assess engagement. Observation notes revealed that teachers tend to overestimate students' engagement in learning activities. Teacher and student interviews confirmed that teachers and students assess engagement differently. Teachers view compliance and on-task behaviors as indicators of engagement, whereas students feel engaged when they are involved in interesting, active, social activities during which they can think deeply and apply what they have learned. This mismatch in definitions and expectations for engagement can have negative consequences for students' learning because this may mean that teachers are less likely to provide a learning environment that is consistent with students' needs.

Aims

The first goal of this study was to determine which instructional activities influence students' engagement in learning in eight middle school classrooms over one school year. A secondary goal was to determine what information teachers use to assess their students' engagement in learning.

Methodology

Eight teachers at a mostly rural middle school in northern Indiana, USA, participated in a year-long intervention designed to enhance student engagement. All teachers' classrooms were observed 12 times throughout the year. At the end of each observed class, surveys were administered to teachers (N=8) and students (N=106) using a variant of the Experience Sampling Method (Csikszentmihalyi & Larson, 1987). Responses on each Experience Sampling Form (ESF) reflected experiences during the observed class session. Teacher ESFs measured teacher's self-reported engagement, teacher's perception of students' engagement, and teacher's efficacy. Student ESFs measured students' engagement, and students' feelings of competence, belongingness, autonomy and meaningfulness. In order to understand how teachers and students think about engagement, teachers and students were interviewed regarding how they interpreted survey items from the engagement subscales on the ESFs. Observer notes were used to assess types of learning activities done in each classroom on days when students' reports of engagement and teachers' perceptions of their students' engagement differed.

Findings

Regression analysis of the student data revealed that students' reports of meaningfulness in their classroom predicted students' self-reported engagement ($b = .596$, $p = .002$). This suggests that students are most engaged in learning when they think that what they are doing is interesting, relevant and appropriately challenging. Regression analysis revealed that teachers' perception of students' engagement was predicted by teachers' own self-reported engagement ($b = .786$, $p = .006$), but it was not predicted by the student self-reports. This suggests that when teachers feel engaged in what they are teaching, they are more likely to perceive that their students are also engaged in learning. Additionally, the lack of relationship among teachers' perceptions of student engagement and any of the student self-reports, particularly students' self-reported engagement, suggests that teachers and students use different criteria to assess engagement. In order to further examine the lack of relationship between teachers' and students' ESF reports of student engagement, teachers' and students' average engagement ratings for each observed class were plotted on a 5 x 5 grid (not at all, a little, sort of, pretty much, very much) such that teachers' and students' ratings could be plotted together in the same cell. These plots provided two types of information. First, they revealed the general trend that teachers tend to overestimate their students' engagement in learning. Second, they exposed which class sessions resulted in the largest discrepancies between teachers' and students' reports of student engagement. Observation notes for each of these class sessions were examined for trends. In general, the learning activities on these days did not offer challenge, and teachers did not press for deeper understanding of concepts nor require students to think more deeply about their answers. This was true regardless of the type of activity. Thus, this demonstrates that students reported low levels of meaningfulness and engagement on the days when teachers estimated their students' engagement in learning as high. Teacher interviews provided additional insight into why they may overestimate students' engagement. Teachers tend to use behavioral indicators, such as compliance and time on-task, to assess their students' engagement. For example, teachers stated that students seem interested "if they're doing the task and staying on task" and if "they are doing what I ask them to do." Since compliance is valued in American schools, many students may behave this way despite boredom or lack of interest. Student interviews supported the finding that perceived meaningfulness predicted students' engagement. In general, students commented that they feel engaged when they are doing fun, active, social activities during which they can apply what they have learned, "see it in action," and talk about the material with their fellow students. Students said that they are interested in learning when they can do "group activities with [their] friends" during which they can "think about [their] answers, justify and defend [their] thoughts, and get help from friends." They also mentioned that they value hands-on activities because "you're doing the stuff not just hearing someone tell you about it" and that with these types of activities "something happens when we put all that work in, with the [worksheets] we just get a grade." Additionally, students contradicted teachers' assertions that students "don't want to do the hard stuff" by saying that "it's ok to do a lot of work when you get something out of it."

Theoretical and educational significance

This research demonstrates that teachers and students define student engagement differently, and thus, interpret survey items assessing engagement differently. Teachers' definition of engagement was consistent with definitions of behavioral engagement, whereas, students' definition of engagement tended to be consistent with definitions of cognitive and emotional engagement (Fredericks, Blumenfeld, and Paris, 2004). This mismatch in definitions and expectations for engagement can have repercussions for students' learning. When teachers misunderstand students' signals, teachers are less likely to provide a learning environment that is consistent with students' needs (Hargreaves, 2000). When students' needs are not met, students' learning can be compromised. Additionally, within the American

educational system where students move from class to class and teachers feel substantial pressure to cover the curriculum and address a large number of state standards, teachers may not be able to take the time to form relationships with students. Without these relationships, teachers may continue to misunderstand students' signals and learning needs (Gutierrez, 2000). Also, under these circumstances, teachers may feel compelled to prioritize curriculum coverage over learning goals and student engagement. Thus, teachers may continue to be satisfied with compliance because they are not able to offer the kinds of activities that students report are most engaging.

The Role of Instructional Opportunities in Motivational Processes that Predict Student Engagement

Hayal Kackar, University of Notre Dame, United States; Julianne Turner, U. of Notre Dame, United States

The goals were to 1) investigate the relationship between middle school students' perceived engagement in instructional activities, and students' perceptions of meaningfulness, competence and autonomy, and 2) to examine how these relationships were affected by the quality of instructional opportunities offered by the task and taken up by the students. Participants were 69 students nested in eight classrooms of a middle school. Data were collected using a variant of the experience sampling method and real-time classroom observations. Results revealed that motivational processes (meaningfulness, autonomy, and competence) and instructional opportunity variables (i.e., the extent to which an open-ended task requires students to connect ideas, and the extent to which students take up opportunities provided by the task) affected students' engagement in unique ways. When it was only the task/instructions that afforded strong opportunities for students to work on content (i.e., without students taking up these opportunities), the relationship between meaningfulness and engagement decreased, and a similar decreasing pattern was observed for competence as well. It was only when students actively took up opportunities to work on content provided by the task, that the relationship between meaningfulness and engagement, and competence and engagement increased significantly. Results supported the theoretical and practical significance of the premise that engaged learning is a product of integrating motivation and instruction. Indeed, instructional opportunities alone were not significant predictors of engagement. Once the motivational processes were taken into account, however, the instructional opportunity variables contributed to the relationship between motivational processes and engagement in meaningful ways.

Aims

The goals were to 1) investigate the relationship between middle school students' perceived levels of engagement in instructional activities, and students' perceptions of meaningfulness, competence and autonomy, and 2) to examine how these relationships were affected by the quality of instructional opportunities offered by the task and taken up by the students.

Methodology

Data and Participants

Data were collected as part of a professional development intervention designed to help middle school teachers understand and implement instructional practices that foster student engagement and achievement. Analyses in this study focus on data collected during one semester from 69 students (47% 6th, 20% 7th, and 33% 8th graders), in eight classrooms (42% in mathematics, 25% in science, 16% in language arts, and 17% in social studies), in a middle school in the midwestern United States.

Procedure Students completed a variant of the Experience Sampling Method (ESM, Csikszentmihalyi & Larson, 1987) in which they responded to a survey (i.e., the Experience Sampling Form, ESF) six times per semester, during the last 8 minutes of class. The ESF contained multiple Likert-scale items ranging from 1 (not at all) to 5 (very much). Classroom observations were conducted six times per semester in the classes where students responded to ESFs. The observation instrument captured teachers' use of instructional practices and the extent to which students take up the opportunities provided by the task.

Measures The items on the ESF were first aggregated and then used to construct the following measures. Engagement was constructed by taking the mean of 9 items (e.g., I was enthusiastic in class, I was interested in class; $\alpha=.88$, $M=3.53$, $SD=.75$). Meaningfulness was constructed by taking the mean of 4 items (e.g., What I learned in class is important to me, I learned information I can use outside of school; $\alpha=.85$, $M=3.37$, $SD=.88$). Competence was constructed by taking the mean of 4 items (e.g., I am satisfied with my work in class, I feel good about how well I could do the work; $\alpha=.74$, $M=4.06$, $SD=.58$). Autonomy was constructed by taking the mean of 5 items (I made decisions about what I did in class today, I worked to reach my own goals; $\alpha=.78$, $M=3.80$, $SD=.71$). Instructional opportunities to work on content was adapted from Gresalfi, 2004, and included in the observation instrument. It was rated on two dimensions: task/instructions ($M=1.87$, $SD=.53$) and students ($M=1.42$, $SD=.38$) (See Table 1 in Appendix).

Analyses

As the data are nested (students nested within classrooms), Hierarchical Linear Modeling (HLM, Raudenbush & Bryk, 2002) was used to test the relationships between the motivational variables and engagement, and the effect of instructional opportunities on these relationships.

Findings

As seen in Table 2 (in Appendix), perceived meaningfulness ($b_{10} = .29$, $p_{30} = .38$, p The instructional opportunity variables contributed to the relationship between motivational variables and engagement in expected ways. When it was only the task/instructions that afforded strong opportunities for students to work on content (i.e., without students taking up these opportunities), the relationship between meaningfulness and engagement decreased ($\gamma_{11} = -1.09$, $p_{11} = -2.34$, $p_{12} = 1.20$, $p_{22} = 3.02$, p These patterns worked differently for autonomy: when task/instructions afforded strong opportunities to work on content, the relationship between perceived autonomy and engagement increased significantly ($\gamma_{31} = 1.61$, $p_{32} = -1.35$, $p > .05$). This finding was not surprising and suggested that the nature of the task being open-ended and requiring students to connect ideas on their own instantly awakened students' feelings of autonomy in relation to engagement. Theoretical and Educational

Significance

Fostering student engagement during instructional activities continues to be a challenging endeavor to educators (Marks, 2000). A large body of motivation research has consistently linked engaged learning to the extent to which teachers provide instructional opportunities that support students' feelings of competence (Urdan & Turner, 2005) and autonomy (e.g., Assor, Kaplan & Roth, 2002), and that enhance the value and meaning students attach to their content learning (Brophy 2008; Marks, 2000). Along the same lines, Brophy (2008) posited that feelings of meaningfulness, competence and autonomy are important factors in the degree to which students value what they are learning, but that beyond theoretical predictors, we know little about classroom situations that afford opportunities for students to develop an appreciation of their learning. Drawing upon these theoretical perspectives, this study found that the three motivational process variables (meaningfulness, autonomy, and competence) and two instructional opportunity variables (i.e., the extent to which an open-ended task requires students to connect ideas, and the extent to which students take up opportunities provided by the task) affected students' engagement in unique ways. Brophy (2008) argued that students are more likely to develop an appreciation of the content when teachers offer "'minds-on' learning opportunities that allow students to develop and discuss content-related opinions and explanations" (p. 141). Our results supported this argument revealing that strong perceptions of meaningfulness and competence in relation to engagement emerged only as a result of students being actively engaged in the task (i.e., by offering explanations, asking questions, drawing connections between ideas) rather than just being presented with the task. Results of this study also supported the theoretical and practical significance of the premise that engaged learning is a product of integrating motivation and instruction (Stipek, Givven, Salmon, & MacGyvers, 1998). Indeed, instructional opportunities alone were not significant predictors of engagement as indicated by the nonsignificant predictors of the intercept, $\gamma_{01} = -.17$, $p > .05$, and $\gamma_{31} = .45$, $p > .05$, respectively (see Table 2 in Appendix). Once the motivational processes were taken into account, however, the instructional opportunity variables contributed to the relationship between motivational processes and engagement in meaningful ways.

THEMATIC POSTER SESSION

Motivational and Social Processes

Observing teaching behaviour associated with a social-emotional intervention programme.

Mary Sheard, University of York, United Kingdom

A new observation tool was developed for use in a longitudinal randomised evaluation of Together 4 All (T4A), a social and emotional intervention programme based on the PATHS (Promoting Alternative Thinking Strategies) prevention curriculum. T4A was recently introduced into six Primary Schools in Craigavon, an area of religious, cultural, social and economic diversity in Northern Ireland. Given the turbulent history of Northern Ireland, a major goal in adopting the programme was to inculcate in this generation of children positive attitudes toward citizenship, respect for others, and recognizing and expressing feelings. The main aim of the evaluation is to find out what are the impacts of the programme on teachers' pedagogic behaviours and on children's pro-social behaviour, mutual respect and understanding, and emotional and social development. Using a 4-point rating scale for recording observations of 15 minute intervals, the observational tool aims to capture the complexity of the teaching behaviours and the subtlety of changes that might occur in these behaviours as a result of programme implementation. Findings analysing classroom observations of teaching behaviour after 6 months of implementation suggested superior teaching behaviour in the intervention classes on 10 out of 11 pedagogical items associated with the T4A programme for schools, while after

eighteen months of programme implementation, findings were equivocal for intervention and control groups. The poster presents a visual model of the interrelationships of teaching behaviours associated with the intervention programme.

Background

A new observation tool was developed for use in a longitudinal randomised evaluation of Together 4 All (T4A), a social and emotional intervention programme based on the PATHS (Promoting Alternative Thinking Strategies) prevention curriculum. T4A was recently introduced into six Primary Schools in Craigavon, an area of religious, cultural, social and economic diversity in Northern Ireland. Given the turbulent history of Northern Ireland, a major goal in adopting the programme was to inculcate in this generation of children positive attitudes toward citizenship, respect for others, and recognizing and expressing feelings. The main aim of the evaluation is to find out what are the impacts of the programme on teachers' pedagogic behaviours and on children's pro-social behaviour, mutual respect and understanding, and emotional and social development. Using a 4-point rating scale for recording observations of 15 minute intervals, the observational tool aims to capture the complexity of the teaching behaviours and the subtlety of changes that might occur in these behaviours as a result of programme implementation. Findings analysing classroom observations of teaching behaviour after 6 months of implementation suggested superior teaching behaviour in the intervention classes on 10 out of 11 pedagogical items associated with the T4A programme for schools, while after eighteen months of programme implementation, findings were equivocal for intervention and control groups. The poster presents a visual model of the interrelationships of teaching behaviours associated with the intervention programme.

Theoretical Framework

The study adopts a socio-cultural perspective. As an intervention programme to enhance social emotional learning, mutual respect and understanding and pro-social behaviour, the T4A programme is an agent of cultural change and social action based on knowledge and understanding of cultural practices, meanings, belief systems and value systems. Central to this is the view that, because communities organise themselves through conflict as well as through co-operation, individuals are often prevented from learning to see the world as others do, and may even be led to believe that there is only one way of seeing or doing and that that is the best way (2). Such has been an issue historically and presently still is in Northern Ireland. From this socio-cultural perspective, teachers, parents and other significant adults are more experienced social partners from whom children learn the social practices and cultural conventions of social interactions. The evaluation study of T4A seeks to identify how the programme impacts on the pedagogic behaviours of teachers as pupils' social partners and agents of cultural change. Identifying changes in teaching behaviours is central to evaluating programme effects on children's social interaction and pro-social behaviours in and out of the classroom.

Methodology: Observing and rating teaching behaviours As part of a mixed methods approach, observation measures were developed to capture the range of teaching and pupil behaviours associated with the programme's emphasis on promoting social emotional development and mutual respect and understanding. Eleven specific teaching behaviours are represented under four headings: Managing Behaviour and Problems, Supporting Emotional Development, Facilitating Peer Interactions, and Supporting Mutual Respect and Understanding. The following 4-point rating scale is used for recording observations of 15 minute intervals: 0 = Not applicable (used when the classroom events preclude the behaviour from occurring) 1 = Not seen 2 = Rarely/Occasionally (1 or 2 instances) 3 = Frequently (pervasive/salient within the observation interval). The frequency or saliency of the targeted behaviour (Factor 1) and the duration of the targeted behaviour (Factor 2) inform the rating. The frequency or saliency factor permits recognition that there are likely to be some teaching situations where a behaviour is precluded from occurring during all or part of the 15 minute observation interval. The duration of the target behaviour is the length of the active time interval, defined as the period during which the target behaviour could occur. Observers combine both factors to arrive at a rating.

Findings Analysis of baseline classroom observations of teaching behaviour undertaken after 6 months of implementation suggested superior teaching behaviour in the intervention classes on 10 out of 11 items, as follows: Positive behaviour management · Positive behaviour modelling · Provision of interpersonal support · Emotion modelling · Promoting social awareness · Encouraging social problem solving · Supporting peer interaction · Providing feedback on peer interaction · Engaging pupils' attention. Emotion regulation was observed more in control classes. Analysis of baseline classroom observations of pupil behaviour after 6 months of implementation suggests superior pupil behaviours in the intervention classes in: Showing mutual respect and understanding · Positive coping strategies · Self expression of feelings · Identifying feelings of others. Directional advantage for the control group was found in co-operative learning. Analysis did not reveal strong patterns in pupils' playtime behaviour. Directional advantage included less physically aggressive behaviour in the

intervention group and more turn-taking in the control group. Using the same observational measures after eighteen months of programme implementation, findings were equivocal for intervention and control groups.

Educational Significance

As PATHS did not use observations, this new observation measure presents an important development for evaluating teaching and pupil behaviours associated with the implementation of programmes to develop social-emotional learning and mutual respect and understanding. The educational significance of the observational measure is as an indicator of the educational effectiveness of social-emotional intervention programmes at early and later stages of implementation. In particular, the measure usefully highlights issues around the sustainability of programme effects.

Effects of intervention based on process of interests' development

Etsuko Tanaka, University of Tokyo, Japan

This study tested effects of intervention based on process of interests' development on learner's perception of practical values at science lesson for junior high school students. "Perception of practical values" is defined as recognition that learning contents is useful to analyze phenomenon caused in our daily life or related to our daily life. In Experiment 1, scientific experiments related to contents student will learn was displayed as introduction of a class and students were informed that they can account for experimental results if they understand this lesson. That let students have positive emotion at start of classes. Only in doing so, intervention to encourage students to perceive values of learning contents will become effective. Experiment 2 examined whether the effect of intervention depends on individuals' learning beliefs and tested effects of intervention that get students solve the problem related to daily life. The result suggests that students who have understanding focused belief can perceive value even without solving daily life problem, but students who have that belief can't. And if teacher have effectual introduction, not only take a mundane example related to learning contents but also emphasize that there are many other mundane examples and get students solve the problem related to daily life, they can enhance learner's perception of practical values effectively.

Background and purpose

We recognize importance of interests in learning contexts, however, very few concrete ways to increase them has been proposed (Hidi & Harackiewicz, 2000). These days, teachers try to please students by using PC or colourful text. But, interests caused by that ways will just be temporary. We have to find the way to encourage substantial and developed interest. This study especially looks at science class, because a large number of students don't like science in Japan. In the Hidi and Renninger (2006) model, interest development is influenced by positive emotion in relation to an activity and by perceiving value and developing knowledge in a domain. Developed interest contains not only positive effect but also stored value and knowledge. In learning contexts, we have to continue to learn even if we have something challenging. So, encouraging students to perceive values of task is important. However, it isn't effective to emphasize its value without interest and knowledge about the task (Durik & Harackiewicz, 2007). At first, teachers have to encourage students to learn actively. In this study, scientific experiments related to contents student will learn was displayed as introduction of a class. Because Harada (1998) showed that even students who dislike science like scientific experiments. In addition, students were informed that they can account for experimental results if they understand this lesson. That will let students have a concrete goal and willingly try to understand contents. Only in doing so, we can encourage them to perceive values of task.

Magara(1991) insists that it is effective to take a mundane example in order to encourage students to perceive practical values, but it is insufficiency. To perceive values of overall learning contents, recognizing that not only examples taken by teacher but also all learning contents are related to phenomenon happening around us is very important. It's expected that they can realize that only when teacher emphasize that there are many other mundane examples related to learning contents.

Experiment 1

Methods The experimental classes were organised and provided at the University of Tokyo for 5 days (day1, 5 for measurement and from day2 to day5 for lesson) during the summer of 2009. The participants were 101 eighth-grade students from junior high schools in Tokyo. They voluntarily participated in the study. They were randomly assigned to 1 of 3 classrooms, each of which corresponded to an experimental condition. 1) Intro + Emphasize group 2) Intro group 3) Emphasize group. Intro + Emphasize group were encouraged to have a concrete goal and willingly try to understand learning contents by displaying scientific experiments related to contents as introduction of a class. In addition to that, the teacher not only took a mundane example related to learning contents but also emphasized that there are many other mundane examples. Intro group had same introduction but the teacher just took a mundane example and didn't emphasize. In Emphasize group, the teacher took a mundane example and emphasize, but didn't have experiments as introduction. Instead, they were displayed at the end of a class.

Students were asked to answer questionnaires before lessons, during classes, after classes, and about a month later. The questionnaires include positive emotion and perception of practical values.

Results and discussion Covariance analysis with pre positive emotion as a covariate was used to test the effect of introduction on positive emotion at the start of the classes: "This class sounds like exciting." The result showed a significant difference among three groups (Day2 : $F(2,60)=5.46$, $pF(2,56)=3.90$, $pF(2,52)=4.74$, p . Multiple comparisons suggested that groups with Intro have higher positive emotion than Emphasize group.

Covariance analysis with pre practical values as a covariate was used to test the effect of interventions on practical values after classes: "Today's learning contents is useful in our daily lives." The result showed a significant difference among three groups (Day2 : $F(2,60)=4.12$, $pF(2,59)=5.07$, $pF(2,51)=3.18$, p . Multiple comparisons suggested that Intro + Emphasize group perceived higher practical values than Emphasize group. This result indicated that it is very important to trigger positive emotion at start of the class in order to encourage students to recognize practical values. On the other hand, multiple comparisons don't showed significant difference between Intro + Emphasize group and Intro group. And a month later practical values didn't have significant differences. These results found that these interventions are not doing enough to influent learner's perception of practical values. And it is possible that the effect of intervention varies between individuals. It can depend on their beliefs about learning. Here is the reason.

To perceive values, students need to realize how learning contents and daily life are connecting. So, students who have the belief that understanding is important in learning will realise how learning contents and daily life are connecting only by being taken a mundane example. On the other hand, students who have that belief won't. So, in experiment 2 tests whether the effect of intervention depends on individuals' learning beliefs. And new intervention that get students solve the problem related to dairy life is added.

Experiment 2

Methods Experiment 2 differs from Experiment 1 in the following respects. First, students were randomly assigned to 1 of 3 classrooms; 1) Intro + Emphasize + daily problem group 2) Intro + Emphasize 3) Intro group. Second, they also answered questionnaire about their understanding- focused belief.

Results and discussion Multiple regression analysis with contrast showed that interaction of daily problem-nondaily problem contrast and understanding- focused belief reached marginally significant ($t(62)=-1.68$, p). The result suggests that students who have understanding focused belief can perceive value even without solving daily life problem, but students who have that belief can't (Figure1). And if teacher have effectual introduction, not only take a mundane example related to learning contents but also emphasize that there are many other mundane examples and get students solve the problem related to dairy life, they can enhance learner's perception of practical values effectively.

Individual Vs Collaborative Learning: Affect, Goal Orientation, Engagement And Achievement

W. Marc Jackman, The University of Trinidad & Tobago, Trinidad and Tobago

This study examined the links between motivational factors such as achievement goals, self-efficacy, and affect within the context of individual versus collaborative learning among prospective teachers in two contrasting university courses: educational psychology and technology education. The psychology course was delivered in traditional teaching mode while the technology education course was technology based and conducted in a computer lab. Multiple regression analyses revealed that positive affect predicted group collaboration in both subject areas (re: educational psychology: $b = .62$, $R^2=.37$, p $b = .46$, $R^2=.39$, p Further regression analyses also revealed that mastery orientation also played a small role among those who chose group collaboration over individual study for technology education students. However, multiple regression analyses showed that individual study was predicted by negative affect (re: educational psychology: $b = .54$, $R^2=.30$, p $b = .45$, $R^2=.33$, p Additionally, stepwise regression analyses revealed that engagement predicted achievement outcomes for both courses with additional influences from group collaboration for the technology students (re: $b = .46$, $R^2=.23$, p

Introduction

Contemporary programmes of higher education (in areas such as engineering, education, medicine, statistics and) are undergoing considerable redesign to include more collaborative learning among students (Adams, Morehead & Sledge, 2008; Balasooriya, Hughes & Toohey, 2009; Delucchi, 2006). This is especially important in teacher education programmes where graduates are expected to play critical roles in building communities of learners (Adams, et. al., 2008). In this context, prospective teachers must have opportunities to engage in and experience the value of collaborative learning during their programmes of study. It is therefore important to assess the factors that facilitate

or impede collaborative learning in order to be better informed and guide the delivery of courses in teacher education programmes.

Given the preeminence of achievement goal orientation, task-engagement and, more recently, affective motivation factors in adaptive learning outcomes, this study explored the links among these factors and students' personal choices to engage in collaborative learning during the two contrasting courses of study. Further, relations among collaborative learning, motivational affect and achievement outcomes were also explored.

Literature Background

Achievement goal orientation is important because it predicts important and valued educational outcomes. This happens because students' reasons for engagement in the learning situation determine the use they make of appropriate cognitive strategies and the understanding, processing and retention of domain specific concepts in long-term memory (Anderman, Austin & Johnson, 2002). In effect, achievement goals direct the "energization and direction of competence-based affect, cognition and behaviour" (Elliot, 1999, p. 169). According to Elliot (1999), the seminal work of researchers Dweck and Nicholls in support of the mastery-performance dichotomy was so compelling and impressive that it laid the foundation for "this framework to become the dominant theoretical approach in the contemporary achievement motivation literature" (p. 170). According to Elliot (1999), mastery and performance-approach may be construed as approach orientations since they both entail approaching success while performance-avoidance is seen as an avoidance orientation with largely negative antecedents and effects. Additionally, the importance of self-efficacy to engagement, affect and learning outcomes was not overlooked in this study.

Consequences of Adopting Mastery Goals

The general consensus in the extant literature is that mastery goals prompt a wide range of adaptive processes and outcomes (Ames, 1992; Dweck & Leggett, 1988; Harackiewicz, Barron & Elliot, 1998; Pintrich & Schunk, 1996; Urdan, 1997). These positive processes and outcomes can be defined as motivational, cognitive, affective, behavioural. However, mastery goals have not been unequivocally associated with positive achievement outcomes in terms of grades (most researchers posit that this is due to the superficiality of examination questions relative to the depth of learning that mastery orientation engenders).

Consequences of Adopting Performance-approach Goals

Concerning affective outcomes, Elliot (1999) found that performance-approach goals show positive relations with desires for challenge during study and calmness under assessment conditions once adequate preparation had occurred. However, in some circumstances performance goals have been related to stress and anxiety under evaluation conditions (Urdan, Midgley and Anderman, 1998). Performance-approach goals have also been curiously associated with positive achievement outcomes.

Consequences of Adopting Performance-avoidance Goals

Performance-avoidance students are posited to be sensitive to negativity in the learning environment. It is also argued that student with this goal orientation also show greater self-preservation concerns and experience considerably less pleasure during task activity (Covington, 1984; Jagacinski & Nicholls, 1990). Elliot and McGregor (1999) also found that performance-avoidance positively predicted test anxiety in examination settings.

Academic Self-efficacy & Its Consequences

Bandura and his colleagues argue that self-efficacy is the foundation of human agency and "unless people believe that they can produce desired effects by their actions they have little incentive to act" (Bandura, Barbaranelli, Capara & Pastorelli, 1996, p. 1206). Although self-efficacy has been assessed as a general measure, Bandura et al. (1996) found that domain specific self-efficacy yielded results that afforded greater predictive and explanatory power.

Essentially, the study explored the extent to which achievement goals (mastery, performance-approach and performance-avoidance), task engagement, self-efficacy and positive and negative affect are associated with or can predict collaborative learning. Further, the extent to which collaborative group study or individual learning figures in achievement outcomes of the two courses mentioned were also examined.

Research Questions included:

Which motivational and affective factors predict collaborative and individual learning for the contrasting subject areas?

Which motivational and affective factors predict academic engagement for the contrasting subject areas?

Which motivational, affective or learning factors predict achievement outcomes for the contrasting subject areas?

Method

Participants

Seventy-five (75) first year B. Ed students participated in the study. The majority, 93%, was female, (i.e. a representative sample of this particular school of education). The study took place at the end of the semester after participants had completed course requirements for the two particular courses study (i.e. psychology of learning and technology education). Participation was voluntary and the questionnaire administration took place in a large lecture hall.

Measures

Students were asked to take a retrospective view of the semester just completed and fill in questionnaires regarding their motivation, affect, and choice of engagement with course content or assignments (individual or group study) and to allow access to their grades for these courses. The PALS (2000 version) motivational questionnaire was used and an retrospective version developed for the study. Questionnaires were also developed to measure collaborative and individual learning preferences as well as engagement factors for the two subject domains.

Analyses

Multiple and stepwise regression analyses were then conducted to establish the predictive relationships among specific variables. More specifically, personal and classroom goal orientation factors and affective factors were entered as independent variables to predict collaborative and individual learning. Then affective and goal orientation factors were entered as independent variables to predict engagement. Stepwise regression analyses were used to determine which factors predicted achievement outcomes for each subject domain. Pearson product-moment correlations were used to identify associations among the variables in the study.

Preliminary Results & Theoretical Implications

Preliminary results revealed that mastery goals were associated with a host of adaptive variables but not achievement outcomes. Engagement factors showed a greater tendency to be related to achievement outcomes. Regression analyses showed differences between the predictive engagement and achievement factors for the two subjects as well as factors that facilitate collaborative and individual study. Surprisingly, only students who experienced positive affect sought to work collaboratively with their peers.

Further, positive affect was also predicted engagement by in one course but not in the other. The differences seen between the two courses were unique and have implications for our understanding of motivation, affect and collaborative learning in higher education settings.

The role of competence beliefs, task value, and achievement goals in predicting mathematics anxiety

Daria Rovani, Faculty of Humanities and Social Sciences, Zagreb, Croatia; Nina Pavlin-Bernardic, Faculty of Humanities and Social Sciences, Croatia; Vesna Vlahovic-Stetic, Faculty of Philosophy, University of Zagreb, Croatia

This paper analyzes the role of competence beliefs, subjective value, and achievement goals in the prediction of elementary school students' mathematics anxiety, considering students' gender, grade and previous mathematics achievement. A sample of 297 fifth to eight-grade students from two elementary schools in Zagreb, Croatia participated in the study. Students answered a questionnaire on motivational beliefs and anxiety in mathematics at the end of school year. Results showed that mastery-avoidance goal was the strongest predictor of mathematics anxiety followed by competence beliefs, interest and attainment value. Motivational beliefs predicted mathematics anxiety above and beyond previous mathematics achievement. Students pursuing mastery-avoidance goals were more prone to mathematics anxiety. In addition, students who had stronger competence beliefs, higher interest in mathematics and higher attainment value were less likely to show mathematics anxiety. This research advances our understanding of how individual differences in motivational beliefs may influence mathematics anxiety. Understanding the motivational background of mathematics anxiety, teachers can make easier to the children to overcome this problem.

Achievement emotions, such as anxiety, play a very important role in teaching and learning (Pekrun, 2006). Mathematics anxiety is commonly defined as a feeling of tension, or fear brought upon by the presentation of mathematical problems that interferes with math performance irrespective of student's true ability (Ashcraft, 2002; Hoffman, 2010). Previous studies of mathematics anxiety were mainly oriented to investigating detrimental effects that mathematics anxiety has on mathematics achievement (e.g. Ma, 1999). Therefore, very little research has examined potential antecedents of mathematics anxiety (e.g. Jain & Dowson, 2009). At the same time, there is an increasingly large number of studies exploring the links between academic emotions and students' motivational beliefs. Contemporary motivational theories tend to emphasize competence beliefs, subjective values and achievement goals as central constructs explaining motivational process. Previous research findings suggest that

achievement goals can predict achievement emotions (Linnenbrink & Pintich, 2002; Pekrun et al, 2006, 2009), as well as competence beliefs (e.g. Hoffman, 2010; Jain & Dowson, 2009) and subjective value (e.g. Pekrun et al., 2002). The aim of present research is to analyze the role of competence beliefs, subjective value, and achievement goals in the prediction of elementary school students' mathematics anxiety, considering students' gender, grade and previous mathematics achievement.

A sample of 297 fifth- to eight-grade students (160 males, 137 females) from two elementary schools in Zagreb, Croatia participated in the study. Students answered a questionnaire on motivational beliefs and anxiety in mathematics at the end of school year. Participants were administered the Mathematics Anxiety Scale for Children (Chiu & Henry, 1990; adapted by Arambasic et al., 2005), Achievement Goals Questionnaire (AGQ; Elliot & McGregor, 2001) and Motivational Beliefs Questionnaire (Rovan et al., 2010) consisting of competence beliefs, interest, attainment value and utility scale.

Hierarchical multiple regression analysis was conducted to predict students' mathematics anxiety. First, demographic variables (gender and grade) were entered to serve as controls. Second, we tested a regression model that only included students' gender, grade and previous mathematics achievement. Third, to evaluate the effects of competence and subjective value beliefs, we tested a regression model that included these measures in addition to previously mentioned measures. Finally, we tested a regression model that also included achievement goals measures: mastery-approach, mastery-avoidance, performance-approach, performance-avoidance and work avoidance.

Results of hierarchical regression analysis revealed that the demographic variables did not account for a significant amount of explained variance ($R^2 = 0.01$). Previous mathematics achievement added significantly to the prediction of mathematics anxiety ($\Delta R^2 = 0.13$, $p < 0.05$), $\Delta R^2 = 0.19$, $p < 0.05$ and $\Delta R^2 = 0.13$, $p < 0.05$.

Interestingly, these results also suggest that students with mathematics anxiety are much more concerned with the possibility of not thoroughly understanding mathematics (mastery-avoidance goals), than with possibility of performing worse than other students (performance-avoidance goals). This research advances our understanding of how individual differences in motivational beliefs may influence mathematics anxiety. This can have important implications for practitioners. Understanding the motivational background of mathematics anxiety, teachers can make it easier for the children to overcome this problem. For example, mathematics teachers could focus on helping students to feel competent, emphasizing task value and supporting students' autonomy.

Development of Preventive Measures to Prevent School Absenteeism in Twente

Annette Van Liere, ROC van Twente, Netherlands; Henk Ritzen, Applied University Edith Stein, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands

This research studies the relationship between school policy regarding school-absenteeism of pre-vocational education schools and pupil's self-experiences regarding school and school-absenteeism. School-absenteeism is a big problem for pupils, as well as for the school and the environment. It is an indicator for early school leaving and is also related to risky behavior. Initially schools took measures by addressing school management and tackling disciplinary problems. Yet, often personal factors like physical/psychological/cognitive problems and negative self-experiences are important factors related to school-absenteeism that are left unaddressed. This research aims at developing more knowledge on the way schools execute their policies regarding school-absenteeism and how pupils respond to these policies. From 10 pre-vocational education schools in the east of Netherlands the school policy concerning absenteeism was measured using a questionnaire. Furthermore, self-experiences of 700 pupils of 3 selected pre-vocational education schools was also measured using a questionnaire. The results of this research will be translated to preventive measures which will be used to further improve their policies and practices to prevent school-absenteeism.

Introduction and hypotheses

School-absenteeism is a very obstinate problem for youngsters, schools, and society. Currently, school-absenteeism is regarded an important indicator for early-school-leaving and risky behavior (Teasley, 2004). Twelve pre-vocational education schools, two secondary vocational education schools and four local municipalities in the Netherlands have committed themselves to investigate these problems and subsequently take measures that aim at a fitting, personalised and just-in-time approach of school-absenteeism. Often schools take measures to tackle problems through school policies and disciplinary actions. Only when a pupil's school-absenteeism becomes frequent or chronic, schools will look at the underlying problems. The chance of absenteeism increases when pupils are experiencing

background problems, negative self-experiences regarding school of when they feel disengaged to school (Kearney, 2008; Reid, 2005; Vuijk, Heyne, & Noll, 2008). Little is known of the effectiveness of certain measures. Moreover research results are inconsistent (Reid, 2005).

This research aims at developing more knowledge on the way schools execute their policies regarding school-absenteeism and how pupils respond to these policies. The following hypotheses will be studied: Pre-vocational education pupils with positive self-experiences toward school are less absent than pupils with negative self-experiences. Schools that attribute school-absenteeism to pupil's behavior contribute to the negative self-experiences towards school and to absenteeism of pupils. Moreover, schools that attribute school-absenteeism to the curriculum contribute positive to the self-experiences towards school and absenteeism of pupils.

Theoretical framework

Each year the amount of youngsters not attending school becomes larger and larger. Several factors, categorized in the pupil himself, school and the social environment, are related to school-absenteeism (Teasley, 2004; Kearney, 2008). Self-experience is an important personal factor to school-absenteeism. Reasons for negative self-experience regarding school, are by example: not feeling engaged, losing interest, boredom or unhappiness, fear for social or assessment situations, looking for attention, being attracted to activities outside school (Vuijk, Heyne, & Noll, 2008). With regard to pupils with negative self-experiences, school-absenteeism will increase, whereas motivation, efforts to do homework and school engagement becomes less, until in the end the pupil leaves school too early. School-absence can be caused by underlying problems like learning-, behavioral or physical/psychological problems (Teasley, 2004). School factors like school-size and location, academic- and social-climate, school-policies and disciplinary measures, the quality and effectiveness of the staff, relationship between school-parents, teacher-pupil, influence absenteeism. Also a pupil's social environment like his/her socioeconomic status (SES), the family structure, parent-child relationship and parental-involvement with school are related to absenteeism (Teasley, 2004). School and pupils think different about school-absenteeism, school tends to attribute school-absenteeism to pupil-related factors, as pupils to school-factors (Reid, 2003). Schools measures regarding school-absenteeism by addressing school management and tackling disciplinary problems leads to a procedure of preventive policies, early detection, administration and interventions when a pupil already starts being absent. Punitive programs and zero-tolerance policies do not curb school-absenteeism. Poor school-climate is related to school-absenteeism and linked to harsh and inflexible disciplinary practices and rigid regulations regarding school reintegration. Activities regarding pro-social preventive measures like improving relationships and relevant, alternative curriculum schemes can reduce school-absenteeism (Reid, 2003; Vuijk, et al., 2008).

Method

Two questionnaires will be used, one to measure school policy of 10 pre-vocational education schools and a questionnaire to measure self-experiences of 700 pupils of 3 selected pre-vocational education schools in the region Twente (Netherlands). In March 2010 the questionnaire "School-policies" has been conducted on 10 pre-vocational education schools, in the region Twente (which is located in the east of the Netherlands) (Ritzen & Liere, 2010). In December 2010 the questionnaire "Self-experiences" will be conducted to 700 pupils of 3 of the ten pre-vocational education schools. For the questionnaire "School-policies", a theoretical study has been performed, leading to common questions and questions grouped in 5 subscales: measures related to school-absenteeism (alpha .87); realized measures (alpha .74); preventive measures (alpha .81); no problem (alpha .88); bottleneck (alpha .88). The questionnaire "Self-experiences" is composed by the Dutch version (Vuijk et al., 2008) of Kearney's Refusal Assessment Scale-Revised (SRAS-R), called SRAS-R-NL; and Ritzen's (2004) version of the Self-experience questionnaire initially developed by Stoel (1982). The SRAS-R-NL contains 32 scale-items 7 point Likert-scale, grouped in four subscales: avoiding school-related stimuli that call negatively affect (alpha .68), avoiding social or evaluative situations at school which one dislikes (alpha .60), the pursuit of attention from significant others (alpha .81), the pursuit of tangible amplifiers outside the school setting (alpha .65). Ritzen's (2004) version of the Self-experience questionnaire contains 60 scale-items 4 point Likert-scale, grouped in 8 subscales, self-experience of: school in general (alpha .75), curriculum (alpha .66), relationship with teacher as didactic (alpha .82), teacher as a person (11 items, alpha .85), occupational training (alpha .70), relationship with classmates (alpha .69), school-organization (alpha .74), academic self-concept (Alpha .70).

Preliminary results

Results of the questionnaire "School-policies", shows that organizational and procedural activities like having a clear vision, using a central administration system, informing the mentor and parents, and supervision are implemented, not imbedded in a organizational quality procedure; evaluation of the activities, clear rules, having a personal conversation, comes in second place. Activities to engage and motivate pupils like improving curricula, an flexible

scheme, special activities, are less. Schools believe that clear rules, powerful school-policy, following-up activities and a good relationship with parents are most effective in reducing school-absenteeism, not disciplinary measures.

The rest of the results will be presented during the Earli conference in Exeter in 2011.

References

- Kearney, C. A. (2008). School-absenteeism and school refusal behavior in youth: A contemporary review. *Clinical Psychology Review*, 28(3), 451-471.
- Reid, K. (2003). The Search for Solutions to Truancy and Other Forms of School-absenteeism. *Pastoral Care in Education*, 21(1), 3-9.
- Ritzen, H. (2004). Zinnvolle leerwegen. Actieonderzoek naar innovatieve leeromgevingen voor ROC-leerlingen van kwalificatieniveaus 1 en 2. Soest: Uitgeverij Nelissen.
- Ritzen, H., Liere, A. (2010). Loopbaanleren: resultaten nulmeting over de mate waarop (v)mbo-leerlingen hun loopbaancompetenties ontwikkelen. In: Gids beroepsonderwijs en Volwasseneneducatie (GVE), 151, 99-124. Amsterdam: Reed Business bv.
- Teasley, M. L. (2004). Absenteeism and Truancy: Risk, Protection, and Best Practice Implications for School Social Workers. *Children & Schools*, 26(2), 117-128.
- Vuijk, P., Heyne, D.A., & Noll, W.E. van der (2008). @school in Rotterdam Een studie naar de prevalentie en etiologie van verschillende typen schoolweigerend gedrag in het Rotterdamse basisonderwijs. Leiden: Universiteit Leiden.

The difference of perceived instrumentality and study strategy use across major and non-major course

Wonsik Kim, Arizona State University, United States; Jenefer Husman, Arizona State University, United States

The purpose of this study to examine how students will differently develop perception of instrumentality between major and non-major courses and how this difference in perceived instrumentality affect their use of study strategies in the class. 231 college students majoring in mechanical and aerospace engineering (MAE) participated in this study. Participants took a survey for the major (MAE) course and a survey for the non-major (HU/SB) at same semester. Two types of instrumentality and study strategies such as collaboration and knowledge building were measured using online surveys. Multivariate analysis of variance method (MANOVA) was used to examine the difference in perception of instrumentality and the use of self-regulated study strategies between major course and non-major course at college level. The study results showed that students had significantly higher perception of instrumentality and were more willing to use self-regulated study strategies when they were taking a major course than taking a non-major course.

Theoretical framework

Faculty and academic advisor ask students to take a range of courses reflective of many traditional academic disciplines because these courses will help students possess basic skills and knowledge in the major areas of study (Husman & Hillpert, 2007). However, it is not unusual to see students who seemed to be disengaged from their course works in college or university level because of low level of perceived instrumentality. According to expectancy x value theories, increasing utility value about current learning activity should result in higher motivation and better learning. In addition, it has suggested that perceiving a current task as instrumental in attaining future goals enhances not only student motivation but also subsequent performance (Vansteenkiste et al., 2004; Wigfield & Eccles, 2002). Perceptions of instrumentality are the connection between completing a present task and reaching a long term future goal (Husman & Hillpert, 2007). Husman and Lens (1999) examined people's perceptions of the connection between current activities and their outcomes. Because it is proximal in definition, instrumentality is situated within one's distal or general future time perspective. It is dependent on both a specific activity and a person's general view of the future (Husman & Hillpert, 2007). Malka and Covington (2005) found that perception of instrumentality accounted for a significant amount of variance in academic achievement of postsecondary students. Students' perception of instrumentality was related to their classroom behaviors that lead to high achievement (Husman & Hillpert, 2007). Previous research has demonstrated the importance of self-regulate study strategies such as knowledge building and collaboration for better performance in school (Weinstein, Husman, & Dierking, 2000). Purposes of studyThe purpose of this study to examine how students will differently develop perception of instrumentality depending on different course type like a major and non-major course and how this difference in perception of instrumentality will affect their use of study strategies related to students' achievement in the class.

Method

Participants

In the study, 231 undergraduate students were recruited from Mechanical and Aerospace Engineering (MAE) courses at a large public university in the southwestern United States. The participants were enrolled in 24 different courses – one 100 Level course; seven 200 Level courses; ten 300 Level courses; and nine 400 Level course. 18.4% of the sample were women and all of the participants were engineering major. ProcedureData for the current study were collected from the fall semester of 2008 to the spring semester of 2010 via an online survey. Research assistants visited the classroom of each approved course section and informed the students about the research opportunity. Participants were asked to complete the survey for one MAE course and one Humanities and Social Sciences (HU/SB) course which they were taking at the semester. Students were offered cash incentive (\$10) for the completion of the survey each semester. Data were downloaded and entered into Excel, and then recoded and analyzed in SPSS. MeasuresPerceptions of Instrumentality (PI). The PI scale was administered to determine perceived instrumentality of a particular college course selected by the participant. Endogenous perceived instrumentality was measured using 4 items that evaluated the perceived instrumentality of learning from the course, such as, "I will use the information I learn in this class in other classes I will take in the future." The 4-item exogenous perceived instrumentality assessed perceived instrumentality of the grade earned in the course, such as "The grade I get in this class will not affect my ability to continue on with my education." Participants responded to a 5 point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Students Perceptions of Classroom Knowledge-Building (SPOCK). Two subscales from SPOCK were administered in this study: Knowledge building and collaboration (Shell et al., 2005). Knowledge building focused on classroom knowledge building. This 7-item subscale assessed students' tendencies to make meaning from and construct their own understanding of classroom material, such as "In this class, I try to fully explore the new information I am learning." The 5-item collaboration subscale assessed the level of collaborative learning at the classroom level, such as "My classmates and I actively work together to complete assignments in this class."Participants responded on a 5-point Likert-type scale ranging from 1 (almost never) to 5 (almost always). These were classroom-specific and participants were asked to focus the course which they were taking.

Analysis

For each participant, we created subscale scores for Perception of instrumentality, collaboration, knowledge building, and self-efficacy by calculating a mean score from the related survey items. Coefficient alpha (Cronbach, 1951) was computed on each subscale to obtain reliability evidence. Descriptive statistics for all variable subscales were computed and analyzed. Multivariate analysis of variance (MANOVA) method was then used to evaluate the difference in PI and study strategies use between major (MAE) and non-major (HU/SB) course.

Results

Descriptive statistics for our variables of interest are displayed in Table 1. Multivariate analysis of variance (MANOVA) result showed that there was statistically significant difference between MAE and HU/SB course on the dependent measures, Wilks's Λ ; = .53, $F(4,457) = 101.30$, $p = .00$. The multivariate η^2 based on Wilks's Λ ; was .47. Analyses of variances (ANOVA) on the dependent variables were conducted as follow-up tests to the MANOVA. Using the Bonferroni method, each ANOVA was tested at the .00125 level. The ANOVA on endogenous PI was significant, $F(1,460) = 260.05$, $p = .00$, $\eta^2 = .36$, on exogenous PI was significant, $F(1,460) = 165.50$, $p = .00$, $\eta^2 = .27$, on collaboration was significant, $F(1,460) = 67.61$, $p = .00$, $\eta^2 = .13$, and on knowledge building was significant, $F(1,460) = 28.42$, $p = .00$, $\eta^2 = .06$. DiscussionThe results of study suggested that students had more perception of instrumentality in major course than non- major course. In addition, they were more likely to use study strategies like collaboration and knowledge building when they were taking major course than taking non- major course at college level. According to the study results, instrumentality as a value factor in expectancy x value theory will increase motivation to use study strategies. However, it is a limitation not to examine the actual effect of instrumentality and study strategies on achievement like a course grade. In addition, it is necessary to add expectancy factor like self-efficacy to see the effect of expectancy x value on motivation and achievement.

THEMATIC POSTER SESSION

Reading, Writing and Talking

Reading on the World Wide Web: A Theoretical Framework

Johan van Strien, Open University of the Netherlands, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Els Boshuizen, Open University, Netherlands

In contemporary education, students not only read printed text, they frequently use the Internet to search for information and read hypertext as well. In contrast to printed (linear) text, which is usually read from top to bottom in a fixed order, the Internet is made up of multiple hypertext (nonlinear) documents. Through hyperlinks, readers can easily choose their own reading paths across multiple documents. However, little is still known of how hypertext

reading comprehension occurs and which processes are involved. Although research on traditional text processing is abundant and provides useful insights on the processing of single and multiple linear text, a clear framework of nonlinear text processing, including hypertext reading, is still lacking. The aim of this poster is to arrive at a theoretical model that gives an extensive overview of the reader, text, and task factors as well as the processes involved in multiple-document and hypertext reading, based on insights from reading and educational research. The resulting model will function as a starting point for a series of empirical studies focussing on the factors and processes identified.

Texts are crucial for conveying and for acquiring new information (McNamara & Kintsch, 1996). It is therefore not surprising that much of the learning that takes place in and out of schools is based on successful comprehension of texts (Kendeou & van den Broek, 2005; Rouet, Britt, Mason, & Perfetti, 1996). In contemporary education, students not only read printed text, they frequently use the Internet to search for information and read hypertext as well. In contrast to printed (linear) text, which is usually read from top to bottom in a fixed order, the Internet is made up of multiple hypertext (nonlinear) documents. Through hyperlinks, readers can easily choose their own reading paths across multiple documents. However, little is still known of how hypertext reading comprehension occurs. Although research on traditional text processing is abundant and provides useful insights on the processing of single and multiple linear text, a clear framework of nonlinear text processing, including hypertext reading, is still lacking.

Research Problem and Aim The central questions to be addressed in the poster are (1) which factors and processes are involved in reading multiple text documents, most notably in the context of reading hypertext documents on the World Wide Web, and (2) how can research on hypertext reading be extended? The aim is to arrive at a theoretical model that gives an extensive overview of the factors and processes involved in multiple-document and hypertext reading, by combining insights from reading and educational research, and to set a research agenda. The resulting model will function as a starting point for a series of empirical studies focussing on the factors and processes identified.

Factors Involved in Reading The factors that are involved in reading will be subdivided into three categories: Reader, text, and task characteristics, based on previous work (e.g., Fox, 2009; Rouet, 2006).

Reader characteristics. Reader characteristics entail both cognitive and motivational factors. Influential cognitive factors include readers' prior knowledge (e.g., Shapiro, 2004), reading skills (e.g., Voss & Silfies, 1996), and working memory capacity (e.g., Burton & Daneman, 2007). In the context of multiple-text learning, readers' epistemological beliefs have been found to be an influential factor as well. Epistemological beliefs are beliefs about the nature of knowledge and knowing (Hofer & Pintrich, 1997). These may include beliefs about the certainty, the source, the justification, the acquisition, and the structure of knowledge (Duell & Schommer-Aikins, 2001). Epistemological beliefs are positively related multiple-text comprehension (Strömsö & Bråten, 2009) and self-regulation of learning (Dahl, Bals, & Turi, 2005; Pieschl, Stahl, & Bromme, 2008). Self-regulation and metacognition skills in turn are important in hypermedia learning (Bannert & Mengelkamp, 2008). Finally, multiple-text reading requires metatextual knowledge, i.e., knowledge about texts, documents, and search tools, as well as sourcing skills; Readers must be capable of integrating information from different, conflicting sources (Rouet, 2006). There is also an increasing amount of attention paid to motivational factors, such as motivation and interest. Hypertext research suggests that learners selecting hyperlinks based solely on their personal interest generally perform more poorly than learners who select links that are semantically related to one another (Salmerón, Kintsch, & Cañas, 2006). In reading research, on the other hand, interest has been associated with positively to comprehension of and learning from text (e.g., Hidi, 2001; Schiefele & Krapp, 1996). These apparent contradictions warrant a closer look.

Text characteristics. Texts differ in their degree of coherence, i.e., the degree to which a text enables readers to make appropriate, meaningful connections between elements of text and the reader's prior knowledge (Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). The influence of coherence on learning has been found to depend on readers' prior knowledge: High-knowledge readers learn more from low-coherence texts, whereas low-knowledge readers benefit from high-coherence (McNamara, Kintsch, Songer, & Kintsch, 1996).

Task characteristics. Different tasks may lead to different outcomes of multiple-text learning, often depending on reader characteristics. For instance, argumentative tasks may be more suitable for high-knowledge learners, whereas less knowledgeable learners may benefit more from summarization tasks (Gil, Bråten, Vidal-Abarca, & Strömsö, 2010).

Processes Involved in Reading Processes and strategic behaviours taking place during (single-text) reading include cognitive strategies (e.g., rehearsal, elaboration, organization), metacognitive and regulatory behaviour (e.g., planning and monitoring), and motivational processes, such as persistence and maintaining interest (Dermitzaki, Andreou, & Paraskeva, 2008). With respect to multiple-document and hypertext reading, it has been argued that reading multiple documents generally involves the same processes as reading single documents (e.g., Strömsö, Bråten, & Samuelstuen, 2008). Successful reading of hypertext requires readers to select information, self-monitor the comprehension process, activate prior knowledge in order to integrate information from multiple texts (Coiro & Dobler, 2007; Stadtler & Bromme, 2007), but in addition requires them to gain knowledge about the quality and trustworthiness of sources (Stadtler & Bromme, 2007) and to deal with conflicting information (Britt & Gabrys, 2002).

Extension of Research on Hypertext Reading The factors involved in and the processes taking place during hypertext reading are not well-documented yet. Existing models of multiple-document reading are incomplete

as these do not consider motivational variables and other relevant variables, such as epistemological beliefs (cf. Rouet, 2006). Studies on the processes involved in hypertext reading have focused on small samples of highly skilled readers (Coiro & Dobler, 2007). As the Internet is made up of numerous hypertext documents, hypertext research is an important knowledge base. However, hypertext research has been more concerned with how texts can be used rather than how they are processed. Also, it has been argued that hypertext research had a technical rather than conceptual focus, and was promotional rather than empirical (Perfetti, 1996). Therefore, findings from hypertext studies will be augmented with insights from reading research to make the link between hypertext learning and learning from traditional text (Shapiro & Niederhauser, 2004). This synthesis of insights from different fields of research will lead to a more complete model. By shifting the focus to from reading multiple linear texts to reading of nonlinear hypertext documents, the literature on reading comprehension will be expanded as well.

Online collaborative writing: Understanding the evolution of a group artifact using CORDTRA

Andri Ioannou, Technology University of Cyprus, Cyprus

CORDTRA (Chronologically-Oriented Representations of Discourse and Tool-related Activity) provides "an innovative representation for analyzing the evolution of discourse and tool-related activity across time" (Hmelo-Silver, Chernobitsky, & Nagarajan, 2009, p. 3). This paper discusses how the CORDTRA methodology helped understand the process of collaborative writing and the evolution of a group artifact in an online collaborative writing activity. The analysis focused on a 4-member group. Group members were asked to work in distance to analyze a case and produce a consensus plan suggesting a solution to the embedded problem. Students discussed ideas, reached consensus, and produced a solution together, using a threaded discussion board and a GoogleDoc to facilitate their collaboration. Results show how the task (i.e., the problem at hand, scoring rubric, and collaboration script), mediating technologies (threaded discussion and GoogleDocs), and most importantly the interaction of individual and group understandings are all interwoven in the collaborative writing process.

Background

Researchers in the field of computer-supported collaborative learning ((CS)CL) tend to concur that collaborative knowledge construction cannot be understood by focusing solely on the individuals as group members, or on the characteristics (affordances) of the technology, or on the cognitive processes apparent in the learning environment (Arnseth & Ludvigsen, 2006; Stahl, 2006; Strijbos, Kirschner, & Martens, 2004). Instead, they focus on the complex interactions among collaborators (i.e., the interaction of individual and group understandings) and the (technologically mediated) environment that enable learning to occur socially. Knowledge, then, is constructed collaboratively, as group and personal perspectives are brought together (Stahl, 2006); successful collaboration requires group members to contribute information, ideas, solutions, and opinions that need to be evaluated to construct and maintain a shared understanding. CL does not just entail sharing a workload or individual knowledge with one another (i.e., cooperation), but rather negotiating multiple interpretations and solutions to establish meaning (Cognition and Technology Group at Vanderbilt, 1993; Scardamalia, & Bereiter, 1996). According to Stahl (2006), for CL to take place, ... the group must engage in thinking together about a problem or task and produce a knowledge artifact, such as a verbal problem clarification, a textual solution proposal, or a more developed theoretical inscription, that integrates their different perspectives on the topic and represents a shared group result that they have negotiated. (Stahl, 2006, p. 2, emphasis added).

As the theme of EARLI 2011 suggests, the study of CL warrants particular attention in our global network society – a society in which today's learners (and tomorrow's professionals) are called upon to work together in geographically separated settings to solve problems (Dede, 2005). Yet, the study of CSCL is not a trivial task. The CSCL community has been calling for methodologies and tools that will help us obtain an understanding of CL (and collaborative writing) without oversimplifying the phenomena observable in the interactions among collaborators (Chi, 1997; Hmelo-Silver et al., 2009; Kulikowich & Young, 2001; Stahl, 2006; Suthers, 2006).

Research Question

The overarching goal of this work is to provide a comprehensive account of the process of collaborative writing and the evolution of a group artifact in an online collaborative activity. The present paper focuses on how the CORDTRA (Chronologically-Oriented Representations of Discourse and Tool-related Activity) methodology helped understand these processes. CORDTRA provides "an innovative representation for analyzing the evolution of discourse and tool-related activity across time" (Hmelo-Silver et al., 2009, p. 3).

Theoretical Framework

Activity Theory (AT; Engeström & Miettinen, 1999a, 1999b) provides a useful theoretical lens for understanding CL in complex learning environments, and thus, it is used here for the study of collaborative writing. According to AT, activities are always motivated by and oriented towards an object and the need to transform this object into an outcome (Engeström & Miettinen, 1999). The object evolves as people pursue it with diverse cultural tools (e.g., discourse, technologies) and under different conditions (rules, type of community, and division of labor). Figure 1 presents the Activity System of the study.

Methodology

Participants and Procedures

Data was collected from 16 graduate students enrolled in a fully online, learning theories course at a large public University in the Northeast USA. During weeks 13 and 14 of the 16-week course students (in 4-member groups) collaborated on case study analysis, online. Groups discussed a case scenario and produced a consensus plan suggesting a solution to the problem embedded in the case scenario. They were provided with a scoring rubric to guide the development of their plan, and a script regarding the expectations for collaboration and coming to a consensus. Details about the case study, scoring rubric, and collaboration script will be included in the final paper. Groups were asked to use the WebCT's threaded discussion board (licensed by the school) and a GoogleDoc to support their collaboration. Data included: (a) logs of online activity (including discourse) archived on the threaded discussion board and the GoogleDoc history, and (b) group artifacts (consensus plans).

Analysis and Results

This paper examines the case of one particular group which presented interesting patterns of online collaboration and writing. Student interactions during the collaborative writing process (i.e., discussion of ideas, consensus building, and production of a group solution) was first analyzed using a coding-and-counting approach to Computer-Mediated Discourse Analysis (CMDA) as described in Herring (2004). More details about this methodological toolkit, the unit of analysis (i.e., the event), and the coding scheme of the study will be discussed in the final paper.

Subsequently, the CORDTRA analysis tool was utilized. This illustrative technique allowed the investigator to go beyond coding-and-counting to carefully examine the complex interactions among collaborators, the task (i.e., problem at hand, scoring rubric, and collaboration script), and the mediating technologies (threaded discussion and GoogleDocs) during the collaborative writing process (Hmelo-Silver et al., 2009). Figure 2 presents the CORDTRA for the group of interest. Briefly, the time of contribution runs at the top of the CORDTRA in chronological order. Each time-point on a CORDTRA diagram represents a collaborator, a coding category (i.e., the event), and the mediating technology used at the time. The CORDTRA serves as a pointer to the online activity. The researcher can zoom in on the areas of the diagram where interesting patterns exist to explore the phenomenon deeper, by going back and forth between the CORDTRA and the recorded data (Hmelo-Silver et. al, 2009).

Within an Activity Theory framework, the CORDTRA helped understand the process of collaborative writing deeper and the evolution of the group artifact during the online activity. The CORDTRA analysis explored how students contributed information, ideas, solutions, and opinions, evaluated those to construct a shared understanding, and built a consensus solution for the case. Results revealed how the task, mediating technologies, and most importantly the interaction of individual and group understandings are all interwoven in the collaborative writing process.

Understanding the process of online collaborative writing and collaborative knowledge construction is not trivial. It is time for innovative methodologies, such as CORDTRA, to shed some light on how collaborators approach the challenge of collaborative writing and learning together online.

Scaffolding student problem solving through classroom discourse

Javier Rosales Pardo, Universidad de Salamanca, Spain; Santiago Vicente, University of Salamanca, Spain; Jose Chamoso, Facultad de Educacion, Spain; David Munez, University of Salamanca, Spain; Jose Orrantia, University of Salamanca, Spain

Research on educational intervention in word problem solving has documented different kinds of instruction that allow the students to perform better. Less is known about how classroom interaction is organized according to the cognitive processes embedded in word problem solving. The aim of this work is to analyse the classroom interaction when teacher and pupils solve arithmetic word problems together. The focus is on how teachers promote these cognitive processes involved in problem solving. The participants were 10 Primary Education teachers with more than 10 years' experience. Five of them taught 6-8-year-old students (G1), and five teachers taught 10-12-year-old students (G2). Each teacher was audio-taped when teaching students how to solve two different arithmetic problems. An analysis of the interaction was required at different levels: 1) The interaction was broken down into episodes; 2) The episodes were broken down into interaction cycles; 3) The content made public was identified; and 4) The

instructional aids embedded in discourse were identified (from here on "instructional aids") No significant differences were found when comparing instructional aids that are addressed to the mathematical, metacognitive and situational content, between G1 and G2. However, significant differences were found between the percentages of instructional aids devoted to mathematical, metacognitive and situational contents made public, within groups. In addition, different levels of autonomy for each academic level are indicated.

Introduction

Word problem solving implies the translation of the problem statement into a mental model of the situation described in the problem. Specifically, word problem solving can be split into two main stages: comprehension and resolution. In the comprehension stage the problem solver must use the relevant information to solve the problem. In the resolution stage, (s)he is ready to plan the arithmetic computations needed to solve the problem. At the same time, these processes interact with other intrinsic mechanisms known as metacomponents. These higher-order executive processes are instrumental in planning, monitoring, and evaluating academic tasks. In addition, to solve arithmetic problems is necessary: firstly, mathematical knowledge in order to select the numerical data and the arithmetic operation (Briars & Larkin, 1984; Riley, Greeno & Heller, 1983); and secondly, situational knowledge in order to create a situational context in which the mathematical information must be embedded (Reusser, 1988; Kintsch, 1988, 1998) It is well documented that the promotion of these processes in the educational intervention leads children to a higher level of development in their mathematical performance when compared to more classical learning experiences in traditional classroom settings (Assink & Verloop, 1977; De Corte & Verschaffel, 1980; Fuson & Willis, 1989; Jitendra, Griffin, McGoey, Gardill, Bhat & Riley, 1998; Jitendra, Hoff & Beck, 1999; Lewis, 1989; Willis & Fuson, 1988; Wolters, 1983; Xin & Jitendra, 1999; Zwerts, 1984; Verschaffel & De Corte, 1997) Despite the theoretical significance of these studies and the consistency of the results, there are few studies in which mathematics classes are described on the basis of an analysis of the cognitive processes that are triggered when an arithmetic problem is solved jointly. If teachers provide guidance for accomplishing the learning goals and to move from a position of shared responsibility to one in which the student takes control of learning goals and processes (Turner, Meyer, Cox, Logan, Di Cintio & Thomas, 1998), this knowledge about the cognitive processes should have greater importance. In the present study, the verbal utterances of two groups of teachers and their students when solving several arithmetical word problems together were audio taped, transcribed and analysed in order to identify: firstly, the presence of those processes mentioned; and secondly, the responsibility assumed by teachers and students to achieve the learning goals.

Method

The participants were 10 primary education teachers with more than 10 years' experience. Five of them taught 6-8-years-old students (G1), and five teachers taught 10-12-year-old students (G2). Each teacher was audio-taped when teaching students how to solve two different arithmetic problems. The number of students in each classroom varied from 25 to 30, and the sessions were approximately 3-15 minutes long. All of the participants were audio-taped in their ordinary classrooms and during the time normally devoted to this type of work. The analysis of the interaction required 4 different levels: 1) the interaction was broken down into episodes. An episode was defined as a set of activities that presents: a) a recognizable objective or goal, b) a regular structure of participation, and c) a recognizable sequence of routines. In the present work we distinguish four types of episodes; 2) the episodes were broken down into interaction cycles. Basically, an interaction cycle starts with an initial question/order and it finishes when that question/order is completed; 3) the content made public was identified. For each interaction cycle we extracted the content that was made public, identifying all the propositions it contained and categorized as mathematical, situational or metacognitive; 4) each interaction cycle was analysed according to the number of instructional aids and kind of support provided by the teachers. Consequently, each interaction cycle showed a certain level of autonomy: 1) teachers are responsible for the content made public without students' participation; 2) teachers offer one or more invasive instructional aids (i.e., those that include part of the answer, either in the question or feedback given to students); 3) teachers offer both invasive and non-invasive instructional aids; 4) teachers only offer non-invasive instructional aids (i.e., those that do not include part of the answer in the question or feedback given to students); 5) students are responsible for the content made public without teachers' participation.

Measures

Two types of measures were used: 1) Percentage of aids that was addressed to each public content (mathematical, situational, and metacognitive); and 2) Level of autonomy per interaction cycle for every academic level.

Results

Overall, no significant differences were found when comparing instructional aids that are addressed to the mathematical, metacognitive and situational content, between G1 and G2 (see Fig. 1). However, in both the academic levels, significant differences were found between the percentages of instructional aids devoted to mathematical, metacognitive and situational contents made public: $G1, \chi^2(2, N=100) = 60.56, p$ Regarding the level of autonomy

that was allowed during the interaction, both groups showed low levels (see Fig. 2): G1, ($M = 1.89$, $SD = .81$); G2, ($M = 2.11$, $SD = .88$). In addition, differences approached significance when comparing level of autonomy between G1 and G2, $t(198) = 1.82$, $p = .07$. The findings of the present study reveal the type of cognitive processes that were supported by the teachers. We found no differences between the two educational levels. However, as we can see (Fig. 1) most of the instructional aids were related to the mathematical information, whereas metacognitive and situational information received far less instructional aids. On the other hand we found differences regarding the level of autonomy assumed by the teachers and students. Despite both educational levels showed low levels, G2 allowed a higher level of autonomy.

Educative implications

Knowing what teachers usually do in their classrooms in their interaction with children is important because it will allow us to make proposals for change or enrichment for teachers' instructional practices, that being not very remote of which already it is being made, could be integrated in their daily activities.

Peer writings as modeling examples and instructional support in writing

Olga Firssova, Open University of the Netherlands, Netherlands; Monique Bijker, Open University the Netherlands, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Els Boshuizen, Open University, Netherlands

As demonstrated in research in different cognitive domains, instruction based on modeling examples stimulates cognitive modeling of task solution and development of own strategies of tackling complex tasks. The aim of this study is to examine how instructional support designed according to principles of cognitive modeling and example-based learning affects the quality of writing produced by advanced level university students. A selection of peer writings accompanied by expert explanations and elicitations that focus attention on the salient text aspects is used as modeling examples of expected task performance. These examples are analysed by students prior to engaging in a complex writing task. We expect this learning activity to positively affect the way students engage in writing and the quality of produced writings. The study is based on between-groups control group design and is embedded in a ongoing masters' programme. Results are expected in the spring of 2011.

Performing complex tasks, such as writing academic papers, articles and theses is known to present a challenge for university students in spite of years of training and practice in writing at school and undergraduate level (Castelló, Ióesta, & Monereo, 2009, Torrance, Thomas & Robbins, 1994). University practice, particularly at advanced levels, is based on the 'tried and true' method of learning by doing, in this case by writing as the prevailing form of the writing skill development (Kellogg, 2008). Available case studies and descriptions of incidents of practice, evidence from research studies indicate that instructional support with a modeling component as an exposure to expert writing strategies with a subsequent discussion, or a training in generative 'getting started' activities, is both needed and appreciated (Rijlaarsdam, 2003; Torrance, Thomas & Robbins, 1993). The aim of this study is to determine the effects of instructional support for writing for graduate level students that is based on the principles of example-based learning and cognitive modeling (Van Merriënboer & Kirschner, 2007). Example-based research conducted in a variety of domains and at different expertise levels convincingly demonstrates that eliciting the process of task solution supports active processing of new knowledge and fosters task performance (Atkinson, Derry, Renkl, & Wortham, 2000, Van Gog, Paas & Van Merriënboer, 2004). Instruction based on worked or modeling examples (i.e., examples with process of task solution information) stimulates cognitive modeling of task solution and development of own strategies of tackling complex tasks (Van Merriënboer & Kirschner, 2007). In theory, available 'good practice' examples of peer work can serve as modeling examples of task performance as they demonstrate a range of possibilities of reaching the task goals within the learner's zone of proximal development. Analyzing a set of such examples will help the learner to get grip of the underlying task model, affecting activities the learner will engage in performing the task and the task performance. However, such examples do not make the process of decision-making explicit, this information will have to be inferred from the text or to be provided. As demonstrated in studies of learning argumentation, information given in the modeling text-based examples is better processed by learners when such examples are accompanied by elicitations that focus attention on particular aspects of the text or steps in the argumentation building process (Schworn & Renkl, 2007). The presented study addresses the question how analyzing examples based on peer work affects performing complex writing tasks and the quality of task performance, i.e. the produced writing. We hypothesise that analyzing peer writings accompanied by elicitations and explanatory information is a good starting point in performing a complex writing task, a better form of preparation for complex writing tasks than learning by writing alone. In the presented study this hypothesis is tested in the real settings of an advanced level university course in which students perform a series of a complex writing tasks.

Method

Participants Participants are graduate students in Educational Sciences with a professional teacher education background. Females prevail (75%) and the age range is 30-55 years. All students enrolled a selected core curriculum course of 4, 3 EC in 2010-2011 academic year are included in the sample (target n = 75).

Materials and procedure

A between-groups control group design with counterbalanced treatments is used, with the independent variable (type of task) at three levels: a preparatory conventional writing task (control condition), an example-based preparatory task with explanatory teacher comments embedded in the text and an example-based task without comments. Selection of examples and teacher explanations are provided by a teacher expert. Participants in the two experimental conditions analyse two pieces of peer writing either accompanied by elicitations and explanatory remarks or only labelled as good practice examples. The control group performs a preparatory writing task of approximately the same study load. Upon completion of the preparatory task all participants perform two writing tasks in the same genre as the studied examples. Participants will provide an indication of knowledge of the task topic, an estimate of time invested in preparation of the topic and the writing task and of the task difficulty (control variables). Effectiveness of this form of support will be measured through the quality of produced texts (the quality of task performance) based on the Structure of Observed Learning Outcomes (SOLO) taxonomy (Biggs & Collis, 1992). Construct validity of the SOLO-based quality scale will be tested in the RASCH model (Bond & Fox, 2001). The effect of the intervention on task performance will be measured by analysis of variance (one-way ANOVA). Repeated measures ANOVA will be used to examine development over time. Results are expected in the spring of 2011.

Atkinson, R.K., Derry, S.J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. *Review of Educational Research*, 70 (2), 181-214.

Biggs, K., & Collis, K. (1982). *Evaluating the Quality of Learning: the SOLO taxonomy*. New York: Academic Press.

Bond, T. G., & Fox, C. M. (2001). *Applying the Rasch Model: Fundamental Measurement in the Human Sciences*. New Jersey: Lawrence Erlbaum Associates.

Castellô, M., Ióesta, A., & Monereo, C. (2009). Towards self-regulated academic writing: an exploratory study with graduate students in a situated learning environment. *Electronic Journal of Research in Educational Psychology*, 7 (3), 1107-1130.

Kellogg, R. T. (2008). Training writing skills: A cognitive developmental perspective. *Journal of Writing Research*, 1 (1), 1-26. Rijlaarsdam, G. (Series. Ed.) & L. Björk G. Bräuer, L. Rienecker & P. Stray Jørgenson (Volume Eds.). (2003). *Studies in Writing. Volume 12. Teaching academic writing in European higher education*. Utrecht: Kluwer Academic Publishers.

Schworm, S., & Renkl, A. (2007). Learning argumentation skills through the use of prompts for self-explaining examples. *Journal of Educational Psychology*, 2 (99), 285-296.

Torrance, M., Thomas, G.V., & Robinson, E.J. (1993). Training in thesis writing: An evaluation of three conceptual orientation. *British Journal of Educational Psychology*, 63, 170-184.

Torrance, M., Thomas, G.V., & Robinson, E.J. (1994). The writing strategies of graduate research students in the social sciences. *Higher Education*, 27, 379-392.

Van Merriënboer, J.J.C., & Kirschner, P.A. (2007). *Ten steps to complex learning*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Van Gog, T., Paas, F., & Van Merriënboer, J. J. G. (2004). Process-Oriented Worked Examples: Improving Transfer Performance Through Enhanced Understanding. *Instructional Science*, 32, 83-98

Teachers, Children and Picture Books: Teaching and Learning in a Visual Age

Petros Panaou, University of Nicosia, Cyprus; Charalambos Vrasidas, CARDET - University of Nicosia, Cyprus

The European Picture Book Collection II project has been an effort to join the European and international community of scholars, authors, educators, and librarians who believe that what happens in one language and literature can no longer be studied and taught in isolation from the rest of Europe and the world. For the purposes of EPBC II, educators and students approached literary texts from various EU states, bringing them into dialogue with each other, and exploring their cultural backgrounds with a particular focus on the role of visuals. Participants discussed the diverse stories within the collection in a comparative manner, identifying similarities and differences, and pondering on issues of difference, identity, and diversity. The pictorial part of the stories was expected to facilitate intercultural communication. The paper evaluates and analyzes the results of the pilots and implementation of this European project in seven different EU countries (Austria, Cyprus, Estonia, Greece, UK, Poland, and Romania).

The European Picture Book Collection II project has been an effort to join the European and international community of scholars, authors, educators, and librarians who believe that what happens in one language and literature can no longer be studied and taught in isolation from the rest of Europe and the world. The first European Picture Book Collection (EPBC) was created by European scholars and educators working in the fields of children's literature and teacher education, and purported to bring to children across Europe at least one picture book from each member

state of the European Union. In 1997, EPBC received the award of "Innovative Reading Promotion in Europe" from the European Committee of the International Reading Association. EPBC II is a project that built on and extended the logic and scope of the original EPBC. A Comenius Multilateral project initiated in 2009, it resulted in the compilation of a new collection of picture books and the development of accompanying educational material. EPBC II addressed three educational areas (second language learning, literature, and culture) so that each area increased the learning motivation and opportunities in the other two. Because the entire process was conducted via attractive visual stories and enhanced educational technology (www.epbcii.org), students were expected to view literature, multiculturalism, and second language learning in a more positive manner. For the purposes of EPBC II, educators and students approached literary texts from various EU states, bringing them into dialogue with each other, and exploring their cultural backgrounds. Participants discussed the diverse stories within the collection in a comparative manner, identifying similarities and differences, and pondering on issues of difference, identity, and diversity. The pictorial part of the stories was expected to facilitate intercultural communication. Picture books, through their dynamic combination of image and text, were also considered as ideal for second language learning. The power of stories was viewed as a powerful motive for second language acquisition. Teachers implemented pedagogical tools that encouraged children to observe and analyze each language and the way it is written, read and structured, in relation to other languages. Innovative ICT tools were developed in order to make use of the picture books' visual nature, turning them into e-books and enabling interactive activities that were expected to bring the e-books in dialogue with each other and engage students in comparative processes. For the purpose of implementing the project, students were introduced to several new foreign languages and/or developed their knowledge of languages they were already familiar with. Through comparative and creative approaches, they were expected to develop positive attitude and basic linguistic and metalinguistic skills, especially in reading and comprehending texts written in their birth languages as well as in foreign languages. Since all educational activities were built around literary texts (European picture books) more emphasis was placed on reading and writing skills, without excluding, of course, the two other basic skills (listening and speaking). Students read engaging visual stories in an interactive environment, and, through comparative and creative approaches, were expected to identify and explore different genres, their characteristics and building blocks. Learning to "read the picture" and interpret the gap between word and image was also central. Finally, students explored the manners in which cultures are reflected in stories and engaged in comparative and creative activities that were expected to encourage them to celebrate pluralism. Equal emphasis was placed on extending their knowledge around specific areas of diverse European cultures (art, history, religion, geography, tradition, etc.). The paper evaluates and analyzes the results of the EPBC II piloting and implementation in seven different EU countries (Austria, Cyprus, Estonia, Greece, UK, Poland, and Romania). The questions guiding the research reported here were:- To what extent were the educational objectives achieved? - What were the strengths and weaknesses of using picture books in teaching and learning? - Which were the most effective teaching practices with regards to the use of picture books in teaching and learning? Qualitative methods of data collection and analysis--such as tools that evaluated the achievement of learning objectives, reflection journals by teachers, interviews of students, and focus group discussions--are used to answer the above-mentioned questions. In addition, experts reviewed the picture books that were used and rated the books according to criteria which were derived from the findings of this research. The conclusions guide future research and educational practice towards a specific direction.

Epistemic Cognition and Multiple-Documents Literacy: An Intervention Study

Leila Eve Ferguson, University of Oslo, Norway; Ivar Braten, University of Oslo, Norway; Oistein Anmarkrud, Department of Educational Research, Norway; Helge Stromso, University of Oslo, Norway

While it can be expected on the basis of theory and correlational studies that more advanced epistemic cognition, for example realizing that diverse sources must be compared to check knowledge claims, may facilitate multiple-documents literacy, there is no experimental evidence to support this view. We therefore designed an intervention where students read multiple documents presenting opposing views on a social-scientific issue and examined possible changes in their epistemic cognition after reading, as well as the relationship between those changes and multiple-documents comprehension. Given the working memory demands of the complex reading task, we also entertained the possibility that the effects of the intervention might depend on students' working memory capacity. Preliminary results from a pilot study involving four 10th graders suggest that the intervention may be effective in changing epistemic cognition. However, whereas the participants changed in the direction of what seemed to be more adaptive beliefs concerning justification for knowing, they, at the same time, seemed to change their beliefs about the stability of knowledge in the direction of what has traditionally been considered more naïve beliefs. Because a control condition was not included in the pilot study, it was not possible to explore whether observed changes in epistemic changes were unique to the intervention condition or whether such changes were associated with good performance on the comprehension measures relative to controls. A complete data set for 140 participants randomly assigned to intervention and control conditions is under collection and analyses of those data are presented at the conference.

Aims

To examine whether a short-term intervention targeting epistemic cognition may promote multiple-documents literacy and, moreover, whether any intervention effects may be moderated by working memory capacity.

Theoretical framework

In today's information society, multiple documents-literacy, that is, the ability to locate, evaluate, and use diverse sources of information for the purpose of constructing and communicating an integrated, meaningful representation of a particular issue, subject, or situation (Bråten & Strömsö, 2010), is required both in and out of school. When faced with literacy tasks that involve using multiple information sources to solve problems or understand complex issues of personal, social, or educational relevance, people have to make judgements regarding what counts as knowledge, the nature of that knowledge, and how to justify knowledge claims, with the term epistemic cognition used to describe such judgements in current literature (e.g., Greene, et al., 2008). It can therefore be expected that more advanced epistemic cognition, for example, realizing that diverse sources must be compared to check knowledge claims or judging knowledge to be tentative and fallible, may facilitate multiple-documents literacy (Bråten et al., in press). Thus far, however, experimental evidence to support this view is essentially lacking. Still, a few studies (Kienhues et al., 2008, in press; Valanides & Angeli, 2005) suggest that even brief encounters with multiple information sources on an ill-structured topic may further the development of more adaptive epistemic cognition. In the present study, we built on those studies and designed an intervention where students read multiple documents presenting opposing views on a social-scientific issue and examined possible changes in their epistemic cognition after reading, as well as the relationship between those changes and multiple-documents comprehension. Given the considerable working memory demands of the complex reading task, we also entertained the possibility that the effects of the intervention might depend on students' working memory capacity.

Methodology

Participants were 140 10th-grade students from four lower-secondary schools in southeast Norway. Before reading, all students' domain- and topic-specific epistemic cognition was assessed, as well as their working memory and knowledge about the topic of the documents. The domain-specific measure of epistemic cognition focused on beliefs about the justification of knowledge claims in science (Greene et al., 2008), and the topic-specific measure of epistemic cognition focused on the stability of knowledge concerning the issue discussed in the documents (Kienhues et al., in press).

Those in the intervention condition read five authentic documents providing conflicting information on the effects of sun exposure for the purpose of giving a presentation on "How sun exposure affects our health." The first document was a neutral, informative text about UV-index and -radiation, whereas two of the documents presented the view that sunrays may protect against cancer and two of the documents presented the view that sunrays may cause cancer. For the participants in the control condition, two of the documents were modified so that they only encountered the viewpoint that sunrays may cause cancer but still encountered the same concepts as those in the intervention group. Participants were randomly assigned to condition and all read the five documents on a computer using the software Read&Answer (Vidal-Abarca et al., in press).

After reading, all participants were again administered the epistemic cognition measures and the knowledge measure. In addition, multiple-documents comprehension was assessed by means of a coherence measure capturing the perceived relatedness of concepts across documents (Ozgungor & Guthrie, 2004) and short-essay, integrative questions capturing the integration of ideas across documents (Rukavina & Daneman, 1996).

Preliminary results and conclusion

The results of four female 10th graders who participated in a pilot study indicated that three of the students changed their domain-specific epistemic cognition concerning the justification of knowledge claims after the intervention, with three of the students putting more emphasis on the need to justify knowledge claims in science by considering multiple sources of information (on a 10-point scale, pre-tests scores were 7.2, 4.5, and 6.0, respectively; post-test-scores were 9.2, 10.0, and 7.7, respectively) and one of the students viewing external authority as a less reliable source for justifying knowledge claims (on a 10-point scale, pre-test score was 7.5: post-test score was 5.8). Three of the students also changed their topic-specific epistemic cognition after the intervention, surprisingly viewing knowledge about the issue to be more certain than before (on a 10-point scale, pre-tests scores were 5.0, 3.1, and 6.9, respectively; post-test-scores were 6.9, 5.0, and 8.4, respectively). Thus, whereas the participants changed their personal epistemology in the direction of what seem to be more adaptive beliefs concerning justification for knowing, they, at the same time, seemed to change their beliefs about the stability of knowledge in the direction of what has traditionally been considered more naïve beliefs. Because the control condition was not included in the pilot study, it

was not possible to explore whether observed changes in epistemic changes were unique to the intervention condition or whether such changes were associated with knowledge gain and good performance on the comprehension measures relative to controls. A complete data set for all 140 participants is under collection at this time point and analyses of the data set that address those issues will be presented at the conference.

References

- Bråten, I., & Strömsö, H.I. (2010). When law students read multiple documents about global warming: Examining the role of topic-specific beliefs about the nature of knowledge and knowing. *Instructional Science*, 38, 635-657.
- Bråten, I., Britt, M.A., Strömsö, H.I., & Rouet, J.F. (in press). The role of epistemic beliefs in the comprehension of multiple expository texts: Towards an integrated model. *Educational Psychologist*.
- Greene, J. A., Azevedo, R. & Torney-Purta, J. (2008). Modeling epistemic and ontological cognition: Philosophical perspectives and methodological directions. *Educational Psychologist*, 43, 142-160.
- Kienhues, D., Bromme, & Stahl, E. (2008). Changing epistemological beliefs: The unexpected impact of a short-term intervention. *British Journal of Educational Psychology*, 78, 545-565.
- Kienhues, D., Stadler, M., & Bromme, R. (in press). Dealing with conflicting or consistent medical information on the web: When expert information breeds laypersons' doubts about experts. *Learning and Instruction*.
- Ozgungor, S., & Guthrie, J.T. (2004). Interactions among elaborative interrogation, knowledge, and interest in the process of constructing knowledge from text. *Journal of Educational Psychology*, 96, 437-443.
- Rukavina, I., & Daneman, M. (1996). Integration and its effect on acquiring knowledge about competing scientific theories from text. *Journal of Educational Psychology*, 88, 272-287.
- Valanides, N., & Angeli, C. (2005). Effects of instruction on changes in epistemological beliefs. *Contemporary Educational Psychology*, 30, 314-330.
- Vidal-Abarca, E., Martinez, T., Salméon, L., Cerdán, R., Gilabert, R., Gil, L., Maóá, A., Lloréens, A., & Ferris, R. (in press). Recording online processes in task-oriented reading with Read&Answer. *Behavior Research Methods*.

THEMATIC POSTER SESSION

Learning and Instructional Technology

Piloting electronic peer-assisted learning with multicultural university students

Cheryl Foxcroft, Nelson Mandela Metropolitan University, South Africa; Liesl Smith, Nelson Mandela Metropolitan University, South Africa; Celeste Barker, Nelson Mandela Metropolitan University, South Africa

Nelson Mandela Metropolitan University (NMMU) has prioritised peer assisted learning as a key strategy to improve the success and graduation rates of its culturally diverse student body. In addition to strengthening existing peer assisted programmes (Supplemental Instruction, tutorials, mentoring), a pilot Electronic Peer Assisted Learning (e-PAL) project was implemented in 2010. e-PAL involves the use of senior students trained as e-PAL facilitators to electronically facilitate learning and learning support, which is embedded in and accessible to all students in a module. e-PAL facilitators work closely with lecturers and professional support staff. Two factors necessitated the introduction of e-PAL. Firstly, most NMMU students are Y-generation learners who want information instantly and use technology extensively to network and communicate. e-PAL involves a blended learning strategy, which combines traditional and technology-enabled learning opportunities. Secondly, traditional peer assisted learning cannot reach all students due to timetable constraints and clashes and the availability of small group lecture venues. e-PAL is less constrained by the timetable as the group can be facilitated at any time that is convenient and students only need access to the internet. The work of theorists that focus on Social Interdependence Theory (e.g., Geertz, Vygotsky, Bakhtin, Doyle, and Erickson) and research conducted on Y-Generation learners, blended learning and peer-assisted learning informed the conceptualisation of e-PAL. The pilot project has been continuously evaluated by gathering qualitative and quantitative data including pass rates, contact data, records of facilitated sessions, student survey feedback, and facilitator online feedback. The findings and lessons learned will be discussed.

South African student success and graduation rates are a source of concern and the Department of Higher Education and Training has tasked higher education institutions to implement improvement strategies. Of the 25 500 student that The Nelson Mandela Metropolitan University (NMMU) enrolls, only 50% finally graduate and 25% graduate in the minimum time period. NMMU has thus prioritised peer assisted learning as a key strategy to address the differential success rates of its culturally diverse student body and improve graduation rates. With its roots in Social Interdependence Theory, peer assisted learning's positive impact on knowledge construction, cognitive development and the stimulation of independent learning has been researched by numerous theorists including Geertz, Vygotsky,

Bakhtin, Doyle, and Erickson. Other advantages include: a. Learning activities are facilitated in such a way that students are actively and collaboratively engaged in learning. b. As students are placed in small groups in SI and mentorship programmes, and sometimes in tutorials and laboratory practicals, they develop a sense of community in this smaller group, which complements the more impersonal large group lectures. c. Students learn to take increasing responsibility for their own learning and learn how to learn. d. The peer facilitators (normally senior students) learn how to facilitate learning; how learning takes place, which enhances their own learning; what resources are available to enhance learning while they also develop their communication, presentation, leadership and interpersonal skills and become more confident and self-assured when working with groups. e. Peer facilitators can be used in medium- to large-sized lectures to assist lecturers to employ small group and active learning strategies that engage students in active and collaborative learning. Internationally, many of the leading teaching and learning universities use peer facilitators to achieve more favourable lecturer/student ratios, which have a positive impact on student success and their learning experience. In addition to existing peer assisted programmes (Supplemental Instruction, tutorials, mentoring) at NMMU, a pilot Electronic Peer Assisted Learning (e-PAL) project was implemented in August 2010 in 8 modules. 9 e-PAL Facilitators each offered a 2-hour session once a week where students could get additional support online with regards to the learning material covered in lectures during that week. The overall strategic objective of NMMU's Electronic Peer-Assisted Learning Project (e-PAL) is to implement an expanded project in which learning support is embedded in a module, accessible to all students, and facilitated electronically by trained e-PAL facilitators working closely with lecturers and professional support staff acting as e-PAL coordinators in order to enhance student retention and success. Two factors necessitated the introduction of e-PAL. Firstly, most NMMU students are Y-generation learners who want information instantly and use technology extensively to network and communicate. e-PAL supports a blended learning strategy, which combines traditional and technology-enabled learning opportunities (Bersin:2003; Tarrison:2004). Secondly, traditional peer assisted learning cannot reach all students due to constraints such as timeslots available on timetables, timetable clashes, and available small group lecture venues. e-PAL is less constrained by the timetable as the group can be facilitated at any time that is convenient and students only need access to the internet. Research conducted on Y-Generation learners indicates that they are most influenced by their peers and that they find more interactive learning environments less intimidating (McCrindle and Wolfinger:2010; Coates:2007; Weiler:2004; Christie:2004). This supports the NMMU notion of creating an interactive peer learning environment that incorporates the Y-generation learner's need for visual stimulation and preference for electronic communication. Furthermore, the decision to design a structured facilitated programme was based on research that has shown that instead of simply placing learning support material online, it is much more effective to have an online PAL facilitator who can facilitate learning through intentionally structured e-tivities (Salmon:2003). Supplemental Instruction statistics have shown that most peer-assisted learning programmes cannot function as a once off "quick-fix" before tests and exams. Comparative analysis on students with similar entry profiles has shown that students who attend sessions regularly throughout the semester are more likely to improve their academic performance, whereas those who only attended once or twice have shown little or no improvement. The e-PAL project is also aligned to NMMU's recently approved Vision 2020 Strategic Planning Framework that has been operationalised in terms of eight strategic priorities. One of the key strategic priorities related to NMMU's core academic functions is to create and sustain a responsive learning environment conducive to excellence in teaching and learning and fostering holistic student success. Among the various strategic goals and objectives identified to address this strategic priority the e-PAL project is aligned to the following: a. Setting high expectations for student success while also providing high support. (ePAL offered an additional 220 hours of support in the 5 month pilot project in 2010) b. Expanding the use of active and collaborative learning strategies to engage students more actively in learning. (e-PAL complements face-to-face peer facilitated sessions) c. Significantly expanding the use of electronic/blended learning so that this becomes an integral part of how learning is facilitated at NMMU. (e-PAL is easy to use and therefore an ideal way to introduce students to an online learning environment) d. Providing complementary learning experiences outside of the classroom to develop students holistically. (Students can access e-PAL from any location as long as they have access to the internet) The pilot project has been continuously evaluated by gathering qualitative and quantitative data including pass rates, contact data, records of facilitated sessions, student survey feedback, and facilitator online feedback. Preliminary findings are that 526 students registered voluntarily on the 8 module sites to access the sessions and learning material. An estimated 2100 students are registered in these 8 modules, 25% of whom made use of e-PAL. Research indicates that a third of learners might participate in voluntary programmes. 25% is thus fair attendance considering that e-PAL has been running for two months. Online questionnaires conducted in September 2010 indicated that 85% of participants enjoyed the e-PAL environment and found it interesting, whilst 100% of participants found the platform easy to use. Findings and lessons learnt will be discussed.

Writing Wiki-Articles as Follow-Up Course Work: How can we support our Students?

Tatjana Hilbert, University of Mainz, Germany

The Wiki-technology enables Internet users to not only read contents but also to edit existing articles and to write about new topics. In a recent study, students from six university courses (N = 167) were advised to use a Wiki in a virtual learning platform for follow-up course-work. All students had to write at least one article about a topic discussed during the university course. Participants in two courses were only given technical support (n = 51). Two courses additionally were given a checklist on minimum standards for the articles (n = 59). In the remaining two courses, new articles additionally were read and discussed in the course (n = 57). The Wiki articles in each course were analysed according to their length, quality, and structuredness. Learning outcome was measured by a multiple choice test at the end of the semester. On the whole, the analysis showed that the quality of articles was better in courses where students discussed their fellow students' articles. Learning outcome was best for students in the minimum standards condition. For using the Wiki-technology for follow-up course work, results indicate that more support helps students to write high-quality articles. However, this may not lead to a good learning outcome.

Newman, J., & Newman, R. (1992). Three Modes of Collaborative Authoring. In P.O. Holt and N. Williams (Eds.), *Computers and Writing: State of the Art* (pp. 20-28). Oxford: Intellect Books.

Apprentices' and supervisors' perceptions of a paper vs mobile and online tool for learning journals

Jessica Dehler Zufferey, University of Fribourg, Switzerland; Laetitia Mauroux, University of Fribourg, Switzerland; Jean-Luc Gurtner, Dept of education, Switzerland

Learning journals (LJ) are used more and more in educational research and practice. They support reflection and articulation of experiences, knowledge and performances. Despite their high potential for vocational education and training (VET), they have only started to be used in several professions in Switzerland, as all newer ordinances make a learning journal mandatory. We worked with baker and pastry cook apprentices since they will have to elaborate a learning journal from 2011 on. We developed a mobile and online tool as instrument of the learning journal for these apprentices. This study compares the mobile and online tool with a paper-based instrument in order to evaluate apprentices' experiences with both instruments. Two classes of apprentices used each one of the two learning journal instruments. We analyzed the ease of use and the usefulness attributed by apprentices and supervisors. Results indicate that apprentices do encounter problems of usability with both instruments. Nevertheless they identify potential usefulness of the learning journal, particularly when they use the mobile and online tool. Supervisors perceive the usefulness of the LJ somewhat differently than apprentices. The findings show that apprentices are not very much willing to use any learning journal. However, when they are forced to choose they prefer the technological version. Preferences of supervisors are less univocal.

Introduction

Learning journals (LJ) are becoming a reality for apprentices in VET in Switzerland. Recent ordinances stipulate the introduction of a LJ. Few specifications are prescribed on how to implement the LJ. Therefore, information about experiences with different implementations of LJs is necessary to inform decisions and shape emerging practices.

Learning journals

Learners use LJ to document their learning processes, outcomes, and progress by means of reflective texts, pictures, figures etc. LJs support the reflection on prior experiences and performance and help learners to recall important information. LJs are used in a multitude of educational contexts, for example in medical education (e.g., Driessen, et al., 2005). Research on LJs in vocational training is, however, rare and shows potentials as well as limitations (Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009). In the present project, a mobile and online tool (MOT; see Figure 1) was developed and tested which allows apprentices to collect pictures of workplace experiences by means of a mobile device and send them to an online repository and develop their LJ on the basis of the pictures. Specifically, the LJ provides text fields for reflection, self-evaluation, evaluation by the supervisor, comments from supervisors. Prompts in the text fields guide the reflection on learning achievements, learning needs and planning of next learning steps (adapted from Kicken et al., 2009). The current study compares the MOT (developed for a specific profession) with a paper instrument that is proposed to all professions in Switzerland (SDBB, 2009). The paper instrument is a two-pages form with four categories for apprentices' notes (description of work process, remarks, sketches/photos, and competences).

Context

Participants were baker and pastry cook apprentices and their supervisors within the Swiss dual VET system. Apprentices in this field already have to create a recipe book and the new ordinance will include as of 2011 a LJ. The MOT we developed for this profession includes both the recipe book and the LJ.

Research questions

This study adopted the technology acceptance model (Davis, 1989) which states that perceived ease of use and perceived usefulness influence whether or not an instrument will actually be accepted and used. Our research questions are:

1. How do apprentices and supervisors perceive the ease of use of the two instruments?
2. How do apprentices and supervisors perceive the usefulness of the two instruments?
3. Would apprentices and supervisors intend to use the two instruments?
4. Which LJ instrument would apprentices and supervisors prefer to use?

Method

Design and sample. One class (16 apprentices and supervisors) used the paper LJ while a second class (8 apprentices and supervisors) used the MOT.

Measures. Apprentices and supervisors filled in a questionnaire which measured the:

- o perceived ease of use (6 items) (6 items, see Davis, 1989),
- o perceived usefulness for their learning (11 items; e.g., "The learning journal helps to collect and document experiences from the workplace."),
- o intention to use the instrument (1 item)
- o preference (1 item: "If I had to elaborate a learning journal like the apprentices from 2011 on, I would prefer to use ..." with the response options "paper version" and "technological version").

All items except the preference item were rated on a 7-point Likert scale from -3 ("I do not at all agree") to +3 ("I totally agree").

Procedure. The pedagogical rationale and the functionality of the LJ instruments were introduced to apprentices and their supervisors. For the six-week long test phase, apprentices were instructed to document their experiences for at least six recipes with the respective LJ instrument. At the end of the test phase, a debriefing (via questionnaires and plenary discussion) session was organized.

Results

Due to the small and unbalanced sample sizes, we present the quantitative data in a descriptive rather than inferential way.

Perceived ease of use. Overall, apprentices did not perceive any of the instruments to be easy to use. This was found for the MOT ($M=0.00$, $SD=1.59$) as well as the paper LJ ($M=0.65$, $SD=1.51$). Overall ratings from supervisors (who were less actively involved in the use of the LJ than apprentices) were higher as well in the MOT condition ($M=0.90$, $SD=0.92$) as in the paper condition ($M=1.46$, $SD=1.47$).

Perceived usefulness. Apprentices evaluated the usefulness of the LJ for their learning as moderately positive. The overall score in the MOT condition ($M=1.81$, $SD=0.83$) was slightly higher than in the paper condition ($M=1.30$, $SD=1.33$) as were all items separately. In contrast, supervisors rated the usefulness of the LJ higher in the paper condition ($M=2.51$, $SD=0.41$) than in the MOT condition ($M=1.91$, $SD=0.62$). Interestingly, supervisors overall rated the usefulness of a LJ higher than apprentices.

Intention to use and preference. Apprentices in the paper condition reported that they would rather not use the instrument if they had the opportunity ($M=-0.94$, $SD=2.21$) while apprentices using the MOT were slightly more positive about its usage ($M=0.38$, $SD=1.85$). Supervisors expressed an intention to use the LJ to a comparable extent in the MOT ($M=0.50$, $SD=0.55$) and in the paper condition ($M=0.67$, $SD=2.34$).

Ongoing analyses on different process and outcome variables (such as the content of LJ or supervisors' comments on their apprentices' LJ) complement these results and will be presented at the conference.

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References

- Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- Driessen, E. W., van Tartwijk, J., Overeem, K., Vermunt, J. D., & van der Vleuten, C. P. M. (2005). Conditions for successful reflective use of portfolios in undergraduate medical education. *Medical Education*, 39(12), 1230-1235. doi:10.1111/j.1365-2929.2005.02337.x

Kicken, W., Brand-Gruwel, S., van Merriënboer, J. J. G., & Slot, W. (2009). The Effects of Portfolio-Based Advice on the Development of Self-Directed Learning Skills in Secondary Vocational Education. *Educational Technology Research and Development*, 57(4), 439-460.

SDBB. (2009). *Leerdokumentation betriebliche Grundbildung*. SDBB.

Personal Learning Environments for Networked Adult Learners in Work-Based Context

Erika Tanhua-Piironen, University of Tampere, Finland; Johanna Sommers-Piironen, University of Tampere, Finland

New social software applications have changed the way people are communicating, participating and working in various informal and formal contexts. Networked learning has expanded and the working life requires employees to continuously update their competences. Lifelong learning is an important but challenging part of the professional development. One promising approach is the idea of Personal Learning Environments (PLE). The main focus of the concept is on the learners' control and management of their own learning. Another concept in this study is a model of a networked adult learner in workplace. This will be further developed and tested during the ongoing research.

The study is based on design research, which is carried out in educational corporate life context. It consists of pilot cases in which social software applications are chosen and introduced to traditional personnel training programs. The data is collected by questionnaires, interviews and monitoring the learning activities of the pilot groups in the chosen social software environments. The design process itself is also in focus and reflections concerning this process constitute a part of the data. The first tentative findings about design process and the initialization of social software show that the instructor has a significant role in the process: in implementing new ways of learning and knowledge sharing with social software and in encouraging learners to take control of their learning.

Introduction

New technologies, including wikis, blogs, social networking and media sharing tools have changed the way people are communicating, participating and working in various informal and formal contexts. Networked learning has expanded and adult learning is strongly moving from classrooms to open learning environments and networks. Furthermore, the working life requires employees to continuously update their competences, making lifelong learning an important but challenging part of professional development. A promising approach to smoothly connect learning and working is the idea of Personal Learning Environments (PLE).

Our aims are to find out how the concept of PLE can be applied to educational work-based contexts and to elaborate the idea of a networked working adult learner. This study belongs to a two-year research project, Future Space for Shared and Personal Learning (F-SHAPE), between two Finnish universities and participating companies. The project targets to design novel concepts for flexible learning to serve the needs of adult learners and working life in particular.

Framework

Although the definitions of Personal Learning Environment (PLE) have varied from the descriptions of technological solutions to more pedagogical approaches (Fiedler & Valjataga 2010), the main focus has constantly been on the learners' control and management of their own learning. As a new approach to the use of Web 2.0 technologies for shared and personal life-wide learning (Attwell 2007), PLEs can be described as interactive, collaborative and communicative spaces in which learning takes place and collective know-how is developed (Attwell 2010). The affordances of social software - connectivity and social rapport, collaborative information discovery and sharing or content creation and modification (McLoughlin & Lee 2007) - offer interesting potential for learning in the 21st century.

The features to consider when designing work-related learning environments (like the PLEs in this case) include among others support for individual reflection and social interaction, integration of theoretical knowledge with learners' practical experience - i.e. informal and formal learning - and tools for collaboration and knowledge exchange (Tynjälä & Hakkinen 2005). As the present and constantly changing working life requires shared expertise, knowledge management and diverse communicative skills as well, PLE appears to be a promising approach to the learning of working life context.

Another encouraging concept in this study is the model of the Networked Student (Drexler 2010) based on constructivism and connectivism. In that model social software and RSS technology are used to support knowledge exploring and construction, social connections, reflections and communication. Concerning a networked adult learner in workplace, this model needs to be further developed and tested.

Methodology

This study is based on design research which is characterized as iteratively developing theory and practice in close collaboration with the research subjects and contexts (Barab & Squire 2004). The empirical part is carried out in educational corporate life context. It consists of pilot cases in which social software applications are chosen and introduced to traditional personnel training programs. The data is collected by questionnaires, interviews and monitoring the learning activities and discussions of the pilot groups in the chosen social software environments. The design process itself is also in focus and reflections concerning this process constitute a part of the data.

Research tasks are focused on questions:

- How to design social software based learning activities in educational working life contexts?
- What kind of features of social software tools will prove useful for these purposes?
- What kind of challenges or barriers may appear when including new elements in traditional learning environments and how these barriers can be addressed?

With these research questions the model of the networked adult learner in working life context will be defined further. The first pilot case is a three-month training for the workplace instructors of apprenticeship students actualised in three groups of approximately 15 employees in financial and insurance business. The main interest is in the use of social software to support discussion and sharing of experiences as well as peer scaffolding in disjointed working groups. The second pilot case is a fifteen-month expert training for 15 specialists in insurance business with the focus on individual and collective reflection (blogs and chat), shared expertise and collaborative content creation (wikis).

Findings

As the first pilot training started in October 2010, solely tentative findings about design process itself and the initialization of social software are described here. Some challenges both in the designing and implementing of new learning environments can be already observed. First of all, the instructors have stated the importance of accurate planning when designing learning activities with Web 2.0-tools. Secondly, both the learners and the instructors need pedagogical and technological scaffolding and guidance with these new learning tools even though some of those are already familiar from informal contexts. Similarly, motivational aspects and additional value of the participation in the learning communities need to be considered because of learners' competing duties and interests. In conclusion, it seems obvious that the instructor has a significant role in implementing new ways of learning and knowledge sharing with social software and in encouraging working learners to take control of their learning.

References

- Attwell, G. (2007). Personal learning environments – the future of eLearning? eLearning papers 2 (1).
- Attwell, G. (2010). Supporting Personal Learning in the Workplace. The PLE Conference. Retrieved from <http://pleconference.citilab.eu>
- Barab, S. & Squire, K. (2004). Design-Based Research: Putting a Stake in the Ground. *The Journal of the Learning Sciences*, 13(1), 1-14.
- Drexler, W. (2010) The networked student model for construction of personal learning environments: Balancing teacher control and student autonomy. *Australasian Journal of Educational Technology* 2010, 26(3), 369-385
- Fiedler, S. & Valjataga, T. (2010). Personal learning environments: concept or technology? The PLE Conference. Retrieved from <http://pleconference.citilab.eu>
- McLoughlin, C. & Lee, M. J.W. (2007). Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era. *Proceedings of ascilite Singapore 2007*
- Tynjälä, P. & Hakkinen, P. (2005). E-learning at work: theoretical underpinnings and pedagogical challenges. *The Journal of Workplace Learning* Vol. 17 No. 5/6, 2005, 318-336

Possibilities of social media in HE guidance

Sakari Saukkonen, University of Jyväskylä, Finland; Jaana Kettunen, University of Jyväskylä, Finland; Liisi Suurnakki, University of Jyväskylä, Finland; Liisi Suurnakki, University of Jyväskylä, Finland

Several innovations have emerged to supplement traditional guidance practice. One such innovation is the use of ICT in HE guidance. The usage of social media in guidance may improve learning outcomes as learning is a collaborative and collective construction of new knowledge on the basis of past experience and current understanding. In this presentation we give an overview of the research project Social media in Higher Education guidance. In the beginning we supposed that 1) social media is may not yet be extensively used by HE organizations, 2) the HE students are probably quite skilful users of net and they spontaneously use quite a wide range of different social media

applications, and 3) not all potentials of social media and/or web 2.0 applications are put in good use in HE guidance. Our preliminary findings are: 1) Finnish HE institutions are using the Internet in guidance in a very traditional fashion – social media applications are not widely used, 2) Student's every day technology practices may not be directly applicable to academic tasks – the Internet is seen as a place of entertainment and personal communication, and 3) From the students' point of view studying, learning, academic advising and guidance are mostly separated from the net. Empirically we are going to gather more survey data of the use of the Internet in HE guidance. Theoretically we need to understand more profoundly the nature of both study and career guidance in HE in order to evaluate the true potentials and benefits of social media.

Study counselling and guidance in Higher Education (HE) generally involves face-to-face interaction and additional interaction through telephone, letters, emails or the Internet. Traditionally most important of all has been the one-to-one interaction between a study counsellor and HE student. Decision making, and a student's direction and progress towards learning and professional goals play a crucial role in the development of individual identity and purpose, as well as positive self-esteem and interpersonal functioning. EU Council resolution on integrating guidance to lifelong learning strategies 21.11.2008 emphasizes how citizens' lives are increasingly characterized by multiple transitions: one of them being from higher education to employment. Guidance plays a decisive role in the major decisions individuals have to take throughout their lives. In this respect, it can contribute to empowering individuals to manage their own career paths in a more secure way, and to achieve a better balance between their personal and professional lives. Several innovations have emerged to supplement traditional guidance practice (Vuorinen 2006). One such innovation is the use of Information and Communication Technology (ICT) in HE guidance. Beginning with access to traditional study and career information, ICT in guidance has evolved to include a wide variety of information sources as well as facilitating interaction among clients and guidance professionals. Watts (2002) identifies four phases in the general development of ICT in guidance: 1) the mainframe phase (1960 to late 1970s), 2) the microcomputer phase (1980s to mid-1990s), 3) the web phase (1990s to early 2000s) and 4) the current digital phase. He also identifies trends that can be seen across the phases: increased accessibility, increased interactivity, and more diffused origination - the trend towards more diverse content creating.

Social media is one of the most promising features of ICT in guidance. The usage of social media in guidance may improve learning outcomes as learning is a collaborative and collective construction of new knowledge on the basis of past experience and current understanding. Social media can facilitate a shift from traditional, individually centered teaching to collective learning of shared understanding (Wells & Ball, 2008). ICT and social media especially may also be helpful in learning from peers, sharing information, and reaching towards different communities inside & outside HE. Web 2.0 has not yet been recognized by institutional actors while the users of web, including many HE students are moving towards web 3.0. The rich connectionism is probably just starting to change the way we communicate and use the web in our social life and also in the use of different services, like career guidance services in HE. Recent report by UK Commission for Employment and Skills reveals that nowadays the Internet is still generally used with the same scheme as in the use of previous printed materials (UKCES 2010). The Internet adds value especially in obtaining educational and labour market information. However the Internet is not used to support transition learning.

According to Vuorinen (2006), effectiveness in the use of the Internet is likely to be improved by providing professional support for users who need it, by systematically integrating web-sites to existing services, by ongoing re-evaluation of standards of practice, by awareness of ethical issues and standards in designing services and by conducting research and evaluation to appropriately guide the evolution of Internet-based career resources and services (see also Sampson 2002).

Our aim is to give an overview of the research project "Social media in Higher Education guidance" which is part of the ESF-funded project "Development of Guidance and Generic Skills in Higher Education" conducted at the University of Jyväskylä, Finland. At the beginning of the project our working hypothesis was that Internet-based guidance environments will play a significant role on HE students study and career guidance. One reason for this assumption has been the growing popularity of social media solutions and applications. In the beginning of the project we supposed that 1) social media may not yet be extensively used by HE organizations, 2) the HE students are probably quite skilful users of the Internet and they spontaneously use quite a wide range of different social media applications, and 3) not all potentials of social media and/or web 2.0 applications are put in good use in HE guidance.

We have been gathering data by examining the current Internet-based guidance services in the Finnish HE field, by conducting a survey directed to a representative sample of Finnish first year HE students, and we have also gathered a small data from HE career guidance staff asking their opinions of the use and usefulness of social media.

In a nutshell our research findings so far are:

Finnish HE institutions are using the Internet in guidance in a very traditional fashion – social media applications are not widely used
Guidance services in the Internet are hard to find, and lack consistency in terms of concepts and service delivery logics
Student's every day technology practices may not be directly applicable to academic tasks – the Internet is seen as a place of entertainment and personal communication
Net communities (like Facebook) are for creating and maintaining personal relationships
From the students' point of view studying, learning, academic advising and guidance are mostly separated from the net
In Finland we have the technology and we have the generation who masters it but we seem to lack people who are willing to do "serious business" over the Internet - like collaborative learning or guidance & counselling

Empirically we are going to gather more survey data of the use of the Internet in HE guidance. Also some data analysis from past surveys is still continuing. Theoretically we need to understand more profoundly the nature of both study and career guidance in HE in order to evaluate the true potentials and benefits of social media. This requires also more extensive understanding of the different features of various social media applications used in HE guidance.

References

- UKCES 2010. Career through the web. The potential of web 2.0 and 3.0 technologies for career development and career support services. UK Commission for Employment and Skills. June 2010.
- Vuorinen, R. 2006. Internet ohjauksessa vai ohjaus internetissä? (The Internet inguidance or guidance in the Internet? Perceptions of guidance practitioners on the use of the Internet as a tool in guidance.) University of Jyväskylä. Institute for Educational Research. Research Reports 19.
- Watts, A. G. 2002. The role of information and communication technologies in integrated career information and guidance systems: a policy perspective. *International Journal for Educational and Vocational Guidance* 2 (3), pp. 139–155.
- Wells & Ball 2008. Understanding – the purpose of learning. In C. Nygaard & C. Holtham (eds.) *Understanding learning-centered higher education*. Copenhagen Business School Press: Gylling, pp. 51–76.

Relationships between students' eye-movements and online search strategies

Meng-Jung Tsai, National Taiwan University of Science & Technology, Taiwan; Fang-Ying Yang, National Taiwan Normal University, Taiwan; Meng-Lung Lai, National Chiayi University, Taiwan

In order to understand the cognitive process of students' learning via online information searching, this study aimed at examining the relationships between students' eye-movements and their online search strategies. A total of forty university students participated in an eye-tracking experiment in which they were asked to answer a multiple-choice question about causes of landslides before and after an online searching task. Students' perceived search strategies were evaluated by a self-reported instrument, The Online Information Searching Strategy Inventory (OISSI), right after the searching task. During the searching task, not only the computer screens were captured but also students' eye-movements were tracked by a FaceLAB eye-tracker with GazeTracker software. Seven indices were obtained from the OISSI: Control, Disorientation, Trial & Error, Problem Solving, Purposeful Thinking, Select Main Ideas and Evaluation, indicating the seven aspects of online search strategies that had been utilized by each subject in this task. As for students' eye-movements, five indices were coded for both relevant and irrelevant areas of interest (AOIs) defined in all of visited web pages. Therefore, a total of 10 eye-tracking indices (5 for relevant AOIs and 5 for irrelevant AOIs) were coded for each subject. The five eye-tracking indices included average fixation numbers, average fixation durations, average regression numbers, average fixation frequency and total reading time. Correlation coefficients between the 7 search-strategy indices and the 10 eye-tracking indices were analyzed to examine their interrelationships. The preliminary results showed significant correlates existed between the two variables and will be presented in details at the conference.

Relationships between students' eye-movements and online search strategies

Purpose

Providing information about human's minds, eye-tracking experiments have been widely used in research about reading (Rayner, 1998) and human-computer interactions (Radach & Kennedy, 2004). Recently, researchers have attempted to use eye-tracking technology to explore students' learning in technology enhanced learning environments. Related research include using eye-tracking technology to analyze the process of multimedia learning

(van Gog & Scheiter, 2010), to examine the multimedia effects on conceptual learning (She & Chen, 2009; Cook, Wiebe & Carter, 2008), to explore computer game learning experience (Alkan & Cagiltay, 2007) and to investigate how graphic overviews facilitate or hinder hypertext comprehensions (Salmeron, Baccino, Canas, Madrid & Fajardo, 2009). Some pilot studies have attempted to explore how users read online information (Larigo, Pan, Hembrooke, Joachims, Granka & Gay, 2008; Matrai, Kosztyn & Sik-Lanyi, 2008). However, little study has been looking deeply into how students construct knowledge via Internet-based learning, especially how they select and interact with the huge amount of information provided on the Internet. In order to understand the cognitive process of students' learning via the Internet, this study aimed at examining the relationships between students' eye-movements and their online information search strategies by conducting an eye-tracking experiment with an online searching task.

Methodology

A total of sixty university students participated in an eye-tracking experiment in which they were asked to perform an online search task about "landslides." The subjects were randomly selected from three colleges of different domain expertise including social science, natural science and engineering backgrounds. Before and after the search task, students were prompted to answer a multiple-choice question about the causes of landslides. The material used for the multiple-choice question was an image with four pictures demonstrating four different contexts of relevant and irrelevant environmental conditions, for example, temperature and rainfall etc. During the search task, students' eye-movements with the computer screens were all tracked and captured by a FaceLAB 4.5 eye-tracker with GazeTracker 8.0 software. For each subject, it took about thirty to forty minutes to finish the whole search task including the calibrations and question answering. Right after the experiment, each subject was asked to answer a questionnaire including The Online Information Searching Strategy Inventory (OISSI) (Tsai, 2009) in order to collect data about students' perceived strategies for online information processing. A total of 54 subjects who successfully passed the calibrations and had completely collected data were included for data analyses in this study. A correlation analysis was used to examine the relationships between students' eye-tracking indices and search strategy indices. Seven indices obtained from the OISSI scale indicate students' Control, Disorientation, Trial & Error, Problem Solving, Purposeful Thinking, Select Main Ideas and Evaluation aspects of strategies perceived by students to use in the task. As for students' eye-movements, five indices were coded for both relevant and irrelevant areas of interest (AOIs) which had been defined in all visited web pages for each subject based on the screen-captured videos. Therefore, a total of 10 eye-tracking indices (5 for relevant AOIs and 5 for irrelevant AOIs) were coded for each subject. The five eye-tracking indices included average fixation numbers, average fixation durations, average regression numbers, average fixation frequencies and total reading time (Rayner, 1998; Radach & Kennedy, 2004). Correlation coefficients between the 7 strategy indices and the 10 eye-tracking indices were analyzed to examine the correlates.

Findings and Significances

A preliminary result showed that there were some significant correlations between the two sets of indices: OISSI indices and Eye-Tracking indices. This means that there was an intimate relationship between students' visual attentions and their online information search strategies. Since the search task in this study served as an opportunity for students to reconfirm or modify their prior knowledge, the search strategies assessed in this study in fact represented students' cognitive strategies for constructing their knowledge via an interaction with the information provided on the Internet. Therefore, this study provided eye-tracking evidences for students' perceived cognitive strategies for Internet-based learning. In addition, the preliminary result also showed that students with different backgrounds paid different attentions to relevant and irrelevant online information, suggesting a further examination is needed for future study. In conclusion, results of this study not only help researchers further understand the cognitive process of Internet-based learning but also provide suggestions for the developments of future Internet-enhanced learning environments.

References

- Alkan, S., & Cagiltay, K. (2007). Studying computer game learning experience through eye-tracking. *British Journal of Educational Technology*, 38(3), 538-542.
- Cook, M., Wiebe, N. E., & Carter, G. (2008). The influence of prior knowledge on viewing and interpreting graphic with macroscopic and molecular representations. *Science Education*, 92(5), 848-867.
- Jarodzka, H., Scheiter, K., Gerjets, P., & van Gog, T. (2010). In the eyes of the beholder: How experts and novices interpret dynamic stimuli. *Learning and Instruction*, 20, 146-154.
- Lorigo, L., Pan, B., Hembrooke, H., Joachims, T., Granka, L., & Gay, G. (2006). The influence of task and gender on search and evaluation behavior using Google. *Information Processing and Management*, 42(4), 1123-1131.
- Matrai, R., Kosztyn, T. Z., & Sik-Lanyi, C. (2008). Navigation methods of special needs users in multimedia systems. *Computers in Human Behavior*, 24, 1418-1433.

- Radach, R., & Kennedy, A. (2004). Theoretical perspectives on eye movements in reading: Past controversies, current issues, and an agenda for future research. In R. Radach, A. Kennedy, & K. Rayner (Eds.) *Eye movements and information processing during reading* (pp. 3-26). New York, NY: Psychology Press
- Rayner, K. (1998). Eye movements and information processing: 20 years of research. *Psychological Bulletin*, 124(3), 372-422.
- Salmeron, L., Baccino, T., Canas, J. J., Madrid, I. R., & Fajardo, I. (2009). Do graphical overviews facilitate or hinder comprehension in hypertext? *Computers and Education*, 53, 1308-1319.
- She, H. C. & Chen, Y. Z. (2009). The impact of multimedia effect on science learning: Evidence from eye movements. *Computers and Education*, 53(4), 1297-1307.
- Tsai, M.-J. (2009). The Online Information Searching Strategy Inventory (OISSI): A quick version and a complete version. *Computers & Education*, 53(2), 473-483.

THEMATIC POSTER SESSION

Learning disabilities

Working memory, logical reasoning, calculi and reading

Beatriz Vargas Dorneles, Universidade Federal do Rio Grande do Sul, Brazil; Luciana Corso, Universidade Federal do Rio Grande do Sul, Brazil

This study describes the different components of working memory to explain variations in children's arithmetic and reading performance. It involved 49 Brazilian students, between 9 and 11 years old, attending public schools. The students completed tasks designed to assess the three components of working memory: central executive, phonological and visual-spatial. They were also assessed in arithmetic, oral reading and logical reasoning performance. The results show a correlation between reading performance and phonological (digit span) and the central executive (digit span backwards). No correlation was found between these components of working memory and calculi. Furthermore, no correlation was found between the visual-spatial task and reading performance or arithmetic performance. However a correlation was identified between the visual-spatial component and the inverse relation between addition and subtraction. As expected, a correlation was found between the arithmetic task and inverse relation between addition and subtraction as well as additive composition.

Our findings confirm that research results in this area are still inconclusive and controversial, highlighting the need for more investigation. One implication of this research for education concerns the importance of refining the relationships between the different components of working memory and the learning of reading and calculi in order to prevent at-risk students from developing problems. Similarly, we could tackle the cognitive obstacles that prevent learning by carefully selecting teaching resources, contents and teaching appropriate learning strategies.

The study of the cognitive processes underlying learning difficulties in mathematics and reading has expanded significantly in recent years. The different cognitive abilities underlying learning have been defined. The importance of working memory (WM) has been highlighted, especially through the WM research-based model proposed by Baddeley and Hitch (1974). It consists of three constantly interacting components: the central executive (CE) in the center of the model and phonological loop (PL) and visuo-spatial (VS) sketchpad on the periphery. Andersson and Lyxel (found difficulties in the CE in children with learning disabilities. They suggested that the deficit would be more restricted to the simultaneous processing and storage of verbal and numerical information in children with difficulties in mathematics only. When these difficulties were associated with reading the deficit would be centered on the processing and storage of numerical and visual information. Research into learning disabilities in mathematics and reading is moving towards a more detailed characterization of the cognitive abilities of these children. Another recently highlighted aspect concerns the role of logical development as a predictor of mathematical performance. The study by Nunes et al. (2007) shows that logical development is critical in predicting children's performance in mathematics. This study did not assess skills linked to reading. Based on this study we chose three logical relations from logical reasoning: the inverse relation between addition and subtraction (IRBAS); additive composition (AC) and one-to-many correspondence (OC). The present work describes the different components of WM and logical reasoning in order to explain variations in children's calculi and reading performance.

Method

This is a cross-sectional quantitative study involving 49 Brazilian students, between 9 and 11 years old, attending public schools, with an IQ above 82 (WISC, 1991). The children completed tasks designed to assess the three components of WM (PICKERING; GATHERCOLE, 2001). The TDE-School Performance Test (STEIN, 1994) was used to assess arithmetic performance. An instrument comprising regular (RW), irregular (IW) and non-words (NW) (SALLES,

2001) assessed oral reading. The logical reasoning was assessed using three groups of six tasks each involving the IRBAS; AC and OC adapted from Nunes et al. (2007). Intergroup differences were analyzed using the Spearman's correlation at a significance level of p

Results and Discussion

Table 1 presents the results of the correlations between arithmetic and reading performance and the cognitive skills

The correlation between WM measures, logical reasoning and reading suggests internal consistency of the instruments used. The correlation between the PL (digit span task) and the RW and IW highlights the role that phonological memory plays in reading. However, our study shows no correlation between arithmetic performance and PL as some studies (GEARY et al., 2000). Contrary to our expectations, there was no correlation between the VS and reading and arithmetic maybe because our study evaluated simple arithmetic that requires conceptual and procedural skills that are more dependent on the language systems (PL) than the VS systems. The same may be true for reading, although the VS system supports the spatial organization and sequence of letters, the PL plays a prominent role in the early stages of reading. However, a correlation between the VS and the IRBAS was found, indicating that the early calculi need spatial parameters to be successful. The correlation found between the CE and RW, IW and NW confirms the results of research highlighting the CE as the one that plays an important role in reading. During reading the CE retrieves information on syntax, word meaning, phonological rules, while the PL retrieve words, phrases or sentences as they are being processed. Contrary to our expectations, our study showed no correlation between the CE and arithmetic. The correlation between the VS and IRBAS shows the importance of spatial aspects to calculi and the correlation between the arithmetic task and IRBAS and AC was expected as the algorithm must be the result of the understanding of these relations. Conclusion Our findings confirm that research results in this area are still inconclusive and controversial pointing out the need for more investigation. One implication of this study for education concerns the importance of refining the relationships between the different components of WM and learning of reading and calculi in order to prevent at-risk students from developing future problems. Similarly, we could tackle cognitive obstacles by carefully selecting teaching resources, contents and appropriate learning strategies.

References

- ANDERSSON, U.; LYXELL, B. (2007) Working memory deficit in children with mathematical difficulties: A general or specific deficit? *Journal of Experimental Child Psychology*, San Diego, v. 96, n. 3, p. 197-228.
- BADDELEY, A.D.; HITCH, G.J. (1974) Working memory. In: BOWER, G.H. (Ed.). *The psychology of learning and motivation*. London: Academic Press. v. 8, p. 47-91.
- GEARY, D.C.; HAMSON, C.O. e HOARD, M.K. (2000) Numerical and arithmetical cognition: A longitudinal study of process and concept deficits in children with learning disabilities. *Journal of Experimental Child Psychology*, 77, 236-263.
- NUNES, T.; BRYANT, P.; EVANS, D.; BELL, D.; GARDNER, S.; GARDNER, A. CARRAHER, J. (2007). The contribution of logical reasoning to the learning of mathematics in primary school. *British Journal of Developmental Psychology* 25, 147-166.
- SALLES, J.F.; PARENTE, M.A. (2002). Processos cognitivos na leitura de palavras em crianças: relações com compreensão e tempo de leitura. *Psicologia: Reflexão e Crítica*, 15, 321-331.
- PICKERING, S.; GATHERCOLE, S. (2001). WMTB-C. London: Elsevier.
- STEIN, L. (1994). TDE. São Paulo: Casa do Psicólogo.

Mathematical abilities of children with autism spectrum disorder.

Daisy Titeca, Ghent University, Belgium; Annemie Desoete, Ghent University, Belgium; Herbert Roeyers, Ghent University, Belgium; Stefanie Pieters, Ghent University, Belgium

Aim: The aim of this study was to investigate the arithmetic abilities of children with autism spectrum disorder (ASD) in comparison to children with mathematical learning disability (MLD) and age-matched control children without ASD and MLD.

Method: Twenty-two children with ASD, 22 children with MLD and 22 age-matched control children without ASD or mathematical problems participated in this study. All 66 children were at least of average intelligence and were assessed with a standardized test for number fact retrieval (TTR) and on some subtests of a functional diagnostic test of basic mathematical knowledge and skills (TEDI-MATH), more specifically the subtests tapping the different components of the Triple Code Model.

Results: ANOVA revealed that children with ASD and children with MLD obtained significantly lower scores than control children on number fact retrieval. Furthermore, a MANOVA conducted with the three subtests tapping the

Triple Code Model revealed a trend toward significance. Post-hoc analyses showed that ASD children did not significantly differ from the MLD or control group, while the MLD group performed worse than the control children. Discussion: Children with ASD show mathematical difficulties on the domain of number fact retrieval. However, children with ASD show a different profile of difficulties than children with MLD. These results have important educational implications and suggest that adjustments in educational techniques should be based on the specific needs of children with ASD. Future research should assess the mathematical abilities more extensively, and should investigate the underlying processes thoroughly.

1. Aims

Up till now, most research in children with autism spectrum disorder (ASD) has focused on the social-communicative deficits of these children. Although some researchers suggest that children with ASD are characterized by a profile of strengths and weaknesses in their cognitive and academic functioning, studies in this domain are relatively scarce, and results are inconsistent. According to recent estimations, approximately 70% of the children with ASD may have intellectual abilities in the normal range – and should therefore be able to follow a regular educational program (Chakrabarti & Fombonne, 2005). This seems however in contrast with the experience of practitioners. Regarding the field of arithmetics, many children with ASD seem to have difficulties with the mathematical techniques used in mainstream schools. In the current literature on children with ASD, the field of arithmetics remains a rather unexplored topic, which only a few studies have examined. A study by Chiang and Lin (2007) shows that – although they think the clinical significance of these results is limited – children and adolescents with autism have significantly lower scores on the Arithmetic subtest relative to the mean of their subtest scores on the WISC-III. Mayes and Calhoun (2003) report that 22% of the children with ASD have an arithmetic disability. The present study wants to elaborate on this theme, by examining to what extent children with ASD experience difficulties with arithmetics and what kind of mathematical problems can be detected. A better understanding of these mathematical difficulties is necessary to adjust the mathematical techniques that are currently used in mainstream schools, so as to minimize the problems that children with ASD experience.

2. Methodology

2.1. Subjects

Twenty-two children with ASD, 22 children with mathematical learning disability (MLD) and 22 control children without ASD or mathematical problems participated in this study. Children in the clinical groups had a clinical diagnosis of ASD or MLD that was previously made by a multidisciplinary reference centre or rehabilitation centre. All 66 children were at least of average intelligence ($M = 100.4$; $SD = 11.8$) and were between 6.9 and 12.5 years old ($M = 8.5$ years; $SD = 1.0$ years). The three groups of children were age-matched and did not differ on intelligence.

2.2. Instruments

In order to estimate the intellectual capacities, all children were assessed with the short version of the WISC-III (Similarities, Picture Arrangement, Block Design and Vocabulary). To examine the arithmetic abilities, all children were assessed on number fact retrieval (with the Arithmetic Number Facts Test; TTR) and on the different aspects of the Triple Code Model (visual identification of Arabic numbers, verbal processing of number words and quantity representation; with the TEDI-MATH).

3. Findings

Analysis of variance (ANOVA) comparing the three groups (ASD, MLD and control group) revealed that children with ASD and children with MLD obtained significantly lower scores on number fact retrieval in comparison with the control group (see Table 1). Furthermore, a multivariate analysis of variance (MANOVA) with the three subtest related to the Triple Code Model as dependent variables, revealed a trend at the multivariate level ($F(6, 122) = 1.91$, p

4. Discussion

Children with ASD show a problem with number fact retrieval that is comparable to that of children with MLD. This finding underscores the importance of following up the mathematical automatization abilities of this group of children. However, children with ASD show a different profile of difficulties than children with MLD: Whereas children with MLD seem to have difficulties with the number words component of the Triple Code Model, children with ASD do not fail these kind of tasks. The results of this study may have important educational implications. The findings suggest that adjustments in educational techniques should be based on a more profound analysis of the strengths and weaknesses in mathematics so as to meet the specific needs of children with ASD. These needs may be different from the needs of children with MLD, as they show a different profile of difficulties. A clear understanding of the specific mathematical difficulties of children with ASD also aims at the development of an appropriate STICORDI-advice (STImulation, Compensation, Remediation and Dispensation), for instance working with memory cards or the use of a calculator. Future research should assess the mathematical abilities of children with ASD more extensively, so that

more aspects of the arithmetic field are included in the assessment and more subtle problems can be detected as well. In addition, it will also be important to investigate the underlying processes thoroughly, so that specific modifications are possible. Such studies are currently being prepared.

References

- Chiang, H. M., & Lin, Y. H. (2007). Mathematical ability of students with Asperger syndrome and high-functioning autism: a review of the literature. *Autism*, 11(6), 547 – 556.
- Chakrabarti, S., & Fombonne, E. (2005). Pervasive developmental disorders in preschool children: confirmation of high prevalence. *American Journal of Psychiatry*, 162(6), 1133-1141.
- Mayes, S. D., & Calhoun, S. L. (2003). Analysis of WISC-III, Stanford-Binet : IV, and academic achievement test scores in children with autism. *Journal of Autism and Developmental Disorders*, 33(3), 329 – 341.

Writing performance in students with dyslexia: beyond single word spelling difficulties

Vince Connelly, Oxford Brookes University, United Kingdom; Anna Barnett, Oxford Brookes University, United Kingdom; Emma Sumner, Oxford Brookes University, United Kingdom

Difficulties with reading and spelling are established characteristics of dyslexia. However, students with dyslexia repeatedly report writing as a persistent problem throughout education (Mortimore & Crozier, 2006). Models of writing development highlight the processes engaged when writing, and provide the theoretical framework for this research (Berninger & Swanson, 1994). This study directly examines the process of writing, and the product, across three cohorts (ages 8-25 years): individuals with dyslexia, typically-achieving age-matched peers and spelling-ability matched. The aim is to explore how difficulties with spelling may hinder writing development with regards to handwriting execution and the quality of compositions. Participants were screened through nonverbal reasoning, reading, and spelling ability; and completed measures assessing spelling, handwriting speed, vocabulary, working memory. Pause distributions within free writing were analysed using the Eye & Pen software and digital writing tablet. Since data collection is not yet complete, this presentation focuses on preliminary analyses of the performance of a single case-control. Initial analyses reveal interesting differences. In free writing the student with dyslexia produced five times as many spelling errors and half the amount of text composed by the control. The student with dyslexia paused more frequently and spent more time 'in-air'. Fewer words were produced during each execution burst, demonstrating a dysfluent writing profile. Results shall be explored in relation to current theoretical models of writing development; suggesting avenues for future research and appropriate intervention.

Literacy and writing skills are essential forms of expression throughout education, and writing tasks are incorporated into a large part of the school day. The established model of writing development by Berninger & Swanson (1994) recognises the importance of handwriting and spelling as transcription skills in developing writers. This model provides the theoretical framework for the direction of study. Working memory is illustrated as the storage and processing capacity governing low- (transcription) and high- (planning, translating, and reviewing) level processes (Berninger & Swanson, 1994). These processes are engaged concurrently while writing. It can be hypothesised that if one aspect of the writing process is impaired, or poorly developed, the coordination of the other processes are not managed effectively.

Spelling performance has consistently been found to be impaired in children and adults with dyslexia (Bernstein, 2009; Kemp et al, 2009). These difficulties, with both reading and spelling, persist despite adequate learning opportunities and educational instruction; this is true globally, in many different languages. Previous research has shown that children with dyslexia take longer than their age-matched peers in copying tasks (Sovik & Arntzen, 1986); and handwriting samples depict poor legibility (Martlew, 1992). In addition, handwriting speed has been distinguished as accounting for a significant amount of variance in the quality of text composition in students with dyslexia (Gregg et al, 2007). Students with dyslexia have also been found to use a smaller range of vocabulary in writing compared to typically achieving peers (Sterling et al, 1998).

The aim of this study is to explore spelling level, the handwriting profile and the quality of written compositions produced by individuals with dyslexia; and comparison control groups in order to differentiate level of performance. In particular, examining handwriting movements and pause distribution in a free writing task, in the hope of determining whether spelling is a factor constraining production for the dyslexic sample. One hypothesis is that poor spelling accounts for the slower handwriting and smaller lexical diversity often reported in writing produced by dyslexic samples. When writing, pausing before a word may allow for the retrieval of the correct grapheme representation from memory. Individuals with dyslexia are predicted to pause more frequently to decipher a spelling;

subsequently placing heavy demands on working memory, thus impeding handwriting performance by increasing motor execution time. This study breaks down writing performance and patterns in execution.

Methodology

There are two separate studies running, one consisting of children in primary schools across Oxfordshire, the other with students at Oxford Brookes University: spanning ages 8-25 years. Both studies have three defined cohorts: participants with dyslexia, and two control groups consisting of typically-achieving participants - the first matched by chronological age and the second by level of spelling ability. All groups consist of 25 participants. Participants with dyslexia were initially recognised by an Educational Psychologist or the Special Educational Needs Coordinator (SENco), as having a diagnosis of dyslexia and further screened to show a discrepancy between cognitive ability and reading/spelling performance. The typically-achieving groups showed no discrepancy, and age-appropriate literacy skills.

Participants complete a series of standardised measures of non-verbal cognitive ability, word and non-word reading, spelling, receptive and expressive vocabulary, handwriting speed, manual dexterity, and verbal/visual working memory. An experimental free writing task was designed to assess writing performance. The set topic asked participants to present their perspective on a current issue. Writing was recorded on a digital writing tablet (using Eye & Pen software) which records the XY coordinates of handwriting to a laptop for later analysis. This analysis gives an indication of pause distributions and durations. Pause duration groups have been established from current literature to attribute to, and define, low- and high- level writing processes. A detailed analysis of spelling errors will be performed across the spelling task and within writing.

Results and findings

As data collection is still underway, group data is not yet available to examine relationships between writing processes and product. Therefore, a preliminary analysis is presented in the form of a case-control comparison. A case study of two female university student, age-matched, both studying psychology, one with dyslexia (19.10 years) and the other typically-achieving (19 .8 yrs), highlights prominent differences. In the free writing task both participants spent approximately 20 minutes composing, the student with dyslexia wrote a total of 276 words and made 15 spelling errors, compared to the control who produced 498 words and only 3 spelling errors. Writing fluency for the student with dyslexia was 15.2 words per minute (wpm), compared to 25.7wpm by the control student; and the student with dyslexia spent 7.10 minutes pausing in-air, not physically composing on the paper, compared to 4.69 minutes respectively. In addition, the student with dyslexia was found to pause for >2 seconds more frequently, and produce fewer words during each execution bursts. Overall, these results reflect a dysfluent writing profile for the student with dyslexia when compared to the control, which may be the result of spelling/handwriting difficulties and/or working memory constraints. This point can be further elaborated with the group comparisons and the results from the supporting measures taken, such as working memory assessment.

The groups of participants will be compared across spelling, vocabulary, and handwriting measures using a general linear model analyses. ANOVA and MANOVA tests will be conducted to assess the relationship between variables concerning the processes and the written product.

Theoretical and Educational Implications

There is a growing need for research to encompass both writing processes and the product, in order to suggest appropriate intervention for these students and also teaching instruction. As little research has examined the quality of composition, level of handwriting fluency and vocabulary knowledge in this population, opportunities to provide substantial support are missed. The results from the measures included will develop our understanding of the cognitive and linguistic profile of this atypical population and highlight areas in need of appropriate further support. In addition, findings from the comparison groups will provide support towards the current models of typical writing development. The overall benefits of this study are long term with regards to the contribution to knowledge in developmental and specialized educational research.

Training written spelling in Italian children with dyslexia-dysorthographia

Barbara Arfe, Facolta di Scienze della Formazione, Italy; Elisa Cona, Centro Regionale Disturbi dell'Apprendimento-ULSS 20, Verona, Italy

The Study tested a spelling training designed to help Italian dyslexic children integrate phonological and visual-orthographical processing of orthographically complex words in writing. Three groups of children participated: a) a group of children with dyslexia (N=10), addressed to a phonological + visual-orthographical training (PhO), b) a group

of dyslexic children (N=10), addressed to a control phonological training (Ph), and c) a spelling age matched control group of young writers with typical development, addressed to the PhO training (PhO-TD). Results show greater improvements in spelling in the PhO groups than in the Ph group.

Developmental dyslexia is a persistent difficulty in learning to read and spell words (Bastien-Tonazzo, Stroumza, & Cavé, 2009). Dyslexic children's spelling problems are as severe as their reading problems and can have long term effects on their writing and compositional skills (Berninger et al., 2008; Connely et al., 2006). According to a widely accepted hypothesis, these difficulties are rooted in a phonological impairment, due to a speech perception deficits (Serniclaes et al., 2001), problems in temporal processing of auditory information (Tallal, 1980), or categorical perception deficits (Manis et al., 1997). An alternative hypothesis is that dyslexic children's difficulties are related to a visual-attention deficit (Spinelli et al., 2002; Valdois, 2004; Plaza & Cohen, 2006) or to a deficit in magnocellular visual processing (Stein & Walsh, 1997). Recently, a third hypothesis has emerged, which combines the two: an asynchrony in processing visual-orthographic and auditory-phonological information would cause the encoding, decoding and word recognition deficits of dyslexia (Breznitz & Misra, 2003). In synthesis, the integration of auditory-phonological and visual-orthographic information may result inadequate in dyslexic children.

In this Study we tested a spelling training designed to help Italian dyslexic children integrate phonological and visual-orthographic processing of orthographically complex words in writing. Italian is a shallow orthography; the majority of Italian letters have only one pronunciation, so that a child can write unerringly by using a phonetic strategy, or a one-to-one sound-letter conversion procedure. For this reason, phonological trainings and spelling under dictation generally succeed in developing spelling skills. However, Italian spelling-sound correspondences are not all equally simple. Some Italian spellings are less shallow than others. The letters c and g, for example, have different pronunciations depending on the letters that follow. Their written spelling is based on orthographic context-sensitive rules (Barca et al., 2007): e.g. the letter c correspond to the sound /k/ when followed by /a/, such as in /casa/house or /tS/, when followed by /i/, such as in /cielo/sky. Moreover, the same sound can correspond to two letters in some orthographic contexts: e.g. /k/ is converted in a grapheme of two letters /ch/ when /k/ is followed by /i/, like in chiesa/church. Italian children experience initial difficulties with this class of words (with context-sensitive orthography) and, this difficulty is particularly severe among young dyslexic children (Barca et al., 2006; Arfé et al., 2009): reading and spelling errors in this class of words result to be persistent, and little sensitive to instructional intervention. The Study investigated whether training Italian dyslexic children to integrate phonological and visual-orthographic processing of these orthographically complex words could improve their written spelling more than traditional interventions.

Three groups of children participated: a) a group of children with dyslexia-dysorthographia (N=10, 3rd to 5th graders), addressed to a phonological + visual-orthographical training (PhO), b) a group of dyslexic-dysorthographic children (N=10), matched by age and spelling skills to the PhO group, addressed to a control phonological training (Ph) (traditional intervention), and c) a control group of young writers with typical development (2nd to 3rd graders), matched to the PhO group by spelling scores and addressed to the PhO training (PhO-TD). Children in the PhO group were presented a written word and were asked to: a) carefully look at it and to read aloud, together with the examiner, the graphemic groups corresponding to the word syllables, b) close their eyes and read the word again silently from their memory, c) write down the word. The Ph training consisted of a traditional spelling under dictation task and games to stimulate phonological awareness. In both groups, children were invited to correct themselves their spelling errors. Pretest and posttest consisted of spelling under dictation a list of 42 four-syllabic words with complex (context-sensitive) orthographic rules; standardized word spelling, nonword spelling and spelling in text dictation tasks were also administered at pretest and posttest (Sartori et al., 2006).

The results show a significant effect of training condition. The PhO group showed significant improvement in real word [t(10)=5,05, p] and nonword [t(10)=2,95, p] spelling, in the spelling of words in text dictation [t(10)=2,91, p], and in the spelling of complex words (with context-sensitive graphemes) [t(10)=4,70, p]. The Ph group improved only in real word spelling [t(10)=2,68, p]. The PhO-TD group improved in real word spelling [t(10)=3,16, p], in spelling in text dictation [t(10)=3,71, p], and in the spelling of "context-sensitive" words [t(10)=4,22, p]. Theoretical and practical implications of these findings will be discussed with a focus on clinical and educational intervention.

Functional Deficits in Phonological Working Memory in Children With Intellectual Disabilities

Kirsten Schuchardt, University of Hildesheim, Germany; Claudia Maehler, Institute of Psychology, Germany; Marcus Hasselhorn, DIPF, Germany

Background.

Recent studies indicate that children with intellectual disabilities (ID) have functional limitations primarily in the phonological loop of working memory. These findings are indicative of a specific structural deficit. The aim of the present study was therefore to investigate various functions of phonological working memory in children with ID.

Method.

In a three-group design, specific subfunctions of phonological working memory were examined in students of the same mental age (one group of 15-year-olds with mild ID [IQ 50–69], one group of 10-year-olds with borderline ID [IQ 70–84], and one group of 7-year-olds of average intelligence [IQ 85–115]). The automatic activation of the subvocal rehearsal process was operationalized by the word-length effect; the size of the phonological store, by a task involving repetition of nonwords of differing syllable length; and accuracy of processing, by both the phonological similarity effect and the quality of acoustic presentation of the nonword repetition task (distorted vs. undistorted item presentation).

Results. The results revealed impairment of the phonological store only in terms of reduced storage capacity, and showed that this deficit increased with length of the item sequences to be remembered. However, this deficit was observed only in children with mild ID.

Conclusions. The findings are discussed in the context of the two-component model of the phonological loop. They indicate that deficits in storage capacity are associated with deficits in language development and thus seem to be one of the causes of cognitive impairment in individuals with mild ID.

Aims

Children and adolescents with intellectual disabilities (ID) are characterized by profound deficits in phonological memory functions (Henry, 2001; Schuchardt et al., 2010). However, the various studies did not find children with ID to underperform to the same extent on all types of phonological tasks, indicating that it is not the entire functioning of this component that is affected, but specific subfunctions. These findings raise the question of exactly which phonological subfunctions are impaired in children with ID. The present study was designed to address this question by experimentally varying specific aspects of phonological information processing. Relying on the model of Hasselhorn, Grube, and Mähler (2000), we conducted an experimental study examining the automatic activation of subvocal rehearsal processes in terms of the word-length effect, the capacity of the phonological store in terms of the syllable-length effect in nonword repetition tasks, and accuracy of processing in the phonological store in terms of the similarity effect and the distortion effect.

Method

Participants. A total of 63 students participated in the study. In a mental age comparison design, a group of 15-year-old students with mild intellectual disability (MID; IQ 50–69), a group of 10-year-old students with borderline intellectual disability (BID; IQ 70–84), and a control group of 7-year-olds with average intellectual abilities (C; IQ 93–115) were compared. The three groups were matched for mental age using scores on the Columbia Mental Maturity Scale (CMMS).

Tasks. The participating children were administered three different tasks assessing their memory span for words (phonologically dissimilar one-syllable words, phonologically dissimilar three-syllable words, and phonologically similar one-syllable words) as well as a nonword repetition task. Sequences of words of increasing length were presented acoustically at a rate of one word per second, starting with two and continuing up to a maximum of eight words. The phonologically dissimilar one- and three-syllable word span tasks used familiar German nouns that did not rhyme and were thus phonologically distinct. The phonologically similar word span tasks, in contrast, consisted of one-syllable rhyming nouns with a high level of phonological similarity.

In the nonword repetition task, a total of 24 meaningless nonwords with lengths of two, three, and four syllables, were presented acoustically and then had to be repeated correctly. Words of different syllable lengths were mixed for presentation. The capacity of the phonological store can be inferred from the length of the nonwords that participants are able to repeat relatively free of errors. The accuracy of processing in the store, which may be independent of its capacity, was assessed by varying the quality of acoustic presentation. To this end, half of the words were presented in distorted form, making their processing more difficult.

Results

Children with ID did not show any specific deficits in the rehearsal process. In all three groups, children showed higher memory span scores when reproducing series of one-syllable words compared to series of three-syllable words. In

other words, all three groups of children with a mental age of 7 years automatically activated the subvocal rehearsal process in the phonological loop—an ability that is fully developed by the age of 6 to 7 years in typical development. Likewise, we found no evidence for intelligence-related differences in the accuracy of processing as a functional characteristic of the phonological store: all three groups showed a significant similarity effect. Likewise, varying the quality of acoustic presentation (i.e., presenting half of the nonwords in acoustically distorted form) did not lead to differences in the groups' performance. Lower levels of intelligence thus evidently did not influence the accuracy of processing.

In contrast, the capacity of the phonological store was clearly limited in children with MID. These children performed at the same level as the younger control group children when asked to repeat two-syllable nonwords, but their performance on three- and four-syllable nonwords declined markedly. In contrast, the scores of children with BID were comparable with those of the average-intelligence control group.

Theoretical and educational significance of the research

Deficits in storage capacity can therefore be seen as a causal factor in ID (IQ

Issues surrounding the definition of developmental dyscalculia

Amy Devine, Centre for Neuroscience in Education, University of Cambridge, United Kingdom; Fruzsina Soltesz, University of Cambridge, United Kingdom; Alison Nobes, University of Cambridge, United Kingdom; Denes Szucs, University of Cambridge, United Kingdom

International research has indicated that developmental dyscalculia (DD) affects between 3 and 10% of the population. Despite the similar prevalence rate, research into DD has been relatively neglected compared to other learning disabilities such as reading disability (Hanich, Jordan, Kaplan, & Dick, 2001; Mazzocco & Myers, 2003). Consequently, there is no consensus as to how DD should be defined or measured; the selection criteria and tests used in different studies have varied greatly. This poster discusses the issues surrounding the different definitions of DD used in past prevalence studies, and also describes a recent large-scale investigation of the prevalence of DD in the UK. The effects of using different selection criteria for DD will be demonstrated on the data from the study sample.

As would be expected with standardized scores, the majority of points fall within 1 SD of the average score for both the reading and mathematics scores.

Although the distribution is somewhat linear there is a moderate amount of spread. In particular, there are some children who got high scores on one test with average scores on the other test. At the top central section of the scatter plot the number of children who gained high scores in reading, with average scores in mathematics can be seen. In the middle right region of the scatter plot the number of children who gained high scores on mathematics, with average scores in reading can be seen.

Also highlighted in the scatter plot is the group of interest: children with lower scores in mathematics, with average or above average reading scores. When low mathematics performance is defined using a cutoff of 1 SD below the average score, with reading performance at or above 1 SD below the average reading score, 5.40% of children fall within this group. The effects of using the different cutoff scores used in previous dyscalculia prevalence studies will be illustrated on the data set and the implications of using different cutoffs for the diagnosis of DD will be discussed.

THEMATIC POSTER SESSION

Teacher Education

Promoting Reflective Awareness of Teachers' Epistemological and Ontological Beliefs

Gregory Schraw, University of Nevada, United States; Lori Olafson, University of Nevada Las Vegas, United States; Michelle Vanderveldt, Cal State Fullerton, United States

We examined change in epistemological and ontological beliefs using pre-posttest surveys and end-of-semester interviews on a sample of 16 graduate students enrolled in an education class. Results indicated that approximately 63% of participants had consistent beliefs. Another 30% experienced minor changes, while only one experienced substantial change. We discuss the role of action research and corresponding active reflection as components of the

learning environment that enhanced awareness and development of beliefs, describing four ways that participatory action research promoted greater understanding of course information and personal beliefs. We concluded that while beliefs do not change during a 15-week course, educational experiences nevertheless helped teachers develop explicit awareness of their beliefs and use this awareness to make informed curricular and pedagogical choices in their classrooms.

Purpose and Research Predictions

This research examined whether teachers' epistemological and ontological beliefs changed during a 15-week graduate class and what role participatory action research played in critical reflection and change. Based on previous work (Brownlee, 2004; Marra, 2005; Olafson & Schraw, 2006) we expected most students to maintain consistent beliefs across the semester based on pre- and posttest measures, even though some students were expected to change. We also predicted that participation in an action research projects would heighten individuals' awareness of their beliefs and lead to beneficial reflection regarding the relationship between beliefs and teaching practices.

Theoretical Framework

A number of studies have examined teachers' epistemological and ontological beliefs. Epistemological beliefs refer to beliefs about the origin and acquisition of knowledge (Schommer-Aikins, 2002), while ontological beliefs refer to beliefs about the nature of reality (Ponterotto, 2005). Epistemological beliefs are related to classroom pedagogy and management strategies in several ways (Brownlee & Berthelsen, 2006; Hofer, 2001). Teachers who endorse relativist beliefs (i.e., a belief in complex, contextually sensitive knowledge) report using more teaching strategies, focus to a greater extent on student-based collaborative learning, and are less apt to adopt a teacher-directed management style compared to teachers who endorse strong realist beliefs (i.e., a belief in simple, unchanging knowledge).

Methods

16 graduate students enrolled in a The Study of Teaching class completed three self-report instruments at the beginning and end of the course, including the Four Quadrant Scale, the Teacher Belief Vignettes, and the Epistemological Beliefs Inventory (EBI) (Schraw & Olafson, 2008). The Four Quadrant Scale partitions epistemological and ontological beliefs along two separate dimensions, which yield four separate quadrants, including a relativist-relativist (quadrant 1), relativist-realist (quadrant 2), realist-realist (quadrant 3), and realist-relativist (quadrant 4) quadrant. The Teacher Belief Vignettes consist of three vignettes that portray realist, contextualist, and relativist views of teaching. The EBI includes 32 items rated on a 5-point Likert scale designed to elicit students' beliefs about knowledge (Schraw, Bendixen, & Dunkle, 2002). We also conducted individual, semi-structured interviews with each participant.

Results

Quantitative Means and standard deviations for scores are shown in Table 1. Dependent t-tests for quadrant placement and EBI variables showed no significant differences between the pre- and posttest. We also examined quadrant placement across time. Ten of 16 participants remained in the same cell. Three switched from cell 4 to 1, two switched from cell 1 to 4, and one switched from cell 1 to 3. The frequency of changes was not statistically significant, and in addition, all but one of the changes occurred between adjacent cells (e.g., cell 4 to cell 1). We also conducted a 2 (time: pretest, posttest) x 2 (type of belief: epistemological, ontological) repeated measures analysis of variance (ANOVA) to compare pre- and posttest means for the epistemological and ontological coordinate scores. The only test to reach significance was for the type of beliefs variable, $F(1, 15) = 31.23, p < .001$, $F(2, 30) = 21.83, p < .001$.

Qualitative Findings

Transcribed interviews yielded a coding scheme that consisted of 44 codes that were grouped together in a higher order of classification to form the resulting three themes summarized in Table 2.

Discussion

Our results highlight two findings. One is that most participants did not experience a substantial change in world views. This finding is consistent with previous research that did not report significant short-term change among in-service teachers, and that when change occurred, it did so in the context of classes that focused on constructivist instruction that emphasized the role of student cooperative discussion and reflection on personal beliefs (Brownlee, 2004; Marra, 2005). A second finding is that participants reported increased awareness of their beliefs due to classroom discussion and the action research project in particular. We identified under Theme 3 four ways that action research promoted great awareness, including opportunities to try new activities in a real-life context, a forum to examine beliefs, connecting theory to practice, and promoting reflection on beliefs and how beliefs are related to practice.

Summary of Three Main Themes from Interviews

Theme 1: Absence of Meaningful Change Most students did not change due to age and experience and a stable set of personal beliefs related to classroom practices. When change occurred, this change was primarily epistemological in nature, and related to a change in the perceived importance of helping student construct relevant knowledge.

Theme 2: The Development of Greater Awareness All participants expressed developing a greater awareness of their beliefs. Many described how their existing beliefs had been tacit, and that the format of the course allowed them opportunities to articulate their beliefs explicitly. Explicit awareness promoted greater reflection on the relationship between beliefs and practices.

Theme 3: Action Research Promotes Greater Awareness of Beliefs Students participated in an action research project that promoted greater awareness of beliefs in four ways. These included opportunities to implement a new practice in the classroom, a forum where participants were able to examine the relationship between their own beliefs and practices, facilitating connections between theory to practice, and promoting systematic reflection on epistemological and ontological beliefs.

The Wheel of Growth of Pre-service Teachers

Tsafi Timor, Kibbutzim College of Education, Israel

The principal aim of this study was to examine pre-service teachers' perceptions of their growth during one year of pedagogical instruction and practice teaching, with regard to three categories of knowledge: personal growth, the growth of pedagogical knowledge, and the growth of content knowledge. The study has focused on the following questions: The study focuses on two questions: 1. Are there any differences in pre-service teachers' perceptions of various dimensions of practice teaching and pedagogical instruction between the beginning of the year and its end? 2. What are the correlations between dimensions pertaining to personal growth, growth in pedagogical knowledge, and growth of content knowledge at the beginning of the year and at its end? The research tools included the "Wheel of Growth" from coaching models. Analysis was conducted by statistical analysis. Findings indicate significant changes in all dimensions of knowledge during the year, a fact which reflects a significant growth. Findings also yielded significant correlations among the three categories, a fact which indicates that the process has occurred simultaneously in all categories of knowledge. It is recommended that the research be replicated in further contexts.

Theoretical Significance

Reports from existing Teacher Training Programmes imply the need to ensure a balance between practical dimensions of training and theoretical knowledge (Vick, 2006). While some researchers see practice teaching as the highlight of the four years of teacher training, others argue that practice teaching is an artificial situation and does not provide a real teaching experience (Vassallo, 2000). Two decades ago Shulman (1987) identified three categories of knowledge essential to training programmes: content knowledge (of a specific domain), pedagogical knowledge (how to teach), pedagogical content knowledge (how to teach a specific domain). Studies indicate that pre-service teachers wish to improve their content knowledge, pedagogical knowledge, and pedagogical content knowledge. Pedagogical knowledge consists of class management, the use of problem-solving strategies, and motivation issues; Content knowledge include learning resources; Pedagogical content knowledge include lesson planning, establishing link between real-life situations and class materials, and problem-solving in specific areas (Jegede & Taplin, 2000). Researchers agree about the importance of personal growth alongside professional growth. (Coolahan, 2002). However, there is no mentioning of relationships between various categories of knowledge, which may be crucial to the creation of a balanced teachers' training programme. The Wheel of Growth from coaching models advocates a balance between the parts of the wheel, each of which representing another domain of life, so that the wheel can spin smoothly (Whitworth, Kimsey-House & Sandahl, 1998). This study has adopted the Wheel of Growth in order to examine pre-service teachers' perceptions of their process of growth during a year of practice teaching and pedagogical instruction, with regard to personal growth, growth of pedagogical knowledge, and growth of content knowledge. This overall goal is to consider necessary changes in the foci of pedagogical training programmes. The study focuses on two questions: 1. Are there any differences in pre-service teachers' perceptions of various dimensions of practice teaching and pedagogical instruction between the beginning of the year and its end? 2. What are the correlations between dimensions pertaining to personal growth, growth in pedagogical knowledge, and growth of content knowledge at the beginning of the year and at its end?

Methodology

Research population consists of 30 pre-service teachers in second year, aged 21-29, two male and 28 female. The "Wheel of Growth" questionnaire was divided into triangles which meet in the center, each of which represents a dimension of pedagogical training and practice teaching. The Wheel contains 9 circle lines numbered 0-10 whereas the midpoint of the Wheel indicates 0 and the outer circle line indicates 10 (Figure 1). It included 11 dimensions.

Course of study:1. The dimensions for the Wheel of Growth were determined by the participants in a class discussion followed by a discourse analysis. They were clustered into three categories:

A. Personal Growth includes the following dimensions: Creativity, Reaction to feedback, Self-Confidence, Team-work, Assertiveness;

B. Growth of Pedagogical Knowledge includes the following dimensions: Managing Time in Class, Managing Discipline in Class, Lesson Planning, Communicating with Learners, Reflecting on Teaching.

C. Growth in Content Knowledge includes the dimension of "Content knowledge".

Growth in "pedagogical content knowledge" was not included as a separate category because the participants pertained to a variety of content disciplines (e.g. Literature, Maths).2. The pre-service teachers ranked themselves for each dimension at the beginning of the year and at its end. The percentage of respondents was 85% and 82% respectively. 3. Analysis of the questionnaires was conducted in a quantitative way: analysis of the first research question was conducted by T-Test and by descriptive statistics. Analysis of the second research question was carried out by the Pearson Correlation Test to calculate correlations between dimensions and categories.

Findings

Research question 1: Findings have yielded significant differences between the beginning and the end of the year (Figure 2).The scores yielded at the beginning of the year ranged from $M=4.88$ ("Self-Confidence") to $M=6.80$ ("Communicating with Learners"). The scores yielded in the different dimensions at the end of the year ranged from $M=7.23$ ("Managing Time in Class") to $M=8.80$ ("Communicating with Learners"). The biggest leap has been perceived in "Lesson Planning" $t(29) = 9.54; p$

Research question 2: Below are examples of correlations between the three categories of knowledge: Growth in pedagogical knowledge: dimension of "Lesson planning": the highest correlation was observed between "Lesson planning" and "Self-confidence" at the beginning of the year ($r=0.79$; p Personal growth: dimension of "Assertiveness": the highest correlation was observed between "Assertiveness" and "Self-confidence" at the beginning of the year ($r=0.72$; p Growth in content knowledge: dimension of "Content knowledge": the highest correlation was observed between the dimensions "Content knowledge" and "Self-confidence" at the beginning of the year ($r=0.62$; p

Summary: 1. The net of correlations within the categories and among the three categories took different forms at the beginning of the year and at its end, indicating that changes have been occurring.2. Pre-service teachers perceived a simultaneous growth in the dimensions pertaining to the three categories of knowledge, mainly in the dimensions "Lesson planning", "Managing discipline in class" and "Content knowledge". The perceived simultaneity in the process might indicate that a certain balance was obtained during the year between the 3 bodies of knowledge.3. Their perceptions may point to the creation of an integrated body of knowledge between theory and practice, especially between pedagogical knowledge and personal growth.

Modeling the relationship between Cypriot teachers' conceptions and practices of assessment

Michalis Michaelides, University of Cyprus, Cyprus

The current project aimed toward the investigation and modeling of the conceptions Cypriot teachers hold about educational assessment and examine their relationships with their assessment practices. Brown's (2006) Conceptions of Assessment III Abridged Survey scale was adapted in Greek and administered to 249 teachers. Analysis of the data revealed that the most popular assessment practices reported were the use of teacher-designed assessments, and written assessments given in class. Teachers expressed strong agreement with the use of assessment for improving teaching and learning and endorsed conceptions of assessment for holding students accountable. Assessment for school accountability purposes found only slight support. Preliminary correlational analysis indicated that the conceptions teachers hold seem to relate to the practices of assessment they report, without any significant differences between demographic groups. Further analysis with structural equation models will attempt to model the relationship between conceptions and practices of assessment and will be presented in the final paper. The findings will contribute to the international discussion of how teachers think about assessment and will shed light on the relationship between beliefs and practices in educational assessment.

THEORETICAL BACKGROUND AND RESEARCH OBJECTIVES

Recent research in educational assessment has promoted the notion of assessment for learning in contrast to assessment of learning. Responding to policies that emphasize national standards and standardized testing in education, researchers have turned to new directions: e.g. the investigation of how teachers make use of formative assessment practices (e.g. Black et al., 2004), and the examination of how teachers conceive of assessment and its purposes (e.g. Brown, 2004, 2009).

Research has linked the conceptions of teachers about teaching and learning with their actual practices, and findings from psychology indicate that beliefs predict behavior. Moreover, the effectiveness of educational policies depends partly on teachers' conceptions and beliefs about these policies. Conceptions can be defined "as a more general mental structure, encompassing beliefs, meanings, concepts, propositions, rules, mental images, preferences, and the like" (Thompson, 1992, p.130); they "describe the organizing framework by which an individual understands, responds to, and interacts with a phenomenon... they appear to be multifaceted and interconnected" (Brown, 2004, p.303). Assessment conceptions have been found to be idiosyncratic (Cizek et al., 1995), inconsistent in the sense that teachers choose assessment practices based on previous experiences, their studies, traditional or modern teaching models, as well as culturally shared (van den Berg, 2002). Brown's (2004) framework describes four purpose-defined conceptions of assessment: (1) assessment can be used to hold schools accountable, (2) assessment as a means for making students accountable, (3) assessment improves educational practice, (4) assessment is irrelevant to education. Brown developed this framework in New Zealand. His findings highlight the importance of the context on conceptions and practices about assessment; local schooling practices and policies differ across countries, e.g. on the emphasis on standardized testing, on accountability matters, etc. Therefore, a cross national investigation of conceptions about assessment would reflect these differences.

The objectives of this study include the description and modeling of teachers' assessment conceptions and practices in Cyprus through a survey instrument adapted from Brown (2006).

METHODOLOGY

Developed in New Zealand, Brown's (2006) 27-item Conceptions of Assessment scale (CoA-IIIa) was adapted in Greek and administered to a country-wide sample of 249 educators together with a brief questionnaire about their assessment practices. The internal consistency for the CoA-IIIa items was satisfactory ($\alpha=.68$). The majority of the sample was female (75%), elementary school teachers (53%), regular classroom teachers (77%) and experienced (64% over 5 years of teaching).

RESULTS

Descriptive analysis of the survey data revealed that most of the teachers (80%) had not more than a brief seminar on educational assessment during their studies or professional careers. The most commonly employed assessment practices reported were teacher-designed assessments, and class written assessment, while the least frequently used were essay type questions and standardized tests or large-scale exam papers.

The agreement teachers expressed with each of the four conceptions on assessment was measured on a 1 to 6 scale. The conceptions of assessment for improving education was ranked the highest (mean=4.39, s.d.=0.57) and assessment as a means for student accountability followed (mean=4.27, s.d.=0.66). The belief that assessment can be used for school accountability received slight support (mean=3.83, s.d.=0.92) while assessment as an irrelevant educational practice received neutral ratings (mean=3.40, s.d.=0.68).

Excluding the irrelevance conception, all other conceptions were positively intercorrelated ($0.40 < r < 0.50$, all $p < 0.01$). This can be interpreted as having similar beliefs about assessment for and of learning simultaneously. A MANOVA test to examine differences on the four conceptions about assessment between gender, and years of experience groups revealed a significant main effect for years of experience (Wilks' $\lambda=.90$, $p < .05$), with univariate effects on the improvement conception and for student accountability. Further analysis will look into differences due to the level of education (elementary vs. secondary, and professional training in assessment).

To answer the question on the relationship between conceptions and practices on assessment, the significant correlation coefficients between the scores on each of the conceptions and the frequency of each practice are presented in the Appendix Table 1. The conceptions teachers hold seem to relate to the practices of assessment they report: The more they endorse assessment for improving education the more they use various forms of assessment. The same applies for the conception of assessment for school accountability, but to a lesser degree.

In the final poster, the data will be analyzed using structural equation modeling to describe more fully the interrelationships between assessment conceptions and practices.

THEORETICAL AND EDUCATIONAL SIGNIFICANCE OF THE STUDY

This paper describes the first attempt to study teachers' conceptions of assessment via a standardized instrument that has been used in various other cultures (New Zealand, Hong Kong, Spain, China, Brazil etc.) Therefore, the findings will contribute to the international discussion of how teachers think about assessment. Such empirical data constitute

valuable input for assessment specialists who recommend new directions in assessment practices. In fact, the Cyprus Ministry of Education is currently pursuing a wide-range educational reform that encompasses assessment methods. Finally, it will shed light on the relationship between beliefs and practices in educational assessment and inform policy-makers on the training and professional development needs.

REFERENCES

- Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Working Inside the Black Box: Assessment for Learning in the Classroom. Phi Delta Kappan, 9-21.
- Brown, G.T.L. (2004). Teachers' conceptions of assessment: implications for policy and professional development. *Assessment in Education*, 11(3), 301-318.
- Brown, G.T.L. (2006) Teachers' conceptions of assessment: Validation of an abridged version. *Psychological Reports*, 99, 166-170.
- Brown, G.T.L. (2009). Teachers' self-reported assessment practices and conceptions. In T. Teo, & M. S. Khine (Eds.), *Structural Equation Modeling In Educational Research: Concepts And Applications* (pp.243-266). Sense Publishers.
- Cizek, G.J., Fitzgerald, S., Shawn, M., & Rachor, R.E. (1995). Teachers' assessment practices: preparation, isolation, and the kitchen sink. *Educational Assessment*, 3, 159-179.
- Thompson, A.G. (1992). Teachers' beliefs and conceptions: A synthesis of research. In D. A. Grows (Ed.), *Handbook of research on mathematics teaching and learning* (pp.127-146). New York: Macmillan.
- van den Berg, B. (2002). Teachers' meanings regarding educational practice. *Review of Educational Research*, 72, 577-625.

The Who and the What: The linkage of theory and practice in mentoring-dialogues

Sandra Moroni, University of Teacher Education Fribourg, Germany; Alois Niggli, University of teacher education, Switzerland

The lack of connection between university-based teacher education courses and field experiences has been a perennial problem in traditional teacher education programs. For this reason a hybrid space was created to tie up university courses and field experience in internships more closely. Thus, learners will be faced with multiple contexts. Our approach is based on the cognitive flexibility theory. Knowledge was primarily acquired in case-based learning situations which dealt the subject of differentiated instruction. In a qualitative longitudinal study involving 25 advanced students, this issue was investigated in three distinct settings.

Preparatory setting 1: Internship discussion between university tutor and student with a primary focus on the scientific knowledge acquired at university.

Preparatory setting 2: Discussion of the same problem between the mentor-teacher and student with a focus on the knowledge acquired through practical experience.

Reflection setting 3: Study group discussion between student, mentor-teacher, and university tutor following a classroom observation session with a focus on both forms of knowledge.

In a first research stage two evaluation strategies to report our findings were used which were based on a qualitative text analysis: (1) ranks and percentages of meaning units of discourse in each of the three settings; (2) transsituational meaning units, produced by the same student in two or three settings. Professional success seems to be based on linking up these meaning units derived from theory or practice. Our study identifies the contents of teacher training programmes which should be paid particular attention to in this respect.

Numerous studies have demonstrated the obstacles to student teacher learning that are associated with the traditional loosely-planned model of field experiences (e.g. Arnold et al., 2011). Our study, aiming at a closer linkage between theory and practice, is based on two theoretical concepts:

First the concept of hybrid spaces (Zeichner, 2010) in pre-service teacher education is used to bring together both school- and university-based teacher educators and practitioners as well as academic knowledge in specific academic knowledge to enhance the learning of prospective teachers. The creation of hybrid spaces is connected with the idea of a third space in school-university partnerships. It implies a more egalitarian status for participants and thus a shift from an either/or-perspective to a both/also-point of view.

Secondly, regarding the learning processes of students we have drawn upon the cognitive flexibility theory by Spiro, Feltovich, Jacobson & Coulson (1991), claiming that complex knowledge is best acquired in case-based, multiple perspective learning environments. Such acquisition will take place if a given concept can be spotlighted at different times, in different contexts and according to different purposes. Thus students will experience a multi-faceted exposure to the concept, which can then be dealt with in varied episodes.

Our instructional steps, which will be described below, are based on these theoretical assumptions.

Subject: The concept focused on in varied contexts was constituted by the subject of differentiated or adaptive instruction, respectively, in the mathematics classroom.

First the conceptual basics of a university-course were discussed with the practitioners who had applied for an ensuing internship. They were then provided with suitable lesson-contents, which they were to work through with their pupils.

(a) In a preparatory setting 1 (internship interview between university tutor and student) a link is established primarily to the scientific knowledge acquired at university. The fundamentals of the course are to be adapted to some specific content, which rises from practice. The perspective of the course is focused on a specific case.

(b) In a preparatory setting 2 (discussion of the same problem between the mentor-teacher and student) a link is established primarily to the knowledge acquired through practical experience. The perspective is opened up to the general classroom situation, its dynamics, to the various backgrounds of individual learners, and to the view of the mentor-teacher.

(c) In a Reflection setting 3 (study group discussion between student, mentor-teacher and university tutor), following a classroom observation session a link is established between both forms of knowledge theory and practice. The focus is on the student's behaviour in the classroom and not only on its planning.

The following questions have been of interest to us:

(1) What: Which key aspects of the theory conveyed are relevant to practice?

(2) When: Does the relevance of these key aspects depend on the different episodes?

(3) Who: Which stakeholders initiate classroom discourse?

(4) Effect: How do teacher students rate the competences acquired?

Later studies are intended to focus on the question of "How", with a special emphasis on the design of the discourse between those stakeholders, who take on different perspectives.

Method

The discussions described above took place during the school years of 2009/2010 and 2010/2011 as part of a course in General Didactics with a focus on "instructional differentiation" at the Fribourg Teacher Training College. There was a vast majority of female students (21 out of 24), who are in their last year of their three-years' teacher education course for primary school teachers.

The discussions between the different participants were analyzed according to Mayring's (2002) Qualitative Content Analysis. There was a two-phased validation: a communicative validation of the first ten students among the workgroup was executed in the pilot study with a dialogic consensus-method. In the main study the codification-system will be monitored by the inter-rater reliability with the remaining 14 students, thus making allowances for the criteria of good practice in qualitative social studies.

According to the principle of triangulation the qualitative data collection was complemented by a quantitative analysis of a questionnaire, in which competences in the field of differentiated classroom instruction were assessed. These constructs were similar to those of the discussions.

Results

In the three discourse settings various aspects of differentiated instruction are addressed, which can be grouped into a macro-level (organisation of classroom teaching) and into a micro-level (methodological interaction in the classroom). During the first setting the focus is clearly on the macro-level, whereas in the third setting problems concerning the micro-level are more frequently raised. An increasing differentiation among the students can clearly be noticed. However, this does not seem to be true for all students to the same extent – there are also students who address organisational aspects during all three settings.

The findings also show a difference of the discourse topics depending on whether the talks took place with the tutor or the mentor. As the respective initiators of topics seem to be relevant this aspect needs special attention: first analyses show that - quite differently from conversations with their mentors - in their conversations with tutors it is especially students who initiate topics.

An appreciation of the competences shows that the students rated their own competences referring to various aspects of differentiated teaching higher at the end of the intervention than at its beginning. Between the final points of the intervention the competences may be temporarily rated lower, which might be explained by the fact that students assess themselves more strictly due to an increasing awareness of the problems of differentiated instruction. The present study makes a contribution to a practice-centred curriculum in teacher education. Its key aspects allow for a programme which can avoid the traditional separation between theoretical foundation of knowledge and its practical implementation. Teacher novices will furthermore be enabled to develop a set of key knowledge which is relevant to differentiated instruction. Ensuing studies will allow for assumptions about the "How" of discourse exchange between students, teacher educators, practitioners in hybrid settings. Moreover, statements about the development of competences and about empowerment in multiple contexts in teacher education will be theoretically meaningful.

Frictions and coherence in teachers' beliefs - Teachers' perceptions on themselves and pupils' role

Elsi Ahonen, University of Helsinki, Finland; Kirsi Pyhalto, Helsinki University, Finland; Janne Pietarinen, University of Eastern Finland, Finland

Research on teachers' professional beliefs has shown that there is a relationship between teachers' professional beliefs and professional practices carried out by them. However, this relationship is complex and dynamic rather than causal. (Bakkenes, Vermunt & Wubbels, 2009; Van Driel, Bulte, & Verloop, 2007.) Moreover, teachers' professional beliefs do not necessarily form a consistent professional world view (Rauste-von Wright, 1986; Van Driel et al. 2007). This means that a variety of complementary and sometimes contradictory professional belief systems may exist simultaneously, which is reflected in various ways in teachers' practices and thus on pupils' and school community's learning. This study aims to analyze the variation, context-dependency and coherence of teachers' professional beliefs about themselves and the pupils in the school's pedagogical practices. A selected group of 68 comprehensive school teachers were interviewed. The interviews were content analysed using an abductive strategy. Results showed that teachers' perceptions on themselves and pupils role vary from active learners to passive objects in different context of the school. There was also variation both between teachers and within the teacher's beliefs. Moreover teachers' perceptions were often highly context dependent. While some teachers emphasised knowledge transmission as a core of teaching, others perceived themselves and the pupils as active and collaborative learners in variety of school practices. Similar kind of inconsistency was characteristic for an individual teacher's perceptions. A teacher often, for instance, referred teaching both as knowledge transmission and as facilitation of pupil's active and collaborative learning. The challenge of promoting teachers' professional learning is discussed.

Research on teachers' professional beliefs has shown that there is a relationship between teachers' professional beliefs and professional practices carried out by them. However, this relationship is complex and dynamic rather than causal. (Bakkenes, Vermunt & Wubbels, 2010; Van Driel, Bulte, & Verloop, 2007.) Teacher's professional beliefs, for instance the way in which they perceive their role as teachers or the kinds of instructional methods they consider effective, are likely to affect their interpretations and instructional practices adopted in a classroom. Not only that, these professional beliefs effect the way teachers' act in their professional community for example how they collaborate and take a stand in curriculum development work and how they utilize other teachers' expertise in developing their own work and school. Hence teachers' professional beliefs guide their actions in pedagogical encounters with pupils and other members of the school community.

However, teachers' professional beliefs do not necessarily form a consistent professional world view (Rauste-von Wright, 1986; Van Driel et al. 2007). This means that a variety of complementary and sometimes contradictory professional belief systems may exist simultaneously, which is reflected in various ways in teachers' practices. These complementary or contradictory professional belief systems are constructed in parallel social contexts within the school community. Lack of a coherent and personally meaningful pedagogical theory upon which collective structures of activity and participation can be a reason, for instance, why shared aims and teachers' willingness to promote school development do not automatically transform into the everyday practices of school (Vermunt 2010). This study aims to analyze the variation, context-dependency and coherence of teachers' professional beliefs about themselves and the pupils in the school's pedagogical practices.

Methods

This study includes data collected from the teachers of nine case-schools around Finland. Altogether a selected group of 68 comprehensive school teachers, including both primary and secondary school teachers, were interviewed (Female: 42, Male: 26, Age: Mean = 44.6, Range = 31, Min./Max.= 30/61 years, Std. Deviation= 9.250). The teachers were selected for interviews on the basis of the open-ended responses to questionnaires collected previously from all the case-school teachers. The criteria for selecting the teachers were variation in the teachers' perceived professional orientation in terms of school development and their own role in it, their educational background, gender, work history and working experience. Teacher interviews were conducted in case-schools during spring 2006 by using teachers' professional landscape inventory developed by Soini, Pyhalto & Pietarinen 2010. The interviews were content analysed using an abductive strategy.

Results

The results showed that although the teachers recognized the importance of facilitating the pupils' active role in learning, they still often considered pupils' role passive and traditional in terms of school practices. The teachers mostly perceived the pupils as active educational participants in informal school settings, but not to the same extent in the core process of teaching and learning. At the same time teachers/ perceive themselves most often as passive

objects in the professional community. Only few teachers perceived themselves as facilitators of learning in their professional community. However, there was variation both between teachers and within the teacher's beliefs. Moreover teachers' perceptions were often highly context dependent. While some teachers emphasised knowledge transmission as a core of teaching, others perceive themselves and the pupils as active and collaborative learners in variety of school practices. Similar kind of inconsistency was characteristic for an individual teacher's perceptions. A teacher often, for instance, referred teaching both as knowledge transmission and facilitation of pupil's active and collaborative learning. There were also discontinuities in the teacher's perceptions about themselves as members of the professional community. A teacher for example reported that she just had to keep the wheel running even though they felt that the practices they performed in professional community were not as good as they could have been.

Discussion

Teachers' professional beliefs about themselves and the pupils form often inconsistent professional world view. Moreover these beliefs seem to vary within and between different contexts of teacher's work. This partial inconsistency and context-dependency of professional beliefs may provide a challenge for the teachers' professional learning and for the systematic use of novel pedagogical practices in the classroom and professional community.

However, we consider these findings quite encouraging especially in terms of developing the pupils' active agency in the school community: most teachers had already identified the need to promote the pupils' active role in school. The next challenge is to contribute to the teachers' professional agency to collaboratively develop instructional practices that promote the pupils' collaborative learning and sense of belonging in everyday classroom activities.

References

- Bakkenes, I., Vermunt, J.D. & Wubbels, T. (2010). Teacher learning in the context of educational innovation: Learning activities and learning outcomes of experienced teachers, *Learning and Instruction*, vol 20, issue 6, p.533-548.
- Vermunt, J. (2010). Patterns in teacher learning in different phases of the professional career. Keynote, EARLI sig Meeting HE& TaTE, Helsinki, June 15. 2010.
- Rauste- von Wright, M. (1986). On personality and educational psychology. *Human development*, 29, 328–340.
- Van Driel, J.H., Bulte, A. M.W.& Verloop, N. (2007). The relationship between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs. *Learning and Instruction* 17, 156-171.

Tiered teaching: Making explicit our teacher education pedagogy

Rena Heap, The University of Auckland, New Zealand; Dawn Garbett, The University of Auckland, New Zealand

As experienced teachers with specific strengths in teaching science, we were confident in our own knowledge of the science education content and skilled in the ways of making this content accessible to students enrolled in a Graduate Diploma of Teaching (Primary) programme. Student teachers who graduate from this one-year programme have to be capable of teaching all curriculum areas to any children aged between 5 and 12. Therefore, they are keen to learn science content and the pragmatic, yet superficial, aspects of delivering information and organising successful experiments. Standard practice for lecturers in this science education methods course has been to model exemplary practice by demonstrating how to run well-organized and dynamic practical sessions. However, we propose that teacher education, globally, in any curriculum area needs to be more than modeling exemplary practice. We wanted our students to see "beneath the surface to the complex thinking and the wealth of experience so crucial in shaping pedagogically meaningful learning experiences" (Loughran and Russell, 2007, p. 218). Consequently we have developed a collaborative team-teaching model, 'tiered teaching'. In this presentation we discuss the impact of tiered teaching on making the complexity of pedagogy transparent when teaching science. Teaching classes together and researching our teaching has enabled us to reframe our assumptions and move beyond the simplistic and misleading idea that teacher education is the modeling of exemplary practice. This research has evolved over three years. We believe this collaborative teaching model is applicable globally to teacher education in any curriculum area.

Aim

The aim of this research was to examine the impact of tiered teaching on making our implicit practice explicit. Teaching classes together has enabled us to reframe assumptions that centre on the simplistic and misleading idea that teacher education is the modeling of exemplary practice.

Method

For over three years we have team-taught in combined classes. Content knowledge has remained a focus for the students and us; however, what was given more prominence through tiered teaching was the subtext (the deeper tier) of learning about teaching. This subtext was addressed by our having dual roles; lecturer and provocateur. The provocateur's role was to critique the lecturer's practice to the students to draw their attention to the complex and challenging craft of teaching. Different models of team-teaching can be identified in the literature. For example, Kirkwood-Tucker & Bleicher (2003) present team-teaching along a continuum comprised of three different models. To the far left lies the series model where lecturers present in a series one after the other. Planning, design and assessment of the course may be shared but the lecturers are not present in each other's sessions. At the center of the continuum is the alternating model where two or more lecturers alternate during the each session. To the far right is the interactive model. Here the lecturers are both present actively teaching as a side-by-side team. Other models parallel this continuum. Our tiered teaching style and purpose does not fit neatly into any of these models in that a) we taught together with alternating the dual roles and b) our model is underpinned by self-study methodology. LaBoskey (2004) identifies five methodological features as being important to self-study. They are that it: is improvement-aimed with evidence of reframed thinking and transformed practice; is collaborative; employs multiple, primarily qualitative methods; is self-initiated; and is made public. Multiple data sources were generated. We documented planning and debriefing discussions, held prior to and following each session. The provocateur kept a handwritten logbook of questions and ideas to draw the students' attention to during the session, as well as additional comments to discuss with one another after the session. We also gathered written data from the students at a mid- and end-point of each course. Data collection and data analysis did not happen linearly but was a hermeneutic, recursive process involving reading and re-reading the data, followed by discussion. Emergent themes became clear. Finally, the data was revisited to identify particular instances to support the themes that emerged (Lankshear & Knobel, 2004).

Findings

Several themes have emerged from the data analysis. The most significant were; the cost of tiered teaching; the shift in priority towards less science education but more teacher education; our own growth in expertise; and the transformation of our practice. In terms of cost, we found that with two of us planning, teaching and debriefing each session, we were investing heavily in the project emotionally, intellectually and in terms of time and energy. We acknowledged that we both felt more comfortable in the sanctuary of our own classrooms, behind a closed door, where each of us felt that we had more autonomy and control. A second theme to emerge was that the science content that we covered during our tiered teaching needed to be pared back so that we had more time to discuss the aspects of teacher education that we considered important and wanted to highlight. A number of successful content-based activities were omitted in favor drawing the students' attention to teaching decisions. The third theme that emerged was our growth in expertise; we developed more confidence and self-assurance in our teacher education practices as our study deepened our understanding of the complex challenges involved in teaching about teaching. An unexpected outcome of our tiered teaching together is that we have taken the intentions and skills of critiquing each other's practices into those classes we teach individually, and this has enabled us to teach on multiple levels even when on our own. Data and analysis to support each of these themes will be given in the presentation.

Theoretical and educational significance

By acting as the experienced eyes in each other's classes we have been able to make more explicit to the student teachers the teacherly decisions we were making in practice. We have been able to open student teachers' eyes to the complex skills that expert teachers bring into play in their wider practice. We have learned to make our thinking as teachers explicit to our students so that they can see how we deal with the myriad of dilemmas and challenges that arise in teaching. Tiered teaching was the impetus to change our pedagogical approach and transform our practice. Through this self-study we recognised that we teach our students on different meta-cognitive levels or tiers. Often several of these tiers are eclipsed by our drive to impart subject specific content and pedagogical knowledge as effectively as possible. At an even deeper tier, we see the practice of thinking critically and reflecting on our teaching - in front of the students; in discussion and in private - as being a means to expand our view of the world and our students' view of their profession. We believe this collaborative teaching model is applicable globally to teacher education in any curriculum area.

References:

- Kirkwood-Tucker, T.F., & Bleicher, R. (2003). A self-study of two professors team-teaching a unifying global issues theme unit as part of their separate elementary social studies and science preservice methods courses. *The International Social Studies Forum*, 3(1), 203-217.
- LaBoskey, V.K. (2004). The methodology of self-study and its theoretical underpinnings. In J.J. Loughran, M.L. Hamilton, V.K. LaBoskey, & T. Russell (Eds.), *International handbook of self-study of teaching and teacher education practices* (pp. 817-869). Dordrecht: Kluwer Academic Publishers.

Lankshear, C., & Knobel, M. (2004). *A handbook for teacher research from design to implementation*. Berkshire, UK: Open University Press.

Loughran, J.J., & Russell, T. (2007). Beginning to understand teaching as a discipline. *Studying Teacher Education*, 3(2), 217-227.

THEMATIC POSTER

Conceptual change and Cognitive Skills

A Learning to Learn Approach to School Improvement in Italy

Chris Goldspink, Incept Labs, Australia; Cristina Stringher, INVALSI, Italy

The need to improve the quality of Italian public education, accounting for about 80% of the total number of schools, has been triggered by international comparative studies on student outcomes. The Italian education system, like those of many other Western Democracies has been subject to constant reform initiatives.

Two sets of ideas have influenced educational reform of OECD countries in the recent past: managerialism and market approaches (see Goldspink 2007 for a discussion). This paper examines how this has been manifest in Italy. The focus is on the influence of such change to the administration of school based education. The paper also explores the impact of this change on learning systems. It is argued that these approaches to reform have been based on philosophies and assumptions hostile to the achievement of improved learning and have delivered little real change wherever they have been applied, Italy included. A 'bottom up' or self-organisational model being pursued in the State of South Australia is examined as a possible alternative. Unlike the 'rationalist' management and economic approaches, this approach focuses on people, relationships and learning, rather than structures and centrally determined standards and conformance. We examine the potential for such an approach in Italy, including the likely barriers and adaptations needed for it to be effective.

This research reappraises the recent influences on Italian educational reform and propose an alternative direction. The argument for the alternative draws on empirical evidence as to the effectiveness of a reform being undertaken in the State of South Australia: a reform informed by learning rather than administrative theory. The potential benefits as well as the challenges associated with perusing a similar approach in Italy are identified.

A political reality in western democracies during the post-war period has been the need to do 'more with less' (Pollitt 1990; Self, 1993). In addition, the influence of neoclassical economic and neoliberal political thinking led to increasing calls for budgetary restraint, downsizing, privatization and deregulation (Wilenski, 1986; Osborne and Gaebler, 1993; Self, 1993; Davis, 1997). Goldspink (2007) has argued that these ideas have had a significant influence on educational policy and reform. This is particularly true in today's Italian educational policy, struggling to achieve better results in PISA studies on student outcomes while combating the lack of resources that has been emerging after the 2008 world crisis.

Despite these reform efforts (or we will argue at least in part due to their misdirected nature), education in the Western world has changed little over the last century (Sarason 1990; Evans 2001). The dominant approach has its origins with enlightenment (modernist) concepts of knowledge and assumptions about 'knowledge needs' derived from class based conceptions of social role (Goodson 1997; Sterling 2001), with Italy being no exception to this very broad developmental pattern. Governments have been motivated to improve effectiveness – focusing on the quality of outcomes for both individuals and the wider community/society – as well as with administrative efficiency. In Italy this is evident in all the principal reform documents of the past decade and has been underlined with the recent Gelmini Reform (MIUR 2002, 2003; Fioroni, 2005; MIUR 2007, 2010). However, while attempts to improve effectiveness have been informed by changing thinking about knowledge and alternative theories of learning, in most countries educational practice has drawn rather eclectically on such theories. Modernist (behaviourist) instrumental approaches are still evident while post-modern (constructivist) influences have also been increasingly embraced, at least at the level of policy (Boudourides 1998; Vanderstraeten and Biesta 2002).

In Italy, the land of positivist Maria Montessori, a similarly eclectic mix of behaviourist approaches and idealistic philosophies was evident in the major school reform of 1923 and still display their influence. During the republican era, school changes have been conducted primarily from a centralized administrative perspective (Vertecchi, 1996). More recently, reform attempts (with the exception perhaps of the Berlinguer reform of 2000 originally inspired by childrens' developmental stages) seem rooted primarily not on learning theories, but on even more general references to European education, postmodernism and globalization. An eminent Italian sociologist has recently pointed out the relative lack of studies dealing with the relations between globalization and education especially in

Italy (Cobalti, 2006). It is also worth noting that in 2007 the Eurydice network was unable to classify Italian school autonomy regulations as pertaining to any school of thought (Eurydice, 2007). In other words, these reforms have lacked any grounding in learning theory or philosophical or theoretical coherence.

If education has been increasingly informed by administrative ideas rather than a coherent understanding of learning, what can we say of this influence? Christopher Hood (2000) has argued that throughout the history of public administration, four broad 'styles' can be discerned. These are fatalist, hierarchist, individualist and egalitarian. The hierarchist (classical bureaucracy), individualist (neo-liberal) and egalitarian (social democratic) approaches are most relevant in Australia, Britain and other Western Democracies.

In Italy, a blend of the four approaches seems to have inspired the reform compromise in the republican era, with the hierarchist possibly prevailing and with recent neo-liberal mainstream propaganda focusing especially on school autonomy yet free from correspondent school evaluations, and on the managerialist idea of "meritocracy". (Eurydice 2007; Cobalti, 2006; MIUR 2003, 2005, 2007, 2010).

This paper examines the implications of these perspectives as they have been applied to education reform in Italy. It is argued that while each has brought some valuable insights and can be demonstrated to have led to some useful change – neither provides a basis for future improvement. Indeed, Italian student outcomes as measured by international comparative studies seem to show that if pursued further, these perspectives will diminish the quality and effectiveness of education. An alternative based on an internally consistent set of assumptions about learning is illustrated. This is based on research into an educational improvement program being undertaken in the public government school system in the State of South Australia. This practical and successful example is used to draw out the limitations of past approaches and provide a grounding point for the development of a set of principles to guide future reform. These principles draw on a well established set of ideas – that of educational systems as 'loosely coupled' – but draw also on recent advances in thinking about the application of complex systems to organisational design and management (Goldspink, C., 2007a, 2007b). Most importantly, however, they are grounded in and consistent with contemporary thinking about the nature of knowledge and learning. Indeed the change process was itself based around learning rather than instrumental and administrative process. The most recent learning theories are thus the third pillar to inform this set of reform principles. These ideas are examined for their relevance to the Italian context. Specific challenges particular to this context are examined to ascertain if the benefits associated with this approach may be able to be realised in Italy. The approach is important to Italian education policy as it offers an option to move beyond long standing ideological debates, political compromise and to allow empirical evidence to drive future innovation in the sector.

Students' cognitive operational stages and students' and teachers' cognitive preferences

Caesar Anton, Technion, Israel; Reuven Lazarowitz, Technion, Israel

The purpose of this study was to investigate the cognitive preferences of 11th grade students and (a) their cognitive operational stages, (b) teachers' cognitive preferences, and (c) students' gender. The study sample included 633, 11th grade biology students and 20 high school biology teachers. Two instruments were used: Biological Cognitive Preferences Inventory (BCPI) for assessing cognitive preferences of students and teachers and; Video–Tape Group Test (VTGT) for assessing cognitive operational stages. The instruments were administered by the researcher, at the 3rd trimester of the academic year. The statistical analysis of BCPI reveals that Principle (P) and Critical Questioning (Q) were the most preferred modes by students and teachers, while Recall (R) and Application (A) were the lowest preferred modes. Analysis of VTGT indicates that only 17% of 11th graders in biology classes have reached the formal operational stage, while 58% and 25% of the study sample have been found in the transitional and concrete stages. The cognitive preferences of students at the concrete stage were high in Recall (R) and Principle (P) modes, while students at the formal stage demonstrated higher level of preferences to Principle (P) and Critical questioning (Q) modes, which is similar to teachers' cognitive preferences. No relationship was found between students' preferences and gender. The results of this study may contribute information to the developers of curricula, textbooks writers and teachers on adapting learning material and instructional strategies to students' cognitive preferences and their cognitive operational stages.

New high school biology curriculum has increased emphasis on four domains: content knowledge, inquiry skills, and attitudes toward science and nature of science. Concepts and principles presented in this curriculum require students to operate on the formal cognitive stage, while studies have shown that only 40% of the high school students are at this operational stage (Adey & Shayer, 1990; Valanides, 1998). Teaching concepts which require formal reasoning from students who are not at this cognitive stage oblige teachers to adequately teach students according to their interests and cognitive preferences (Tamir, 1975), to obtain information on their students' cognitive stage, (Hofstein &

Mandler, 1985), and to develop educational material suited to heterogeneous students population (Witenoff & Lazarowitz, 1993). No studies on students' cognitive preferences and cognitive stages were carried out in the Arab high schools in Israel. This study fulfills this educational need. The construct of cognitive preferences was proposed by Heath (1964) and investigated by Tamir (1975, 1988) and Lazarowitz & Penso (1992) in their studies as a potentially new outcome variable in new science curricula. Heath (1964) suggested the following modes of cognitive preferences: (1) Recall (R): Acceptance of information without consideration of implications, applications or limitations. (2) Principles (P): Acceptance of information because it exemplifies or illuminates a fundamental scientific principle, concept, or relationship. (3) Questioning (Q): Critical questioning of information regarding its completeness, generalization, or limitations. (4) Application (A): Emphasis on the usefulness and applicability of information in a general, social, or scientific context. Research question The main question of this research: Is there a correlation between the cognitive preferences of 11th grade biology students learning according to the new biology curriculum and the following variables: (a) their teachers' cognitive preferences; (b) students' cognitive operational stages; (c) students' gender.

Method

The study was conducted in 18 Arab Israeli high schools during the last semester of the academic year (April ad May). Data was collected with instruments using quantitative approach. Sample In this study were involved 633, 11th grade students (boys, N=206; girls, N=427, 16 to 17 years old) from 18 Arab high schools in Israel. All students studied biology at the five points study level for matriculation exams according to the new biology curriculum. Furthermore 20 biology teachers participated in this study. Instruments Two instruments were used: 1. The Biology Cognitive Preferences Inventory (BCPI) included 28-items designed according to the blueprint of Heath (1964). Every item begins with an introductory statement that is followed by extension statements, each corresponding to one of the four modes described, and all of them are correct, but differ on their cognitive preference. Students are asked to rank the four statements within each item in order of their preference by assigning 4 to the most preferred, and 1 to the least preferred statement. 2. The Video-Tape group Test (VTGT), is based on 12 video-taped tasks designed by Shemesh & Lazarowitz (1988), and used for assessing students' reasoning stages. For each correct answer and explanation, students receive 2 points; for a wrong answer, but correct explanation, 1 point and 0 points for other possibilities.

Procedure

The two instruments were administered in each classroom by the researcher in the following mode: The VTGT was assessed at the first week of the third term of the academic year and the BCPI at the second week of the third term. The instruments answered by students and teachers were coded and analyzed in a non-parametric analysis.

Results

The statistical analysis of BCPI revealed that Principle P is the most preferred mode by students (and teachers), while Application, A is the lowest preferred mode. Analysis of VTGT indicate that only a small percentage of 11th students (17%) have reached the formal operational stage, while 58% and 25% of the sample have been categorized as transitional or concrete thinkers, respectively. It was found that there are differences in cognitive preferences between students which are in different operational stages. Students in concrete stages tend to prefer R () and A modes () while students in formal stage preferred P() and Q modes (). However, the biology teachers tend to prefer P() and Q modes () which is similar to the students' cognitive preferences of the formal operational stage ($F(12,1874) = 9.6, p=0.06$). No significant differences were found between males' and females' cognitive preferences ($F(4,628) = .34, p=n.s., \eta^2=.00$) or students performance on any of the six operational modes.

References

- Adey, P., & Shayer, M. (1990). Accelerating the development of formal thinking in middle and high school students. *Journal of Research in Science Teaching*, 27, 267-285.
- Heath, R. H. (1964). Curriculum, cognition and educational measurement. *Educational and Psychological Measurement*, 24 (2), 239
- Hofstein, A., & Mandler, V. (1985). The use of Lawson test of formal reasoning in the Israeli science education context. *Journal of Research in Science Teaching*, 22(2), 141-152.
- Lazarowitz, R. & Penso, S. (1992). High school students' difficulties in learning biology concepts. *Journal of Biological Education*, 26(3), 215-223.
- Shemesh, M., & Lazarowitz, R. (1989). Pupils' reasoning skills and their mastery of biological concepts. *Journal of Biological Education*, 23(1), 59-63.
- Shemesh, M., Eckstein, S. & Lazarowitz, R. (1992). An experimental study of development of formal reasoning among secondary school. *School Science and mathematics*, 92 (1), 26
- Tamir, P. (1975). The relationship among cognitive preference school environment, teacher's curricular bias, curriculum and subject matter. *American Educational Research Journal*, 12, 235-264.

Tamir, P. (1988). The relationship between cognitive preferences, students' background and achievement in science. *Journal of Research in Science Teaching*, 23, 201-216.

Valanides, N. C. (1998). Formal operational performance and achievement of lower secondary school students. *Studies in Educational Evaluation*, 24, 1-23.

Witenoff, S., & Lazarowitz R. (1993). Restructuring laboratory for junior high school biology students in heterogeneous classroom. *Research in Science and Technological Education*, 11, 225-239.

Detection of strategies to handle multiple choice questions by using an eye tracker

Gun-Brit Thoma, Leibniz-Institute for Science Education, Germany; Inger Marie Dalehefte, Leibniz-Institute for Science Education and Mathematics, Germany

Multiple choice tests play an important role in assessing knowledge, skills and abilities because they are less costly and easy to score, a more reliable measure of knowledge in a limited testing period and they allow greater efficiency than other test formats. However, theoretical perceptions as well as research findings indicate that people do not always use the same strategies to answer the questions in a test. It seems that especially experts and laypersons differ with regard to their strategies due to their different amount of prior knowledge. There is a lack of a systematic analysis of strategies to handle different kinds of questions such as multiple choice questions. The aim of the study is, therefore, to reconstruct the strategies that experts and laypersons use to solve multiple choice questions by using an eye tracker. A sample of different experts and laypersons (N=50) answered a computer-based multiple choice test while an eye tracker recorded their eye movement. We assume that laypersons who have little to no prior knowledge of a topic will probably guess the right answer. In contrast, experts can probably exclude some wrong answers or they can immediately name the correct answer because of their prior knowledge. Analyses of the eye movement are supposed to reinforce our hypotheses. This means the results of the study will reveal experts' and laypersons' strategies to deal with multiple choice questions as well as give in-depth insight into the relationship between processing strategies and eye movement.

Aims

In a number of research areas there is a need to assess knowledge, skills and abilities. One test format which plays an important role in assessment and which is used very often is the multiple choice test. Multiple choice test formats are often chosen because they are less costly and easy to score, a more reliable measure of knowledge in a limited testing period and they allow greater efficiency than other test formats (Bortz & Döring, 2006). This format also plays an important role in large scale studies such as TIMSS and PISA. Based on its popularity and broad acceptance in the test field it is of great importance to acquire more knowledge about the way people handle and process throughout a test. Theoretical assumptions as well as research findings indicate that people do not always use the same strategies to answer and solve questions. It seems that especially experts and laypersons differ with regard to their strategies due to their different amount of prior knowledge and experiences (Chi, 2006; Gruber, 2006). So far little is known about whether experts and laypersons differ in their strategies to answer multiple choice questions. We assume that laypersons who have little to no prior knowledge of a topic will be likely to guess the right answers (Attali & Bar-Hillel, 2003; Bortz & Döring, 2006; Burton, 2001; Burton & Miller, 1999). In contrast experts can possibly exclude some wrong answers or they can immediately name the correct answer because of their prior knowledge. Experts do not have to guess. Thus, there is a lack of systematic analysis of strategies to handle different kinds of questions and tasks. This study is a preliminary attempt to acquire insight into the strategies of experts and laypersons to solve a test by using eye tracking. The eye movements of a person are directly linked to her/his visual attention and can, therefore, give some indication of the strategies used and the extent of knowledge (Joos, Rötting & Velichkovsky, 2002; Funke & Spering, 2006). The aim of the study is to reconstruct the strategies and patterns that experts and laypersons use to answer and solve multiple choice questions using of an eye tracker. The study addresses two research questions:

- a) Which strategies can be identified while solving multiple choice questions?
- b) Which strategies do experts and laypersons use to solve the multiple choice questions?

Methodology

The sample (N=100) consists of persons with different level of knowledge about the topic "human brain". The expert group consists of psychology and medicine students whereas the layperson group consists of students of a topic peripheral discipline like history, business or law. Students fill in a questionnaire (paper-pencil) regarding their individual background. They then answer a computer-based multiple choice test about the topic "human brain". This test fits international standards, has 22 items about facts and functions of the human brain, and distinguishes between persons with different knowledge in this topic. Experts' and laypersons' eye movement are recorded with a stationary eye tracker while they answer multiple choice questions presented one after another. The difficulty of the items and the position of the right answers are varied systematically.

Findings and theoretical significance

This study revealed fundamental knowledge about what kind of strategies experts and laypersons use to solve multiple choice questions. The findings indicate that persons use different strategies based on their pre-knowledge. In summary, data show that experts use more efficient strategies than laypersons. Future research questions concern to what extent these findings can be replicated with other kinds of multiple choice formats. This attempt to explain strategies with respect to multiple choice data is highly relevant for research areas connected to item construction. This means, more knowledge about these strategies can, for instance, supply important information of how these strategies are influenced and what kind of role the position of item distracters plays.

References

- Attali, Y. & Bar-Hillel, M. (2003). Guess Where: The Position of Correct Answers in Multiple-Choice Test Items as a Psychometric Variable. *Journal of Educational Measurement*, 40(2), 109-128.
- Bortz, J., & Döring, N. (2006). *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler* (4. Auflage). Berlin: Springer Verlag.
- Burton, R.F. (2001). Quantifying the Effects of Change in Multiple Choice and True/False Tests: Question selection and guessing of answers. *Assessment & Evaluation in Higher Education*, 26(1), 41-50.
- Burton, R.F. & Miller, D.J. (1999). Statistical Modelling of Multiple-choice and True/False Tests: ways of considering, and of reducing, the uncertainties attributable to guessing. *Assessment & Evaluation in Higher Education*, 24(4), 399-411.
- Chi, M.T.H. (2006). Laboratory Methods for Assessing Experts' and Novices' Knowledge. In: K.A. Ericsson, N. Charness & P.J. Feltovich, *The Cambridge Handbook of expertise and expert performance* (S. 167-184). Cambridge University Press.
- Funke, J. & Spering, M. (2006). Methoden der Denk- und Problemlöseforschung. In J. Funke (Hrsg.), *Denken und Problemlösen. Enzyklopädie der Psychologie, Themenbereich C: Theorie und Forschung, Serie II: Kognition, Band 8*, (S. 647-744). Göttingen: Hogrefe
- Gruber, H. (2006). Expertise. In: D.H. Rost (Hrsg.), *Handwörterbuch Pädagogische Psychologie* (S. 175-180). Weinheim: Beltz Verlag.
- Joos, M., Rötting, M. & Velichkosky, B.M. (2002). Bewegungen des menschlichen Auges: Fakten, Methoden und innovative Anwendungen. In T. Herrmann, S. Deutsch & G. Rickheit (Eds.), *Handbuch der Psycholinguistik*. Berlin/NY: DeGruyter.

What is the Effective way of Preparation? : Interaction with Beliefs about Learning.

Keita Shinogaya, Keio Advanced Research Center, Japan

This study examined the effect of monitoring activity on presented questions during preparation through experimental history classes. In Study 1, 86 Japanese junior-high school students were randomly assigned into the two conditional groups: question-only group, question and monitoring group. In Study 2, 76 junior-high school students were assigned into the three conditional groups: answering-only group, judgment-only group, answering and judgment group. As a result, there was a significant interaction with learners' beliefs about learning. Although some researches mentioned the effect of individual-difference factor on the effect of pre-questions, learners' information processing has never been revealed. The result of this study suggested not only the effect of learners' beliefs but important role of monitoring process. These findings are useful to make concrete suggestions to teachers about what and how to task students as preparation.

Introduction

This study focused on what effects preparation has and how the effect brings about. In daily life, students prepare for the next lecture at home beforehand. To make students' learning effective, we need to reveal the effective way of preparation. According to previous researches about advance organizer, learners can understand the relations between the main facts in the text when they read advance organizer (e.g., summary) beforehand, (Mayer, 1983; Titsworth & Kiewra, 2004). Indeed, the understanding of the causal relationship among the historical events deepened in history class if the learners read the textbook before the lecture (Shinogaya, 2008). But, there was no effect among learners who considered history learning as simply memorizing the historical events (the level of "meaningful learning belief[1]" is low). Therefore, the present studies examined the effective way of preparation for all learners through a series of experimental classes.

Study 1

Purpose According to the previous studies, given adjunct pre-questions enhanced learners' understanding of the text (e.g., Rickards & McCormick, 1988). These results suggest that it may be possible to direct learners' attention to the

causal relations between historical events when they take the lecture if they were given some questions beforehand (e.g., "why this event happened?"). However, taking other researches into account (Thiede et al. 2003), not only giving learners questions but also making them to monitor their current state to the goal is necessary to let the learners' attention to the materials. Therefore, Study 1 examined the effect of monitoring activity on presented questions during preparation. The monitoring activity in this study was to answer the presented questions and to judge their confidence in their answers (e.g., Chi et al., 2001).

Participants, Procedure, and Measures

86 Japanese junior-high school students were randomly assigned into the two conditional groups. Experimental history classes were conducted for 5 days. All participants did preparation with a textbook for 5 minutes, and then took a lecture for 45 minutes. In the lecture, the teacher presented more detailed information about historical events that weren't written in the textbook. During preparation time, participants in questions-only group were given questions that asked causes of historical events. On the other hand, participants in questions and monitoring group were asked to make answers to the questions and to judge their confidence in their answers. Before the 5 days lectures began, the students' beliefs about learning history (meaningful learning belief) were measured with 4 items used in the previous research (Ichikawa, Horino, & Kubo, 1998). Participants responded to each of the items (e.g., "To understand the relations between facts is important in learning history") on a 5-point scale. Mean score of 4 items were used as individual-difference variable. At the 5th day, two tests were conducted. One asked participants to recall the name of the historical events in textbook, and the other asked them to explain the cause of the historical events.

Results

As seen in Figure 1, there was the significant difference between two groups at the score of the causal relation tests ($F(1, 40) = 4.94$, $p(t(37)) = 2.07$, $p(b) = .38$, $p(b) = -.20$, n.s.).

Study 2

Purpose In study 1, the effects of answering to the presented questions and judging of confidence were confounding. Therefore, study 2 revealed the effect of each activity during preparation.

Participants and procedure 76 junior-high school students were randomly assigned into the three conditional groups: answering-only group, judgment-only group, answering and judgment group. During preparation, participants in answering-only group were presented questions and asked to make answers to them. Participants in judgment-only group were presented questions and judged their confidence on their own knowledge about the questions. Participants in answering and judgment group answered to the questions and judged their confidence on their answers. All other procedure was the same as study 1.

Results

As the results of comparison analysis, there was a main effect of answering to the presented questions ($F(2, 54) = 3.08$, $p = .05$). And as shown in Figure 3, there were the interaction with meaningful understanding belief. The belief impacted the test score in the answering-only group ($b = .46$, p

Discussion

Answering-only? judgment-only? answer and judgment meaningful learning belief This study revealed that answering to the given questions during preparation enhanced learners' understanding of the lecture. This finding supported the results of previous researches (Pressley et al., 1990). The result showed that judgment of confidence can direct learners' attention to the questions, and this finding also supported the previous researches about self-regulated learning (e.g., Thiede et al., 2003). Although some researches mentioned the effect of individual-difference factor on the effect of pre-questions (e.g., Ozgungor & Guthrie, 2004), learners' information processing has never been revealed. This study is significant because it suggests not only the effect of learners' beliefs but important role of monitoring process. These findings are useful to make concrete suggestions to teachers about what and how to task students as preparation. In presentation, I will show more detailed data (e.g., relations among learners' answers to the questions, judgment scores of confidence, and test performances) and propose a model of self-regulated learning, regarding the relationship between preparation and lecture. [1] sub category of beliefs about learning that put importance on understanding the relations among facts

Analysis of 1st year university students' personal epistemologies using scenario-based interviews

Jo Brownlee, QUT, Australia; Susan Walker, Queensland University of Technology, Australia; Beryl Exley, QUT, Australia; Sandra Lennox, Notre Dame University, Australia; Sharyn Pearce, QUT, Australia

Personal epistemological beliefs, or beliefs about knowing, provide a way in which to understand learning in a range of educational contexts because they are considered to act as filters for all other knowledge and beliefs, including the beliefs we hold about learning. However such beliefs often remain implicit and recent debate in the field has centred on how best to measure such beliefs. Using semi-structured scenario-based interviews, this study investigated the nature of beliefs about knowing and learning of 35 first year teacher education and creative writing students at a large metropolitan university in Australia. The scenarios drew on direct classroom teaching experiences in order to provide scaffolding for students who typically find questions about knowing and knowledge challenging to address. The focus of this paper is on examining the richness of data that emerged from the scenario-based interviews. The analysis indicated relationships existed between individuals' core beliefs about knowing and their beliefs about learning, suggesting that the scenarios were useful in eliciting core beliefs about knowing.

Introduction

Higher education, in particular the first year of university studies, can be an important time for effecting changes in thinking, particularly in relation to beliefs about learning and knowing (Chai, Khine, & Teo, 2006). Personal epistemological beliefs, or beliefs about knowing, provide a way in which to understand learning in a range of educational contexts because they are considered to act as filters for all other knowledge and beliefs, including the beliefs we hold about learning. However such beliefs often remain implicit and recent debate in the field has centred on how best to measure such beliefs. This paper reports on the effectiveness of using scenario-based interviews as a way to investigate the nature of beliefs about knowing and learning in first year teacher education and creative writing students.

Measuring personal epistemology with scenario based interviews

First year students from a large university in a metropolitan area in Australia were selected at random to participate in a scenario based interview about their beliefs about knowing and learning. Fifteen early childhood preservice teachers, 14 primary preservice teachers, and 6 creative writing students who were in the first year of their undergraduate degrees participated in the interview. An analysis of their scenario-based interview responses is the focus of this paper. The interviews, conducted by the research assistant, were semi-structured scenario-based, and took between 30 to 60 minutes each. The research assistant was trained in how to administer the interview including how to probe in a non-leading manner. Semi-structured interviews are a common method of investigating epistemological beliefs (e.g., Sutton, Cafarelli, Lund, Schurdell, & Bischel, 1996). However, for this study we used scenario-based interviews which were based on the original work of Stacey, Brownlee, Thorpe and Class EAB016 (2005). The scenario was designed to reflect actual classroom practice because it seems students are often challenged by the abstract topic of personal epistemology. Nist and Holschuch (2005) have also used such an approach to interviewing to help students to think about their personal epistemologies. Their research showed that the use of a scenario enabled research participants to be able to articulate their beliefs more clearly. The scenarios in the current study thus were aimed at helping students to reflect on a specific scenario with which they were familiar in their chosen field of study. We ensured that across early childhood, primary and creative writing students, the scenarios used reflected the sorts of experiences they might encounter in their professional experience. With each of the scenarios, the same interview questions were posed, for example: a) Sometimes people talk about there being "right answers" or "truth" in child care/ primary teaching/ creative writing. Do think that anybody's opinion is as good as another's? Do you trust the opinions of experts? b) How would you go about learning something that you needed to know that would help you to be a child care worker/ primary teacher/ creative writer?

Analysing the interviews

The interviews were carefully examined and interpreted using content analysis. As strong traditions of research regarding beliefs about knowing and beliefs about personal learning have provided well defined categories, a theory – driven approach was used to categorise the interview responses. In this study the categorisations used to analyse the data were referred to as objectivism, subjectivism and evaluativism (categories adapted from Kuhn & Weinstock, 2002). Within research regarding beliefs about learning, the categories described by Marton et al. (1993) as quantitative and qualitative have also appeared in many studies over time (e.g., Marton et al., 1993). The researchers used these broad categories as a rubric to analyse the data in this study. A perceived measure of success of the use of scenario- based interviews was the extent to which we would be able to observe these categories of knowing and learning in the interview data. That is, were the students able to articulate clearly what they believed about knowing and learning in order for us to apply these rubrics to the data. Findings from the scenario-based interviews We were able to clearly analyse the interviews using the rubrics described earlier. Data was rich and, for the most part, elaborated to such an extent that enabled us to make reasonably clear determinations on the categorisation of data. Specifically, the interview data revealed that core beliefs about knowing and beliefs about learning were related for these students. We noted patterns of thinking in which 1) evaluativistic beliefs tended to be associated with more qualitative conceptions of learning (sometimes with quantitative views included as part of the pattern) and 2)

subjectivist or objectivist beliefs were related more to quantitative beliefs about learning. ImplicationsThe focus of this paper was to assess the value of using scenario-based interviews as way to gather rich data for analysis of personal epistemologies. We argue that the methodological approach of using scenario-based interviews contributes to this explicit reflection on personal epistemologies. Being involved in such interview processes appears to support students in their explicit reflection on beliefs, particularly in the context of scenarios which provide a more concrete experience for students to reflect upon.

References

- Chai, C. S., Khine, M. S., & Teo, T. (2006). Epistemological beliefs on teaching and learning: A survey among pre-service teachers in Singapore. *Educational Media International*, 43(4), 285-298.
- Kuhn, D., & Weinstock, M. (2002). What is epistemological thinking and why does it matter? In B. Hofer & P. Pintrich (Eds.) *Personal epistemology: The psychological beliefs about knowledge and knowing* (pp 121-144). New Jersey: Lawrence Erlbaum.
- Marton, F., Dall'Alba, G., & Beatty, E. (1993). Conceptions of learning. *International Journal of Educational Research*, 19, 277-300.
- Nist, S. L., & Holschuch, J. P. (2005). Practical applications of the research on epistemological beliefs. *Journal of College Reading and Learning*, 35, 84-92.
- Stacey, P. S., Brownlee, J., & Thorpe, K., & Class EAB016 (2005). Measuring and Manipulating Epistemological Beliefs in Early Childhood Pre-service Teachers. *International Journal of Pedagogies and Learning*, 1, 6-17.
- Sutton, R. E., Cafarelli, A., Lund, R., Schurdell, D., & Bischel, S. (1996). A developmental constructivist approach to pre-service teachers' ways of knowing. *Teaching and Teacher Education*, 12(4), 413-427.

Examining Affordances and Constraints of Epistemic Development through a Vygotskian Lens

Suzanne H. Broughton, Utah State University, United States; LeAnn G. Putney, University of Nevada, Las Vegas, United States

Current research on students' epistemic beliefs relies on Piaget's view of development. This view may not take into consideration the role of experience prior to schooling as a mediating factor. This study examined students' epistemological beliefs through a Vygotskian (1987) perspective on learning and development, placing experience as an integral part of cognition, thus creating opportunities for learning that lead development. We examined small group discussions related to science beliefs in two demographically contrasted 6th grade classrooms. Discursive analytic results indicate a contrast in level of sophistication of student beliefs in the two cases. The primary deciding factor in level of epistemic belief development between these cases is prior experience with the information either within or beyond the schooled setting.

Researchers have studied students' epistemological beliefs by focusing on the fluidity or rigidity of their beliefs, the nature of the concepts being learned, the information source, and how well students can express an argument based on the information (See Hofer & Pintrich, 1997). Their view of development of these beliefs is often credited to Piagetian theory. However, these researchers may not take into consideration the role of experience prior to schooling as a mediating factor in epistemic development. Our aim was to examine students' epistemological beliefs through a Vygotskian perspective on learning and development. Vygotsky's (1978, 1987) work places experience and human activity as an integral part of cognition, which creates opportunities for learning that lead development.

The discourse practices children experience at home later become a means for participating in classroom activities (Hicks, 1995). Hicks further argued that children use this experiential knowledge for structuring school experiences. Children whose prior experiences and discourse practices are consonant with those found in formal classroom settings may learn academic discourses with ease, while if not, they may encounter difficulties.

Theoretical Framework

We examined student's epistemological beliefs from a Vygotskian perspective, rather than the more usually accepted work of Piaget. Vygotsky (1987) viewed use of signs and symbols as mediators of human cognition. Language becomes a tool for developing thought, while we develop language through thought. This interaction of thinking and speech results in experience for the learner, which Vygotsky viewed as a key factor in further impacting the relationship of thinking and speech. Learning and development are reciprocally related, thoroughly situated in culture, and individual development is "a process in which children grow into the intellectual life of those around them" (Vygotsky, 1978, p. 88). Vygotsky (1978, 1987) argued that, while learning systems may be similar among children, these systems cannot be identical for all children because of their differing social experiences.

Epistemological Beliefs

Epistemological beliefs are an individual's beliefs about the nature of knowledge and knowing (Hofer & Pintrich, 1997). Hofer (2000) proposed four independent dimensions of epistemological beliefs including certainty, simplicity of knowledge, source, and justification. Justification is often used by researchers who hold a Piagetian developmental view on epistemological beliefs (Kuhn 2005). In this study we targeted student's beliefs about the nature of science (NOS) because they are epistemic in nature.

Method

We incorporated a text-based intervention and small group discussion with a discursive method of analysis. The discursive analysis was based on the interactional ethnographic orienting theoretical approach (Castanheira, Crawford, Dixon & Green, 2001) to examine dialogic responses of students during small group discussions. While this study did not lend itself to a full ethnographic approach of observing over time, we used the orienting aspect of organizing the discourse accordingly as patterns of who participated in the small group discussions, in what ways, and with what outcomes and consequences related to their NOS beliefs. Discourse and componential cross-case analysis provided tools for uncovering student's NOS beliefs and affordances and/or constraints of prior experience on learning opportunities.

Participants

Students in two 6th grade classrooms participated in separate small group discussions. Students in Classroom 1 (n=23) attended a charter school, were primarily Hispanic (50%) and from lower-income families. Students in Classroom 2 (n=24) attended a private school, were primarily White (88%) and from upper-middle income families. Each discussion group consisted of five or six students, randomly selected from among their peers. Each discussion was led by the first author and lasted approximately 20 minutes.

Intervention

We used Questioning the Author (QtA) (Beck & McKeown, 2006) discussion format. QTA encourages critical analysis of text and encourages students to challenge authority related to text information. The text for this study described the scientific rationale for Pluto's reclassification.

Each discussion was audio taped and transcribed for analysis. From these we purposefully selected two groups as telling cases (Agar, 1994). We analyzed students NOS beliefs within and across the two classrooms.

Results

Sources of Knowledge

The analysis revealed a striking contrast between students in Classroom 1 and 2 regarding sources of knowledge (Table 1). Students in Classroom 1 relied solely upon text information for their answers. Students were typically restating ideas from the text such as "Pluto shares Neptune's orbit and Pluto's round shape."

In contrast, students in Classroom 2 either built upon or diverged from text information. For example, Ryan's answer was based upon an experience of attending an outside-of-school event. This suggests that students in Classroom 2 were relying upon experiences and knowledge gained outside of this particular opportunity for learning.

Challenging Authority

Differences emerged regarding student's NOS beliefs about authority (Table 2). Students in Classroom 1 typically viewed text as an authority source as evidenced by their sole reliance on the text for answering questions. In contrast, students in Classroom 2 commonly relied on prior knowledge and experiences to answer questions.

Students in Classroom 1 viewed scientists as the authority for science knowledge. However, no evidence of this authority belief was exhibited by students in Classroom 2. Rather, students in Classroom 2 were likely to challenge the scientists' decision to reclassify Pluto, suggesting that they do not view scientists as having final authority on science knowledge.

Further, each student in Classroom 2 argued that scientists make mistakes. This view was all but missing from students in Classroom 1, with the exception of one student. This provides further evidence students in Classroom 2 relied on their views that scientists make mistakes as justification for challenging scientists as the authority.

Conclusions

The two cases illustrate how differences in the sociocultural context could constrain opportunities for learning. Students in Classroom 1 relied on the text for answering questions while students in classroom 2 exclusively drew upon outside knowledge. Classroom 1 students may not have had opportunities for prior learning or learning

outside of the classroom that would have afforded them the epistemic beliefs for challenging authority. In contrast, students in Classroom 2 likely had opportunities for developing more sophisticated epistemic beliefs, including the belief that it is okay to challenge authorities. Given that the demographics of these two classrooms were radically different, and that neither teacher had previously taught the material, it appears that the deciding factor between these two is prior experience with the information.

THEMATIC POSTER

Science Education

Teachers' Emotions and Plausibility Perceptions of Human-induced Climate Change

Doug Lombardi, University of Nevada, Las Vegas, United States;

Gale Sinatra, University of Nevada, Las Vegas, United States

Topic emotions can have an appreciable impact on the learning process, particularly for controversial topics (Broughton, Sinatra, & Nussbaum, 2010; Griffith & Brem, 2003). Controversial topics may elicit strong emotions that could influence a plausibility judgment about the topic's message. Individuals—especially those who are not disposed to think deeply—may judge a message to be of lesser plausibility based on their emotions, and therefore, would not evaluate the quality of that message in comparison to their background knowledge (Chinn & Brewer, 2001). In such a case, individuals may not engage deeply in the topic and their learning would be reduced. This study examined the relationships among teachers' emotions about human-induced climate change, their plausibility perceptions, background knowledge of weather and climate distinctions (an important scientific principle related to understanding climate change), and needs for cognition and closure. Eighty-five teachers participated in the study and we found that topic emotions, specifically anger, shame, and hopelessness, were significant predictors of teachers' plausibility perceptions of human-induced climate change. More anger resulted in judgments of lesser plausibility, whereas greater shame and hopelessness resulted in greater plausibility. Need for cognition did not predict plausibility, but one subcomponent of need for closure—decisiveness—was significantly related, with greater decisiveness related to lesser plausibility perceptions of human-induced climate change.

Purpose of the Study

Strong emotions are associated with the topic of human-induced climate change (Moser, 2007) and teachers may have adverse feelings when teaching about climate change. In another controversial topic—biological evolution—teachers may experience appreciable anxiety when teaching. Because of their anxiety, teachers may avoid discussing sensitive aspects of evolutionary theory with their students (Griffith & Brem, 2004). Anxiety and other strong emotions could discourage teachers from promoting mastery-level learning in their students (Linnenbrink, 2007).

Emotions based on the instructional topic (e.g., human-induced climate change) may also interfere with cognitive processes (Pekrun, Frenzel, Goetz, & Perry, 2007). For example, individuals use plausibility judgments to evaluate the compatibility of incoming information (Chinn & Brewer, 2001) with their background knowledge (Connell & Keane, 2004). Therefore, when exposed to scientific evidence, individuals may evaluate data quality based on their plausibility perceptions. Strong topic emotions may either raise or lower plausibility perceptions and severely limit this evaluation. An individual's inclination toward a particular view of knowledge (e.g., seeking closure; Kruglanski, 1989) may enhance the effect of strong emotions on plausibility perceptions. However, this effect may be dampened by individuals who are epistemically disposed toward a high need for cognition (Cacioppo, Petty, Feinstein, & Jarvis, 1996).

The purpose of this study is to examine the relationship between background knowledge, needs for cognition and closure, topic emotions and plausibility perceptions. We specifically asked the question: how do background knowledge about weather and climate distinctions (an important conception related to climate change), need for cognition and closure, and topic emotions predict plausibility perceptions of human-induced climate change? We hypothesized that there would be a significant relationship between the predictors and plausibility perceptions.

Methods

Eighty-five teachers participated in the study. Forty were in-service science teachers from a school district in the southwestern United States, who were enrolled in professional development workshop. The remaining 45 were pre-service teachers from the same district enrolled in a local university's science methods course. Participants ranged in age from 24 to 60 ($M = 33.0$, $SD = 11.7$), with 0 to 35 years of teaching experience. The participants were predominantly female (75%) and white (76%).

Participants completed five questionnaires: (a) emotions about human-induced climate change (and teaching about climate change), (b) knowledge of weather and climate distinctions, (c) plausibility perceptions of human-induced climate change, and (d) needs for cognition and (e) closure. The participants completed the questionnaires prior to any instruction about climate change using an online electronic survey tool.

We created the Emotions about Teaching Human-Induced Climate Change questionnaire, containing five items. Participants read statements about human-induced climate change (the first three items) and teaching about the topic (the last two items), then rated how well ten different emotions reflected their intensity of feelings about the statement using a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree). The ten emotions are anger, anxiety, boredom, curiosity, fear, frustration, happiness, hopelessness, shame, and surprise.

We used the 13-item Distinctions between Weather and Climate Measure (DWCM; Authors, 2010) to measure background knowledge. The DWCM has 13 statements that participants classified as being either “weather” or “climate.” To assess participant plausibility perceptions of human-induced climate change, we used the Plausibility Perceptions Measure (PPM; Authors, 2010). Participants rated the plausibility of eight statements about climate change culled from the latest report by a United Nations’ expert panel (Intergovernmental Panel on Climate Change, 2008). Participants rated each statement on a 10 level scale (0 = greatly implausible or even impossible and 10 = highly plausible).

Cacioppo et al. (1996) developed the Need for Cognition Scale, which has 18 items measuring the extent to which people engage in and enjoy effortful cognitive activities. Webster and Kruglanski (1994) created the Need for Closure Scale examining students’ “motivation with respect to information processing and judgment” (p. 1049). This instrument has 42 items where participants rate their need for—or desire to avoid—cognitive closure. The instrument includes five subscales measuring: (a) preference for order, (b) discomfort with ambiguity, (c) decisiveness in judgment, (d) affording predictability, and (e) close-mindedness.

Results

We conducted two multiple regression analyses to examine the relationship between the predictor variables (DWCM, needs for cognition and closure, and topic emotions) to PPM (the criterion variable). The first regression (Model 1) includes only topic emotions that individuals have about climate change (see Table 1, only key variables included for conciseness). There was a significant relationship between the predictors and PPM, $F(17,67) = 3.49$, $p < .001$, with $R^2 = .469$. Specifically, hopelessness and shame about human-induced climate change were significant predictors, where a higher intensity of emotion resulted in greater plausibility. In Model 1, background knowledge and needs for cognition and closure did not significantly contribute to prediction of plausibility.

Model 2 includes only emotions about teaching climate change (see Table 2, only key variables included for conciseness). There was a significant relationship between the predictor variables and PPM, $F(17,67) = 1.85$, $p < .039$, with $R^2 = .319$. Anger about teaching climate change and decisiveness (a need for closure subcomponent) were significant predictors, with greater anger and decisiveness resulting in lower plausibility judgments. In Model 2, background knowledge, and need for cognition did not significantly contribute to prediction of plausibility.

Importance of the Study

Earlier studies have shown a relationship between anxiety and teaching about biological evolution (Griffith & Brem, 2003). This study reveals a relationship between anger, shame, and hopelessness to the controversial topic of climate change, providing additional evidence for topic emotions that may impact instruction. As Broughton, Sinatra, and Nussbaum (2010) state, individuals can “exhibit overall enjoyment of science learning, [whereas] a specific topic, may unexpectedly trigger negative emotions” (p. 32). Furthermore establishing a relationship between topic emotions and plausibility perceptions may provide insight into how controversial topics are taught. That is, teachers may bring these negative emotions to the classroom when they teach about climate change. This research begins to shed light on how emotions may influence the teaching and learning of controversial topics.

Children as co-researchers: children’s views from collaborative science inquiries

Charles Max, University of Luxembourg, Luxembourg; Chris Siry, University of Luxembourg, Luxembourg

The aim of this research work is to analyse the process of 4 to 6 year-old children's learning of science by focusing on how these children document and comment their lived and co-elaborated experiences during and immediately after open science learning activities. Drawing from a longitudinal corpus of classroom interactions (200 h), this excerpt is part of a larger three-year study (2008 - 2011) conducted in five Luxembourg pre-school and elementary schools. The

research project is exploring the nature of young children's science learning as a social phenomenon that is interactively achieved, discursively bound and contextually mediated. Of particular interest are the multiple resources, which young learners bring from socio-cultural, institutional and historical contexts and, which they use to make meaning about water phenomena through interactive practices and multimodal talk-in-interaction. The poster will display the multi-dimensional framework of the study based on a thorough combination of sociocultural, interactional and micro-ethnographic perspectives in order to frame „doing science" in collaborative learning activities as a cultural enactment. The data for the study were collected in the spring semester of 2009-2010 academic year via participatory observation, video and document analysis, interviews with teachers and pupils. This research poster informs about the challenges, the process and the outcomes of involving young children as active researchers in the enquiry work of a project on early science learning in pre- and primary school.

Subject

Developing scientific literacy from young age on is the focus of numerous educational reforms internationally during the past decades. In order to shed light on the learning processes of children as they collaborate in early science, this study focuses on interactive practices of children when "doing science" in early childhood classrooms with a complex multilingual background. More specifically, the research analyses the mutual accomplishment of the particular learning context through children's joint acting with equipment and their multimodal interactions. We conceive science learning as an interactional achievement, one that encompasses the enactment of elementary science as culture and as a cultural accomplishment. This enactment unfolds through a dynamic, non-linear and creative combination of culturally given tools and the children's specific linguistic repertoires and discourse formats that they develop across multiple contexts.

Rationale

The rationale behind the present research is to explore the nature of young children's science learning as a social phenomenon that is interactively achieved, discursively bound and contextually mediated. A further issue concerns the multiple resources of young learners, they draw upon when making meaning about water phenomena through multimodal interactive practices. The following questions are guiding the research:

- How do 4 to 6 year-old children display their understanding about water phenomena?
- How does the multimodal nature of children's ways of doing, arguing, reasoning, imagining, re-presenting and talking about water phenomena allow construction of a collaborative framework for exploring the specific science phenomena?
- How does the context-sensitive organization of talk and multimodal interactions of the children shape promising opportunities for science learning in an early education class?

This poster presents challenges, processes and outcomes of the research's initiative to involve 4 – 8 year-old children as active researchers in this project on science learning in pre- and primary school. We understand students as co-researchers when they participate in collecting and analysing research data and inferring imaginable actions (Fielding, 2001). There is a growing body of research (Christensen & James, 2000; Mason & Urquhart 2001; Punch, 2002; Alderson & Morrow, 2004; Flutter & Ruddock, 2004), which involves children as participants and co-researchers and addresses the various ways, they might be actively involved (Darbyshire et al., 2005). Arguments to involve children actively as co-researchers in a multi-method framework are manifold as this allows to a) get a richer and multivoiced evidence, b) overcome unfocused and incomplete perspectives on the processes under inquiry, c) using a more appropriate way of talk as means to access children's views d) start a dialogue with participants in the study who get the chance to reply to data and intermediary findings from an external lens, d) empower the research participants in the area of enquiry (Kellet, 2009, 2010), e) broaden the unit of analysis while keeping the empirical part still manageable (Matusov, 2007).

Multi-method framework

The study is framed by a multi-dimensional approach based on a thorough combination of different research perspectives. In particular, these perspectives include cultural historical perspectives on human activity (Daniels et al., 2010), sociocultural approaches on learning as cultural enactment (Goodwin, 2007), conversational analytic perspectives on learning as an interactional achievement (Melander & Sahlström, 2009) and micro-ethnographical discourse analyses to conceptualizing "doing science" as a cultural accomplishment (e.g., Schlieben-Lange, 1983).

Our multi-method data gathering framework engages children actively in the research process. As we explore what children value in science activities, we acknowledge their voice in the learning process. This allows us to collect their unique insider-perspective on the joint learning process, and to get access to their understandings of the phenomena under scrutiny. Additionally, their own recordings allow us to analyse their discursive practices as enactments of elaborate science, demonstrating representations of science concepts but also the conditions of such science accomplishments.

Research design/ context

Drawing from a longitudinal corpus of classroom interactions (age 4-8), this excerpt is part of a larger three-year study (2008 - 2011) conducted in five schools. By working in collaboration with early childhood teachers, this project documents the emergence of practices through which children co-construct science as a discursive accomplishment, while simultaneously supporting teachers in implementing science activities and expanding inquiry-based approaches. Small handheld video cameras give the children the possibility to a) collect jointly relevant moments of their inquiry activities, b) to express their findings, insights or thoughts in multimodal ways during or immediately after joint science activities. This device gives the students freedom to record important moments without an adult filter and to talk by using own discursive formats.

All the recordings (200 hours) have been organised within a searchable database using Transana, an open-source software (Woods, 2007). They serve as the main data source for the current analytic work. Key episodes are being transcribed in relation to the core research questions. The transcripts serve to analyse the dynamics of speech while children interact (1) in small groups during inquiry activities, and (2) during classroom talk, teacher initiated.

Findings / Analysis

The project has generated tangible outcomes about the multimodal, and discursive ways of young children's enacting of knowledge and reasoning about science topics. In considering the ways children develop shared meanings, the initiative of involving multilingual children as co-researchers allows to considerably increase insights in the genuine features of knowledge building through participating in emerging multimodal and multilingual discourses. In our case, the spontaneous scientific discourse – featuring both specific conceptual content and scientific inquiring – and the children's extended comments on pictures, video clips... from their data collection allowed a richer understanding of their conceptual frameworks (understood as enrichment or reorganization processes) as enacted through discourse during multilayered interaction.

Analyzing and cognitive modelling of strategies in science education

Sascha Bernholt, IPN Leibniz-Institute for Science Education, Germany; Jan Lenk, University of Oldenburg, Germany; Claus Moebus, University of Oldenburg, Germany; Ilka Parchmann, IPN Kiel, Germany

The use of a specific language supports scientists to grasp their ideas, share their thoughts, and solve problems. For example, the application and interpretation of chemical formulae is crucial for chemists, but also one of the most difficult and unpopular topics in chemistry education. To develop successful didactical approaches, more insights in learning strategies and difficulties are required. We address this issue with an integrated approach involving educational research, neuroimaging, and cognitive modelling.

A computer-based learning environment was developed to answer the question, which strategies students develop to match different types of representations. Students from introductory chemistry courses (N=418) responded to tasks that required the matching of formulae with their respective names and appropriate particle models. They were asked for the strategies they used to identify the underlying rules of this symbolic language at specific time points within the learning environment (open-ended questions) and in additional interviews (N=8). The results show that students' strategy quality increased slightly, but significantly, over the course of the learning environment.

Further 63 students took part in a fMRI study, working on tasks about formulae, too. Based on the strategy questions and the interview results, different strategies were modelled using ACT-R. Comparing the strategy-dependent module-region correlations between measured and predicted BOLD-curves show mixed results. The modelled strategies differ in their implementation and need further revisions but the obtained results provide already a firm footing.

Theoretical background

The use of a specific language supports scientists to grasp their ideas, share their thoughts, and solve problems (Krajcik & Sutherland, 2010). For example, the application and interpretation of chemical formulae is crucial for chemists, but also one of the most difficult and unpopular topics in chemistry education for students and even freshman students, as numerous studies revealed (Schmidt, 1997). Problems are mainly referred back to difficulties in connecting different levels of representation (macroscopic, submicroscopic, symbolic/mathematical). However, these problems do not only pertain to the use of chemical formulae but to a large array of topics and concepts across the science domains (DeJong & Taber, 2007).

Research indicates that novices and experts apply different strategies when solving science problems (Williams & Noyes, 2007). Accordingly, strategy use is a major predictor for achievement in scientific problem solving situations (Taasobshirazi & Glynn, 2009). A model to explain complex behaviour in science domains is the Adaptive Control of Thought-Rational (ACT-R) theory (Anderson et al., 2004). This cognitive architecture can be used to quantify and visualise the relationships among cognitive variables involved in learning and problem solving. In addition, Anderson (2007) postulates a neurophysiological analogy between the cognitive architecture and particular brain regions. These regions are captured within ACT-R by a set of seven modules with specific functions. Assuming the viability of the brain mapping assumption, the modules predict BOLD signals for the corresponding brain regions, making it possible to compare BOLD signal predictions generated from strategy-specific ACT-R models with BOLD signals obtained from actual fMRI scans (Mßbus & Lenk, 2009; Mßbus et al., 2010).

Research questions and methods

In order to develop successful didactical approaches, more data and results about learning strategies and difficulties are required. We address this issue with an integrated approach involving educational research, neuroimaging studies, and cognitive modelling. We focused at first on students in introductory chemistry courses as complex problem solving activities require multiple strategies, leading to a large variety of individual pathways and solution methods. A computer-based learning environment was developed to answer the research question, which strategies students develop to match different levels of representation.

Students (aged 10 to 13 years; N=418) responded to tasks that required the matching of chemical formulae with their respective names and appropriate particle models (intervention time: 90 min). They were asked for their used strategies to identify the underlying rules of this symbolic language at specific time points within the learning environment (open-ended questions) and in additional interviews (N=8). Further 63 students took part in a fMRI study, working on tasks about formulae, too. Based on the strategy questions and the interview results, different strategies were modelled using ACT-R. With Bayesian identification analysis the problem solving strategies were matched to participants. Finally, the strategy-based predictions of BOLD-curves were compared to the obtained fMRI data.

Results

The results show that students without prior knowledge and training in chemistry classes are able to understand the basic characteristics of chemical formulae and simple particle models. The students expressed 25 procedures to match formula and names (partially combinations). These were categorized into six levels of strategy quality. Over the course of the learning environment, the strategy quality increased slightly, but significantly (one-way repeated-measures ANOVA, $e = .98$, $F(1.96, 777.9) = 108.54$, $p < .001$). In addition, the quality of the applied strategy correlates with the obtained scores ($r = .22$, $p < .001$).

Four different major strategies of the students were modelled using ACT-R. The individual BOLD curves for the trials were aggregated onto a trial template of 10 scans. Comparing the strategy-dependent module-region correlations between measured and predicted BOLD-curves for the 10-scan template shows mixed results. For six out of seven modules correlations between .73

The project design and results show that combinations of methods and data from different disciplines offer in-depth coverage of complex learning processes. These insights help to identify students' strategies when solving problems in a self-paced manner. However, the range of possible interpretations especially with regard to the results of neuroimaging studies is still limited. Further research is needed to bridge the gap between the different disciplines and to develop descriptive and prescriptive models of student learning (Mason, 2009).

References

- Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y. (2004). An integrated theory of the mind. *Psychological Review*, 111, 1036–1060.
- Anderson, J. R. (2007). *How Can the Human Mind Occur in the Physical Universe*. Oxford: University Press.
- De Jong, O. & Taber, K. S. (2007). Teaching and learning the many faces of chemistry. In S. K. Abell, N.G. Lederman, *Handbook of research on science education* (pp. 631-652). Mahwah, NJ: Lawrence Erlbaum Associates.
- Krajcik, S. & Sutherland, L. M. (2010). Supporting Students in Developing Literacy in Science. *Science*, 328, 456-459.
- Mason, L. (2009). Bridging neuroscience and education: A two-way path is possible. *Cortex*, 45, 548-549.
- Mßbus, C. & Lenk, J. C. (2009). Bayesian identification of problem-solving strategies for checking the ACT-R/Brain-mapping hypothesis. In U. Schmid, M. Ragni, & M. Knauff (Eds.), *Proceedings of the KI 2009 Workshop on Complex Cognition* (pp. 37-47). Retrieved from <http://www.opus-bayern.de/uni-bamberg/volltexte/2009/212/> (last access: 2010-10-28).

Mßbus, C., Lenk, J. C., Claassen, A., Özyurt, J., & Thiel, C. M. (2010). Checking the Brain Mapping Hypothesis: Predicting and Validating BOLD Curves for a Complex Task Using ACT-R. In D. D. Salvucci & G. Gunzelmann (Eds.), *Proceedings of the 10th International Conference on Cognitive Modeling 2010* (pp. 163-168). Philadelphia, PA: Drexel University.

Schmidt H.-J. (1997). Students' misconceptions - looking for a pattern, *Science Education*, 81(2), 123-135.

Taasoobshirazi, G. & Glynn, S. M. (2009). College students solving chemistry problems: A theoretical model of expertise. *Journal of Research in Science Teaching*, 46(10), 1070-1089.

Williams, D. J. & Noyes, J. M. (2007). Effect of experience and mode of presentation on problem solving. *Computers in Human Behavior*, 23, 258-274.

Cognitive Processes for Solving Physics Tasks in Upper Secondary Education

Bettina Kreiter, Universität Duisburg Essen, Germany

The goal of this research project is to describe the cognitive processes that are needed for solving physics tasks in upper secondary education; this description would, in theory, help develop a model of competence, which does not yet exist for upper secondary education. The theoretical cognitive processes will be empirically validated by measuring students' cognitive processes, analyzing tasks and measuring competence. The use of this psychological knowledge is important to properly create a category system of cognitive processes for solving physics tasks in upper secondary education. Our main question, which is present at the moment, is how to validly measure and define the cognitive processes that students use while solving physics tasks.

References:

Anderson, Lorin W. und Krathwohl, David R., Hg. (2001). *A Taxonomy for Learning, Teaching, and Assessing. A Revision of Bloom's Taxonomy of Educational Objectives*. New York, Addison-Wesley Longman, Inc.

Bloom B. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.

Mayer, R. E. (2003). *Learning and instruction*. Upper Saddle River: Pearson Merrill Prentice Hall.

Ropohl, M. (2010). *Modellierung von Schülerkompetenzen im Basiskonzept Chemische Reaktion: Entwicklung und Analyse von Testaufgaben*. Berlin: Logos Verlag

Schecker, H., Parchmann, I. (2006). Modellierung naturwissenschaftlicher Kompetenz. *Zeitschrift für Didaktik der Naturwissenschaften*; Jg. 12, S.45-66.

Sekretariat der Ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland [KMK]. (2004b). *Einheitliche Prüfungsanforderungen in der Abiturprüfung Physik*.

Walpuski, M., Kampa, N., Kauertz, A. & Wellnitz, N. (2008). Evaluation der Bildungsstandards in den Naturwissenschaften. *Der mathematische und naturwissenschaftliche Unterricht* (61), S. 323-326.

Fostering representational competence considering students' preconceptions in ray optics

Rosa Hettmannsperger, University of Koblenz-Landau, Campus Landau, Germany; Wolfgang Schnotz, University of Landau, Germany; Andreas Mueller, University of Geneva, Switzerland; Jochen Kuhn, University of Landau, Germany; Wieland Mueller, University of Landau, Germany; Sibel Telli, Universität Koblenz-Landau, Campus Landau, Germany

It is a well-known fact in science education that creating multiple representations plays an essential part in understanding science. The special difficulty in physics stems from the fact that students already have developed physical concepts based on everyday experiences. Their common-sense understanding interacts with the new knowledge acquired in school. This research aims to implement instructions which take into consideration common misconceptions in order to support students in creating "scientifically appropriate" representations. The study was designed as pre-and post-test quasi-experimental design. Students of two classes of the 8th grade in one grammar-school formed real pictures by using a spherical concave mirror. As a result, there are some indications that instructions adapted to widespread misconceptions – while operating on representations – improves students' conceptual understanding more than encouraging the use of various representations alone.

1. Theoretical background

There is a broad consensus among science education researchers and cognitive scientists that students need to develop and understand multiple representations to deal with scientific concepts.

Representational competence means the ability to generate and use different representations in a skilled way and implies understanding how to co-ordinate and to translate different kinds of representations with equivalent meanings into another (Rost 2006).

The special difficulty in physics stems from the fact that students' former schemata are composed of physical concepts based on everyday experiences. Students' beliefs about how the world works are often in contrast to scientific explanations of physical phenomena (Wiesner 1992; Duit 1993).

Following recent research on conceptual change and cognitive science in physics education (Tyson, Venville, Harrison & Treagust 1997, diSessa 2008; Treagust & Duit 2008; Hubber, Tytler, & Haslam 2010), instructions were developed that take into consideration students' prior knowledge being reflected in external representations in order to support students in creating "scientifically appropriate" representations.

2. Research questions

- Are tasks, which demand overcoming common misconceptions by dealing with and operating on domain specific representations in order to be solved, useful to foster representational competences in ray optics?
- To what extent do these tasks help students to improve knowledge and problem-solving in ray optics?
- To what extent do these tasks help students to improve their conceptual understanding in ray optics?

3. Hypothesis

- Students whose prior knowledge about picture formation was taken into account will outperform students who have been taught the same issue, but whose prior knowledge was not addressed, in knowledge and problem solving concerning picture formation.
- Students whose prior knowledge about picture formation has been taken into account will outperform students who have been taught the same issue, but whose prior knowledge has not been addressed in their general conceptual understanding of ray optics.

4. Methods

In a quasi-experimental pre-and post-test study students of two classes of the 8th grade in a German grammar-school were taught by the same teacher to form real pictures produced by a spherical concave mirror. Both treatment and control condition included 3 lessons. Furthermore, pre- and post-tests demanded one class hour in each case. The sample ($n = 57$) included 24 boys and 33 girls.

The treatment condition included instructions adapted to common misconceptions about picture formation (Goldberg & McDermott 1987; Reiner, Slotta, Chi & Resnick 2000). In contrast, students' ideas about this issue were not addressed in the control condition. In both conditions students were encouraged to deal with various kinds of representations. Two tests were implemented before and after the lessons: a curricular valid achievement-test with regard to ray optics and a concept-test based on existing results on students' concepts in ray optics (Goldberg & McDermott 1987, Wiesner 1992)

5. Results

Students in both conditions improved significantly both in knowledge and problem-solving ($MTG_{pre} = 5.27$, $MTG_{post} = 10.24$, $MCG_{pre} = 8.25$, $MCG_{post} = 12.32$, see Figure 1, p $MTG_{pre} = 19.39$, $MTG_{post} = 30.22$, $MCG_{pre} = 21.5$, $MCG_{post} = 26.04$, see Figure 2, p p). We assumed that tasks in both conditions were useful to foster students' experimental competences in ray optics (see research question one). An ANCOVA revealed no significant differences between both groups in the post-achievement-test. As a consequence, the first hypothesis could not be verified. However, an ANOVA indicates that both groups differed in their augmentation of conceptual understanding measured in the concept-test ($p = .005$). Students in the treatment condition improved more than students in the control condition, ($F = 8.655$, $\omega^2 = .13$). For this reason, the second hypothesis was confirmed.

6. Discussion

The present study shows that a relatively short intervention taking into account widespread preconceptions can lead to a significant and practically important improvement of conceptual understanding.

A follow up study with a larger sample size ($n \approx 500$) will be performed in November 2010. The following additional variables will be collected: intelligence, motivation in physics lesson and former achievement in subjects, which could exert an influence on representational competences in ray optics, such as physics, mathematics and German language. Students' worksheets will be collected to analyze how students operate on self-developed and given external representations. Long-term effects will be checked by repeating the post-tests six months after the intervention. In addition, think aloud interviews will be conducted with a small part of the sample ($n \approx 30$) after the intervention and the post-test.

7. References

- diSessa, A. (2008). A bird's eye view of the "pieces" vs "coherence" controversy (from the "pieces" side of the fence). In Vosniadou, S. (Ed.), *Handbook of research on conceptual change* Mahwah: Erlbaum, 35 – 60.
- Duit, R. (1993). Alltagsvorstellungen berücksichtigen! *Praxis Naturwissenschaften Physik*, 42 (6), 7 – 11
- Goldberg, F.M. & McDermott, L. C. (1987). An investigation of student understanding of the real image formed by a converging lens or concave mirror. *American Journal of Physics*, 55 (2). 108 – 119.
- Hubber, P.; Tytler, R. & Haslam, F. (2010). Teaching and Learning about Force with a Representational Focus: Pedagogy and Teacher Change. In *Research in Science Education*. 40 (5), 5 – 28.
- Reiner, R., Slotta, J.D., Chi, M.T. H., Resnick, L.B. (2000). Naive Physics Reasoning: A Commitment to Substance-Based Conceptions. *Cognition and Instruction*, 18 (1). 1 – 34.
- Rost, D. H. (Ed. 2006). *Handwörterbuch Pädagogische Psychologie*, 3. Auflage, Beltz Psychologie Verlags Union, Weinheim.
- Treagust, D. & Duit, R. (2008). Conceptual change: a discussion of theoretical, methodological and practical challenges for science education. *Cultural Studies of Science Education* 3 (2), 297 – 328.
- Tyson, M. L., Venville, G. J., Harrison, A. G. & Treagust, D. F. (1997). A multidimensional framework for interpreting conceptual change events in the classroom. *Science Education*, 81 (4), 387 – 404.
- Wiesner, H. (1992). Schülervorstellungen und Lernschwierigkeiten mit dem Spiegelbild. *Naturwissenschaften im Unterricht – Physik*. 3 (14), 16 – 18.

Changes in self-regulated learning in first-year students of a university of applied sciences

Barbara Otto, Institut of Psychology, Germany; Daria Mueller, University of Frankfurt, Germany

How does students' self-regulated learning (SRL) change during their first semester? Can features of the learning context predict the extent of SRL? And can students' academic achievement be predicted by students' SRL and learning context? The present study approached these research questions and surveyed 114 first-year students in the fields of architecture and civil engineering. Based on a process model of self-regulation a student questionnaire was developed to assess various components of SRL and features of the learning context. This instrument was applied at the very beginning (t0), at the end of the first semester (t1), and at the end of the second semester (t2). Additionally, at the pretest cognitive abilities were assessed as control variable by five subtests of WIT-2. Furthermore, data of students' academic achievement (grades, credit points) will be reported to us soon. Concerning the development of SRL during the first semester t-tests for dependent samples were conducted and revealed a significant gain in students' overall SRL. Additional linear regression analyses revealed that the perceived learning context accounts for 23% of students' SRL at t1, whereas it even accounts for 48% of students' SRL at t2. Further regression analyses are pending relating to the question whether SRL and the perceived learning context can predict academic achievement even after controlling cognitive abilities. Conclusions to be drawn in theory and practice will be discussed at the end of the presentation.

Objectives

Every person's life is a chain of learning processes. Being able to regulate one's own learning processes is seen to be the key to successful learning in school and beyond (Boekaerts, 1999). Thus, it is assumed, that self-regulated learning (SRL) significantly determines differences in academic achievement even beyond students' cognitive abilities. Accordingly, many empirical studies have already revealed that the extent of SRL is positive associated with academic achievement (e.g. Fuchs et al., 2003; Pintrich, 2003; Zimmerman & Martinez-Pons, 1986).

Especially critical academic phases, such as the transition to higher education, require the basic ability to learn in a self-regulated way but can also be seen as challenge to further develop these competencies. Only those students who can deal with the higher academic demands in a self-regulated way will persist in their field of study and finally graduate. Hence, if students lack in SRL competencies this might lead to an early drop out of their program at the university.

Actually, recent studies concerning the retention of students at German universities (HIS, Heublein et al., 2008, 2010) showed that about 30% of German students drop out of their bachelor program without a degree. This percentage is even higher at universities of applied sciences: Here, 39% of the enrolled students discontinue. This drop out particularly happens within the first two semesters before the first intermediate examinations are done. One reason of this discontinuity might be seen in a low level of SRL competencies at the beginning of first semester and/or in a lacking development of SRL competencies within the first semesters. As student retention is a key issue particularly at universities of applied sciences the examination of the extent and the development of first semester students' SRL competencies as well as the particular conditions which promote positive developments in SRL are of great interest. Speaking of these conditions in the present study the assumptions of self-determination theory (Deci & Ryan, 1985) can also apply for the development of SRL as SRL is always a self-determined action. Thus, it is presumed that the

perceived learning context plays an important role in students' SRL and consequently also in students' academic achievement.

Therefore, the following research questions are addressed in the present study:

1. How does students' SRL change during the first semester at a university of applied sciences?
2. Can features of the perceived learning context predict the extent of SRL?
3. Can students' academic achievement be predicted by students' SRL and perceived learning context even after controlling for their cognitive abilities?

Theory

Self-regulation

Based on a process model of self-regulation (Zimmerman, 2000) the learning process is divided into three consecutive phases: pre-action, action, and post-action. In pre-action the given assignment and the particular conditions in the learning environment initiate the beginning of the SRL processes by evoking certain motivational and emotional tendencies within the learner. If the learner is not intrinsically motivated or shows low self-efficacy he needs to apply self-motivating strategies. Under these conditions the student has to set goals for his learning. Moreover, the learner will have to plan the application of learning strategies as well as the time he is going to invest. Afterwards, the learner starts with learning (action). He will apply different learning strategies as well as volition strategies. In case the learner deviates from his planned learning behavior it is beneficial if he self-monitors his actual behavior. Finally, a learning outcome results. In post-action the student has to compare his actual result with his prior set goal. Hereby, he also has to evaluate whether the final result can be interpreted as success or failure. Furthermore, he will also reflect how he approached the given task. Consequently, certain emotions (e.g. satisfaction) will arise depending on whether the task was successfully solved or failed. These subsequent emotions and evaluations have an impact on future learning, as they can lead to modifications in planning strategies and time or in setting goals.

Learning context

SRL is always accomplished in a particular learning context. This learning context can be more or less supportive for the development of SRL. According to self-determination theory (Deci & Ryan, 1985) the maximum of self-determination and thus also of SRL can only be reached if the learning context satisfies three basic needs of a learner, namely the need for autonomy, the need for competence, and the need for relatedness. Usually, teaching staff at a university designs the learning context of the students. Therefore, the teaching staff is supposed to have a significant impact on students' SRL.

Method

To approach the research questions 114 first-year students in the fields of architecture and civil engineering of a university of applied sciences were surveyed. Their average age was 22.05 years ($SD=2.95$), and 65% of them were male. In order to assess the longitudinal data a student questionnaire was developed to assess SRL (63 items, $\alpha=.85$) and features of the perceived learning context (12 items, $\alpha=.68$). This instrument was applied at the very beginning (t_0) as well as at the end of the first (t_1) and second semester (t_2). Additionally, at the pretest cognitive abilities were assessed as control variable by five subtests of WIT-2. Furthermore, data of students' academic achievement (grades, credit points) at the end of the second semester will be reported to us by the university soon.

Results

Concerning the development of SRL during the first semester t-tests for dependent samples were conducted and revealed a significant gain in students' overall SRL ($T=2.21$, p Additional linear regression analyses controlling for cognitive abilities revealed that the perceived learning context accounts for 23% of the extent of students' SRL at the end of the first semester, whereas it even accounts for 48% of the variance in students' SRL at the end of the second semester. Further regression analyses are pending relating to the question whether SRL and the perceived learning context can predict academic achievement, even after controlling cognitive abilities. Conclusions to be drawn in theory and practice will be discussed at the end of the presentation.

THEMATIC POSTER

Social Aspects of Learning

Perception Of Relevance, Frequency, Impact And Seriousness Of Suffering And Wellbeing States

Daniela Raccanello, University of Verona, Italy; CAMILLA GOBBO, University of Padova, Italy

Considering the extant literature, it is possible to draw indications on how children represent physical or psychological suffering and wellbeing states from studies focused on themes such as memory of positive and negative events, concepts of health and illness, or ability to distinguish bodily and psychological domains. However, our knowledge on children's representation of internal states deriving from negative or positive experiences of different domains is still scarce. Therefore, we investigated how children and adults evaluate physical and psychological states of both valences on some dimensions, exploring the role of age and gender. The participants were 61 5/6-, 7/8- and 9/10-year-olds, and 20 college students. They evaluated a list of physical and psychological states of suffering and wellbeing according to their relevance, frequency, affective impact and seriousness, and justified their answers. Main results showed that wellbeing states were perceived as more relevant, less frequent and more positive than suffering states. In addition, physical states of suffering were evaluated as more relevant and serious than psychological states by 5/6-year-olds, while it was the opposite for adults. Finally, perception of relevance was positively correlated with perception of frequency and, only for suffering, with perception of seriousness. From an applied point of view, this knowledge could be helpful in devising an intervention for parents and teachers, aiming at improving adults' abilities to relate with children taking into account how they actually perceive and evaluate events with positive or negative repercussion on their lives.

Introduction.

Taking into account an educational perspective, it assumes particular relevance to understand the internal representation of positive and negative events characterizing children's daily life, exploring how and in which terms they form personal evaluations of dimensions such as relevance, affective impact, and seriousness. Considering the extant literature, it is possible to draw some indications on how children represent suffering and wellbeing states on the basis of studies focusing on themes such as memory of positive and negative events, concepts of health and illness, and ability to distinguish between bodily and psychological domains (e.g. Bibace, Wiehe, & Leeman, 2001; Carey, 1995; Fivush, Hazzard, McDermott Sales, Sarfati, & Brown, 2003; Gobbo & Raccanello, 2010; Schmidt & Fröhling, 2000; Wellman & Gelman, 1992). However, even if these studies suggest a growing interest towards this topic, our knowledge on children's representation of internal states relating to negative or positive experiences pertaining to the physical or psychological domain, is still scarce. Only recently, some data about narratives of personal events revealed that 9-year-olds' and their mothers' evaluations of seriousness often do not match (Gobbo, Zanon, Raccanello, & Tornatora, 2009). However, this study examined evaluation of only one dimension and concerned only negative events. Therefore, the main aim of the present work was to investigate how children and adults evaluate relevance, frequency, affective impact and seriousness relating to internal states of either domain and valence. First, we hypothesized higher relevance, frequency and more positive evaluations for wellbeing than for suffering states. Second, we examined whether level of state importance was related to the perceived frequency and, for suffering states, to seriousness. Third, analyzing children's and adults' justifications, we aimed at exploring the dimensions underlying children's and adults' evaluations and their relationships. Furthermore, we investigated whether perception of relevance, frequency, affective impact and seriousness of states changed at different ages; in particular, on the basis of previous findings (Gobbo & Raccanello, 2010), we hypothesized a lower relevance for physical suffering and higher relevance for psychological suffering at increasing ages. Finally, we explored the role played by gender.

Method.

The participants were 61 children: among them, there were 20 5/6-year-olds ($M = 5$ years, 10 months; 13 girls, 7 boys), 20 7/8-year-olds ($M = 7$ years, 11 months; 12 girls, 8 boys) and 21 9/10-year-olds ($M = 10$ years, 0 months; 10 girls, 11 boys). In addition, 20 college students ($M = 22$ years, 3 months; 13 girls, 7 boys) were involved. They were orally proposed a list of states related to physical (e.g. to have headache) and psychological (e.g. to be sad) suffering and physical (e.g. to be in shape) and psychological wellbeing (e.g. to be happy). For each state (5 for each type of suffering and wellbeing) we asked participants to evaluate their perception of relevance, frequency, affective impact and seriousness (the latter only for suffering states), by means of 5-point Likert-type scales, and to justify their answers (except for frequency). In a preliminary phase, children's understanding of each state was assessed and definitions were given when required.

Results and discussion.

Four repeated-measure ANOVAs were run, separately for each dimension, with Age and Gender as between-subjects factors and State (physical and psychological suffering, physical and psychological wellbeing) as within-subjects factor, using the Bonferroni correction for pair comparisons. As far as relevance is concerned, wellbeing states were perceived as more relevant than suffering ones (State: $F(3,219) = 110.17$, $p < .001$); in addition, only for suffering, the physical domain states were more relevant than the psychological for 5/6-year-olds, while it was the opposite for adults (Age X State: $F(9,219) = 3.49$, $p < .001$). Regarding frequency, wellbeing states were considered more frequent than suffering states (State: $F(3,219) = 109.19$, $p < .001$); moreover, for the 7-year-olds and adults physical suffering was perceived as less frequent than psychological suffering (Age X State: $F(9,219) =$

2.30, $p = .017$, $\eta^2 = .09$). Considering affective impact, as expected suffering states were evaluated more negatively than wellbeing states (State: $F(3,219) = 480.47$, $p < .001$); however, only for suffering, adults' evaluations were more negative than for all the other groups (Age X State: $F(9,219) = 2.25$, $p = .020$, $\eta^2 = .09$). Regarding seriousness, physical suffering was perceived as more serious than psychological suffering by the 5/6-year-olds, while it was the opposite for adults (Age X State: $F(3,73) = 3.85$, $p = .013$, $\eta^2 = .14$). Furthermore, we found significant correlations between perceptions of relevance and frequency for each kind of state (physical suffering: $r = .28$, $p = .011$; psychological suffering: $r = .45$, $p < .001$, $r = .43$, $p < .001$, $r = .41$, $p < .001$, $r = .54$, $p < .001$, $r = .60$, $p < .001$). In conclusion, our results showed that wellbeing states were perceived as more relevant, less frequent and more positive than suffering states. In addition, physical states of suffering were evaluated as more relevant and serious than psychological states by 5/6-year-olds, while it was the opposite for adults. Finally, a strong relationship between judgments of relevance and frequency of personal experiences of particular states in both children and adults suggests that the types of states that one has to face more often counts more in one's own daily life. From an applied point of view, this knowledge could be helpful in devising an intervention for parents and teachers taking into account how children actually perceive and evaluate events with negative or positive repercussion on their lives.

Quality of the home learning environment and the transition to school: An Australian Study.

Susan Walker, Queensland University of Technology, Australia; Donna Berthelsen, Queensland University of Technology, Australia

The quality of children's early home learning environment and early learning competencies appears to be instrumental to school adjustment and achievement. This poster reports data analyses from a nationally representative sample of children participating in Growing Up in Australia: The Longitudinal Study of Australian Children (LSAC). Three research questions are addressed: (1) Are early home learning experiences at age 4 years related to academic outcomes at 8 years? (2) Are differences in academic outcomes at age 8 accounted for by the level of children's language and emergent academic skills at age 4 years? (3) Are differences in academic outcomes explained by children's learning-related behaviours at age 6 years? The regression analyses use data from three data waves of LSAC, when children were age 4, 6 and 8 years. The sample group for the analyses were 3,643 children in the Kindergarten Cohort who were 4 years of age at recruitment into the study. Regression analyses controlled for a number of socio-demographic factors. Significant contributions to learning outcomes were: being read to daily by an adult in the home at age 4 years; children's approaches to learning at 6 years of age, and learning competencies at age 4 and 6 years.

There is increasing recognition of the importance of the early years of school in establishing the foundation for future academic achievement. The quality of children's early home learning environment and early learning competencies appears to be instrumental to school adjustment and achievement. Research indicates that early and subsequent engagement with school is contingent on developing early competencies in literacy skills; the ability to build positive relationships with peers and teachers; and self regulation (Pianta & Stuhlman, 2004). It has been found that the process of social and academic disengagement with school can begin as early as first grade (Alexander, Entwistle & Horsey, 1997; Hamre & Pianta, 2001; Jimerson, Egeland, Sproufe, & Carlson, 2000). However, in Australia, there have been no attempts to replicate findings about the influences on early school learning that have been derived from longitudinal research in other national contexts. This paper reports data analyses from a nationally representative sample of children participating in Growing Up in Australia: The Longitudinal Study of Australian Children (LSAC). This research involves a longitudinal cross-sequential design. Two cohorts of children (a birth cohort and a kindergarten cohort) were identified from Medicare records and selected based on a stratified random sampling procedure designed to make the sample as representative of the broader Australian population as possible. Biennial data collection commenced in 2004. Three research questions are addressed in the analyses: (1) Are early home learning experiences at age 4 years related to academic outcomes at 8 years? (2) Are differences in academic outcomes at age 8 accounted for by the level of children's language and emergent academic skills at age 4 years? (3) Are differences in academic outcomes explained by children's learning-related behaviours at age 6 years? The regression analyses use data from three data waves of LSAC, when children were age 4, 6 and 8 years. The sample group for the analyses were 3,643 children in the Kindergarten Cohort who were 4 years of age at recruitment into the study. Outcome measures for the analyses when children were 8 years of age are teacher ratings on the Academic Rating Scales (ARS) for language and literacy and mathematical thinking. The measure of classroom behaviour at age 6 and 8 years is a 6-item measure of Approaches to Learning (e.g., attentiveness and task persistence). Children's receptive language competence and emergent literacy skills at age 4 were measured by the Peabody Picture Vocabulary Test (PPVT – short form) and the Who Am I? Early home experiences at 4 years of age include reports of home learning activities from parent interviews. The regression analyses controlled for a number of socio-demographic factors. Results indicated that variables making significant contributions to learning outcomes at age 8 were: being read to daily by an

adult in the home at age 4 years; children's approaches to learning at 6 years of age, and learning competencies at age 4 and 6 years. Children beginning school with early academic skills and with positive approaches to learning indicate a positive learning trajectory that will support ongoing engagement and success through school. While the regression models tested found that early learning experiences and competencies contribute to learning outcomes at age 8 years, over and above socio-demographic factors; nevertheless, the socio-economic position of the family and the child's Indigenous status were influential in the full models tested. Positive learning opportunities prior to school appear to be critical to tackling social inequalities during childhood. In particular, these findings suggest that the early acquisition of learning-related social skills such as attentional skills and self regulatory skills prior to school entry is crucial. Support for socially disadvantaged families can help mediate some of the negative effects on children's early learning, particularly if a comprehensive approach is taken that considers the multiple factors that influence children's early school success.

Motives Whom to Choose as Supportive Persons in Networks

Markus Hirschmann, University of Regensburg, Germany; Hans Gruber, University of Regensburg, Germany

Today's working processes are shaped by innovative and complex problems. In many cases employees are not able to solve these problems successfully on their own. They lack certain knowledge or expertise and thus need support by their colleagues and other employees. This calls for continuous sharing and exchange of individual's knowledge and experiences in teams and networks. Due to that, sharing of expertise in networks is a crucial aspect of modern workplace learning. But at many workplaces knowledge and expertise is shared primarily with close colleagues, but not at all with approved experts. The motives of these decisions with which persons expertise is shared, have not been analysed. The purpose of this study is to get better insight into this process. Therefore, we used a social network analysis (1) to identify individuals who are in a central position within a network, because they share their knowledge and experiences with colleagues, and (2) to elaborate factors that predict the choice of these persons on three different levels – individual, socio-cultural, and organisational. In the domain of software engineering and business consulting, we analysed five project teams each in small and medium-sized enterprises. Data collection is still in progress. We will use multilevel analysis to analyse the data. At the conference we will present the results of this study.

Wasko, M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, 29, 35-57.

Promoting Psychological Well-Being Globally: Findings from Italian Primary and Secondary Schools

Alessandra Cavallo, University of Padova, Italy

This contribution represent the Italian part of a large international project being conducted in countries around the world, under the leadership of Dr. Bonnie Nastasi of Tulane University, USA. The purpose of this international project is to develop definitions of psychological well-being and psychologically healthy schools, based on perspectives of key stakeholders (teacher, student, school, community) within participating countries. The project represents a first step in understanding psychological health of individuals and schools from a social-cultural perspective and subsequently developing programs to promote well-being of students through individual and ecological change. Preliminary findings suggest that basic education has two main goals: to promote high quality learning outcomes and pupils' personal growth and well-being. The interrelated nature of learning and well-being is here referred by examining the kind of condition that pupils, teachers, parents, school administrators and psychologists find correlated to students' well-being during primary and secondary school.

Theoretical Framework

The following depiction reflects an ecological and developmental framework for conceptualizing psychological well-being (Nastasi, 2004). The goal of this project is to depict the individual and social-cultural factors that influence well-being within specific countries, communities, and/or cultural groups. In order to avoid imposing Western-based student mental health and well-being, collaborators conducted formative research to gather data from key stakeholders, within participating countries, about conceptions of psychological well-being for individuals (children and adolescents) and school and community contexts. More information can be found in the following publication Nastasi, B.K., Moore, R. B., & Varjas, K. M. (2004). *School-Based Mental Health Services: Creating Comprehensive and Culturally Specific Programs*. Washington, DC: American Psychological Association.

Project Objectives

Identify definitions of psychological well-being held by various stakeholder groups.

Identify definitions of psychologically healthy environment held by various stakeholder groups.

Research Questions

What is a psychologically healthy environment (home, school, community, society)?

What factors influence psychological well-being of children and adolescents?

What are the roles of schools, families and communities in promoting psychological well-being?

What are effective ways to promote development psychological well-being of children and adolescents in schools?

Methods

Focus group interviews—students, parents, teachers.

Ecomap activity—students.

Individual interviews—administrators, physical/mental health support staff.

Italian participants

Students—primary and secondary grade levels (8 groups of 6-8 each: 4 primary; 4 secondary). Data collection involved 2 sessions with each small group of 6 to 8 students, who are similar in age level (e.g., ages 6-8, 9-11, 12-14, & 15-17). Groups were gender-specific, with balance of male and female across age levels. The first session concerned a focus group discussion consisting of general questions like what is expected of children/adolescents your age in school? What is expected of friends your age? What are children/adolescents your age expected to contribute to your community, society, country? Describe a good/ not good parent, describe a good/ not good teacher; questions about emotions and questions about the sources of distress. The second session concern a Ecomap activity. The purpose of this activity was talk about the people and events that were important for the students, for example, in their home, school, community and describe a drawing that showed their relationships with these people and events.

Parents of primary and secondary grade level students (4 groups of 6-8 each: 2 primary; 2 secondary). Data collection involved 4 focus groups with small groups of 6 to 8 parents primary school children (ages 6-11) and secondary grades (ages 12-17). The purpose of this activity was identifying ideas about children's well-being, parents expectations for their children, ideas about child rearing, and how parents think schools and families can help to promote children's well-being.

Teachers of primary and secondary grade levels (4 groups of 6-8 each: 2 primary; 2 secondary). This session concerned a focus group discussion on teachers ideas about children's well-being, their expectations for their students, their ideas about disciplining students, and how teacher think schools and families can help to promote children's well-being. School administrators (5 individual) and school or community mental/physical health staff (5 individual). This session concerned a focus group discussion about issues related to promoting the psychological well-being of children and adolescents. The data yielded were analyzed throw the use of Atlas.ti software. This process were supported by a top-down strategy based on the following code categories.

Valued competencies. Any reference to competencies valued in the culture, to optimal functioning, engaging in culturally acceptable behaviour.

Adjustment difficulties. Any reference to adjustment problems, mental illness, dysfunction, maladjustment, lack of competence, or culturally unacceptable behaviour.

Feelings. Any reference to emotions; includes labels or terms for feelings, how feelings are expressed.

Stressor. Any reference to risk factors or stressors present in the social-cultural environments of family, school, peer group, community, and society. Any risk factor/stressor that can potentially impede an individual's development or education or cause psychological distress.

Support. Any reference to resources or sources of social support available in the social-cultural environments that can facilitate coping with stress, address psychological problems, or provide some type of help or support. Includes both informal social supports (e.g., family, peers, teachers; and formal supports or professional services (e.g., from school counselor, psychiatrist).

Reaction to stressor. Any reference to how an individual responds to or copes with stress or problems; can include emotional, cognitive, and behavioural responses.

Reaction to support. Any reference to how an individual responds to support or help from others; can include emotional, cognitive, and behavioural responses.

Role definitions. Any rfence to the defintion of a spific role in society (e.g., teacher, student, parent, fried).

Socialization practices. Reference to how one becomes socialized according to social-cultural norms, or how one facilitates development of education of the child/student. Includes practices related to discipline or education that are used to help children develop competencies or meet adult or situational expectations.

Definition of psychological well-being. Definition of psychological well-being (these are explicitly provided in interviews with administrators/providers) or reference to attitudes toward mental health (e.g., how cultural or societal attitudes and understanding have changed over time).

Results highlight the importance of listening pupil's voices where aspects of well-being are concerned. The perspectives of children and adolescence can provide a salient basis for making recommendations, directing further exploration and constructing ideologies. The research data represent an interest possibility in terms of create the conditions for educational development in school, aimed at promoting more and more plenty well-being of the students. Results showed that a positive relations with teachers in the classroom and between home and school (as a support and presence of positive communication), is acting on the psychosocial adaptation of children and adolescents at school. Such information may in fact result in lines as design active collaboration between school administrators, teachers, students and families in building a school environment which stimulate the freedom of expression and mutual respect. This aspect requires that the people working together from different point of view, respect one another, avoid stereotypes about particular disciplines and consider individuals for their ability to contribute to a collaborative process.

Educational success despite difficult circumstances. Profiles of resilient students

Manfred Prenzel, TUM School of Education, Germany; Katharina Mueller, Technical University Munich, Germany

The OECD coordinated "Programme for International Student Assessment" (PISA) has repeatedly shown a strong dependency of students' academic achievement on their socio-economic background (Ehmke & Baumert, 2007). Internationally, this dependency is particularly high in Germany. While showing that the competencies of 15-year-olds depend strongly on economic, cultural and social background variables, the PISA-findings do not yet answer the question whether all students who are socio-economically deprived are affected by social disparities in the same way. Regarding the group of 'top performers' (OECD 2009) it can be assumed that there are atypical developments of positive adaptation which are favored by differential student- and school-level input and process variables. The presented research project investigates this question by a person-centered approach applying the PISA-2006 database (Prenzel et al., 2007). The aim of the secondary data analysis is (1) to identify disparity-causing variables, (2) to operationalise the phenomenon of academic resilience (Luthar 2006) on the basis of large-scale-assessment data, and (3) to describe profiles of positive adaptation. For this purpose, we are using latent class analyses (Hagenaars & McCutcheon, 2002) to identify subpopulations of students who are characterized by low socio-economic and cultural resources but strong achievement in the scientific PISA tests. These students show resilience in a sense that their actual achievement is over what is predictable with regard to their socio-economic status.

State of the art: Large scale assessments like PISA show that there are great social disparities in the educational success of students. In particular, features of the socio-economic background plays a major role for students' competence development and access to higher educational institutions. The interaction of social disparity causing effects ranging from structural and process features of family life conditions to institutional mediation mechanisms turns out to be extremely complex.

Recent findings from PISA have indicated a decreasing - but still strong - social gradient (described by the relation between social background and the achieved level of competence) for Germany (Ehmke & Baumert, 2007). However, the international comparison shows that good performance is not necessarily dependent on social origin, because the degree of social disparity varies strongly in the other OECD countries. Moreover, international comparison of so-called 'top performers' (i.e. students belonging to the leading group on the competence levels V and VI) indicate that there are a number of students showing high levels of competence in science despite having a low socio-economic status (OECD 2009).

Whereas there are detailed findings for the group of 'top performers' as a whole (OECD 2009), we still need to gain a deeper understanding of the processes and mechanisms that enable some students with below-average economic and cultural resources to perform highly. We use the concept of "academic resilience" to describe these students' atypical process of positive adaptation in the face of adverse circumstances. More precisely, "Resilience refers to a dynamic process encompassing positive adaptation within the context of significant adversity" (Luthar, 2006, p. 543). Resilience is characterized (1) by the fact that it is a dynamic, bi-directional development process between the individual and the environment, (2) that it is variable over time and situations (Wustmann, 2005). (3) Moreover, resilience is a domain-specific concept (Luthar, 2006). Based on the already existing results we assume that the so defined resilient students as well as 'top performers' differ from the total sample by differential interests, motivations and domain-specific activities regarding science subjects and positive attitudes towards learning (OECD, 2009b). Additionally, gender, migration status, home language and the socio-economic context of school supposedly relate to students' performance as well as self-concept (Artelt, Demmrich & Baumert, 2001) and educational processes and settings at home Ehmke, 2008).

Aims and research questions:

The study focuses on top performing students in PISA who have weak socio-economic and cultural resources in their families. Their atypical development of positive adaptation is assumedly due to differential student- and school-level input and process variables. The aim of the secondary data analysis is (1) to identify these variables, (2) to operationalise the phenomenon of academic resilience on the basis of large-scale-assessment data, and (3) to describe profiles of positive adaptation. The findings should help to develop an evidence-based concept of academic resilience.

The research questions are: (1) Which student- and school-level input and process variables characterize 15 year-olds with top performances in scientific literacy, but below-average indices of social background? (2) What qualitatively different profiles of resilience can be identified?

Methodology:

The presented research project investigates these questions by using a person-centered analytic approach and the PISA-2006 database (Prenzel et al., 2007). In a first step subtypes of related cases are extracted that differ from the sample average by both top performances and low socio-economic backgrounds. With regard to individual, institutional and family characteristics (student- and school-level input and process variables) this group is compared with those students showing a competence development as expected. In a second step qualitative profiles of resilience are identified within the group of deprived students using Latent Class Analysis (Hagenaars & McCutcheon, 2002).

Theoretical and educational significance of the research:

These different findings of empirical educational research are used to adapt the concept of resilience within the scope of large scale assessment data and thus gain empirical evidence of traits reducing social disparity. It is investigated whether the interdisciplinary approach of resilience is methodologically connectable and applicable for issues in the context of school particularly in internationally standardized assessment of schools.

References

- Artelt, C., Demmrich, A., & Baumert, J. (2001). Selbstreguliertes Lernen. In J. Baumert, E. Klieme, M. Neubrand, M. Prenzel, U. Schiefele, W. Schneider, P. Stanat, K.-J. Tillmann, & M. Weip (Hrsg.), PISA 2000, Basiskompetenzen von Schölerinnen und Schölern im internationalen Vergleich (pp. 271-298). Opladen: Leske + Budrich.
- Ehmke, T. (2008). Welche Bedeutung haben lernförderliche und naturwissenschaftsbezogene Einstellungen und Prozesse im Elternhaus für die Erklärung sozialer Disparitäten in der naturwissenschaftlichen Kompetenz? Zeitschrift für Erziehungswissenschaft, Sonderheft 10, pp. 129-148.
- Ehmke, T., & Baumert, J. (2007). Soziale Herkunft und Kompetenzerwerb. Vergleiche zwischen PISA 2000, 2003 und 2006. In M. Prenzel, C. Artelt, J. Baumert, W. Blum, M. Hammann, E. Klieme, & R. Pekrun (Hrsg.), PISA 2006. Die Ergebnisse der dritten internationalen Vergleichsstudie (pp. 309-335). Münster: Waxmann.
- Hagenaars, J. A. & McCutcheon, A.L. (2002). Applied Latent Class Analysis. Cambridge University Press.
- Luthar, S. S. (2006). Resilience in development: A synthesis of research across five decades. In D. Cicchetti, D. J. Cohen (Eds.). Developmental psychopathology: Vol. 3. Risk, disorder, and adaptation (2nd ed., pp. 739-795). Hoboken, NJ, US: John Wiley & Sons Inc.
- OECD (2009): Top of the Class - High Performers in Science in PISA 2006. Organisation for Economic Co-operation and Development: Paris. Access 13.04.2010, http://www.oecd.org/document/51/0,3343,en_32252351_32236191_42642227_1_1_1_1,00.html
- Prenzel, M., Artelt, C., Baumert, J., Blum, W., Hammann, M., Klieme, E., & Pekrun, R. (Hrsg.). (2007). PISA 2006. Die Ergebnisse der dritten internationalen Vergleichsstudie. Münster: Waxmann.
- Wustmann, C. (2005). Die Blickrichtung der neueren Resilienzforschung. Zeitschrift für Pädagogik, 51(2), pp192-206.

Thematic Poster

Special Needs Education

Factors that influence high school completion regarding students with special needs

Karen Tetreault, Université du Québec à Trois-Rivières, Canada; Sylvie Frechette, Université du Québec à Trois-Rivières, Canada; Nadia Rousseau, Université du Québec à Trois-Rivières, Canada; Helene Fournier, U. du Québec à Trois-Rivières, Canada

Mainstreaming is a priority in the Quebec school system. However, very few studies have documented the situation of students with special needs in this setting. Therefore, this study aims to determine school related factors that influence their high school completion, to document suggestions provided by students to improve school experience, and to compare the nature of the suggestions from students with or without diplomas. Two methodological approaches are used. Statistical analyses are performed on data collected from 10,059 students from one Quebec geographic area. Qualitative analyses are conducted on 35 semi-structure interviews with youths having a high school diploma or not. This study enlightens our comprehension of the obstacles encountered by students with special needs.

Introduction

In the last forty years, the Quebec school system changed considerably. Various committees advised the government over the years. The Ministry of Education implemented various services to help students with special needs. Mainstreaming has become a priority. The services offered to students officially identified as having special needs should improve both retention and certification rates. Currently, few studies have considered the school experience of students with special needs within this context.

Theoretical framework

The Ministry of Education (MELS, 2009) had determined a classification of students. Most students can be at risk at one time or another during their schooling. This group includes students with learning disabilities and behaviour issues. Another group includes students with special needs such as intellectual disabilities, physical disabilities, behaviour problems, dysphasia, and pervasive developmental disorders. These students are particularly vulnerable to leaving school without certification.

The Ministry of Education (MELS 2009) defines dropping-out as abandoning one's schooling without certification before the age of twenty. Dropping-out is a multidimensional phenomenon that results of the combination of many variables. Students that drop out of general education give the following reasons: lack of motivation, academic reasons, personal or family related issues, hope to earn a living or have a job, their training perceived as completed, wanting to continue their schooling elsewhere, and repeated academic failures (Potvin et al., 2004). Three quarters of high school dropouts regret their decision and would like to complete their high school degree (Gauthier et al., 2004).

At risk students have the following characteristics: male gender, unproductive coping strategies, low self-esteem, poor social skills, negative perception of school, academic difficulties, lack of motivation, and behaviour problems (Fortin, Potvin & Royer, 2000). Repeated school failures greatly influence a teenager's decision to drop-out of school. An advisory committee to the Quebec government (CSE, 1996) states that the current school system's homogeneous curriculum negatively affects school success and perseverance of students with special needs.

Objectives:

- 1) Determine the school related factors that influence high school completion.
- 2) Analyse the suggestions provided by students (with or without diplomas) to improve the school experience of future students.
- 3) Compare the nature of the suggestions from students with and without diplomas.

Method

Two methodological approaches are used in the study. A quantitative approach is chosen to fulfill the first objective. Statistical analyses are performed on data collected from 10,059 students from one Quebec geographic area. These students are grouped in three cohorts according to their first year in the school system, known as kindergarten. At the time of our data collection, the 1983 cohort subjects are 25 to 26 years old, the 1988 cohort ones, 21 to 22 years old, and the 1992 cohort ones, 16 to 17 years old. All students are divided in two main categories: regular students and students with special needs.

A qualitative approach is used to attain the second and third objectives. One-hour semi-structured interviews are performed with 35 youths of the above cohorts: 19 are high-school dropout and 16 have a high school diploma. A questionnaire is created to focus on personal characteristics, school experience and work field experience. Also, youths are asked to give suggestions to improve the school experience.

A first step of coding is performed using Atlas-ti. Codes and categories are created by one coder. Then they are all reviewed by a second coder. Two procedures are used to score the interviews: code frequencies and subject frequencies.

Findings and discussion

The data analysis focuses mainly on the school trajectory of students with special needs. The preliminary data shows that approximately one third of the cohorts (1983: 30.5%; 1988: 37.9%; 1992: 28.9%) are officially identified as having special needs. Within the students with special needs groups, boys are more represented than girls. For instance, in the 1988 cohort, 47.1 % of boys are identified as student with special needs compared to 28.0% of girls. Amongst the 29% of students without diplomas in the 1988 cohort, 84.2% are students officially identified as having special needs.

Youths with or without diplomas identify academic, family related and personal factors perceived as affecting school success. They are investigated and outlined in an extensive description. A comparison based on frequencies shows that youths without diplomas make more external attributions to explain success or failure such as teachers' attitudes and pedagogical techniques whereas youths with diplomas assigned success to student engagement and will. More precisely, factors relevant to school and teachers are more frequent than family or personal factors among youths without diplomas. Several suggestions will be made to keep students in school or reconnect them with.

Conclusion and educational significance of the study

The originality of the study is twofold. Firstly, no study in Quebec has ever documented the school trajectories of students from kindergarten to university. Secondly, students were asked to voice their opinion on their school experience. Therefore, this study enlightens our comprehension of the obstacles encountered by students with special needs. The latter will provide useful information in the creation of recommendations to improve their situation.

References

- Conseil sup  rieur de l'  ducation (2008). De la flexibilit   pour un dipl  me d'  tudes secondaires de qualit   au secteur des adultes. Quebec : Quebec Government.
- Fortin, L., Potvin, P., & Royer,   . (2000). Les caract  ristiques psychologiques, sociales et environnementales des   l  ves    risque de d  crochage scolaire. In L. Fortin, P. Potvin,   . Royer, D. Marcotte, A. No  l et M. Thibault (eds), Validation d'un mod  le multidimensionnel et causal de l'adaptation sociale et de la r  ussite scolaire des   l  ves    risque. Quebec : CRIRES et GRISE.
- Gauthier, M. Hamel, J. Molgat, M. Trottier, C., Turcotte, C. & Vultur, M. (2004). L'insertion professionnelle et le rapport au travail des jeunes qui ont interrompu leurs   tudes secondaires ou coll  giales en 1996-1997. Sainte-Foy : INRS.
- Minist  re de l'  ducation, du Loisir et du Sport, (2009). Indicateurs de l'  ducation –   ditions 2009. Quebec : Quebec Government.
- Potvin, P., Fortin, L., Marcotte, D., Royer,   . & Deslandes, R. (2004). Guide de pr  vention du d  crochage scolaire. Loretteville : Centre de transfert pour la r  ussite   ducative du Qu  bec.

Grandparents with a typical and a disabled grandchild: their involvement in care and development

Ekaterina Kornilaki, University of Crete , Greece; Maria Kypriotaki, University of Crete , Greece

The prolonged life expectancy and changes in family are responsible for the increased involvement of grandparents in their grandchildren's rearing and development. Research evidence suggests that grandparents have a variety of roles within their intergenerational families and a positive effect on their grandchildren's well-being. However, less is known on grandparents of children with special educational needs. This study aims to investigate and compare the extent and kind of grandparents' involvement in families with a typical developing grandchild and a child with special educational needs. The potential factors associated with their involvement will be explored (geographical distance, health, family status etc), their emotional closeness with the child and the satisfaction they derive from this relationship. Structured questionnaires were administered to paternal and maternal grandparents with a nursery or primary school grandchild. The study is in progress. The findings will be discussed in relation of the need to consider grandparents as part of the family support system and provide them support and encouragement.

There is a growing body of research evidence on the role of grandparents on their grandchildren's upbringing. The reasons of grandparents' increasing involvement on of their grandchildren's lives are several. People now live longer and on average they become grandparents at around the age of 54 (Dench & Ogg, 2002). That means that they will be grandparents for about one third of their life and will probably spend more time being grandparents than parents with underage children (Harpert & Levin, 2005). Family changes are also responsible: working parents, single parents, families in crisis. As a result grandparents will try to fill the parental void (Tan, Buchanan, Flouri, Attar-Schwartz, & Griggs, 2010). Although their involvement can range considerably, research shows that when they are involved they

have a variety of functions. According to Ross (2006) they can be the confidants to whom children tell their secrets, the protectors and supporters, the benefactors as they provide financial support and those who connect the family with their roots as they are the living history of the family. Grandparent involvement has been found to have beneficial outcomes for the children. Closeness and involvement are positively associated with children's well-being measured as psychological adjustment (Griggs, Tan, Buchanan, Attar-Schwartz, & Flouri, 2010).

Less research evidence is available on grandparents' involvement with their grandchildren with special educational needs. Grandparents provide emotional and instrumental support in those families and help parents cope with the stress and the daily errands (Seligman, 1991). It has been found that they also add to the mother's well-being and adjustment (Florian & Findler, 2001).

In Greece the members of intergenerational families are closely knit. Grandparents are actively involved in their grandchildren's lives. However, their involvement has not been recognized by policy makers and studied sufficiently. The aim of this study is to explore and compare grandparents' involvement in families a) with a typical developing grandchild and b) with a grandchild with special educational needs. More specifically, this study aims to assess: i) The extent and ii) the kind of grandparents' involvement. It is hypothesized that grandparents will fill the parental gap during the hours parents are at work, will play with their grandchild, will help with school work, teach skills and participate in extra-curriculum activities. The degree and the kind of their involvement are expected to vary depending on the age and kind of difficulties faced by their grandchild. iii) Potential factors associated with their involvement will be examined including geographic distance between their home and their grandchild's home, age, health, family status, educational level, professional commitments and free time. iv) The emotional closeness between the child and the grandparent, v) the relationship between emotional closeness and the extent and kind of their involvement and vi) the satisfaction they derive from their involvement. vii) The difference in the kind and the degree of involvement between maternal and paternal grandparents.

The participants of this study are a) the grandparents of nursery and school aged typical developing children and b) the grandparents of children with difficulties who attend special schools. Grandparents' demographic information, the extent of their involvement and the kind of activities they share with their grandchild will be accessed by structured questionnaires. Elder & Kings (2000) grandparent involvement scale has been adjusted for this purpose. The factors associated with their involvement, such as distance, health, free time etc will also be examined by a structured questionnaire. The emotional closeness between the grandchild and the grandparent is accessed by Elder, Conger, Parke, & Kings (2000) scale.

The study is in progress. The findings will be discussed in relation of the need to consider grandparents as part of the family support system and provide them support and encouragement.

Parents and children with or without special educational needs: Beliefs, relationships & activities

Maria Kypriotaki, University of Crete , Greece

The purpose of this study was to explore: a) the quality and b) the quantity of the relationships that parents develop with a child with special educational needs or with a child without special educational needs. The sample of the study consisted of 199 parents with children attending a public school in Greece. Parents responded to a questionnaire in order to have their beliefs on the value of children and their relationship with their children explored. A check list assessed the time that parents spend with their child and the activities that parents do with their child on weekdays and on Sundays. The main findings revealed that: a) parents of children with special educational needs have a stronger belief that their child is a source of personal and family trouble than parents of children without special educational needs, b) both parents of children with and without special educational needs display an equivalent degree of the belief that their child offers them personal happiness, c) parents of children without special educational needs have a stronger sense of cooperation with their child than parents of children with special educational needs, d) fathers spend less time with their child on weekdays and on Sundays in comparison with the time that mothers spend with their child; this was found for both parents of children with and parents of children without special educational needs.

The role that a family plays in a child's development is indisputable (e.g. Goldstein, Hamm, & Schumacher, 2007). Parents play a crucial role, because the parent-child relationship gives children the opportunity to develop skills and abilities, useful to future social interactions and affects their social behavior (Korosis, 2003).

Many researchers focused on the family that has a child with special educational needs and concluded that:

- there is a negative impact on the quality of the relationships between the couple (e.g. Eddy & Walker, 1999),

- the family faces an increased degree of difficulty when coping with crisis situations (Minnes, Nachshen, & Woodford, 1999),
- parents have increased physical, financial and emotional needs (Oelofsen & Richardson, 2006),
- parents experience increased levels of stress (e.g. Ainbinder, Blanchard, Singer, Sullivan, Powers, Marquis, & Santelli, 1998),
- parents have limited social interactions, (e.g. Edwards, Higgins, & Zmijewski, 2007).

The involvement of parents in their child's activities strengthens the positive self-image of the child (King et al., 2003). The participation of the child in the family life is of crucial importance for the development of many social skills (King et al., 2003).

Research has also revealed that:

- mothers spend more time with their child (Bundesministerium für Familie, Senioren, Frauen und Jugend, 2006),
- there are some differences between the kind of activities that fathers prefer and the activities that mothers do with their child (Woodworth et al., 1996),
- there is a difference in the time that fathers spend during weekdays according to the gender of the child, when the child is at the pre-school age (Fthenakis & Minsel, 2002).

The literature review reveals that the role that parents play to the future development of their child is multidimensional. A family that has a child with special educational needs deals with a variety of difficult situations. The participation of the child in different activities and the interaction of the child with the members of the family, as well as with other people (outside the family) are of great importance. The time parents spend with their child (each parent separately and both parents together) is very important, because the activities that parents do with their child, help the child to develop several abilities and skills that he/she will use in the future. Many researchers focused their surveys on the difficulties and problems that the members of a family that has a child with special educational needs face. A considerable part of the international research has focused on the everyday participation of a child with special educational needs in family activities (e.g. King et al., 2003; Murphy et al., 2008; Sandler et al., 2004). On the other hand there is little research as far as it is known, on the perceptions that parents have about the value of the child with special educational needs, on the quality of the parent-child interaction, as well as on the amount of time and the activities that parents do with their child (during weekdays and on weekends). The present research responded to this lack of research.

The aim of the present study is to explore: a) the quality and b) the quantity of the relationships developed between parents with a child with special educational needs, and between parents with a child without special educational needs. Participants were 199 parents of children (7-12 years old) with and without special educational needs. Parents responded to a questionnaire with a five-point Likert scale which assessed the quality of relationships between parents and children and parents' beliefs on "the value of the child". A check list also explored the time that parents spent with their child and the activities that parents do with their child on weekdays and Sundays.

The results of the study revealed that: a) parents of children with special educational needs have a stronger belief that their child is a source of personal and family trouble than parents of children without special educational needs, b) both parents of children with and without special educational needs display an equivalent degree of the belief that their child offers them personal happiness, c) parents of children without special educational needs have a stronger sense of cooperation with their child than parents of children with special educational needs, d) fathers spend less time with their child on weekdays and on Sundays in comparison with the time that mothers spend with their child; this was found for both parents of children with and parents of children without special educational needs, e) both parents of children with and parents of children without special educational needs spend more time with their child on Sundays than on weekdays, f) parents of children with special educational needs do less activities with their child on Sundays than parents of children without special educational needs, g) mothers do more activities with their child on weekdays than fathers do.

The findings of the present study are in line with previous research findings (e.g. Ainbinder et al., 1998; Eddy & Walker, 1999; Fthenakis & Minsel, 2002). Moreover, the present study extended exploration into the quality and the quantity of the parent-child relationships in families with children with or without special educational needs and the differences these relationships reveal between mothers and fathers.

The Transition to School for Children with a Developmental Disability: What makes a Difference?

Donna Berthelsen, Queensland University of Technology, Australia; Susan Walker, Queensland University of Technology, Australia; Jan Nicholson, Murdoch Childrens Research Institute, Australia; Suzanne Carrington, Queensland University of Technology, Australia; Stephanie Dunbar, Queensland University of Technology, Australia

The transition from early intervention programs to inclusive school settings presents children with developmental delays and disabilities with a range of social and learning challenges. The Transition to School Project is a longitudinal project which began in 2008. The study is tracking cohorts of children with developmental disabilities from recruitment in the year in which they commence school and across the next two years. This poster presents quantitative and qualitative data from parents and teachers for 150 children participating in the Transition to School Project. Data was collected through parent phone interviews, teacher questionnaires and direct child assessments. Research questions addressed are: How satisfied are parents with their child's inclusive program and the level of support provided for the transition? How easy was it for the child to make the transition? What are the benefits and challenges for the teacher to include the child in regular classroom? Collective responses from parents and teachers are reported as well as two case studies of children contrasting easy and more challenging transition experiences. Findings from this project can inform the development of effective transition-to-school programs and inclusion through the early school years for children with developmental delays and disabilities.

The transition from early intervention programs to inclusive school settings presents children with developmental disabilities with a range of social and academic challenges. While the inclusion of young children with disabilities in regular classrooms has been an important direction in Australian educational policy for the last two decades, research on child outcomes for successful inclusion in mainstream classrooms is limited. The transition to school represents a qualitative change in context for young children, in which they are confronted with a number of social and academic challenges (Rimm-Kaufman & Pianta, 2000). Typically, most children make the transition to school successfully and embark on learning trajectories that are characterized by few or no difficulties. However, children with disabilities have additional support needs and are at high risk for poor outcomes. It remains important to identify potentially modifiable factors that are causally related to transition difficulties for children with additional learning needs. In the Australian state in which this research was conducted, young children with developmental disabilities attend sessional programs at Early Childhood Special Development Programs (ECDPs). In the transition year, when typically developing children begin a preparatory (Prep) full-time school program, many children with developmental disabilities continue to attend an ECDP for 2 to 3 days each week, while beginning attendance in a mainstream Prep program for 2 to 3 days; increasing to full-time attendance across the year if the transition is successful. The research question addressed in this paper is: What factors are predictive of a successful transition to school? The processes that are hypothesised to affect child outcomes are the teacher-child relationship, teacher support, and parent involvement. The child outcomes examined are children's classroom engagement, peer acceptance, and social adjustment. The Transition to School Project is a longitudinal project which began in 2008. The study is tracking cohorts of children from ECDPs through the early years of school from recruitment in the year in which they begin attendance in a Prep program and across the next two years. Data collection in the project involves direct assessment of children in the first year, parent phone interviews across three years, and questionnaires completed by the children's teachers in each year of the study. Quantitative and qualitative data are collected. Data from parents and teachers for 150 children in their first year of participation in the study are analysed for this paper. Mean age of the children is 5.6 years and 74% are boys. The most common diagnostic category as identified by parents is Autism Spectrum Disorder (ASD) including Asperger's Syndrome. From the qualitative data, benefits for the child's attendance in the Prep program noted by the teachers included the availability of positive peer models. Child-related concerns related to the management of children's aggressive and non-compliant behaviours. Major challenges for teachers related to planning to ensure appropriate activities across the curriculum. Results from parent interviews indicated that most parents saw socialisation and learning to play with other children as a major benefit of their child attending an inclusive setting. However, some parents also mentioned preparation for formal schooling and the opportunity to learn skills that would be important for future participation in educational settings as potential benefits for their child. Inclusion in a regular classroom also presented some challenges for parents. A number of parents commented that their child's particular needs (e.g., communication or attentional difficulties) posed problems for the child in a regular setting. Parent satisfaction with the school placement was related to the extent that they felt the school provided support to the child. Quantitative analysis using logistic regression to identify child characteristics, family and school factors that explained teacher and parent-reported ease of transition indicated that teacher-reported ease of transition was related to the children's learning related social skills (e.g., attentiveness and task persistence) and the child's level of competency from parent reported data, as well as the extent to which the teacher believed that the child was appropriately placed in the Prep program. Parent-reported ease of transition was related to the child's level of competency (from parent report) and the extent to which the parent felt their child was receiving adequate support in the school setting. Two case studies of children contrasting easy and more challenging transition experiences are presented to illustrate the diversity of

children's experience. Findings from this project will inform the development of transition-to-school programs to promote adjustment and achievement in the early school years for children with developmental disabilities.

Did Fidgety Philip delay his homework? - On the coincidence of procrastination and ADHD in children

Lars Behrmann, University of Munster, Germany; Fred Rist, University of Muenster, Germany; Elmar Souvignier, University of Muenster, Germany

Research from the last years has shown a connection of ADHD and procrastination in adults. Regarding children, however, this relation was never clarified. The purpose of our study was to examine if child procrastination consists of the same behavioral and emotional characteristics as it does in adults. Furthermore, we wanted to shed some light on the relation between child procrastination and ADHD plus their predictive values for student achievement (school grades). We therefore adapted the Procrastination Questionnaire for Adult Students (PQS; Glöckner-Rist et al., 2009) for the demands of children from grades 5 to 7 and administered it to a sample of $N = 1967$ students (54% boys, 46% girls: M age = 11.3 years, $SD = 1.03$). ADHD ratings were assessed by 77 teachers using the German translation of the SNAP-IV Teacher Rating Scale. Our findings show that procrastination in children is not different from adults concerning delaying behavior, though, in that motivation to alternative activities and estimated aversiveness of delayed tasks cannot yet be discriminated by 5th-7th grade students. Moreover, we found procrastination and ADHD to be non-linearly related, meaning children exhibiting either ADHD or procrastination values above the 85 percentile had a 4.8 times increased risk of developing comorbidities, whereas below this threshold there was no relation at all. Procrastination and ADHD independently predicted grades (18% overall variance explanation). Both constructs should therefore be ascertained separately in educational and research settings to allow for selective analyses and interventions.

Adult procrastination is commonly assumed to consist of three behavioral and emotional characteristics, i.e., delaying behavior, aversiveness of the delayed task and the motivation to start alternative activities. In the last years, research connected these symptoms to the appearance of ADHD in that adults diagnosed with ADHD frequently report higher procrastination rates than non-diagnosed adults (e.g. Ferrari & Sanders, 2006). Regarding children, however, it is still unknown whether procrastination symptoms are exhibited in the same way as in adults. Furthermore, to our knowledge, the relation between child procrastination and ADHD has not yet been examined at all. The purpose of this study was, first, to present a child-oriented adaptation of the Procrastination Questionnaire for Adult Students (PQS; Glöckner-Rist et al., 2009) and an overview of its factorial structure. Second, we wanted to shed some light on the relation between child procrastination and ADHD. For that reason, we correlated students' ADHD and procrastination scores and, in addition, cross-tabbed student data for risk analysis. Furthermore, we examined the predictive values of ADHD and procrastination values for student achievement.

Sample:

The sample consisted of 77 teachers and their classes ($N = 1967$ students) from a moderately sized German city and its suburbs. The classes ranged from grades 5 to 7 and covered all three regular German educational levels. Gender ratio was almost balanced with about 54% of the students being male and 46% being female. The students' age ranged from 9 to 15 years (mean age = 11.3 years, $SD = 1.03$).

Instruments:

The Procrastination Questionnaire for Adult Students (PQS; Glöckner-Rist et al., 2009) consists of 20 self-report items that measure delaying behavior, aversiveness of the delayed task and the motivation to start alternative activities. The PQS was adapted for language and content to fit the demands of students from grades 5 and higher. All item difficulties were in the acceptable range from .30 to .57. (mean item difficulty = .44). In accordance to the adult version of the questionnaire, exploratory factor analysis revealed the items indicating delaying behavior to form a distinct factor. However, the "Aversiveness factor" and the "Alternative Activities factor" merged into one single factor "Distractibility". Internal consistencies were high for "Delaying Behavior" ($\alpha = .80$) and for "Distractibility" ($\alpha = .86$). Due to sufficiently high scale intercorrelations ($r = .70$), an overall procrastination score was computed.

ADHD in students was assessed with the German translation of the SNAP-IV Teacher Rating Scale for ADHD (Steinhausen, 2006). The genuine factor structure could be exactly replicated with very high internal consistencies of the factors "Attention Deficit" (9 items, $\alpha = .96$), "Hyperactivity" (9 items, $\alpha = .96$) and "Oppositional Behavior" (8 items, $\alpha = .95$). High scale intercorrelations ($r = .69$ to $r = .82$) allowed for the computation of an overall ADHD score.

Design:

The study was conducted in the framework of a longitudinal intervention program to lastingly enhance children's reading comprehension. Beside various achievement tests, self reported procrastination was assessed for all participating children. Teacher ratings concerning ADHD in individual students, however, were merely assigned to an alphabetically determined sample of up to 15 students from each class. This procedure was chosen due to time-related feasibility of the assessments in the regular school setting. Therefore, data on ADHD were only available for $n = 936$ students.

Analyses and Findings:

The Pearson correlation coefficient between self-reported procrastination and teacher-rated ADHD was moderate ($r=.24$, $pr=-.01$, $n.s.$) . To determine the relevance of both disorders for student achievement, regression analysis was conducted with ADHD and procrastination scores as predictors and grades in the subject German as criterion. Collectively adding both predictors in the regression model led to an additional 4.7% of variance explanation (from 13.3% respectively 12.3% to 18.0% overall variance explanation).

Theoretical and educational significance:

The factorial structure of the child-oriented version of the PQS (Glöckner-Rist et al., 2009) indicated procrastination symptoms to present itself in a different way as it does in adults: As the "Aversiveness factor" and the "Alternative Activities factor" merged into one single factor, it appears that the ability to discriminate between both constructs is not yet developed in children from grades 5 to 7. From a test- theoretical perspective, the item adaptation can be considered successful in that item difficulties and scale reliabilities were in a very good range.

Moreover, results indicated a non-linear relationship between procrastination and ADHD since both constructs were meaningfully related only in students above the 85 percentiles. In other words, children demonstrating either increased ADHD or procrastination values are at special risk of developing mutual comorbidities. Combining this finding and the fact that both constructs independently explain variance in student achievement, ADHD and procrastination should therefore be ascertained separately in educational and research settings to allow for selective analyses and interventions.

References

- Ferrari, J. R., & Sanders, S. E. (2006). Procrastination Rates Among Adults With and Without AD/HD: A Pilot Study. *Counseling & Clinical Psychology Journal*, 3(1), 2-9.
- Gloeckner-Rist, A., Engberding, M., Hoecker, A., & Rist, F. (2009). Prokrastinationsfragebogen für Studierende (PFS). In A. Gloeckner-Rist (Ed.), *Zusammenstellung sozialwissenschaftlicher Items und Skalen*. ZIS Version 13.00. Bonn: Gesis.
- Steinhausen, H. (2006). *Psychische Störungen bei Kindern und Jugendlichen: Lehrbuch der Kinder- und Jugendpsychiatrie und -psychotherapie* (7. Aufl.). Elsevier, München.

THEMATIC POSTER

Teacher Education

Self-directed professional development of teachers. How they search for information about SEN.

Rune Andreassen, Ostfold University College, Norway

The study addressed how school teachers search for and read information about special educational needs (SEN) to develop their professional knowledge. In particular, we focused on experiences in searching for information from colleague consultations, printed sources and Internet sources. A digital questionnaire was administered to 263 Norwegian elementary school teachers. The digital survey data were analysed using descriptive statistics and correlations. The results supported the notion that teachers use several information sources extensively, Internet included, to develop their competence on SEN. Specifically, domain knowledge seems to be important, not only for teachers' competence per se, but also by promoting their curiosity to search for more information as part of their ongoing self-directed professional development. Teachers' beliefs about their evaluation of Internet sources' trustworthiness were highlighted. Few other studies have explored the role of teachers' self-efficacy beliefs related to information literacy.

Aim

The aim of this study was to investigate how in-service teachers search for and read information about special educational needs (SEN) to develop their professional knowledge. TheoryResearch indicates that teachers' initial professional training is not sufficient to cope with the complex and demanding nature of teaching in inclusive

classrooms of today (Coutsocostas & Alborz, 2010; Flores, 2005; Mehdinezhad, 2008). Osler (2002) argues that there is increasing evidence to indicate that the level of understanding about SEN conditions and what implications they can have for teaching makes a significant difference to the effectiveness of the teaching strategies on these children's learning. In recent years there has been a sense of dissatisfaction with how issues related to SEN are included within initial teacher training courses (Garner, 1996; Mintz, 2010). At the same time there has been an extremely increase in easily accessible information, especially through the Internet. As stated by Demiralay and Karadeniz (2010), information literacy can be one of the important bases for lifelong learning both in private and professional life. When it comes to teachers, research indicates that conversation with colleagues may play the dominant role for professional development (Jensen, 2008). In this study we investigated how elementary school teachers search for information about SEN. We hypothesized that conversation with fellow teachers was the most common way to acquire knowledge about SEN, with Internet and printed sources also frequently used. The use of Internet sources in searching for such information was proposed to be related to gender, age, domain knowledge and participants' beliefs in their capability to evaluate source trustworthiness in the domain of special education.

Method

The sample consisted of 263 in-service teachers from 40 elementary schools who responded to a Web survey. One 30-items digital questionnaire was constructed and used to outline the present circumstances and relationships of teachers' self-directed professional development in the field of special educational needs. A mix of Likert scale and multiple choice questions were asking for participants' gender, age and domain knowledge related to special needs education by reporting on their level of educational specialization and to self-rate their special education competence. Participants experience in searching for information on special education was assessed by asking them about the amount of colleague consultation, use of printed information and use of Internet during the current school year for the purpose of developing their knowledge about SEN. They were also asked to indicate which SEN topics they had most frequently been in search of. To assess participants' beliefs about their capability to evaluate the trustworthiness of Web-based information on special education, we developed the Source Evaluation Self-Efficacy Scale (SESES) by combining questions. Finally, the participants were asked to indicate to what extent they emphasized different source features when judging the trustworthiness of web sites on SEN related topics. The data were analyzed using SPSS, and the survey results were interpreted on the basis of descriptive statistics and correlations.

Results

Firstly, this study confirms that in-service teachers extensively search for SEN related information. The most dominant way to search such information is by consulting teacher colleagues. More than 90 % of the participants had consulted colleagues about SEN topics during the current school year, followed by printed material (57 %) and Internet sources (51 %). Secondly, the more domain knowledge teachers possessed in the field of special educational needs, the more they searched for information in printed material and on the Internet to develop their competence. Thirdly, learning difficulties (problems with reading, writing and/or mathematics) and socio-emotional difficulties were found to be the most searched topics among the participating teachers, regardless of information source. Fourthly, participants' SESES scores, that were generally high, were significantly related to domain knowledge and use of domain-specific Internet sources.

Conclusions

This study contributes to the burgeoning literature on source use and source evaluation within both reading and information literacy related to special educational needs. In-service teachers seem to consider themselves as lifelong professional learners by using several information sources extensively, the Internet included, to develop their competence on SEN. Relevant domain knowledge seems to be important, not only for teachers' competence per se, but also by stimulating their curiosity to search for more information as part of their ongoing self-directed professional development. Few other studies have explored the role of teachers' self-efficacy beliefs for educational use of information technology (Hoy & Davis, 2006).

References

- Coutsocostas, G. & Alborz, A. (2010). Greek mainstream secondary school teachers' perceptions of inclusive education and of having pupils with complex learning disabilities in the classroom/school. *European Journal of Special Needs Education*, 25, 149-164.
- Demiralay, R. & Karadeniz, S. (2010). The effects of use of information and communication technologies on elementary student teachers' perceived information literacy self-efficacy. *Educational Sciences: Theory & Practice*, 10, 841-851.
- Flores, M. A. (2005). How do teachers learn in the workplace? Findings from an empirical study carried out in Portugal. *Journal of In-Service Education*, 31, 485-508.

Garner, P. (1996). A special education? The experiences of newly qualifying teachers during initial training. *British Educational Research Journal*, 22, 155-164.

Hoy, A., & Davis, H.A. (2006). Teacher self-efficacy and its influence on the achievement of adolescents. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 117-137). Greenwich, CT: Information Age Publishing.

Jensen, K. (2008). *Profesjonsl ring i endring. [Changing professional learning.]* Oslo: Institute of Educational Research, University of Oslo. Retrieved August 17, 2010 from http://www.pfi.uio.no/prolearn/index_norsk.html

Mehdinezhad, V. (2008). Evaluation of teacher education programs by students and graduates. Doctoral dissertation. University of Turku, Finland. Retrieved October 5, 2010 from <https://oa.doria.fi/bitstream/handle/10024/38831/diss2008valmeh.pdf?sequence=1>

Mintz, J. (2010). Understanding of special educational needs terms by student teachers and student paediatric nurses. *European Journal of Special Needs Education*, 25, 225-238.

Osler, A. (2002). Inclusion, exclusion and children's rights: A case study of a student with Asperger syndrome. *Emotional and Behavioral Difficulties*, 7, 35-54.

Teachers' beliefs on making a Professional Development Plan

Sandra Janssen, Open University, Netherlands; Karel Kreijns, Open University, Netherlands; Theo Bastiaens, Open University, Netherlands; Sjef Stijnen, Open University, Netherlands

Professional development plans (PDP) are increasingly used on Dutch schools as an instrument to promote professional development of teachers. By implementing a PDP it is expected from teachers to be more pro-active in their professional development. Moreover it provides teachers an opportunity for dialogue about performance and learning with colleagues and supervisors. However, the use of PDPs in school is rather new and it can be regarded as an innovation process within a school. Teachers might have their own beliefs about making a PDP and this determines how teachers make sense of this 'innovation', and consequently, how they act on it. Our research aims to investigate the beliefs teachers have about making a PDP and how these beliefs interrelate with individual and organizational factors. To answer this question an explorative case study is performed on four schools. Within these schools the teachers and the person who implemented the PDP in the school are interviewed about the implementation and beliefs about making a PDP.

The Dutch government has introduced a law of Professions in Education that obligates teachers to maintain and develop their abilities in their profession and file this in a portfolio. Subsequently, many schools have to implement different kind of instruments to act upon this policy. A Professional Development Plan (PDP) is one of these instruments. The PDP is the section of a teacher's portfolio that is used to structure the professional development in terms of learning goals and plans of action. Often, the PDP is part of a cycle in which teachers get a performance interview, update the PDP, and receive evaluations from their supervisor to determine whether they developed their abilities. However, research from the Dutch National Platform for Professions in Education in schools showed that schools have relative small experience with implementing personnel policy. The introduction of the PDP can therefore be regarded as an innovative process. Implementing an innovation in school policy does not mean that teachers will act in the same way as the management had in mind. Indeed, Kelchtermans, Ballet, Peeters, and Verckens (2009) pointed out that: "teachers are no passive receivers or mechanical and obedient performers of what others have decided. Desirable objectives (e.g. from the government or society) are always analysed, interpreted by the knowledge, beliefs and values of those who are involved" (2009, p. 163). Teachers have their own frame of reference that determines how they make sense and act on the school policy or development in work. This sense-making is an interplay between the individual's prior knowledge, beliefs and experiences, the context in which the policy is implemented the representation of the policy (Spillane, 2002). In our research we investigate the beliefs teachers have on making a PDP and how this relates to individual and organisational factors. With this knowledge schools may implement a PDP more successfully and guidance in making a PDP can be adjusted to the beliefs, knowledge and skills of teachers to be more effective.

Teacher's beliefs

According to the theory of planned behaviour (TPB), do beliefs people have about particular aspects of the behaviour influence the intention to perform or not to perform the behaviour. In general, intention is determined by three variables; attitudes toward the behaviour, subjective norms and perceived behavioural control. These variables in turn are determined by salient beliefs about the behaviour. First, attitudes are based upon beliefs of the consequences of performing behaviour and evaluations of those consequences (outcome beliefs and their evaluations). Second, normative beliefs determine the subjective norms people have; the beliefs about the views of other individuals about the behaviour and strength of the individual's desire to gain approval of these groups (normative beliefs and motivation to comply). Third, beliefs about factors likely to facilitate or inhibit the behaviour determine the perceived

behavioural control (Ajzen, 1991). Identifying these beliefs is the first stage in planning an intervention for those cases where teachers do not have the intention to adopt and use the PDP as an instrument for their professional development. In general, an intervention that is adjusted to the beliefs people have, might change their intention and thereby their behaviour. We hypothesize that the beliefs about making a PDP are influenced by individual and organisational factors. The process of meaning making is influenced by individual factors and the context in which something is implemented (Spillane, 2002; Kelchtermans, et al., 2009). Indeed, research on professional learning distinguish individual and organisation factors (e.g. Geijssels, Sleegers, Stoel, & Krýger, 2009). Individual factors included in our research are knowledge about making PDPs, and experiences with professional development. Organisational factors are support from colleagues and management and supporting conditions. Our study aims to get more insight into the adoption of PDPs by teachers and the variables that influence the beliefs they have about making a PDP. In other words, which organisational and individual variables interrelate with the beliefs of teachers about making a PDP? An explorative case study was chosen to uncover the interaction between factors that are significant for making a PDP (c.f., Merriam, 1994). Four different schools participated to determine the influence of contextual factors. Each school represents a case in which different actors were interviewed. The person who is involved by the implementation of a PDP and the teachers of the school. The data of all teachers were analysed to find out which beliefs teachers have and how they can be influenced by individual factors. Besides that, the cases are compared by similarities and differences in organisational factors that might influence the beliefs of teachers. By the time that the EARLI takes place, the data is analysed as data collection is now happening (October-November 2011). Based on earlier research, it is expected that the way the making of a PDP is supported by management, the culture in the school, and sustained use will influence teachers' beliefs about making a PDP (e.g. Smith, & Tillema, 2001). Besides that, differences are expected between teachers beliefs about the PDP, as teachers differ in how they approach professional development. Moreover, with this research we uncover how different organisational and individual variables interrelate with the beliefs of teachers about making a plan for their professional development.

- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50, 179-211.
- Geijssels, F.P., Sleegers, P.J.C., Stoel, R.D., & Krýger, M.L. (2009). The effect of teacher psychological and school organisational and leadership factors on teachers' professional learning in Dutch schools. *The elementary school journal*, 109, 406-427.
- Kelchtermans, G., Ballet, K., Peeters, E., & Verckens, A. (2009). Goede praktijkvoorbeelden als hefboom voor professionalisering? Een explorerend onderzoek naar determinanten en kritische kenmerken. *Pedagogische Studiën*, 86, 161-184.
- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.
- Smith, K., & Tillema, H. (2001). Long-term influences of portfolios on professional development. *Scandinavian journal of educational research*, 45 (2), 183-203.
- Spillane, J. P., Reiser, B. J., & Reimer, T. (2002). Policy implementation and cognition: Reframing and refocusing implementation research. *Review of Educational Research*, 72(3), 387-431.

Differences in the use of learning diaries and conditions for an effective use in teacher education

Tina Hascher, University of Salzburg, Austria; Franz Hofmann, University of Salzburg, Austria

The present study aims at clarifying to what extent and in particular under which circumstances teacher students' use and evaluation of learning diaries during first field experiences support the learning process of reflection on action. Two dimensions are of special interest: (1) differences in the use of diaries depending on teacher students' attitudes towards diaries; (2) differences in the teacher students' attitudes towards diaries depending on personality factors and differences in the use of diaries depending on personality factors.

In winter 2008 46 teacher students collected field experiences in a school setting of 15 lessons which have been framed by preparing sessions and reflective post-discussions with their mentors. For all participants, data from three instruments are available: a questionnaire about personality aspects administered about 6-8 month before the field experiences; a less structured learning diary during field experiences; a questionnaire on diary writing after field experiences. The results support the idea of the relevance of students' attitudes towards learning diaries as well as the role of individual pre-conditions for the use and the efficacy of learning diaries. The results are discussed in terms of learning to become a reflective practitioner.

Theoretical Framework

Instruments of self-regulated learning like learning diary and portfolio are popular and commonly used in teacher education. Primarily, those tools are supposed to support the development of reflective teaching. Based on numerous publications it must be assumed, however, that diaries are often implemented without considering whether they

meet the learners' individual needs and whether they cause valence and acceptance by all learners. Thus, it has to be analysed if learning diaries provide beneficial learning conditions for everyone (for corresponding remarks about undifferentiated use of learning diaries see Badr Gßtz & Ruf, 2007; Bosse & Messner, 2008; Hofmann & Thonhauser, 1998; Kroath & Mayr, 1998).

Objectives

The present study aims at clarifying to what extent and in particular under which circumstances teacher students' use and evaluation of learning diaries during first field experiences support the learning process and the acquisition of the competencies of reflection (for an overview see Gläser-Zikuda & Hascher, 2007). We investigated whether learners' positive attitudes towards the instrument and selected personality variables are important prerequisites (see also Ackerman, 1993). With regard to the concept of „aptitude-treatment-interaction" the interaction between student teachers preconditions and the efficacy of learning diaries is worth to be analysed. Which roles do personality aspects play if the use of this instrument is compulsory for all learners of the training-groups and the instrument is not structured? Furthermore, the present study investigates whether learners do not appreciate unreservedly and indiscriminatingly the production of learning diaries (see the role of acceptance for treatment efficacy mentioned by Dane and Schneider, 1998). If effects of the writing of learning-diaries prove to be unequal a need for change in pedagogical practice has to be discussed.

As an authentic setting for our study we choose the first field experiences in the context of a teacher education course at an Austrian university. One objective of the course was that the participants clarify their professional motives under a pedagogical perspective and to contribute to the acquisition of reflective competencies. Although research on self-regulated learning points out the role of individual preconditions for a successful learning process the relevance of a fit of the used learning material and the individual learner was not yet analysed systematically. We hypothesised that teacher students' use of learning diaries, the quality of their learning process and their evaluation of learning diaries as a tool will be influenced not only by the learning setting but also by cognitive, motivational and social personality aspects.

Methods

In winter 2008 254 students started the teacher education program at the University of Salzburg. Out of this group, a representative sample 46 teacher students participated. All participants collected field experiences in a school setting of 15 lessons which have been framed by preparing sessions and reflective post-discussions with their mentors. For all participants, data from three instruments are available:

- (1) a questionnaire about personality aspects administered about 6-8 weeks before the field experiences (verbal competencies, the Big 5, and motivational variables; NEO-FFI, Borkenau & Ostendorf, 1993);
- (2) a less structured learning diary during field experiences where the teacher students were asked (a) to document an observation, (b) to comment the observation in own words, and (c) to reflect the observation with references to familiar scientific literature;
- (3) a questionnaire on diary writing (e.g., attitudes towards diary writing; individual style of diary use; uncertainty orientation, Dalbert, 1999).

All diaries were analysed in terms of quantitative (e.g., amount of signs, number of days) and qualitative aspects (e.g. design of the diary, mentioned perspectives). Personality aspects were tested as predictors of diary differences.

Results and Discussion

The results indicate that learning diaries with sparse structures and norms lead to a tremendous heterogeneity in productivity and outcomes. The observed episodes were mainly presented in narrative style by the teacher students and only seldom related to theoretical knowledge. It has to be noticed that according to the questionnaire about the diary use, reflexion on action was more often initiated by discourse with peers than by reflective writing. As was shown in other studies on the use of learning diaries in teacher education (Hascher & Wepf, 2007; Hascher, Moser & Cocard, 2005; Nissilä, 1999; Numrich, 1996), the teacher students appreciate the potential of cognitive scaffolding like the support of remembering, growing awareness and deeper understanding of a situation. A positive evaluation of the diary method is closely related to the definition of learning diaries as a learning tool.

The results also show that attitudes towards diaries are independent of language competence but the use is not with regard to teacher students' writing styles. Accordingly, students with low language competence seem to prefer oral exchange with peers in comparison to written reflexion in diaries. The same preference can be found for extraverted teacher students.

As expected, relationship between personality traits and the use of learning diaries can be found. The results count for different functions of different personality aspects. For example, low openness seems to lead to a higher need of

feedback to learning diaries. Interestingly, the use of diaries as a learning tool was related to low tolerance of uncertainty on the one hand and low neuroticism on the other hand. The findings also indicate that moderator variables like conscientiousness as a pre-condition for a careful work with learning diaries should be taken into account. Furthermore, the results give some information about pre-conditions of the field experiences as learning setting. Openness and extraversion seem to be favourable factors for teacher students to cope with the school reality and to reflect about the tasks of a teacher. There are no significant differences in motivational orientations with regard to diary quantity but the findings point toward a trend of the role of outcome orientation and differences in terms of attitudes and quality. Positive attitudes towards learning diaries seem to be supported by low competition orientation; low tasks orientation less supportive for deep level written reflexion. The results will be discussed with regard to the aim of supporting the development of reflective practitioners through the use of diaries (Schßn, 1991).

Pupils' voice in primary school – a valid basis for diagnostics and evaluation?

Gerlinde Lenske, Universität Koblenz-Landau, Germany; Anna-Katharina Praetorius, Universität Koblenz-Landau, Germany; Andreas Helmke, Universität Landau, Germany

Teaching is very complex, therefore it is almost impossible for a teacher to perceive all information needed to reflect and analyse a given lesson. A teacher needs to take another point of view to get a more realistic image of the lesson. Therefore, feedback focussing on teaching skills and lesson quality plays an important role for the advancement of a teacher. One opportunity to get feedback is to ask the pupils. Pupils' voice is considered to be as meaningful as a colleague's feedback. Previous studies generally focussed on judgements made by pupils from the fifth or higher grades. At the moment we know very little about the validity of pupil's voice from younger students. Therefore validating the generalizability over different age groups is an important issue. Our current study focuses on that issue. We tested how valid the judgements of pupils in primary schools are, if they are faced with items of common standardized questionnaires. Therefore, we used standardized interviews combined with vignettes, describing typical classroom situations. Our sample includes 90 students from the third and fourth grade. We analysed the data with Qualitative Content Analysis after Mayring (2000). The results show that young pupils have a lack of understanding the items of common questionnaires in the intended way. The conclusion is that it is necessary to modify the instruments for primary school. Otherwise, by using common instruments, the validity of pupils' voice is highly limited.

Previous studies show that the prognostic validity of pupil's voice (aggregated on class level) is comparatively high, if the increase of school achievement or school interest should be predicted (Clausen, 2000). With evidence-based feedback in form of pupil's voice, teachers can compare their own view of instructional quality to the pupil's perspective. Through that teachers are able to analyse their strengths and weaknesses. In a next step they can derive an intervention to improve their teaching skills. In the context of instructional quality, feedback in the form of pupil's voice is the foundation of diagnostics and evaluation (Helmke, 2009).

But is every feedback of every class valid enough to be the basis of diagnostics? Several studies investigated the judgements of pupils from the 5th grade up to the 13th grade. However, there is a lack of studies dealing with this topic in primary school. Our knowledge on the validity of pupil's voice in primary school is limited. More surprisingly, a lot of standardised questionnaires for primary school dealing with instructional quality are already developed and in use (i.e. in Germany, Switzerland, Austria).

The aim of the current study is to gain a first insight on how valid the pupil's voice of younger children is. We focus on two research questions:

- 1) To what extend are pupils (3rd and 4th grade) able to understand items of common standardised questionnaires dealing with instructional quality?
- 2) Are pupils (3rd and 4th grade) able to rate the quality of a lesson validly by answering those items?

Using the information of Developmental Psychology we can assume that items including complex information won't be interpreted in the right way, because young children (up to 11 years of age) often reduce complex information in an incorrect way. Furthermore we know that children at that age mostly do not realise if they make an absurd interpretation because of their egocentric or subjective view (Piaget, 1979). Additionally it is known, that young children have problems to define abstract terms (Case, 1999). Contradictory, many instruments used for feedback in primary school include items with complex information and some also employ abstract terms.

Considering the results we generated the following hypotheses:

- 1) The children will show inter-individual differences in the comprehension of the items.
- 2) There will be items the pupils will not understand in the intended way (complex items).
- 3) In most cases the pupils won't realize their misunderstanding of the item.

In order to explore these questions and to validate the hypotheses, our first step was the retrieval of available questionnaires to generate an itempool. In addition, we accomplished a delphi-study and had a discussion of experts to select 60 items of the pool for the current study.

In our on-going study we used standardised interviews to explore how far the young children are able to understand those selected items and how far they can answer them validly by rating vignettes (containing typical classroom situations). Our sample includes 90 children from three different schools. For the data analyses we used the Qualitative Content Analysis according to Mayring (2000) and the software Maxqda. To rate the item-comprehension of the pupils we developed a system of five categories. This system was derived deductively from theory and was completed inductively by detailed analyses.

Results

The analyses show that there are inter-individual differences in the comprehension of the items. There are items which some children understand in the intended way, but other children at the same age and class don't. Additionally, the second hypothesis could be verified. We found items from standardized questionnaires developed for primary school, which none of the tested children could understand in the intended way. In this context the third hypothesis could be verified too, because in 74% of the cases, children are not aware of their misinterpretation. Furthermore we identified halo-effects, which made some children rate teacher performance better than they objectively would have done. Our results also show that there are some items, which children can understand, but cannot judge correctly, because these items require didactical knowledge.

Discussion

This study shows that we should focus on the development of age-appropriate standardised instruments for pupil's voice in primary school. Young Children are able to give feedback, but we have to find the right questions or items for this procedure. Not only abstract terms cause problems, but also the complexity of items and item topics requiring didactical knowledge are too difficult for younger children. Our study makes clear that a lot of the common instruments include items, which could not be answered validly from children at that age. Therefore it could be useful to investigate problem-causing items in a systematic way (i.e. IRT-Modelling). Maybe the halo-effects could be reduced with suitable instructions before giving feedback. In order to find out, which instruction works best, experimental studies are planned as one of our next steps. Furthermore the results show that young children often do not realise when they misinterpret information. Researchers should be aware of that fact and should not try to valid instruments by asking children questions like "Are there any questions or items you did not understand?".

References

- Borich, G.D. (2007). *Observation Skills for Effective Teaching* (5. Aufl.). Upper Saddle River, NJ: Pearson Education.
- Case, R. (1999). *Die geistige Entwicklung des Menschen*. Heidelberg: Schindele.
- Clausen, M. (2002). *Unterrichtsqualität: Eine Frage der Perspektive*. Mýnster: Waxmann.
- Ditton, H. (2002). *Lehrkräfte und Unterricht aus Schýlersicht, Ergebnisse einer Untersuchung im Fach Mathematik*. Zeitschrift fýr Pädagogik, 48 (2), 262-286.
- Doyle, W. (1986). *Classroom organization and management*. In M. C. Wittrock (Hrsg.). *Handbook of research on teaching* (3. Aufl., S. 392-431). London: Macmillan.
- Gruehn, S. (2000). *Unterricht und schulisches Lernen. Schýler als Quellen von Unterrichtsbeschreibung*. Mýnster: Waxmann
- Helmke, A. (2009). *Unterrichtsqualität und Lehrerprofessionalität. Diagnose, Evaluation und Verbesserung des Unterrichts*. Seelze: Klett-Kallmeyer.
- Mayring, Ph. (2000). *Qualitative Inhaltsanalyse. Grundlagen und Techniken* (7. Auflage, erste Auflage 1983). Weinheim: Deutscher Studien Verlag.
- Piaget, J. (1979). *Sprechen und Denken des Kindes*. Pädag. Dýsseldorf: Verl. Schwann.
- Wagner, W. (2008). *Methodenprobleme bei der Analyse der Unterrichtswahrnehmung und –wirksamkeit*. Universität Koblenz-Landau, Psychologie.

Fear and Self-Appointed Superiority: Two Hindrances in Education for a Global Networked Society

Anna Tapola, Linnaeus University, Sweden; Lena Fritzen, Vaxjo university, Sweden

The aim of this paper is to examine the preconditions for education for a global networked society in teacher education, especially with regard to food security and increased health for a growing world population of seven billion people. Research questions were linked to Swedish preservice teachers' (i) willingness to contribute to social justice; (ii) their readiness to promote increased health among others; and (iii) their attitudes towards collaborating with others who have a different cultural background. The data consisted of 18 randomised individual position statements

(N=235) written by preservice teachers, and constitutes a 7,774 word corpus. The position statements were collected after the preservice teachers had carried out a mandatory exercise that included a dilemma discussion. They completed the exercise by writing their individual statements. The data were subject to a critical discourse analysis embracing a discourse-historical approach. The analysis of the position statements shows: (I) a low level of willingness to contribute to social justice; (II) a reluctance to promote increased health among others; and (III) negative attitudes towards collaborating with others who have a different cultural background. The findings show that a significant discursive construction – Discourse of Xenophobia – was particularly prominent. This discourse reveals a fear of what is different; risks, and a lack of safety; unequal relationships with other people; and the idea that someone else needs 'us' more than we need 'them'. Finally, our research outcomes are discussed in terms of preconditions for education for a global networked society.

THE AIM of this paper was to examine the preconditions for education for a global networked society (EGNS) in teacher education (TE), especially with regard to food security and increased health for a growing world population of seven billion people. The study addressed three RESEARCH QUESTIONS, all of which concerned standpoints taken by a group of Swedish preservice teachers. (1) What are the preconditions for contributing to social justice in an international arena? (2) What are the preconditions for promoting increased health among others? (3) What are the attitudes towards collaborating with others who have a different cultural background? THE CONTEXT was Swedish TE, the first term of study, and a mandatory exercise that involved working on a dilemma. The dilemma text consisted of an intricate fictional story about a proposed international collaboration project between two agricultural colleges; one in Sweden and another in a vastly different Asian context. Preservice teachers were required to take a stance on a series of moral-laden issues, for example aspects of food security and health for all, democracy versus dictatorship, and whether the proposed collaboration would comply with the democratic core values that professional teachers are supposed to protect in their teaching practice. The exercise included A FOUR-STEP PROCEDURE:

A. Prior to the exercise, all of the preservice teachers received detailed information about the dilemma and its scientific context, which enabled them to make necessary preparations.

B. Discussions first took place in 18 workgroups (at the university) where the preservice teachers had to find as many valid arguments as possible, which would support different positions with regard to the dilemma text.

C. The initial discussions were immediately followed by discussions in cross-groups, where the preservice teachers presented and exchanged the various arguments they had discussed in their original workgroups.

D. Preservice teachers wrote their position statements (as homework) where each person individually took a stance, and argued in favour of a chosen position. All of the position statements were sent to the teacher educator and stored in a database. A randomised sample of these position statements constituted the data that was analysed. NO PARTICIPANTS were involved in the study. We analysed authentic texts only. THE DATA consisted of 18 individual position statements (N=235). A randomised multi-stage cluster sampling included one position statement from each workgroup; the analysed data corresponded to 7.7 per cent of all of the written position statements. THE DATA COLLECTION METHOD consisted of a database search. THE METHODOLOGY is grounded on critical discourse analysis (for example, Fairclough, 2010) and the discourse-historical approach (DHA) (Reisigl & Wodak, 2009; Wodak, 2001a, 2001b). Three dimensions are of particular interest within DHA: (i) immanent dimensions that focus on functional linguistic characteristics of the constituents; (ii) socio-diagnostic dimensions that focus on properties related to power, democracy, morality, and various rationalities that inform our choices to act in certain ways, etc; and (iii) historical dimensions, i.e. dimensions that focus on variations over time with respect to the phenomena under study. Several ANALYTICAL METHODS were used in order to analyse the three dimensions mentioned above. Systemic functional linguistics (SFL) was used in analysing the immanent dimensions (Halliday & Matthiessen, 2004). SFL focuses on the functions of language use, for example, 'who is doing what to whom, in what way, and why' (transitivity analysis). The socio-diagnostic dimensions were covered by a Habermasian argumentation analysis (Fritzién & Tapola, 2010), theoretically grounded on Habermas's Theory of Communicative Action (Habermas, 1984, 1987), and his discourse ethics (Habermas, 1994). The historical dimensions were covered by a contextual analysis in the sense that the findings of the previous analyses (the present) were contextualised with regard to the past, and also in some respect, to the future. The contextualised analysis was theoretically grounded on DHA (for references see above)

ETHICAL CONSIDERATIONS:

All of the data consisted of authentic texts only. All of our findings were reported in a de-identified form, and it is not possible to trace the original position statement. In summary, FINDINGS from the analyses of position statements written by preservice teachers showed: a low level of willingness to contribute to social justice; a reluctance to promote increased health among others; and negative attitudes towards collaborating with others who have a different cultural background. The study showed that a significant discursive construction – Discourse of Xenophobia – was particularly prominent. This discourse deals with a fear of what is different; risks, and a lack of safety; unequal relationships with other people; and the idea that someone else needs 'us' more than we need 'them'. We CONCLUDE that the preconditions for EGNS in TE were negative. According to the present study, Swedish preservice teachers

were reluctant to collaborate with peers who are culturally different, and live far away. This conclusion shows, on the other hand, that EGNS is much needed in order to counteract prejudices, oppression, and self-appointed superiority.

REFERENCES

- Fairclough, N. (2010). *Critical discourse analysis* (2nd ed.). Harlow: Pearson Education Limited.
- Fritzeén, L & Tapola, A. M. (2010). Habermasian socio-philosophical theories and socio-constructionism in pedagogical practice – A theoretical discussion. Paper selected for oral presentation at EARLI SIG 13 Symposium in Tel Aviv, 30 August–2 September.
- Habermas, J. (1984). *The theory of communicative action: Reasons and the rationalisation of society* (Vol. 1). Boston: Beacon Press.
- Habermas, J. (1987). *The theory of communicative action: The critique of functionalist reason* (Vol. 2). Boston: Beacon Press.
- Habermas, J. (1994). *Justification and application: Remarks on discourse ethics*. Cambridge, MA: MIT Press.
- Halliday, M. A. K. & Matthiessen, C. M. I. M. (2004). *An introduction to functional grammar*. London: Hodder Arnold.
- Reisigl, M. & Wodak, R. (2009). The discourse-historical approach. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis*. Second Edition. London: Sage. 87-121.
- Wodak, R. (2001a). What CDA is about – a summary of its history, important concepts and its developments. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis*. London: Sage. 1-13.
- Wodak, R. (2001b). The discourse-historical approach. In R. Wodak & M. Meyer (Eds.). *Methods of Critical Discourse Analysis*. London: Sage. 63-94.

Between curricular demands and „dangerous moments“: multiperspectivity in history lessons

Katrin Kello, University of Tartu, Estonia

Based on individual interviews with Estonian history teachers, the paper will discuss different choices or even dilemmas a history teacher faces when attending to different educational aims and external expectations – especially, the expectation that history teaching should contribute to constructing and maintaining collective memories, i.e. shared conceptions of the past, and the concurrent need to relativize and deconstruct these collective memories by enhancing the pupil's critical thinking and his or her understanding of the constructed nature of history. Particularly, the paper will discuss how teacher's considerations and practices may be influenced by the pupils' and teacher's belonging to a mnemonic community other than that of the ethnic Estonians, as well as by the country's culture of history generally.

Based on 26 individual interviews, the paper will look at how Estonian history teachers who belonged to different mnemonic communities (teachers teaching mainly ethnic Estonians, and teachers teaching at Estonian schools with Russian as the main language of instruction), described dealing with different interpretations of past in their lessons.

The study is based on the notion that in addition to the history education's aim to transmit some common repertoires of representations about past, also ability to decide on the validity of historical accounts and understanding the diverse ways in which the past functions in the present-day society (Seixas 2000), as well as critical self-reflection, ability for dialogue, and a more „cosmopolitan orientation toward human affairs" (Hansen et al. 2009) need attention in contemporary history teaching (cf. e.g. Council of Europe 2001).

More broadly, the study has been informed by the concept of culture of history by Jörn Rüsen (1994), and the theory of social representations (Wagner and Hayes 2005).

Most of the interviews (two pilot interviews in 2007 and 24 more focused interviews in 2009-2010) commenced by request to describe two to three of the interviewee's main aims as (history) teacher. In the conversation that followed additional questions about the interviewee's vision about the subject and his or her pupils were asked. In the second part of most of the interviews the teacher could comment on 22 anonymous statements chosen from a decade (1999-2008) of the Estonia's teachers'-oriented weekly's „Õpetajate Leht" (Teachers' Newspaper) articles on history teaching. The statements were partly contradictory, partly provocative, and intentionally ambiguous, so that the comments reflected various concerns and discourses that were actual for different interviewees.

The group-level representations of the school subject 'history' that could be constructed based on the interviews approximates the official representation contained in the Estonian national curricula for history: knowledge, understanding and analysis of the facts of the past; skills of deliberation, argumentation and self-expression; critical mind, ability to gain knowledge independently and to account for various perspectives, interest for history or the subject, tolerance and other positive traits.

Delivering knowledge was however the center of the teachers' work, so that their other educational aims were dependent on it. And although the teachers acknowledged the contextual and conventional nature of the body of knowledge taught, as well as the interpretive role on the teacher and pupil, and valued bringing different interpretations and perspectives into the classroom, they were somewhat pessimistic about the pupils' ability to deal with this diversity – to accept the multiplicity of interpretations and to form their own opinions. Many teachers maintained that a multiperspective approach was appropriate only or mostly at the upper secondary school level. Also the teacher's methodical problems and lack of time were mentioned or implied.

Unsurprisingly, if referring to occurrences of different interpretations in their lessons, the teachers mostly referred to topics from the 20th century Estonian and Soviet history. Partly, the metalevel discussions (e.g. explaining why different interpretations of a same event exist) had been provoked by the pupils' voiced opposition to official or textbook history (i.e., the "dangerous moments", as one teacher referred to them). Connected to this, some teachers who worked at Russian-medium schools mentioned political dilemmas connected to their task of teaching – critically, as expected by the National Curriculum – the official interpretations of Estonian and Soviet history, and of raising simultaneously loyal and critical citizens of the Estonian state.

A more general dilemma common to most of the teachers was the simultaneousness of the need to construct and deconstruct (to learn and understand the 'basics' on object-level, and to analyse different interpretations on meta-level) under a time pressure, in face of students with different interests and abilities, in face of national final examinations, etc. Thus, all history teachers have to coordinate various, sometimes contradictory educational aims, partly set to them from above (the national curriculum, national final examinations), and they need support in such efforts: for example, examples about how to recognise a fruitful question on the backdrop of different educational aims, so that there could be more possibilities to coordinate different approaches (i.e., enhancing as well as relativizing of collective memories) in history teaching.

Also, it seems possible to conclude, that although in the media, the existence of a "mnemonic divide" in Estonia seems to be presented as a problem for the school history teaching, pupils who belong to mnemonic communities other than the mainstream can also be viewed as a resource that helps to pay more attention to different interpretations of – and perspectives on – the past. Another important potential resource could be the teachers' more relaxed or even playful attitude towards the historical knowledge, as well as the notion that it is good, right and fun to have a diversity of interpretations and associations.

References

- Council of Europe (2001) "Recommendation Rec(2001)15 on history teaching in twenty-first-century Europe". Adopted by the Committee of Ministers on 31 October 2001 at the 771st meeting of the Ministers' Deputies.
- Hansen, David T., Stephanie Burdick-Shepherd, Cristina Cammarano and Gonzalo Obelleiro (2009) "Education, Values, and Valuing in Cosmopolitan Perspective". *Curriculum Inquiry* 39, 5, 587-612.
- Rýsen, Jörn (1994) "Geschichtskultur als Forschungsproblem". In Ders., *Historische Orientierung. Über die Arbeit des Geschichtsbewusstseins, sich in der Zeit zurechtzufinden*. Köln, Weimar, Wien: Böhlau Verlag, 235-245.
- Seixas, Peter (2000) "Schweigen! die Kinder! or, Does Postmodern History Have a Place in the Schools?" In *Knowing, Teaching, and Learning History: National and International Perspectives*. Peter N. Stearns, Peter Seixas and Samuel Wineburg, eds. 19-37, New York: New York University Press.
- Wagner, Wolfgang and Nicky Hayes (2005) *Everyday Discourse and Common Sense: The Theory of Social Representations*. Houndmills: Palgrave Macmillan.

THEMATIC POSTER

Instructional Strategies

The impact of motivation-related variables on scaffold use

Lai Jiang, Institute Tropical Medicine/Katholieke Universiteit Leuven, Belgium; Jan Elen, Katholieke Universiteit Leuven, Belgium

The use of scaffolds lies at the core of the effectiveness of learning environments. In view of establishing a solid research agenda on the optimization of the use of scaffolds, this study aims at investigating the effects of motivational variables on scaffold use. More specifically, the effect of (a) achievement goal orientation and (b) self-efficacy on students' use of learning goals and postquestions were studied. One hundred and ten students in three conditions

studied a science text in 50 minutes. Participants had to respond to learning goals and/or to postquestions. Their usage of these scaffolds was recorded in log files. The results revealed that quantity of scaffold use was influenced by achievement goal orientation and self-efficacy. Avoidance goal orientation and self-efficacy influenced quality of scaffold use which in turn was found to predict students' posttest score. The results confirm the importance of motivational variables in scaffold use.

Introduction

Scaffolds are often added to/inserted in the learning environment because of anticipated or typical learner difficulties associated with a task. They are beneficial for learning only when they are adequately and optimally used (Elen & Clarebout, 2006). Therefore, the use of scaffolds lies at the core of the effectiveness of learning environments and the study of that use is of paramount importance to instructional research. It has been claimed that to make best use of scaffolds, students must be knowledgeable and motivated enough to (1) recognize scaffolds' functionalities, (2) be able to carry out the cognitive operations these scaffolds suggest (knowledgeable: cognitive / metacognitive ability required), and (3) be willing to pursue the learning path proposed by the scaffolds (motivation required) (e.g., Elen & Clarebout, 2006; Winne, 1983). In order to ensure students are knowledgeable and motivated to adequately and optimally use scaffolds, the factors that contribute to students' knowledgeability and motivation need to be identified. While cognitive and metacognitive (regulative factors), such as prior knowledge and self-regulation skills, have already been widely empirically studied (e.g., prior knowledge: Martens, Valcke, & Portier, 1997; metacognitive skills: Azevedo & Witherspoon, 2009), much less is known about what makes learners motivated to use scaffolds. To date self-efficacy and achievement goal orientation have been claimed to influence quantity of scaffolds use through its impact on task engagement (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). In addition, self-efficacy and goal orientation were assumed to exert influence on quality of scaffold use through their impact on strategy use. However, the arguments are mainly theoretical rather than empirically supported. Thus, there is a need for research that identifies the variables influencing students' motivation on adequate and optimal use of scaffolds. Of special interest in the current study is the investigation on how students' achievement goal orientation and self-efficacy influence their actual use of two scaffolds (i.e., learning goals and postquestions).

Method

Materials

A program, called OBESITAS (See figure 1), provides a computer-based prose environment in which participants were asked to study a scientific text on the relation between overweight and impulsivity. The text comprises 2,178 words (17 paragraphs). Each paragraph was displayed on a separate screen. Learning goals were provided at beginning of the text and/or postquestions were inserted at the end of the text.

Participants and procedure

One hundred and ten university students were pre-tested one week before the experiment. The results of the pretest were used to equally assign higher/lower prior knowledge students into three conditions. In the experiment, before completing the self-efficacy and goal orientation questionnaires, participants got the opportunity to have a glance at the to-be-learned text and to read a short description of the post-test. This would allow them to have a clear idea about the task demand. Afterwards they were invited to indicate their self-efficacy and goal orientation with respect to the upcoming task. Then, they got the text on their computer screen. Students studied the text in one of three conditions: with learning goals ($n = 37$); with postquestions ($n = 37$), and with both ($n = 35$). During the learning session, all learning behaviours of each participant were recorded in individual logfiles. Finally, a post-test was conducted to measure participants' factual knowledge (i.e., terms and abbreviations) (recorded as knowledge score), understanding of the relations between causal factors for obesity (recorded as insight score) and the ability to solve problems (recorded as application score).

Measure quality of scaffold use

Students in the learning goal condition and combined condition were asked to interpret the assigned learning goals and specify their learning objectives based on the assigned goals. A note space was provided which allowed students to write down notes. These were recorded and used to find out whether students carried out the intended cognitive processes (e.g., searching the text for relevant information and making inference of the text). The following variables were recorded in logfiles and used to assess quality of scaffold use: students' responses to learning goals, answers to the postquestions, notes and study sequence. The quality assessment intended to find out whether students used learning goals/postquestions to monitor their cognitive actions and to adjust their studying processes when necessary.

Results

The relations between quantity and quality of scaffold use and performance

The current results are in line with the argument that scaffold use is a highly relevant factor for students' performance in instructional environments. Time spent on postquestions was found to be positively related to the knowledge score. Quality of scaffold use was found to be highly correlated to knowledge score, insight score and application score.

The relations between learner variables and quantity of scaffold use

A negative correlation between performance-avoidance goal orientation and time spent on the postquestions, $r = -.21$, $p < .05$ (one-tailed) was found. The relation between mastery-avoidance and time spent on learning goals was not linear (see figure 2). Students who were medium mastery-avoidance goal oriented were willing to spend the most time on learning goals. Self-efficacy was negatively related to the sum of the access times of postquestions, $r = -.17$, $p < .05$ (one-tailed).

The relations between learner variables and quality of scaffold use

Avoidance goal orientation (i.e., performance-avoidance goal and mastery-avoidance goal) had negative impacts on quality use of scaffolds. A quadratic relation is found, suggesting that a medium self-efficacy is most beneficial for scaffold use.

Conclusions

This study provides insights into the impact of scaffold use on performance and of motivational variables on scaffold use. Results suggested that goal orientation and learning efficacy are the potential variables influencing quantity of scaffold use. Hence, instructors may create situations in which students' motivation for using scaffolds are promoted. Examples could, for instance, manipulate students' learning efficacy as a means to promote optimal scaffold use. Specifically, in this study, avoidance goal orientation and learning efficacy were found to be important variables for quality of scaffold use. This implies that instructors should pay attention to students' task specific goal orientations in environments as well as their learning efficacy level. Research has shown that altering the general goal structure of learning environments as well as the feedback students receive during their learning can affect students' goal orientation and self-efficacy (e.g., Linnenbrink, 2005).

Incorporating digital resources into Early Childhood classroom: An analysis from teachers' practices

Elena Ramirez, University of Salamanca, Spain; Begona Orgaz, University of Salamanca, Spain; Jorge Martin, University of Salamanca, Spain

This research examines how six early childhood teachers integrate into their practice a digital technological resource consisting of a technological desk designed to be used with children at early ages. It includes an IBM computer with a CD-Rom reader, Internet access and Windows XP operating system. Using a system to analyze classroom interaction that allows us to segment teaching practice into categories differentiated by level of generality, we studied recordings of 18 classroom sessions (three per teacher) in which the resource described above is used. The results show that common patterns exist among the teachers studied as regards the development of these practices. The most important pattern detected is the central nature of tasks in the classroom and the subordination of ICT resources to these curricular elements. It is also important to underscore the appearance of different pedagogical approaches when ICT are incorporated into the early childhood classroom. These findings pose challenges for the development of future research studies regarding the consistency and diversification of the patterns of action found and for teacher education.

Summary

Knowledge of what teachers actually do with digital resources in their classroom practice is essential in order to explain not also what aspects form the basis for the real incorporation of information and communication technologies (ICT) into teaching processes, but also to be able to untangle the mechanisms behind how these resources are employed in direct teaching situations (Loveless, 2003). From our theoretical approach, two key aspects can be emphasized: first, the incorporation of ICT resources into classroom practice will depend on the teacher's pedagogical knowledge of the discipline (Loveless, 2003; Koelher y Mishra, 2009), specifically on the intersection between that knowledge and knowledge of ICT; and second, it will also depend on whether these resources make sense or not within the 'action plans' that the teacher is using to manage his or her activity in direct teaching (Leinhardt, Weidman and Hammond, 1987; Zhao, Frank, Ellefson, 2006). This study examines how six early childhood teachers integrate into their practice a digital technological resource consisting of a technological desk designed to be used with children at early ages. It includes an IBM computer with a CD-Rom reader, Internet access and Windows XP operating system. The purpose of this study is to analyze how teaching is carried out using these media in direct teaching contexts, describing what is done with the classroom activities, the actions carried out and their relation to

the most important elements of the curriculum: contents, objectives, activities, and assessment. By means of this analysis we hope to locate the role of ICT within the teachers' action plans and in relation to their knowledge of the subject.

Method

Participants We video-recorded 18 class sessions in early childhood education taught by six different teachers who were collaborating in our research project, at December, March and May-June of 2009. Our intention was to collect data regarding their classroom practices involving the ICT resource. So we were recorded in video and audio each of the 18 sessions lasting approximately 60-70 minutes each. The moments were selected randomly along the morning journey. All the audio and video recordings were transcribed in order to analyze the data, and thus we had available the texts of all them.

Procedure Using a system to analyze classroom interaction that allows us to segment teaching practice into categories differentiated by level of generality (Sánchez et al. 2008a, 2008b), we studied recordings of 18 classroom sessions in which the resource described above is used. The research was carried out was based on the transcriptions of the 18 classes, using the methodology of class interaction analysis described below: First, the class is divided into Typical Classroom Activities (TCA), which identify all those activities having a defined goal during the class. Some examples of TCA are: explaining contents, doing individual work, class planning, giving homework, preparing to go out for recess, and so on. TCA allow us to work out a general pattern of the class and what takes place in it. Secondly, each TCA is divided into Episodes that specify the teacher's classroom activity in more detail. These allow us to organize the TCA internally, structuring them into smaller activity sequences that serve specific goals. Thirdly and finally, the teachers' instructional actions are identified and classified into five types: Identifying, Planning, Explaining, Recapitulating, and Supervising-Assessing. These five actions in turn are performed on elements of the curriculum: Objectives, Contents, Tasks, ICT Resources, and Non-ICT Resources (Gimeno, 2010), which can figure in the foreground (primary elements) or the background of the action (secondary elements). In the research we present, the study of the instructive actions that the teacher carries out in the classroom, together with the analysis of primary and secondary curricular elements, provides a profile of the action schemes of the teachers analyzed. This profile gives us information as to the central points around which teaching activity is organized in actual practice.

Results and discussion

In particular in this study we have obtained important findings that allow us to identify the schemes of action that the six early childhood teachers carried out in their classrooms with the digital resource and its role in these teaching practices. The table below provides summary information which indicates the differences between our first categories. These initial data show significant differences between the instructional actions teachers performed on each TCA, and also significant differences between primary and secondary curricular elements in each TCA. Table 1: Initial partial results Instructional actions Primary curricular elements Secondary curricular elements Typical Classroom Activities (TCA) $\chi^2=184,83$, $p<.001$; $\chi^2=93,65$, $p<.001$; $\chi^2=52,068$, $p<.001$

The results show that common patterns exist among the teachers studied as regards the development of these practices. The most important pattern detected is the central nature of tasks in the classroom and the subordination of ICT resources to these curricular elements. It is also important to underscore the appearance of different pedagogical approaches when ICT are incorporated into the early childhood classroom.

These findings pose challenges for the development of future research studies regarding the consistency and diversification of the patterns of action and found.

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Meaningful learning using technology. What educators need to know and do (pp.161-179). New York: Teachers College Press.

Scaffolding Japanese students' refutation in classroom and its effect.

Mika Nakano, Fukuoka Institute of Technology, Japan

In Japan, the number of the schools which introduce debate into classes is now increasing from elementary to higher levels, as a means of cultivating argumentative skills as well as developing human resources in a globalized world. Despite this trend, however, empirical studies about how to teach debate are scarce and its effect has not been sufficiently tested yet. The problem here is that teachers who have tried debate education experienced difficulties, as opposing others is sometimes too hard for Japanese students mentally and technically. The present study aims at (1) introducing a teaching method of refutation especially for students who learn debating for the first time, and (2) examining the influence of refutation on the quality of argument through the course. The curriculum was consisted of thirty classes (90 minutes) throughout a year from April 2009 to February 2010 for 160 college freshmen in the engineering department in Fukuoka, Japan. The main points of the findings were: (1) most participants improved their organization structure referring to other points of view, and (2) a developmental process of understanding refutation was revealed. For pedagogical implication, to teach debate to Japanese students who are especially unwilling to debate, we need scaffolding to have them realize their improvement with confidence by reducing their mental blocks. By discussing their developmental stages of subordinate skills and argumentative patterns, the future prospects of argumentative education for Japanese students will be further explored.

Recently, argument has been receiving increasing attention from educational researchers to explore human interaction. Previous studies have focused on how social influences affect development of reasoning, regarding argumentation facilitates deep understanding and elaborative learning (Anderson et al., 2001; Barron, 1991; Bell & Linn, 2000). In Japan, the number of the schools which introduce debate into classes is now increasing from elementary to higher levels, as a means of cultivating argumentative skills as well as developing human resources in a globalized world. Despite this trend, however, empirical studies about how to teach debate are scarce and its effect has not been sufficiently tested yet. The problem here is that teachers who have tried debate education experienced difficulties, as opposing others is sometimes too hard for Japanese students mentally and technically. In the past, Japanese education hadn't placed much significance on argument for a long period. This is mainly because the main stream of Japanese education has long been centered on individual memory, not interaction among students and teachers (Maruno, 2001). Education has deprived students of chances to learn how to argue, unless they access to special environment surrounded by people who like to do so. The author found that Japanese students tend to hesitate to argue with friends: low in approach argumentativeness and high in avoidance argumentativeness, compared to other Asian countries (Nakano, 2007). These attitudes make classroom discussion difficult for not only students but also teachers.

On the other hand, among various kinds of discussion, it has been clarified that the format of debate is suitable for inexpedient Japanese college students in the early stage (Nakano, 2006, 2008). There are two reasons for this. The first reason is to experience the basics of argument. As debate is designed to develop arguments by constructing one's own argument, refuting others' and summarizing the whole arguments separately, participants smoothly learn what they should do during their participation in the argument. The second reason is to refute someone without conflict that arises in relationships. It is not always simple to distinguish between people who argue and the content which is argued. In these senses, debate can be utilized to teach argumentation in a way which reduces students' psychological barrier to argue with peers. Debate provides a section assigned to each purpose for argument, which facilitates arguing in the order that suits appropriate goals.

The present study aims at (1) introducing a teaching method of refutation especially for students who learn debating for the first time, and (2) examining the influence of refutation on the quality of argument through the course. The curriculum was consisted of thirty classes (90 minutes) throughout a year from April 2009 to February 2010, and was used for college freshmen in the engineering department in Fukuoka, Japan. The number of students were 160 ($M=157$, $F=3$). The average age was 19.7 ($SD=1.8$). The course as a whole was divided into three stages according to the developmental model of argumentation. The students can learn basic skills and knowledge which are necessary for argumentation and debate. In this program, the lesson for refutation began in the 18th class on November 2009. To test the effects of learning refutation, the pretest ($N=154$) was conducted on the day for the first refutation class, and the posttest ($N=150$) was in the last 30th on February 2010 by questionnaire and interview. In this study, analysis was based on the answers for the question asking "please refute to the written text about smoking". This text has 260

words and was created by one of the freshmen who don't take this class. They were asked to fill in the questionnaire in ten minutes before the classes began. The research questions are as follows:

- (1) Do students explain more about their ideas using various data, examples, and reasoning by learning refutation?
- (2) Are the quality of refutation improved and highly evaluated by others by learning refutation?
- (3) Are the structures of refutation organized by learning refutation?

The part of the results are shown here, according to the above three categories. As for the first question, the number of the refutation texts output was calculated. In the pretest, the average number was 70.0 (SD=57.5). In the posttest, the average number was 115.0 (SD=57.7). From this result, we can find that they wrote 1.6 times as many texts as before ($p<.0001$).

As for the second question, an evaluator as the third party, who is the same generation of the participants and don't take this argumentation lesson, rated the quality of their refutation from 1 to 3: "1" is "unreasonable"; "2" is "reasonable"; "3" is "persuasive". In the pretest, the average score was 1.45 (SD=.61). In the posttest, the average number was 1.96 (SD=.53). The percentage of 1 "unreasonable" decreased: 62% in the pretest to 16% in the posttest. We can conclude that the evaluation by others was improved by the refutation lesson ($t(211)=6.69$, $p<.0001$).

As for the third question, the five coding schema were set: "pointing", "claim", "reason", "data & example", and "conclusion", which are necessary components for refutation. In the pretest, the average number of components covered was 1.65 (SD=.12). In the posttest, the average number was 2.59 (SD=.11). From this result, we can find that their refutation improved and organizational through the lesson ($p<.0001$). The component which changed most between pretest and posttest was "pointing". The percentage of "pointing" increased: 6% in the pretest to 45% in the posttest ($r=.54$, $p<.0001$). In addition, we found correlation between "pointing" & "persuasive" ($r=.36$, $p<.0001$), which shows the refutation which include "pointing" were evaluated higher by the third party.

For pedagogical implication, to teach refutation to Japanese students who are especially unwilling to argue, teachers need to have them realize the importance of refutation reducing their psychological barriers. By reducing the mental block, it is then easier and more effective to teach a higher level of debate skill. By discussing their developmental stages of subordinate skills and argumentative patterns, the future prospects of argumentative education will be further explored.

Effects of conversational function coding in small group discussion

Eiji TOMIDA, Ehime University, Japan

The author has developed a discussion scheme and a paper work sheet called "the track sheet" to help students' learning. The aim of the present study is to examine the effects of introducing the track sheet on discussion processes in actual classes for undergraduate students. Sixty-seven students were participated in the discussion sessions. Each group consisted of from three to five discussants. They were assigned to one of three groups: total-coding, self-coding, and non-coding. In the total-coding groups, they were instructed to code the function of utterance made by all members. The self-coding groups were instructed to code the function of their own utterances. The non-coding groups did not code any utterance. The measurement for dependent variables was performed with single-item questions to be self-rated and conversational categories actually observed in the sessions. As results, the facilitating effects of the track sheet were partially indicated. It is also shown the difficulties in using the track sheet can be easily solved through repeated practice. The findings indicate that the discussion training program using the track sheet would be a potentially effective leaning situation with further improvement.

Introduction

In educational studies, the positive effects of social interaction on learning have been examined and the verified findings are widely acknowledged (Pontecorvo, 1993). Following the theoretical and empirical attentions to the learning benefits of social interaction, teachers across the world have introduced far more group discussion sessions into their classes than before (Kimmel & Volet, 2010; Slavin, 1995). The researchers have revealed that the advantage of social interaction is determined by the quality of discussion (e.g., Wegerif, Mercer, & Dawes, 1999). However, in general, managing group discussions is often difficult for students ranging from elementary school to college levels. This is especially true for those who have not been particularly exposed to low context communication environments.

The present study is related to the endeavor to improve the discussion skills of such learners in a university course that is held in a large classroom with over 50 students. The author has developed a discussion scheme and a paper work sheet called "the track sheet" to help students' learning. The aim of the present study is to examine the effects of introducing the track sheet on discussion processes in an actual class for undergraduate students.

Method

Participants and class contexts

The present study targeted the third to the fourth classes of the course "student guidance" that was offered at a national university in Japan. This course was open to juniors in a teacher-training course. Ninety-seven students who took this course were the participants of this study. Sixty-seven students out of them participated in all the relevant activities and were subject to the subsequent analysis. As the main task, the participating students took part in a small group discussion in each class on a problem related to student guidance. In the third class, they discussed how teachers should have dealt with an injury case which actually happened in a junior high school in the past. In the fourth class, they discussed whether or not they should introduce a richer career education program to students preparing for college entrance at the cost of their course hours.

Discussion Scheme

The discussion scheme used in the program was developed in the author's previous study. It consists of three major categories: "proposal," "reaction," and "management." The proposal category, which pertains to proposing one's own ideas or opinions to other discussants, has three conversational actions: "opinion," "reason," and "example." The reaction, which pertains to the responsive moves to other discussants' previous statements, involves six actions: "reply," "question," "addition," "impression," "doubt," and "refutation." The management, which pertains to contributions to group management in discussion, has five actions: "definition," "goal," "facilitation," "summary," and "approach." These categories were used in the track sheet next to blanks with each speaker's name and their options for conversational action. In employing this sheet, the discussants are made aware of the elements of discussion and supposed to become more sophisticated in their discussion methods.

Research design and hypothesis

The participating students were assigned randomly to one of three groups: total-coding, self-coding, and non-coding. Those who were assigned to the total-coding group were instructed to code the function of every utterance made by all members on the track sheet. The self-coding groups were instructed to code the function of their own utterances. The non-coding groups did not code any utterance. They were simply aware of the scheme for the discussions. In addition to the one between-subject factor, repeated measures for dependent variables were arranged as a within-subject factor.

In the present study, the following predictions were made concerning the effects of functional coding on a track sheet. The coding may promote the participants' thinking and/or discussion development, since they are required to reflect on their own speech before speaking. However, the positive effect will not be manifested before the second discussion session. It is expected that in the first session their thinking will be inhibited by the coding procedure, because they are not familiar with the activities.

Measures

Measures for the effects were twofold. The first measures were single-item questions to be rated on a 5-point Likert-type scale for (a) speaking difficulty, (b) well-organized speech, (c) promoted thinking, (d) well-organized discussion proceeding, (e) inconvenience for speech, (f) inspirational discussion, and (g) confusion by complexity of the scheme. Attitude toward and personal involvement in the discussion themes were also self-rated in the same manner as the previous ratings. The second measures were the frequencies of actual conversation category. The numbers of the categories were counted for each participant.

Result and Discussion

As to the first measures, it was found that the scores of both speaking difficulty and inconvenience in speech significantly improved between the first and second discussions. This result indicates the both scores improved through repetition in all groups in spite of the difference in usage of the track sheet. Those who discussed in the total coding condition marked higher personal involvement score than those in the other conditions with marginal significance. This result partially supports the prediction that the coding may promote the participants' discussion development. However, in contrast to the prediction, the effect of the coding appeared in the first session, not in the second.

In analysis of the second measures, the frequency of doubt in the second session appeared significantly less than in the first. It is implicated that, through repetitive discussions, vague status of thinking such as doubt was transformed into clearer utterances such as question and refutation. On the other hand, the frequencies of refutation, facilitation, and approach declined in the second session. Those facts can be interpreted in terms of the primacy effect of introducing the track sheet.

Even though further analysis is needed, the facilitating effects of the track sheet were partially indicated. In addition, it is shown the difficulties in using the track sheet can be solved through repeated practice. The findings indicate that the discussion training program using the track sheet would be a potentially effective learning situation with further improvement.

Learning-supportive communication structures in tutorial dialogues

Anneliese Elmer, Institute of Education, University of Zurich, Switzerland; Christine Pauli, University of Zurich, Switzerland; Kurt Reusser, University of Zurich, Switzerland

In the school context, silent work phases harbour potential for tutorial teaching-and-learning discourse. On the basis of sociocultural theories, this specific form of learning support from the teacher is attributed with great importance for students' learning. There is consensus that pedagogical skills in a tutorial setting provide effective support for the student's learning process. Moreover, empirical findings point to the importance of the active role of the student in the interaction, as well as of the interaction itself, for effective tutoring.

The question of what characterises tutorial teaching-and-learning dialogues in the context of mathematics instruction when solving mathematical word problems was examined using video analyses of 12 tutorial dialogues, each with one teacher and one student. The content and structure of these dialogues was analysed by coding the type of teacher and student contributions and identifying three patterns of discourse organisation (consensual, constructive, transactive). The results indicate that in all tutorial dialogues, the constructive pattern of discourse (substantial contributions from teacher and student, clearly directed by the teacher) occurred the most frequently, compared to the rather seldom occurring transactive pattern of discourse, in which the teacher's and student's participation in the course of the dialogue is on virtually equal footing.

Theoretical background

Didactic communication takes place in various contexts of instruction. Besides classroom discourse, independent student work makes up approximately half of lesson time in most countries (cf. Hiebert et al., 2003). These silent work phases harbour potential for tutoring, which is seen as an effective form of instruction. Based on sociocultural theories, effective tutorial dialogue in a mutual problem-solving activity should enable socially supported learning in the zone of proximal development (Vygotsky, 1986), by optimally adapting support to the student's level and current needs. Investigations show that the effectiveness of tutoring does not merely depend on the tutor's pedagogical abilities. Chi, Nastasi & Pressley (2001) report that although tutors dominate the teaching-and-learning discourse, students' contributions to constructing shared understanding, and their interaction, influence learning effectiveness in a tutorial setting. Moreover, this study shows that learning based on open, cognitively activating hints of the tutor can be equally as good as when students receive explanations and feedback.

Investigations into tutoring refer predominantly to dialogues between students with differing expertise or dialogues between adults and small children, but rather rarely to dialogues between qualified teachers and students within school instruction.

Embedded in the Pythagoras Study (authors, 2009), the current investigation therefore addressed the question of how teachers, as professional tutors, support students in solving problems typical for school mathematics instruction in 1:1 teacher-student interactions. Of concrete interest was the extent to which teachers successfully stimulate constructive activities of the students and/or enable students an active role in the discourse, making substantial statements. Thus, the tutorial teaching-and-learning discourse was examined regarding the following questions:

- a) What types of teacher and student contributions occur in the discourse?
- b) What discourse patterns regarding students' participation in mutually solving the task are shown in the tutorial dialogues?

Methods

The data base consisted of 12 videotaped tutorial dialogues, in which 6 Swiss and 6 German teachers each solved a mathematical word problem with one student (8th/9th school year). All students solved the same word problem. The analysis is based on a qualitative, two-stage approach which, through two coding systems, describes the teacher-student interaction both regarding content and structurally. The analytical instrument is based on a similar instrument developed by Hogan, Nastasi and Pressley (2000) for analysing group discourse in science instruction. It was developed further for the current purpose. In a first stage, all discourse contributions of the teachers and students were recorded and categorised into various types of statements (e.g. substantial vs. non-substantial contributions, metacognitive contributions etc.) in order to discern who was involved in developing the solution and with which discourse contributions. On this basis, the second stage identified three types of discourse patterns, which differ in

quality regarding the extent and type of student participation: consensual pattern (barely any substantial student contributions), constructive pattern (substantial contributions from teacher and student but no mutual elaboration), transactive discourse pattern (mutual elaboration). This second phase describes the interaction in terms of participation of teacher and student in the problem-solving process and in the discourse. For the description of the quality of the interaction, in each dialogue, the number of statement types and of discourse patterns was ascertained.

Results

The results show that the lengths of the tutorial dialogues vary greatly, lasting between 6.5 and 17 minutes, which is related to the solution process. Comparing the progression of the tutorial dialogues with one another, independently of the total duration of the dialogues, a similar distribution of the three discourse patterns is shown throughout. The constructive discourse pattern occurs the most frequently, the consensual pattern constitutes a smaller proportion, and the transactive discourse pattern occurs very rarely. Thus, it is apparent that no one discourse type is predominant for any of the 12 teachers. Furthermore, based on the analysis of the discourse contributions, the results show in what form teachers and students participate in the problem-solving process in terms of content. While in the consensual discourse pattern, the teacher predominantly poses narrow questions and the student answers briefly and with little content, in the constructive discourse pattern, the student's content-related participation in the problem-solving process is clearly extended. In the transactive discourse pattern, an interaction between teacher and student then becomes apparent, which shows a mutual elaboration of the problem-solving process.

Conclusion and significance

The results of the analysis of communication structures in tutorial dialogues highlight, particularly through the dominance of the constructive discourse pattern, that teachers successfully adapt their questions and prompts to the cognitive achievement level of the students, enabling them to make substantial discourse contributions. The constructive discourse pattern might therefore be considered as an indicator of scaffolding (Wood, Bruner & Ross, 1976). However, the discourse remains clearly driven by the teacher and does not assume traits of an equal discussion, as is apparent from the rare occurrence of the transactive pattern. A transfer of responsibility or a fading of support was very seldom observed.

On the methodological level, it was apparent that the analytical system was successful in illuminating the typical process of supporting learning during problem-solving. Thus, possibilities for optimisation are also apparent, which are important for teacher training, as individual learning support in instruction with heterogeneous learning groups is highly valuable.

References

- Authors, (2009).
Chi, M. T. H. (2001). Learning from human tutoring. *Cognitive Science*, 25, 471-533.
Hiebert, J., Gallimore, R., Garnier, H., Givvin, K. B., Hollingsworth, H., Jacobs, J., et al. (2003). Teaching mathematics in seven countries: Results from the TIMSS 1999 video study (NCES 2003-013). U.S. Department of Education. Washington, DC: National Center for Education Statistics.
Hogan, K., Nastasi, B. K. & Pressley, M. (2000). Discourse Patterns and Collaborative Scientific Reasoning in Peer and Teacher-Guided Discussions. *Cognition and Instruction*, 17 (4), 379-432.
Vygotskij, L. S. (1986). *Thought and Language*. Cambridge MA: The MIT Press.
Wood, D., Bruner, J. S. & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17, 89-100.

The Creative Process and Cycles of Feedback: Models, feeling and the genesis of new ideas

Carol Aldous, Flinders University, Australia

Innovation and enterprise, in a global networked society, depend for their success on the development of new ideas. But from where do new ideas come? How do they arise? Are feeling and intuition involved? Finding answers to questions such as these have been at the heart of creativity research for more than fifty years and hold important implications for education.

The early twentieth century heralded creativity as a definitive process involving a series of stages that take time. Introspective methods and case study research identified the phases of preparation, incubation, illumination and verification. One model, the 'Eureka Process' (Shaw 1989), sought to highlight the role of feeling in the genesis of new ideas and predicted the presence of a series of feedback loops arising between each of the phases. The feedback loops

were named after researchers who theorised their existence. However no large scale data to confirm their existence have been presented.

A study of 405 middle school students solving two novel problems in the Mathematics Challenge for Young Australians found empirical evidence of these feedback loops. A set of scales tapping both cognitive and non-cognitive approaches to reasoning, identified the 'Areti', the 'Vinacke', the 'Lalas', the 'Communication' and 'Rossman' loops. Of note was the finding that the 'Lalas loop' was characterised by gradual illumination for the number oriented problem, but by sudden illumination for the spatially oriented problem. Data were tested by full structural equation modelling with maximum likelihood estimation procedures using AMOS graphics version 4.01

Aims

The research documented in this paper forms the basis of a major study which set out to discern whether there is any substance to the idea that individuals can feel their way to a solution in a novel mathematics problem solving event (Aldous 2009.) This necessitated identifying, describing and measuring this so called feeling in order to test its relationship with solving novel mathematics problems successfully. This was done through the structural equation modelling of a comprehensive model of creative problem solving that encompassed the person, process, product and environmental dimensions of creativity.

An unanticipated outcome of this research is evidence, found within the measurement model of the comprehensive model of creative problem solving, of a series of feedback loops arising at different stages of the creative process. These feedback loops are consistent with those proposed by Shaw (1989).

Theoretical Background:

Building on the classic model of creative problem solving which included the phases of preparation, incubation, illumination and verification have been a plethora of process models of creative problem solving (e.g. Cropley, (2001); Finke, Ward, & Smith, (1992); Shaw (1989) among many others). However, of these process models only two of them (viz: Shaw and Cropley) have highlighted the role of feeling in the creative process. Interestingly, Shaw identified and named five feedback loops arising between each phase of the classic model and speculated the presence of many more. The existence of multiple feedback loops, operating simultaneously and successively, both consciously and non-consciously, over n parallel paths, is consistent with neural network models of the brain.

The first loop, the 'Areti loop', refers to the cycling that occurs between the phases of preparation and incubation and is hypothesised to involve moving between conscious and non-conscious processing. The second loop, the 'Vinacke loop' relates to the cycle of feedback existing between the phases of incubation and illumination. It also draws upon non-conscious and conscious thinking. The third loop, termed the 'Lalas loop' relates to the cycle of feedback occurring between the phases of illumination and verification. Within the 'Lalas loop', explanation and verification lead to further illumination. The 'Communication loop' occurs between the verification phase and the creative outcome or product. Finally the 'Rossman loop' encompasses multiple feedback loops and validation processes from all previous steps in the creative process.

Methodology

The comprehensive model of creative problem solving was developed using a set of constructs hypothesised to have a bearing on successful novel mathematics problem solving. The constructs were derived from Carroll's (1963) model of school learning, and Shaw's (1989) model of creative problem solving. The constructs and their allied dimension of creativity are listed below.

Antecedents;

Personal abilities (including spatial and verbal) (Person dimension);

Perseverance and motivation (Person dimension);

Opportunity to learn (Environment dimension),

Achievement outcome (Product dimension), and

Approaches to reasoning (Process dimension)

Importantly, the latter construct was used to measure both cognitive and non-cognitive approaches to reasoning including those of feeling and intuition. A self-report instrument known as the Systems of Reasoning Questionnaire

(SRQ) comprising a set of five scales was used. Items in these scales measured five approaches to reasoning. These were a Strategic approach, a Free-flowing approach, a Spatial-verbal approach, a Feeling approach and a Systematic approach to reasoning.

Data were collected from 405 middle school students who were participants in a national program known as the Mathematics Challenge for Young Australians. Entrants had three weeks in which to answer six novel problems. Students involved in the study answered the (SRQ) upon completing two of the six novel problems. One of the problems was spatially oriented the other number oriented.

Findings in brief

Fit statistics revealed a good fit to the data for the comprehensive model of creative problem solving (RMSEA of 0.036) for both the spatial and number oriented problems.

Standardised estimates were used to prioritise the order of the three highest items within each process scale for the two measurement models. Patterns of emphases were similar in both data sets but with some notable differences.

Within the strategic approach to reasoning the pattern of emphasis was on preparation leading into incubation indicative of the 'Areti loop'. Within the Free-flowing approach to reasoning the pattern of emphases was on incubation leading into insight or illumination consistent with the 'Vinacke loop'. The Feeling approach to reasoning was characterised by feelings of knowing culminating in sudden illumination in the case of the spatial problem, but a more gradual realisation in the number problem. The cycle of explication and illumination was consistent with the 'Lalas loop'. Finally the systematic approach to reasoning was characterised by the elaboration and organisation of ideas in the case of the spatial problem but verification and checking in the case of the number problem.

Of interest was the finding that the spatial-verbal approach to reasoning indicated simultaneous processing in the case of the spatial problem, but sequential processing in the case of the number problem.

Theoretical Significance

Research into creative problem solving has theorised the existence of a number of oscillatory mechanisms involving the interaction of both conscious and non-conscious reasoning, the role of feeling in listening to the self and the interaction of spatial and verbal reasoning involving a series of feedback loops. However empirical evidence for such mechanisms involving large scale data has been scarce. The findings presented here go some way to redressing this issue.

References

- Aldous, C.R. (2009) The genesis of new ideas: Models, feeling and solutions in B., Matthews and T. Gibbons (Eds) The process of research in education: A festschrift in honour of John P. Keeves, Adelaide, SA Shannon Research Press
- Cropley, A. J. (2001) Creativity in Education and Learning. A guide for Teachers and Educators. London: Kogan Page.
- Finke, R. A., Ward, T. B. & Smith. S. M. (1992). Creative Cognition: Theory, Research, and Application. Cambridge, MA: MIT Press
- Shaw, M. P. (1989). The eureka process: A structure for the creative experience in science and engineering. Creativity Research Journal, 2, 286-289.

THEMATIC POSTER

Collaboration

Journal clubs - an intervention to promote collaboration between higher education and working life

Lea-Riitta Mattila, Metropolia University of Applied Sciences, Finland; Eija Salomaa, Hospital of the city of Espoo, Finland; Hannele Hokkanen, Metropolia University of Applied Sciences, Finland; Arja Haggman-Laitila, Metropolia University of Applied Sciences, Finland

The aim of this presentation is to describe journal club intervention which is part of the project Collaborative Intensity launched by Metropolia University of Applied Sciences and the hospital of the city of Espoo. A model for the partnership between higher education and working life is developed in the project. The concept journal club refers to arranged meetings where the staff of acute geriatric wards convene to discuss the use of research knowledge in patient care to promote evidence-based practice and to improve the outcomes of patient care.

In the clubs, the topics discussed dealt with clinical issues and answers were sought from research articles to solve problems specified by each ward/outpatient unit. The clubs met once a month to form a series of presentations dealing with a problem by employing research articles. The students paired up to make an oral presentation of a research article to staff members. After the presentation, they acted as chairpersons in the discussion. The students had a vocational college diploma in nursing and they studied towards a bachelor's degree in nursing. The articles were presented according to the written guidelines based on the phases of research process. The theoretical background and implementation of the journal club intervention will be described in the conference.

The aim of this presentation is to describe journal club intervention which is part of the project Collaborative Intensity launched by Metropolia University of Applied Sciences and the hospital of the city of Espoo. A model for the partnership between higher education and working life is developed in the project. The initial conceptual model for the partnership developed in the project Collaborative Intensity identified attitudes and lack of common understanding as factors impeding partnership. The journal club intervention is aimed to diminish these impeding factors. Three acute care hospital wards are involved in journal clubs. The mission statement of the wards is to support patients' rehabilitation in a patient centered way after the acute phase of illness and to promote patients' independence. A multidisciplinary team of nurses, social workers, physicians, occupational therapist and physiotherapists serve the patients in the wards. Patient safety, discharge planning and continuity of care are emphasized in daily care. The concept journal club refers to arranged meetings where the staff of acute geriatric wards convene to discuss the use of research knowledge in patient care to promote evidence-based practice and to improve the outcomes of patient care. A nursing journal club is a meeting of staff at the workplace to discuss the application of research knowledge to patient care. The club provides an opportunity to enhance critical thinking skills and to find peer support for new ideas on the development of care. The aim is to foster the special expertise of the staff as well as to encourage them to have professional discussions and share knowledge. The staff need guidance on how to apply research knowledge to their work. Key skills include the capability to read research reports critically and to consider research results from the point of view of practical applicability. Discussing scientific studies together may help staff to understand research and its practical implications. The nursing students have a prominent role in the clubs as presenters of the article and in chairing discussion. The students pair up to make an oral presentation of a research article to staff members. After the presentation, they act as chairpersons in the discussion. The students have a vocational college diploma in nursing and they study towards a bachelor's degree in nursing. The articles are presented according to the written guidelines received from the teacher based on the phases of research process. The journal club creates a common learning environment to the staff members and students. The planning phase of the clubs started in April 2010 by a discussion at a project meeting during which the idea was presented. Subsequently, the units that had decided to participate named a common patient care-related subject with development needs. The subject was narrowed down into problems whose solutions were sought in research articles. It is required of the chosen subject and problem whose solutions are sought in scientific studies that they are significant to patient care. It is also characteristic of the problem that they occur repeatedly in clinical practice and that it is possible to find several studies offering potential solutions to them. In the implementation phase the nursing journal club meetings will be held on the premises of the wards. Nursing students present the articles and chair the discussions. The articles are presented according to instructions given to the students. The presentations will focus on the significance of the research results to patient care and their practical applicability. A club meeting lasts 45-60 minutes. The topic discussed since November 2010 to April 2011 will be assessment of patient's confusion or delirium. The clubs meet once a month to form a series of presentations dealing with a problem by employing research articles. In the evaluation phase the learning experiences of the staff and students will be discussed to enhance common understanding and positive attitudes between the professionals and to develop journal clubs further as a multidisciplinary learning environment. The theoretical background and implementation of the journal club intervention will be described in the conference.

Literature

- Mattila L-R. & Eriksson E. 2007. Nursing students learning to utilize nursing research in clinical practice. *Nurse Education Today* 27(6), 568-576.
- Rogers J L. 2009. Transferring research Into Practice. An Integrative Review. *Clinical Nurse Specialist* 23,4, 192-199.
- Rycroft-Malone J, Harvey G, Kitson A, McCormack B, Seers K & Titcher A. 2002. Getting evidence into practice: ingredients for change. *Nursing Standard* 16, 37, 38-43.
- Titler M G, Kleiber C, Steelman V, Goode C, Barry-Walker B R J, Small S & Buckwalter K. 1994. Infusing Research into Practice To Promote Quality Care. *Nursing Research* 43, 5, 307-313.

Collaboration of teachers investigated within three different learning situations in primary schools

Jannet Doppenberg, Eindhoven University of Technology, Netherlands; Anouke Bakx, Fontys PABO Eindhoven, lectoraat L&I., Netherlands; Perry den Brok, Eindhoven University of Technology, Netherlands

During the last two decades there has been a growing awareness of the potentially strong role of teacher collaboration in relation to teacher learning. However, while theoretical 'ideals' of teacher learning are abundant in the literature, relatively little is known about what teacher learning in collaboration with colleagues actually looks like in everyday work. The aim of this study was to obtain more understanding of teacher learning related to different learning situations in which teachers collaborate with each other. In this study teacher learning was studied within three learning situations, differing in nature, taking into account both the undertaken activities by teachers and learning outcomes. Data was collected through a structured questionnaire completed by 411 teachers representing 49 primary schools. The questionnaire was based on a literature review and results of a prior interview study. Preliminary quantitative analyses showed that, four reliable and independent scales for undertaken activities and three reliable and independent scales for learning outcomes could be identified, which are comparable with categories defined in literature. Variance analyses showed that the undertaken activities and learning outcomes differed between the three learning situations. Moreover, large differences were found between activities and learning outcomes across schools.

Rationale and theoretical framework During the last two decades there has been a growing awareness of the potentially strong role of teacher collaboration in relation to teacher learning (Levine & Marcus, 2010). Collaboration with colleagues is seen as a powerful learning environment, which stimulates the professional development of teachers, the innovative development of schools as well as student learning and also characterises professional learning communities (Vescio, Ross, & Adams, 2008). However, while theoretical 'ideals' of teacher learning are abundant in the literature, relatively little is known about what teacher learning in collaboration with colleagues actually looks like in everyday work (Borko, 2004). In this study teacher learning is defined as a process of conscious and unconscious undertaken activities by teachers in collaboration with colleagues, which lead to change in cognition and/or behaviour at the individual and/or group level (Meirink, 2007). Following the literature, in this study we distinguish the context conditions that influence teacher learning in collaboration with colleagues; the organisation (structure, size of group) and topic and nature of collaboration. In a prior interview study conducted by the authors, teacher learning was studied within different collaborative settings in primary schools. Results of this study indicated that depending on the collaborative setting more or less different activities and learning outcomes were reported by teachers and school leaders. However, no direct link could be established between activities and outcomes. Thus, the first aim of the present study was to check if the reported activities and learning outcomes of that study could be confirmed with a larger sample of teachers and schools. The second aim was to investigate the link between activities and learning outcomes across different learning situations and schools. Accordingly, the following research questions were formulated: 1) What activities and learning outcomes do teachers perceive across different learning situations? 2) To what degree do the reported activities and learning outcomes vary between different learning situations? 3) What associations exist between reported activities and learning outcomes?

Method

To answer the research questions a questionnaire was developed based on a literature review and results of the mentioned prior interview study. The constructed questionnaire consisted of three learning situations referring to a specific topic and nature of collaboration. One situation referred to the implementation of new lesson materials, another to the implementation of a new teaching method and the last to teachers sharing the responsibility for one class. Per situation the same set of questions were asked with respect to the activities undertaken (22 items) and perceived learning outcomes (9 items). Items in the questionnaire scales were constructed as concrete point scales for undertaken activities (never, weakly – yearly) and as a Likert-type five-point scale for learning outcomes (almost not – very much). Data was collected from 411 teachers, representing 49 primary schools in the Netherlands. Thus, across situations the total data set contained 1233 response sets. Gender distribution of the respondents was as follows: 24 % were male and 76 % female. Exploratory factor analyses suggested the existence of four relatively independent scales for activities - labelled exchange and assistance, discussion and joint work, intervision and collegial consultation -, and three scales for learning outcomes - labelled individual outcomes, group outcomes and individual outcomes referring to changes towards colleagues. These scales seemed to align well with categories such as distinguished by literature. Reliability analyses (Chronbach's alpha) showed that these scales were consistent (alphas ranged from .74 to .95). Among the activities and among the learning outcome scales correlations were moderate ($r=.40$) suggesting that they were relatively independent. To answer the research questions we performed descriptive analysis (research question 1), variance analysis (research question 2), and regression analysis and correlations analysis (research question 3).

Results and conclusions

Since the data analyses are still in progress, at this moment only preliminary result can be reported. Variance analysis showed that the undertaken activities and learning outcomes differ between the three learning situations. Especially for the situation referring to the implementation of a new teaching method, teachers reported more learning outcomes than for the other situations. Moreover, large differences were found in activities and learning outcomes between schools. More precise and elaborate results will be discussed and presented in the poster.

References

- Borko, H. (2004). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher*, 33(8), 3-15
- Levine, T. H., & Marcus, A. S. (2010). How the structure and focus of teachers' collaborative activities facilitate and constrain teacher learning. *Teaching and Teacher Education*, 26, 389-398.
- Little, J. W. (1990). The Persistence of Privacy: Autonomy and Initiative in Teachers' Professional Relations. *Teachers College Record*, 91(4), 509-536.
- Meirink, J. A. (2007). Individual teacher learning in a context of collaboration in teams. Doctoral dissertation. Leiden: ICLON.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80-91.

Partnership between higher education and working life - Developing a conceptual model

Leena Rekola, Metropolia University of Applied Sciences, Finland

The collaboration and partnership of organizations and higher education has been depicted for decades in international literature. In spite of this, research information covering the subject is still rather sparse and the research is considered challenging. Partnership requires a new paradigm and new cooperative practices. There is no co-ordinated definition for it, nor have any widely tested work models been compiled to ensure its development. Metropolia University of Applied Sciences and the hospital of the City of Espoo involved in a project called Collaborative Intensity, in which a work model for partnership between higher education and working life is being developed. In the first stage, knowledge of the development of the partnership model will be produced through a systematic literature review and the recognition and naming of the terminology for the model. The second stage will create a preliminary model for partnership. In the third stage the development of the partnership model will be presented as well as specified and complemented. In the fourth stage a presentation of the partnership model and its development process will be produced, and complemented by specialist feedback.

The purpose of the ESR-funded Collaborative Intensity project (2008-2011) is to produce a partnership model between higher education and working life. The partnership model is being developed as a multidisciplinary collaboration between the hospital of the City of Espoo and Metropolia University of Applied Sciences. The focus will be on sharing expertise and knowledge, in addition to parallel development. Partnership enhances the sharing of the newest research information and the best practices, and group together the training and activities of social, rehabilitative and health care sectors in particular, along with their evaluation and development. The project aims to produce an innovative collaborative model for different organizations. It is based on functional coactive relations and learning environments which transcend boundaries. The new work model is intended to advance the collective recognition, use and development of know-how between different organizations. At the beginning stages of the project the partnership will operate through a pilot programme, in which work models based on the service idea of the newly planned hospital in Espoo will be developed for geriatric work. The pilot consists of three partially independent subprojects carried out at the Espoo hospital.

The collaboration and partnership of health care organizations and higher education have been depicted for decades in international literature. In spite of this, research information covering the subject is still rather sparse and the research is considered challenging. Partnership aims at offering new solutions for new problems, which no organization can overcome alone. Partnership requires a new paradigm and new cooperative practices. Partnership is used in various instances. There is no co-ordinated definition for it, nor have any widely tested work models been compiled to ensure its development

The aim of this presentation is to describe the conceptual work model as well as the development of the model. The partnership model and its development process will be presented in the action research, in which the principle, structural and processing factors of the model are recognized, evaluated and named. The results and their actualization will be evaluated with the help of experience gained from the project. The research for the project is

divided into four phases (2009 – 2011) and the following research questions will be answered: What kind of partnership models have been developed for working life and higher education? How were they developed? Which factors advance and hinder the partnership? What kind of results have been achieved through development work?

Information retrieval and material analysis are performed through qualitative analysis. In the first stage, knowledge of the development of the partnership model was produced through a systematic literature review and the terminology for the model was recognized and named. Reference literature was searched in the Cinahl, PubMed and Eric databases for 1999-2009. The search yielded 1012 references, of which 205 abstracts were picked according to certain inclusive and exclusive criteria. Altogether 21 full texts were chosen for the final analysis. In the second stage an initial model for the partnership was created. A total of 31 persons from the partner organization took part in the focus group interviews. They were carried out in six groups. The interviews were performed during 2009. The material was analyzed through qualitative content analysis.

In the third stage the development of the partnership model was presented as well as specified and complemented through the experience gained from the project collaborations. A total of 29 persons took part in the focus group interviews carried out in four groups during the autumn 2010. In the fourth stage a presentation of the partnership model and its development process will be produced (autumn 2010 – spring 2011), and the presentation will be complemented by specialist feedback (spring 2011).

Based on the results of the literature review and the first focus group interview, features seen as advancing partnership included the arrangements of the co-operation, an ethical principles and culture of the organizations, work principles directing co-operation, management of change, and publicity. Features hindering co-operation were cultural differences between the organizations, prejudice, and the lack of respect, resources and mutual understanding. Partnership processes in the development and sharing of expertise transpired as unilateral cooperation or shared learning. Shared learning occurred in student guidance, the improvement of treatment work premised on demonstration, the advancement of leadership, and in collective training. For the sharing and developing of expertise, configurations of student guidance had been established. The development of the model and its concepts will be presented at the conference.

References:

- Conally, M., Jones, C. & Jones, N. (2007). Managing collaboration across further and higher education: a case in practice. *Journal of Further and Higher Education* 31 (2), 159-169.
- Foskett, R (2005). Collaborative partnership between HE and employers: a study of workforce development. *Journal of Further and Higher Education* 29 (3), 251-264.
- Jackson, F. H., Dinkar, R. & DeFranco, A. (2005). Collaborative partnerships in an urban environment: working together to benefit all. *International Journal of Contemporary Hospitality Management*, 17 (7).
- Mac Intyre, G.(1999). Active partners: education and community development. *Education & Training* 41 (4/5), 175-183.
- Quill, B.E & Aday, L.A (2000). Toward a New Paradigm for Public Health Practice and Academic Partnerships. *Journal of Public Health Management Practice* 6 (1), 1-3.
- Sundet, K. & Kelly, M.J. (2007). Agency Academic Collaboration in Evidence-Based Practice: A Case Example in Data Driven Innovation. *Journal of Evidence-Based Social Work* 4 (3/4), 163-182.
- Winterton, J. (2006). Social dialogue and vocational training in Europe. Are we witnessing the emergence of a European model? *Journal of European Industrial Training* 30 (81), 65-76.

The Coach Teacher as an Advocate of the Partnership Between Higher Education and Working Life

Liisa Lukkari, Metropolia University of Applied Sciences, Finland; Minna Marjamäki-Kekki, City of Espoo, Finland

The aim of this lecture is to view the coach teacher as a "tool" in the partnership frontier between higher education and working life. The coach teacher pilot is a part of Collaborative Intensity project (2008-2011) and its goal is to produce a partnership model between higher education and working life, which can be transferred and adapted to any collaboration between different parties. The partnership model is developed as an action research in the Espoo-Metropolia pilot project.

The coach teacher acts as a coordinator, a support for students and a developer of the clinical instructors' guidance skills. The coach teacher seeks and creates opportunities for students to take part in innovative and multidisciplinary learning situations with representatives from working life and higher education. The basic skills demanded of a coach

teacher are the good guidance of students and availability to and support of students during clinical practice. The aims of the coach teacher pilot are the support and guidance of students, the support of the mentors and development of their pedagogical competency, the purpose being to improve the quality of guidance. The aim is also cooperation and coordination between the working life and higher education.

The partnership model is developed as an action research in the Espoo-Metropolia pilot project. Involved in the pilot are the Faculties of Welfare and Functioning and Health Care and Nursing of the Metropolia University of Applied Sciences and the staffs of the hospital of Espoo city and Recruiting unit of Espoo city. The coach teacher acts as a coordinator, a support for students and a developer of the clinical instructors' guidance skills. The coach teacher seeks and creates opportunities for students to take part in innovative and multidisciplinary learning situations with representatives from working life and higher education. The basic skills demanded of a coach teacher are the good guidance of students and availability to and support of students during clinical practice. This clinical practice plays a major role in the development of professionalism, competence, and the skills needed in working life. Clinical practice should enhance work in multiprofessional working groups. Clinical work comprises almost one half of the degree programme.

The aims of a coach teacher:

Aim number one is the support and guidance of students. Students should commit themselves to clinical practice and the practice environment, which creates opportunities for advance recruitment. They receive a welcome letter before clinical practice, the head nurse of the hospital and the coach teacher hold an information session, after which the coach teacher presents the hospital premises and accompanies the students to the wards where the information session continues. According to research, during clinical practice students experience a supportive mentor relationship and regular feedback as important (Warne et al 2010). Within this pilot students and the coach teacher meet for reflection meetings, in which they discuss subjects connected to learning in multiprofessional student groups. The coach teacher makes regular rounds of the wards, at which time she/he meets with students and mentors and provides support and guidance.

Aim number two is to support the mentors and development of pedagogical competency, the purpose being to improve the quality of guidance. According to research, an individualized mentorship as well as the teacher/student relationship is of fundamental importance during clinical practice (Warne et al. 2010). Mentors are informed about the curriculum, the learning context, and they are assisted in integrating theory and practice. According to research, mentors need pedagogical training (Vuorinen 2005). The aim is to enhance mentors' skills with pedagogical education and unify the quality of guidance in the hospital. Regular meetings of the mentor network should bring consistency and better quality to mentorship. Guidance material is developed and updated, and at the end of clinical practice feedback from students is collected (Mikko Saarikoski's Cles-scale).

Aim number three is cooperation and coordination between the working life and higher education. According to research, the appointment of a contact person promotes operations and understanding of methods as well as the exchange of practices found to be useful (Hinkkanen 2002). The coach teacher coordinates collaboration between education and working life.

The aim is mutual expertise and networking as well as making up-to-date information on education available to working life. The coach teacher coordinates teachers' working life periods in which exchange of expertise facilitate the creation of innovative learning environments. Teachers' working life periods promote mutual understanding, exchange of expertise, strengthening of teachers' skills and multidisciplinary learning situations in a clinical environment.

Research and development is practically orientated, and beneficial to both working life and education. Research club activities allow students to present scientific articles based on the needs of the working community and bring research knowledge to the working community in a clear and understandable way. Multidisciplinary patient case study exercises develop both students' and working life representatives' professional skills in multidisciplinary work and the assessment of the patient's condition. The theses written for the project support the hospital and profit unit strategy. Thesis subjects relate to the sub-project themes of the Collaborative Intensity project: patients' safe medication, rehabilitation and discharge.

References:

Hinkkanen Leena. 2002. Hoitotyön opettajan ja käytännön ohjaajan yhteistyön käytännön opiskelun ohjauksessa. Pro gradu –tutkielma. Tampereen yliopisto. Hoitotieteen laitos. Tampere.

Vuorinen R, Meretoja R, Eriksson E. 2005. Hoitotyön ohjatun harjoittelun sisältö, edellytykset ja vaikutukset - systemoitu kirjallisuuskatsaus. *Hoitotiede* 5/2005.

Warne Tony, Johansson Unn-Britt, Papastavrou Evridiki, Tichelaar Erna, Tomietto Marco, Van den Bossche Koen, Flores Vizcaya Moreno Maria, Saarikoski Mikko. 2010. An exploration of the clinical learning experience of nursing students in nine European countries. *Nurse Education Today* 30 (2010) 809-815.

Virtual Collaboration and Intercultural Learning at Universities

Julia Huenniger, University Augsburg, Germany; Klaus Bredl, Institute of Media and Technological Enhanced Learning, Germany; Jane Fleischer, Institute for Media and Educational Technology, Germany

These days, societies are characterized by their interculturality. International communication is a part of everyday life and cross-cultural contacts go without saying. As a tool to broaden the sphere of interculturality social software can be used. This paper promotes the use of digital media in teaching to encourage intercultural learning in all subject areas. To begin, we will define social media and changes in the internet. Specifically, we will go into detail on the varied possibilities of collaboration online. Subsequently, a short description of the relevance of intercultural learning at universities and the potential of digital media to create intercultural communication possibilities will be demonstrated through several examples. We will conclude with challenges and possibilities for future research.

Virtual CollaborationFirst, we must define the term "web 2.0". According to Kerres (2006), web 2.0 can be defined as changed perception and use of the internet: "Characteristic of web 2.0 is that conventionally computer-run applications are translocated into the the internet" (p. 1). The internet is no longer just used for the gathering of information from experts, because contributions can come from anyone and content is created in a dialogue between many users. Users have an active role, because their contributions are in the center of everything: "Opinions can be shared in various forms, linked with contributions of a similar nature and can eventually become influential opinion pools" (Stanoevska-Slabeva 2008, p. 16). The internet becomes social through the offering of new things: On one hand, through the possibility that everyone can take part. On the other hand, through the growing importance of communication with other users.[1] This so-called "participatory web" phenomenon is not a term we will come to hear less often in the near future (Fisch/Gscheidle 2008)."Participation" is a prerequisite for collaboration, a method that is becoming more and more important, especially in regards to social media. Ideas and experiences are shared online. Users generate content and work together - creating synergies. Collaboration has additional value, because individual work is reviewed, edited and criticized by others to create a final product. The objective in all of this is not, however, necessarily the end result, because collaboration "focuses on processes: transformations that lead to learning" (Neumayr 2007, p. 123).Collaboration requires participation from everyone involved: At universities, this means the participation of everyone involved in the teaching and learning process. Similarly, online all authors need to be engaged.Consequently, integration of the social web to promote collaboration seems appropriate for university teaching. The degree to which intercultural learning and communication through digital media can also be implemented will be presented in the following section.Intercultural LearningThe prefix "inter" is Latin and means "between". It declares that new things can be found or founded between people from different cultures (Leimgruber 2007, p. 19).Intercultural learning begins with the dialogue between people from different cultures. This is where social software can be used to motivate intercultural learning, because online interculturality can be authentically produced and shared (Bolten 2007): The internet offers "forms of publication and communication that can not only be used for individual and collaborative knowledge management, but next to its informative function it also facilitates social connections between users" (Býffel/Pleil/Schmalz 2007). In addition to blogs and wikis, forums and podcasts also help to support intercultural learning at universities (for example, to learn a foreign language, or in specific subject areas such as international management, etc.). Students from different cultures can write about their learn progress in blogs and share their experiences with others. These blog entries can be commented by other users and this, in turn, can lead to some interesting discussions. Another option is wiki projects: Students can write about everyday things from their cultural standpoint, for example, which might also generate a dialogue with others. Participants not only learn about their own and other cultures, but also about how to negotiate. Bolten describes the negotiation process: "Collaboration via internet depends on time differences, languages and the set rules for working together. Because of this, the learning process here is intercultural and, subsequently, also authentic and believable" (Bolten 2007, p. 228). Especially through the use of digital media and media products in teaching - which have been simplified by social media - intercultural learning is conceivable for all subject areas.Virtual Collaboration and Intercultural LearningTo date, intercultural learning has been implemented mostly in social or economic fields of study, in addition to foreign language studies. However, even in these subject areas the social web isn't utilized to its full potential. The establishment of an extended concept of culture and diversity have led to an increase in intercultural themes at universities. With the advancement of globalization, it is important particularly for all social

and arts scholars to have special knowledge of intercultural issues, especially because society today is characterized by interculturality. Economic, political, social and ecological relations at a state level are increasingly being put into a more global context. International exchange is a part of everyday life; cross-cultural contacts go without saying (große Holthaus/Kßler 2004, p. 7f.). In this context Social media can be used to create and promote interculturality via emails, forums, news groups, blogs, e-Tandems, Wikis (Bolten 2007). In this regard Banks (2006, p. 76) points out what is crucial in terms of intercultural web collaboration: "We have learned that intercultural collaboration on e-learning is demanding and time-consuming but is ultimately worthwhile, because new knowledge, creativity, insights and practices can be developed. However, critical shared reflection on beliefs and practices of e-learning is an essential requirement to maintain the process of effective intercultural collaboration." Conclusion Virtual collaboration has become essential in the field of intercultural learning. Bolten (2005) describes the corresponding terms of social media and intercultural learning as "double chance", because they not only deliver important information, but help to build connections, relationships between users. Dervin (2010, p.2) gives advice on the implementation of intercultural learning in Web 2.0. He thinks, that learners "should be led to reflect on how to make intercultural communication more respectful of individuality and how people use identities and cultures to talk about themselves, construct who they're and others, manipulate, etc. Project pedagogy and taskbased learning represent good alternatives for combining Web 2.0 and interculturality." As a result of the above research, it can be concluded that prerequisites for and relevance of virtual intercultural communication should be a topic for future study. At the University of Augsburg's Institute of Media and Educational-Technology a concept for a seminar will be developed, implemented and evaluated in the winter semester of 2010/2011, in which the above mentioned will be tested.[2]-----[1]To account for this development and omission of the from the advertising industry originating (O'Reilly 2005) controversial term "web 2.0": Changed and new offers online will be identified with the term "social media". The new internet will be described accordingly as the social web.[2]The results will be available when the finished paper is handed in.

Building a school-family-community partnership based on a structuring device: success plans

Dany Boulanger, Université de Sherbrooke, Canada; Francois Larose, Université de Sherbrooke, Canada

Aims

In this paper, we will present the results of a second-order data analysis from a study focused on school-family-community partnerships. We assess how the evolution of a particular device, that is to say schools' success plans, promotes building partnerships. This study used two central constructs: the ecosystemic approach (Smith & Thelen, 2003; Bronfenbrenner, 2004) and the activity theory (Engeström, 1987, 2001).

Methodology

The failed partnership practices attributed to a lack in the systematization of the activities identified and in their articulation lead us to study success plans as a requirement when building a partnership and when requesting the participation of all the stakeholders, parents in particular. Data analysis will be accomplished by using the activity theory (Engeström, 1987, 2001). We have conducted a textual data analysis (Lebart, Salem, & Berry, 1998) on all of the success plans produced over a period of seven years. We applied a similar process to stakeholders' responses to semi-structured interview questions carried out among all of the stakeholders (N=357) participating in the program.

Findings

We are witnessing all the stakeholders coming together around shared zones and a change in the status of parents in which their skills are being recognized.

Theoretical and educational significance of the research

This study shows the efficiency and relevance of using activity theory when analyzing the dynamics of jointly building a school-family-community partnership, and underlines the importance of all the stakeholders participating, the parents in particular.

Aims

In this paper, we will present some results of a second-order data analysis from a study sponsored by the Fonds québécois de recherche sur la société et la culture (2006-2009). We studied how the evolution of a particular device, that is to say schools' success plans, reflects how a partnership between school and community stakeholders and parents from disadvantaged backgrounds is built. This study used two central constructs: the ecosystemic approach (Smith & Thelen, 2003; Bronfenbrenner, 2004) and the activity theory (Engeström, 1987, 2001).

Problem and research objectives

On an international level, we are witnessing the implementation of practices that seek to build a partnership between school, family, and community based on an ecosystemic logic. In partnership-based programs, school personnel and community workers define and implement activities that seek to promote school participation among parents from socio-economically disadvantaged communities. The inefficiency of these practices is often associated with the fact that they are centered strictly on the school, so that the leadership is mainly taken on by the teachers and school board, who treat parents as mediocre support workers (Vincent & Martin, 2002; Gutierrez, Field, Simmons, & Basile, 2007). They are based on a phenomenon of cultural discontinuity and imply a weak link between systems, known as cultural realms (Cairney, 1997, 2001). Moreover, these practices do not generally have devices facilitating this articulation and making it possible to define and assess activities identified in an operational way and build them over a long period of time.

Theoretical framework

This talk is based on a second-order data analysis of data gathered within the framework of a study on the impact of a program developed in the Province of Quebec, seeking to support educational achievement among primary school pupils in socio-economically disadvantaged communities. The program *Famille, école, communauté, réussir ensemble* (FECRE) is based on a structuring device, which is to say schools' success plans. Defined within an ecosystemic perspective, success plans target systems as a whole, perceiving them as resources.

Data analysis will be accomplished by using the activity theory (Engeström, 1987, 2001). Activities carried out among children, by each of the stakeholders, from their reference system, are defined as objects to whom stakeholders attribute meaning and who reflect their socio-cultural realm. They are based on patterns of recurring practices. Cultural tools are used to mediate the relationship between these activities and the objects that are associated with them. They may be material tools (documents, texts) or semantic tools such as attitudes or beliefs. These tools, which facilitate the articulation between objects from distinct cultures, are a components of practices developed where systems meet and determine the conditions of the stakeholders' participation.

Our research objectives are to identify: 1) how implementing a device that will organize curricular and extra-curricular activities, that is to say the success plan, when it is jointly built by stakeholders coming from different networks, will create an effective school-family-community partnership; and 2) in what way a longitudinal interaction perspective will make this joint venture possible.

Methodology/research design

This talk is based on a second-order data analysis of data gathered within the framework of the FECRE's assessment. This program, over a period of seven years and involving 22 primary schools (between 2002 and 2009), was assessed during the three last years of the implementation. We have conducted a textual data analysis (Lebart, Salem, & Berry, 1998) on all of the success plans produced over a period of seven years. In this approach, which uses correspondence analysis on a body of discourses, a certain number of forms (words) or segments (concepts) characterize certain activities. These discursive elements, as they pertain to operators reflect the more or less off-centered position of specific activities in relation to the centre of the factorial plan. In turn, these off-centered positions reflect the part of the variance that is not explained by successively taking factors into consideration. We applied a similar process to stakeholders' responses to semi-structured interview questions carried out among all of the stakeholders participating in the program (N=357). By conducting this analysis, we obtain a measure of effect for the success plans on the implementation of partnership practices based on their ecosystemic roots. In this way, we were able to compare how the success plans evolved according to what the stakeholders' discourses. Thus, we compared these discourses to how the parents' participation evolved, such as it can be extrapolated from the success plans.

Results

The results show a progressive evolution of the success plans' means, displaying a complex articulation between school, family, and community. In the beginning, the means were centered on the school. Progressively, the ties between stakeholders developed and became a component of the implementation of several means that tend to decompartmentalize. We are witnessing all the stakeholders coming together around shared zones and a change in the status of parents in which their skills are being recognized. Notably due to their ecosystemic foundation, the success plan is considered a first rate tool for implementing an effective school-family-community partnership and instigating parental participation.

Theoretical and educational significance of the research

This study shows the efficiency and relevance of using activity theory when analyzing the dynamics of jointly building a school-family-community partnership, more specifically when this partnership is based on a non-instrumental conception of parental participation as stakeholders in their children's schooling. It underlines the importance of the

participation process of all school stakeholders, parents included, when building, implementing, and assessing the efficiency of operationalization devices with respect to the school-family relationship in a perspective of real empowerment, notably in disadvantaged communities.

THEMATIC POSTER

Self-regulation and self-efficacy

Teacher Self-Efficacy as a Predictor for Instructional Behaviour? A Longitudinal Analysis.

Doris Foerster, University of Frankfurt, Germany; Mareike Kunter, Goethe-University, Institute of Psychology, Germany; Anja Philipp, University of Frankfurt, Germany

This paper investigates teachers' self-efficacy beliefs as possible influences on their instructional behaviours under a longitudinal perspective. In a sample of 155 secondary teachers, teachers' self-efficacy beliefs and teaching practices (e.g. cognitive activation, classroom management, individual learning support) were assessed at the end of grade nine and the end of grade ten. While teachers reported their self-efficacy beliefs, their instructional behaviours were evaluated by the teachers as well as their students. Cross-sectional correlations between self-efficacy beliefs and characteristics of instruction could be substantiated; however, cross-lagged analyses confirmed a longitudinal effect of self-efficacy only on individual learning support. By contrast, instructional features such as cognitively activating behaviour were determining the level of teachers' self-efficacy one year later. This was true even when students rated the instruction. These results indicate that the influencing effects of self-efficacy are as yet unclear and that classroom contexts can determine motivational orientations of teachers, which had the capacity to change even in highly experienced teachers.

Aims and theoretical framework

Motivational characteristics of teachers - as part of their professional competence (e.g. Alexander, 2008) - have been increasingly investigated over the last few years. Constructs like self-efficacy, enthusiasm, autonomous or controlled motivation - originally used to describe students' motivation - have been applied to teachers in order to explain differences in teachers' behaviours. One of the most widely researched motivational construct is teachers' self-efficacy. While some researchers link teachers' self-efficacy beliefs to student outcomes such as student achievement (e.g. Caprara et al., 2006) or student motivation (e.g. Midgley et al., 1989), others consider their consequences for teachers' well-being (e.g. Schwerdtfeger et al., 2008) and teachers' instructional behaviours (e.g. Tschannen-Moran et al., 1998). Despite these attempts to corroborate the relevance of teacher self-efficacy for educational purposes, previous studies leave at least two questions open. First, few studies have yet examined teachers' self-efficacy beliefs from a longitudinal perspective. Consequently, the assumption of a positive causal influence of self-efficacy on outcome variables such as instructional behaviours is often based on cross-sectional data. Secondly, data from previous research may be biased due to confounding of data sources: In many cases, teachers not only assess their level of self-efficacy, but also rate their instruction at the same time. This paper therefore deals with teachers' self-efficacy beliefs and their impact on instruction over time. In line with previous research findings, it is expected that teachers' self-efficacy at an earlier date will influence their later instructional behaviours, i.e., their classroom management activities, cognitive activation and individual learning support they provide to their students. At the same time, however, we investigate to what degree earlier teaching behaviours impact on teachers' self-efficacy beliefs. Moreover, analyses will address the question whether the expected relationships can be established not only for teachers' self-reported items but also for a more objective measure such as students' evaluation of teacher instruction.

Method

Sample: Analyses were based on a sample of German secondary mathematics teachers. A representative sample of 9th-grade mathematics classes and their teachers were recruited within the COACTIV study - a study embedded in the German PISA study of 2003. For undertaking the intended longitudinal analyses, it was, however, critical that classes and teachers did not fluctuate over the two measurement points. Thus, the resulting subsample included 155 teachers (53% male, mean age 48 years, average professional experience of 22 years) and their corresponding students (N=4413, mean age 15 years), facilitating the linking of the different data sources. **Design:** Data were collected at two measurement points; at the end of grade nine and at the end of grade ten. All scales were administered at both time points. **Instruments:** Scales from the teacher questionnaire tapped teachers' self-efficacy ($\alpha = .67$ at Time 1/.68 at Time 2) and teachers' instruction in mathematics covering cognitive activation (e.g. cognitively challenging instruction), classroom management (e.g. disciplinary problems) and individual learning support (e.g. personal confidence). The student questionnaire also gauged the three dimensions of teachers' instruction (e.g. cognitive autonomy, effective use of time, adaptive explanations, respectively). Cronbach's α 's for the teacher rating scales

above .7 and intra-class correlations above .82 indicated good reliability of the aggregated student responses. Statistical procedure: After ensuring reliability of student ratings as well as sufficient agreement on the students' assessments (ADm

Results

Analyses supported the well established cross-sectional correlations between self-efficacy beliefs and characteristics of mathematics instruction (e.g. cognitively challenging tasks $r=.17$, cognitive autonomy $r=.18$, individual support $r=.38$, all p 's

Theoretical and Educational Implications

This paper investigated the role of teachers' self-efficacy beliefs to support high quality teaching behaviours. Using a longitudinal design, the – often implicitly assumed – effect of self-efficacy on instruction was challenged. Instead, it could be demonstrated that earlier teaching "successes" – i.e., teaching in a way that students find cognitively stimulating – had a positive impact on later teachers' self-efficacy beliefs. In addition, our findings show that self-efficacy beliefs change and develop, even for highly experienced teachers. This finding underlines the reciprocity and high interdependency of classroom activities (Caprara et al., 2006). In-class conditions seem to influence motivational orientations of teachers. Future research attempts will need to further clarify whether there are contextual circumstances under which motivational orientations may be reflected in teachers' instructional behaviours.

References

- Alexander, P. (2008). Charting the course for the teaching profession: The energizing and sustaining role of motivational forces. *Learning and Instruction*, 18(5), 483-491. doi: 10.1016/j.learninstruc.2008.06.006
- Caprara, G., Barbaranelli, C., Steca, P., & Malone, P. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of School Psychology*, 44(6), 473-490. doi: 10.1016/j.jsp.2006.09.001
- Midgley, C., Feldlaufer, H., & Eccles, J. (1989). Change in Teacher Efficacy and Student Self- and Task-Related Beliefs in Mathematics During the Transition to Junior High School. *Journal of Educational Psychology*, 81(2), 247-258. doi: 10.1037//0022-0663.81.2.247
- Schwerdtfeger, A., Konermann, L., & Schönhofen, K. (2008). Self-efficacy as a health-protective resource in teachers? A biopsychological approach. *Health Psychology*, 27(3), 358-368. doi: 10.1037/0278-6133.27.3.358
- Tschannen-Moran, M., Hoy, A., & Hoy, W. (1998). Teacher Efficacy: Its Meaning and Measure. *Review of Educational Research*, 68(2), 202-248. doi: 10.3102/00346543068002202

Social utility and social desirability of self-presentation strategies. An exploratory study.

Maria Cristina Matteucci, University of Bologna, Italy

The main purpose of this study was to identify the use of self-presentation strategies on undergraduate students and to explore the underlying dimensions of self-presentation tactics in terms of social utility (or competence) vs. social desirability (or sociability). These two main dimensions have been recognized by the literature on social judgment as fundamental for the production of assessments. Recently several studies have shown the predominant role of morality as a distinct dimension used by individuals to achieve positive evaluations. In order to investigate relations between morality, competence and sociability norms, fifty undergraduate students were asked to complete a questionnaire with different self-presentation strategies, namely, to appear as likable versus as likely to succeed to their teachers. They were asked to indicate to what extent they considered important each trait included in the questionnaire in order to achieve the desired outcome. The same questionnaire was completed three times: the first with standard instructions, the second with social utility instructions, the third with social desirability instructions. Factorial analyses suggest the presence of two main dimensions that underlie self-presentation tactics. Findings confirm that students are able to make desired impression on others with appropriate responses based on the particular purpose suggested by the instructions. Theoretical and educational significance of the research are discussed.

Aims.

In educational settings the use of self-presentation strategies in order to influence opinions and judgments of others, especially teachers, has been widely demonstrated (Matteucci, 2004). In order to use the right strategy to influence the judgments of others and obtain a positive evaluation, people have to know what features are relevant to the audience (Baumeister & Jones, 1978). The literature on social judgments has been working for two decades on the dimensions that organize the production of assessments by individuals (for a review: Judd, James-Hawkins, Yzerbyt, Kashima, 2005). In summary, what emerges from the literature is that not all features have the same kind of value and

two main dimensions have been recognized: the social utility and social desirability (Beauvois, 2003; Dubois, Beauvois, 2005). The social desirability refers to what makes people pleasant or unpleasant, socially attractive, and includes features such as pleasant, friendly, sociable and helpful. The social utility refers to the individual's ability to meet the requirements of a particular social context or organization, then the chance of success within that group or organization. Some authors have defined the social utility as "competence" (Wojciszke, 2005), and usually it includes traits such as "competent", "intelligent", "smart" and features such as internality (Beauvois, 2003). Recently, several research lines have shown the predominant role of morality as a distinct dimension and characteristic that people use to evaluate their ingroup positively (Leach, Barreto, Ellemers, 2007) and in forming global impression of others (Wojciszke, 2005). Given the centrality of these dimensions in social judgment and, consequently, in educational context, it seemed important to begin to understand the relation among the three dimensions.

This paper describes an explorative study realized within a research programme aimed at identifying the use of self-presentation strategies in educational settings. The main purpose is to investigate whether students are able to enhance their self-descriptions by using different traits for different purpose and to explore the underlying dimensions of their self-presentation tactics.

Method

Participants, procedure and materials. Fifty undergraduate students (F: 80%, mean age: 25.1, SD: 7.1) attending an Italian University volunteered for this experiment. The self-presentation paradigm (Darnon, et al. 2009) was used. They were asked to respond to the same questionnaire three times using three different instructions. The first asking them to assess the subjective importance ("standard" condition) of 30 traits, on a 7-point Likert scale (1 "not at all important" to 7 "very important"), then they were asked to evaluate the 'importance of these traits to be judged by their teachers as students who are successful ("social utility" condition) and, finally, students were asked to rate the importance of the same traits to be judged by their teachers as someone appreciated by others ("social desirability" condition).

Findings

First, a factor analysis on the traits items was conducted. Principal components factoring with oblique rotation (Oblimin) was used. The analysis revealed two factors accounting for 45.17% of the variance. The first factor accounted for 27.1% of the variance and contained desirability traits such as: good, honest, benevolent, sincere. The second factor included the utility items: skilled, valuable ambitious, and competent. It accounted for 18% of the variance. The correlation between the two factors was not significant.

A Friedman's non-parametric test was conducted to determine whether participants had a differential rank ordered preference for the items according to the three instructions (independent variable). Results confirm a statistically significant difference in mean ranks across instruction conditions with $p < .05$. In this case, the multiple comparisons indicate (at the 0.05 significance level) that several traits obtain higher values than at least one of the other instructions (see Figure 1).

Theoretical and educational significance of the research

This explorative study led to encouraging results confirming that students are able to use different self-presentation strategies for different purposes. Results suggest also the bi-dimensional structure of the social judgment. The present findings might well apply to the educational contexts, where self-presentational motives can be translated into behavioural tactics. Thus, the ability to adjust one's self-presentational tactic when interacting with different audiences and with different purposes is a social skill pertaining to the self-monitoring capacity. In order to achieve specified social goals (e.g. get included in a peer study group) or to influence evaluative judgments, the results of the present study emphasize the powerful importance of the underlying dimensions of traits. Social utility and social desirability seem to include also morality traits. Further studies are planned in order to deeper investigate the issue.

References

- Baumeister, R.F. & Jones, E.E. (1978). When self-presentation is constrained by the target's knowledge: Consistency and compensation. *Journal of Personality and Social Psychology*, 36(6), 608-618.
- Beauvois, J. L. (2003). Judgment norms, social utility, and individualism. In N. Dubois (Ed.), *A sociocognitive approach to social norms* (pp. 123–147). London: Routledge.
- Darnon, C., Dompnier, B., Delmas, F., Pulfrey, C., & Butera, F. (2009). Achievement Goal Promotion at University: Social Desirability and Social Utility of Mastery and Performance Goals. *Journal of Personality and Social Psychology*, 96, 119-134.
- Dubois, N., & Beauvois, J. L. (2005). Normativeness and individualism. *European Journal of Social Psychology*, 35, 123–146.

Judd, C. M., James-Hawkins, L., Yzerbyt, V., & Kashima, Y. (2005). Fundamental dimensions of social judgments: Understanding the relations between judgments of competence and warmth. *Journal of Personality and Social Psychology*, 89, 899–913.

Leach, C. W., Ellemers, N., & Barreto, M. (2007). Group virtue: The importance of morality (vs. competence and sociability) in the positive evaluation of in-groups. *Journal of Personality and Social Psychology*, 93, 234–249.

Matteucci M.C. (2004). Giudizi degli insegnanti e strategie di autopresentazione degli alunni: l'intervento della norma di internalità. *Psicologia dell'educazione e della formazione*, 6(3), 337-355.

Wojciszke, B. (2005). Morality and competence in person- and self-perception. *European Review of Social Psychology*, 16, 155–188.

Self-Efficacy, Prior Knowledge, and Confidence in Prior Knowledge on Conceptual Change Learning

Jacqueline Cordova, University of Nevada, Las Vegas, United States; Gale Sinatra, University of Nevada, Las Vegas, United States

This study explored how combinations of self-efficacy, prior knowledge and confidence in knowledge interacted with time during conceptual change learning. One hundred and sixteen college students rated their self-efficacy and confidence in their knowledge about seasonal change prior to reading a refutational text. Students also completed a test of their knowledge of seasonal change at pre, post, and delayed posttest. Students were divided into three profiles based on similar self-efficacy, prior knowledge, and confidence in prior knowledge at pretest using k-means cluster analysis. The profiles included 1) moderate self-efficacy, low knowledge, low confidence, 2) high self-efficacy, moderate knowledge, moderate confidence, and 3) high self-efficacy, high knowledge, high confidence. The combination of high self-efficacy, moderate knowledge, and moderate confidence was most productive for conceptual change. This group exhibited the greatest reduction in misconception as well as a significant increase in conceptual understanding from pre to post and these gains were maintained at posttest. The combination of high self-efficacy, high knowledge, and high confidence was least productive for conceptual change. Those high on self-efficacy, knowledge, and confidence demonstrated the lowest reduction in misconceptions and no increase in science ideas over time. Results indicate that learner characteristics most productive for conceptual change learning may differ from those most productive in traditional learning situations.

Pintrich, Marx and Boyle (1993) hypothesized that self-efficacy beliefs may facilitate conceptual change through fostering confidence in one's ability to gain understanding and change one's ideas. Conversely, self-efficacy beliefs may hinder conceptual change through fostering confidence in one's own conceptions to the point of reluctance to accept alternative ideas. Limited research has been conducted investigating the combined role self-efficacy, prior knowledge, and confidence in prior knowledge may play in conceptual change. Therefore, the purpose of this study was to explore how varying combinations of self-efficacy, prior knowledge and confidence in prior knowledge would influence conceptual change science learning through refutational text.

Two research questions guided this study including: 1) What basic profiles of students exist based on their topic specific self-efficacy, prior knowledge, and confidence in prior knowledge? and 2) Do these emergent profiles explain differences in conceptual change?

Methods

Participants

One hundred and sixteen students from a large southwestern U.S. university participated in the study. Participants ranged from 18 to 52 years of age ($M = 25.39$, $SD = 7.93$); most were female (72.4%), white (69.8%), and juniors (50.9%).

Procedures and Materials

Participants first completed a demographics survey, followed by a series of researcher-developed questionnaires measuring their 1) self-efficacy for learning about seasonal change, 2) current knowledge about seasonal change, and 3) confidence in that knowledge.

Participants then read a five paragraph refutational text presenting the scientific conception of why the seasons change which had been shown to promote conceptual change in college student participants in prior research (Broughton, Sinatra, & Reynolds, 2010). Afterwards and at a two week follow-up session, students were asked to again complete the Seasons Concept Inventory, which was scored for both misconceptions and scientific understanding.

Results

In regards to our first research question, students were divided into groups based on similar learner characteristics using k-means cluster analysis. Three theoretically sound profiles were revealed using self-efficacy, prior knowledge, and confidence in prior knowledge at pretest. The three group profiles were 1) moderate self-efficacy, low knowledge, low confidence (moderate/low/low) ($n=38$), 2) high self-efficacy, moderate knowledge, moderate confidence (high/moderate/moderate) ($n=44$), and 3) high self-efficacy, high knowledge, and high confidence (high/high/high) ($n=34$).

In regards to the second question, two mixed model 3 x 3 factorial ANOVAs with group profile serving as the between-subjects factor and time (pre, post, delayed post) serving as the within-subjects factor were conducted on two aspects of students' conceptual change (number of scientific ideas and number of misconceptions).

The results of the first ANOVA indicated that the interaction between profile and time on the number of scientific ideas was statistically significant, $F(4, 226) = 8.88$, $p = .136$. Follow-up ANOVAs indicated that the high/moderate/moderate group exhibited a significant increase in conceptual understanding from pre to post with no significant reduction in science ideas at follow-up, $F(2, 86) = 40.66$, $p = .486$. The moderate/low/low group also demonstrated a significant increase in conceptual knowledge at both post and delayed posttest; though there was a significant reduction in the number of science ideas from post to delayed posttest, $F(2, 74) = 41.69$, $p = .530$. The high/high/high group, however, showed no significant increase in science ideas over time, $F(2, 66) = 1.53$, $p > .05$, $\eta^2 = .044$. Means and standard deviations are presented in Table 1.

The results of the second ANOVA indicated that the interaction between profile and time on the number of misconceptions was not statistically significant, $F(4, 226) = 1.65$, $p > .05$, $\eta^2 = .028$. Therefore, main effects were examined.

There was a statistically significant difference by time, $F(1, 113) = 14.52$, $p = .114$. Although all three groups did demonstrate a significant reduction in misconceptions from pretest to posttest as well as from pretest to delayed posttest indicating that they did experience enduring conceptual change, all three groups showed a significant return of misconceptions from posttest to delayed posttest. There was also a statistically significant difference by group, $F(1, 113) = 35.49$, $p = .386$. The moderate/low/low group and the high/moderate/moderate group showed the greatest reduction in misconceptions with no significant difference between them. The high/high/high group showed the lowest reduction in misconceptions. Means and standard deviations are reported in Table 1.

Discussion

The combination of high self-efficacy, moderate knowledge, and moderate confidence was most productive for conceptual change. The high self-efficacy, high knowledge, and high confidence combination was least productive for conceptual change. It is important to note that whereas this group started out high in prior knowledge, they were not at ceiling. This group's mean for scientific ideas was 9.26 out of 34. Though research generally indicates that moderate to high self-efficacy, high prior knowledge and high confidence in that knowledge may typically be positive for learning, it appears that this may not be the case with conceptual change learning. Our results indicate that learner characteristics most productive for conceptual change learning may differ from those traditionally viewed as most productive in learning situations. In conceptual change, learners who are too confident in their prior knowledge may be reluctant to change that knowledge. These results show that there is still much to learn about the optimal combination of individual difference characteristics for promoting conceptual change (see Sinatra & Mason, 2008). These differences between traditional learning and conceptual change based learning may further demonstrate the need for conceptual change based instructional practices in content areas where misconceptions abound over more traditional instructional practices.

A Qualitative View On Students' Acceptance & Subjective Perceived Learning Success

Petra Herzmann, Universität zu Köln, Germany; Michael Stralla, University of Cologne, Germany

The efficient use of learning strategies is crucial for learning success. However, there is little analysis as to whether these competencies can be taught effectively in the classroom. The aim of the reported pilot study was to clarify, whether specific trained teachers indirectly stimulate the build of coherent mental representations of their 5th grade secondary school students. Therefore we compared four geography classes. The project consists of two stages: the enhancement of teachers' knowledge about techniques of coherence formation in school (stage 1) and the enhancement and support of students' strategies for learning with texts, with pictures, with text-picture-combinations and for metacognitive regulation of these strategies in regular school lessons (stage 2).

The scientific monitoring of our project based on a self-developed classroom test as well as items for strategies for text comprehension, picture comprehension, mapping between text and pictures and metacognition before and after the training. Additionally, we emphasize the context the strategy training was implemented by using qualitative measures. Therefore we investigate the students' experiences with the project to reconstruct their perspective on the implemented strategy training. Through a Qualitative Content Analysis of classroom discussions, five substantial categories could be developed inductively, describing aspects of context encouraging and supporting students' interest and persistence in the strategy training.

Referring to the results of the previous project we conduct a following project at present. To extend the results described above the poster will show first results of the qualitative measures, particularly with regard to the classroom discussions.

The efficient use of learning strategies is crucial for learning success. However, there is little analysis as to whether these competencies can be taught effectively in the classroom. The aim of the reported pilot study was to clarify, whether specific trained teachers indirectly stimulate the build of coherent mental representations of their 5th grade secondary school students. Therefore we compared four geography classes. The scientific monitoring was an integral part of this project which consists of two stages: the enhancement of teachers' knowledge about techniques of coherence formation in school (stage 1) and the enhancement and support of students' strategies for learning with texts, with pictures, with text-picture-combinations and for metacognitive regulation of these strategies in regular school lessons (stage 2). These strategies and skills can be called strategies for coherence formation because they enable learners to construct one coherent mental representation based on multiple external representations (Seufert, 2003). Following the three-layered model of self-regulated-learning by Boekaerts (1999) the taught cognitive strategies and metacognitive skills were didactically supported by a motivational framing. The motivational framing was based on the program 'Text Detectives' (see Gold, Mokhesgerami, Rýhl, Schreblowski & Souvignier, 2004).

In line with a direct strategy training approach the participating teachers taught the strategies mentioned above explicitly. Lessons of two training classes and two control classes were parallel concerning the topics, materials (despite the training) and the test. After the direct instruction the students received cards where the four strategies were described stepwise. These cards were implemented in lessons and homework whenever students had to deal with learning material that includes texts, pictures, tables or formula. Overall, the training program lasted six weeks.

Researchers on the topic of learning strategies and self-regulated learning typically ask quantitative research questions (such as "how much?" or "how often?") and tended to measure strategy knowledge and use with self-report surveys. The scientific monitoring of our project was also based on questionnaires the students had to fill in. For example a self-developed classroom test to analyse the learning performance before and after the training. The ANCOVA with verbal abilities as a covariate revealed significantly higher learning outcomes for the training group. A repeated measure analysis showed improvement of the training group concerning the text, picture and mapping strategies.

Additionally, we emphasized the context the strategy training was implemented by using qualitative measures. Therefore we investigated the students' experiences with the project. What changes did the students perceive? What were their experiences during the training? Did they accept the program? How did the strategies affect their learning process? To answer these research questions we conducted classroom discussions to reconstruct the students' perspective on the implemented strategy training. The written transcripts of classroom discussions were analysed by using techniques of Qualitative Content Analysis (Mayring, 2008).

Through analysis five substantial categories could be developed inductively, describing aspects of context encouraging and supporting students' interest and persistence in the training. The first category may be designated 'level of preparatory training in using learning strategies'. The prior knowledge and usage of learning strategies for encoding texts, pictures, graphics and formulas has a strong influence on the acceptance of training components. If the level is high, the willingness to deal with new strategies and to discard one's own strategy inventory to finally rebuild it considering the new strategies is low.

A second essential category is associated with the first. For learners it is essential to derive benefit from the usage of new learning strategies. For example to execute the reading strategy – altogether five steps – requires additional time and mental effort. The students are willing to invest, but have to see added value of their endeavours. Furthermore the interviewed students underlined the need for challenging tasks to practise the new learning strategies. The students raise a topic, which seems to be particularly important. The students reported back that challenging tasks enhance their willingness to deal with the new learning strategies. Another essential aspect to increase students'

persistence is the amount of incentives to use learning strategies. The students have articulated that in order to be more motivated, setting is very important. In their opinion, the variety of methods function as incentive. Working in groups, one of the new learning methods, enrich and enliven ordinary instruction which students find an especially positive aspect of the new training. The last substantial category concerns the (metacognitive) understanding of strategies. In the learners' opinion strategy training in lessons seems to be more effective, if the teacher ensures a broad (metacognitive) understanding of the taught strategies.

Referring to the results of the previous project we conduct a following project at present. The aim of the following project is to qualify teachers how to diagnose and to foster the use of learning strategies of their students. From each of the 40 participating schools in three regions of Germany between 6 and 10 teachers will be part of the program. We include teachers who teach Math, German and natural science Classes to ensure the transfer of the taught strategies and skills.

The expected increase of competences will be measured by using quantitative measures concerning the outcomes of the learning process (school grades, self-developed tests) as well as by using qualitative measures. The qualitative measures focus on the implementation of training-contents in lessons and the process of school development. Therefore, interviews with the participating teachers and the students will be conducted. At the school level we will carry out expert interviews with the headmasters and coordinators from 4 schools as well as in-depth interviews with 20 participating teachers to investigate their experiences with the project, particularly their attitude about the collaboration of the staff and their realization of training components in lessons. To deepen the analyses at classroom level additional observations will be conducted by videotaping selected classrooms in phases of direct training. To extend the results described above the poster will show first results of the qualitative measures, particularly with regard to the classroom discussions.

Reference List

- Boekaerts, M. (1999). Self-regulated learning: where we are today. *International Journal of Educational Research*, 31, 445–457.
- Gold, A., Mokhlesgerami, J., Rýhl, K., & Schreblowski, S. & Souvignier E. (2004). *Wir werden Textdetektive: Lehrermanual*. Gßttingen: Vandenhoeck und Ruprecht.
- Mayring, P. (2008). *Qualitative Inhaltsanalyse: Grundlagen und Techniken* (10., neu ausgestattete Aufl., Dr. nach Typoskr.). Beltz Pädagogik. Weinheim: Beltz.
- Seufert, T. (2003). *Wissenserwerb mit multiplen Repräsentationen: Wirksamkeit von Kohärenzbildungshilfen*. Berlin: Logos-Verl.

Development and evaluation of an observation instrument to assess 4th grade students' self-regulated

Manuela Leidinger, Saarland University, Germany; Franziska Perels, Saarland University, Germany

The aim of the study was to develop and evaluate an observation instrument to assess 4th students' self-regulated learning in regular classes. Within the theoretical background of the study self-regulated learning is defined as a cyclical process that "...refers to self-generated thoughts, feelings, and actions, that are planned and systematically adapted as needed to affect one's learning and motivation" (Schunk & Ertmer, 2000, p. 631). It is an important factor for effective (school-based) learning and academic achievement because learners are active, constructive participants in the learning process (e.g. Pintrich, 2000; Zimmerman & Bandura, 1994). To assess learner's self-regulation often self-report measures are used. The difficulty, which comes with using self-report data, is that there are only few correlations between self-regulation and other types of assessment (e.g. Winne & Perry, 2000). Observational research has the advantage to provide information on learner's self-regulatory competencies from a more objective perspective. In this context Perry et al. (2002) point out that one advantage of observation measures over self-report measures is that they reflect what people actually do versus what they say to do. In the present study an observation instrument was developed and evaluated to assess students' self-regulated learning. Altogether, the learning behaviour of 124 students was coded regarding the use of strategies of self-regulated learning. The instrument served to produce reliable and valid scores.

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the self-regulation model of Zimmerman (2000) that describes self-regulation as a cyclical process with three learning phases: the forethought or planning phase, the performance or volitional control phase and the self-reflection phase. Between the self-reflection phase and planning there are feedback loops. So feedback from prior performance influences current performances. The forethought phase focuses on self-motivation beliefs and task analysis, which includes goal setting and strategic planning. These components lead to emotional and motivational conditions, which affect the planning of the given task. During the performance phase the self-regulation strategies include the use of self-control and self-observation (self-monitoring) strategies. In sense of self-regulated learning dealing with a task people monitor their own behavior. Therefore, self-monitoring is described as the systematic observation and documentation of thoughts, feelings and actions regarding goal attainment. It is a basis of self-regulated learning (Bandura, 1986; Zimmerman, 2000). After having completed the task, the self-reflection phase begins, which is characterized by self-judgment and self-reaction, including the comparison of one's behaviour with goals (Bandura, 1986). The learners evaluates the results and attribute their behavior regarding their effort and draws conclusions for further learning behaviour.

To assess learner's self-regulation often self-report measures are used (Spßrer & Brunstein, 2006). The difficulty, which comes with using self-report data, is that there are only few correlations between self-regulation and other types of assessment (Winne & Perry, 2000). Observational methods have the advantage to provide information on learner's self-regulatory competencies from a more objective perspective. In this context Perry et al. (2002) point out that one advantage of observation measures over self-report measures is that they reflect what people actually do versus what they say to do.

In the present study an observation instrument was developed and validated to assess students' self-regulation in regular classes at primary school. In 21 math classes four or six students were videotaped and subsequently coded regarding the use of strategies of self-regulated learning. 18 of these 21 math classrooms took place in grade 4, six of them in grade 3. As the focus was on the learning behaviour of each singular student, the videotaped classroom lessons had to be analysed four or six times according to the number of students, which were videotaped. As mentioned before, the coding system is based on the model of self-regulation by Zimmerman (2000), which groups self-regulation strategies into three areas according to the cyclical phases of self-regulation. Some of these strategies weren't observable, so they became excluded. For example it wasn't possible to observe, if students set realistic and ambitious goals. So for the forethought phase planning (e.g. "The student organises his/her desk space") and self-motivation strategies (e.g. "The student encourage him-/herself") were assessed, for the performance phase volitional (e.g. "The student works constantly") as well as self-monitoring strategies (e.g. "While learning the student controls his/her approach with regard to the given task") and for the self-reflection phase strategies of self-evaluation (e.g. "The student controls his/her results"). The final version of the rating scale contains 22 items altogether. The coding captures whether a certain strategy takes place or not.

Before the analysis of the collected observation data, two observers went through an observer training by using the videotaped classroom lessons, which were not included in the analysis of this study. In the beginning of the training, observers were trained in differentiating between the categories of the observation instrument, based on the theoretical model of self-regulation, as mentioned above. After two collaboratively coded video-tapes (six observed students), observers started coding separately. The results were discussed together afterwards. The observer training took place until interrater agreement reached 80% or more.

Most of the participating schools were located in a rural landscape in south-western Germany. The participation was voluntary. Altogether, 21 classroom lessons took part in the observation study, whereupon three lessons were used for observer training. Finally the learning behaviour of 124 students (Mean age = 10 years, SD = 0.621; 47.1 % male, 52.9 % female) was coded by capturing which strategies per minute were available. Each time sample took one minute, producing 45 segments for one lesson. But because the observations could have been different in length, a standardized average frequency related to the total length of each lesson was generated (rates per minute).

To validate the instrument the reliabilities of the ratings for the coding system were appraised by computing Cohen's (1960) Kappa coefficient. This measurement method is for nominal data and is most frequently used to assess the reliability of the data of observation studies. Students' self-regulation strategy use during each one minute segment was coded. Interrater reliability based on the coding of 124 videotaped students ranged between 0.43 ("The student gets distracted from learning for a short time (In order to estimate content validity, the observation instrument was shown to experts of self-regulated learning (teachers, researchers, educational psychologists...). The experts estimated the representativeness and relevance of the generated items and categories in real-life classrooms. The results of the evaluation will be discussed at the conference.

Regulation of Learning in the Context of Collaborative Challenges

Lindsay McCardle, University of Victoria, Canada; Stephanie Helm, University of Victoria, Canada; Allyson Hadwin, University of Victoria, Canada; Kara Shaw, University of Victoria, Canada; Peter Wild, University of Victoria, Canada

The purpose of this study was to (a) explore strategies individuals identify for themselves (I strategies) and for their team (WE strategies) to address challenges encountered in 3 collaborative tasks, and (b) examine regulatory shifts in the challenges students encountered across tasks. Data included: (a) self-reported challenges, (b) I strategies, and (c) WE strategies proposed for addressing these challenges in future. The most prominent collaborative challenges reported included teamwork and collaboration. The predominant strategies students proposed to address both types of challenges were related to improving communication. Students evidenced changes over time in the challenges they reported suggesting they successfully regulated learning. We posit that if students are successfully regulating themselves (SRL) and their team (SSRL), by choosing and applying specific strategies to address challenges, those challenges should change over consecutive collaborative tasks.

Success in collaboration depends on: (a) strategies and self-regulatory skills individuals contribute to the group, (b) support members provide to one another that facilitates individuals' self-regulatory competence (co-regulation), and (c) shared or collective regulation of learning involving metacommunicative awareness and successful coordination of strategies (Barron, 2003). Winne and Hadwin's (1998) model describes SRL as comprising four weakly sequenced recursive phases including: (a) task definition, (b) goal setting and planning, (c) strategy enactment, and (d) evaluation/adaptation. Similarly, successful collaboration among group members is assumed to occur when individuals collectively regulate their learning across these four phases (Hadwin, Jarvela, & Miller, in press). From this perspective, strategies are repertoires of tactics applied selectively for specific tasks and task conditions (McKeachie, 1988). Students are strategic when they: (a) deliberate about the appropriateness of alternative study methods for this task and task purpose, (b) base judgments on sound strategy knowledge about how tactics work, why they work, and when they are useful, (c) draw on self-knowledge about past task and strategy experiences, and, (d) make conscious choices between alternative study methods (Hadwin & Winne, 1996).

Episodes of challenge or difficulty provide salient contexts for studying regulation in action. Challenges create need for engaging regulatory processes including monitoring and evaluating challenge sources, and deliberating about strategies to address that challenge. When learners confront challenge they are required to change strategies or beliefs (Hadwin et al., in press). Complex tasks that present challenges are a rich context for empirically investigating regulatory processes and strategies (Hadwin et al., in press). However strategies become more complex in collaborative tasks. Strategies might focus specifically on what "I" can do to address the challenge my team encountered (SRL strategies), or they may focus on what "we" can do to address that same challenge (shared regulation strategies; Jarvenoja & Jarvela, 2009).

Research Purpose

The purpose of this study was to (a) explore strategies individuals identify for themselves (I strategies) and for their team (WE strategies) to address challenges encountered in 3 collaborative tasks, and (b) examine regulatory shifts in the challenges students encountered across tasks. We posit successfully regulating individually (SRL) and collectively (SSRL) by choosing and applying specific strategies to address challenges should reduce the likelihood of experiencing the same challenge on a subsequent task.

Methods

Forty-two upper year students participated in research. Students were enrolled in an Environmental Science (N = 24), or a Mechanical Engineering (N = 18; unspecified, N = 6) course at the University of Victoria. Students worked in interdisciplinary collaborative teams to complete two assignments during class time and one major assignment outside class time. After each assignment, students individually completed a structured reflection on their collaborative process.

Data included: (a) individuals' perception of the main challenge their team encountered (Jarvenoja & Jarvela, 2009); (b) individuals' self-generated list of two things they would like to do to address this collaborative challenge in future tasks (I strategies); and (c) individuals' self-generated list of two things they would like their team to do to address this collaborative challenge in future tasks (WE-strategies). Challenges grouped into four broad categories: (a) personal priorities, (b) work-communication, (c) teamwork, and (d) collaboration. Answers to open-ended questions were coded using an inductive coding scheme guided by Winne and Hadwin's (1998) model of SRL. Students' strategies for addressing challenges fell into one of seven categories: (a) communication, (b) regulation, (c) group processes, (d) task processes, (e) motivation, (f) no change, and (g) other. Multiple codes were applied if more than one idea was present in a student's statement.

Results and Discussion

Conditional probability matrices were used to examine patterns of I strategies and WE strategies proposed for each type of challenge. Findings regarding I strategies indicated that for personal priority, students most often suggested they needed to adapt communication (43%). For work-communication challenges, students most often suggested they needed to adapt communication (56%). For teamwork challenges, students suggested using communication (33%), group process (27%) and regulation (26%) adaptations. For collaboration challenges, students also suggested using communication (37%), group process (22%) and regulation (22%) adaptations.

In terms of how their team could adapt (WE strategies) to address personal priority challenges, predominant suggestions were communication (41%), group process (24%) and regulation adaptations (20%). For work-communication challenges, students predominantly suggested communication adaptations (40%) and group process adaptations (26%). Teamwork challenges elicited suggestions to adapt communication (37%), regulation (23%) and group processes (20%). Finally, for collaboration challenges, students suggested communication (34%) and regulation (31%) adaptations.

One indicator of regulating learning would be if students differentiated strategy recommendations according to specific challenges they experienced. Preliminary findings suggest that this occurred to a limited extent. Students did propose different kinds of strategies for each type of challenge. For example, students suggested regulation adaptations as a WE strategy more often for dealing with collaboration challenges than other types of challenges. However, students most often suggested improved communication as both an I strategy and a WE strategy, regardless of the type of challenge encountered. This could indicate lack of regulation or emphasize the role of communication in collaborative tasks. A conditional probability matrix was also used to examine patterns in challenges faced across time. From the first to second in-class assignment, students the majority of students identified new challenges (65%). From the first in-class assignment to the major collaborative assignment, the majority of students again identified new challenges (81%). While further research is warranted this may suggest that the I strategies and WE strategies students chose helped them to successfully regulate those challenges in a subsequent task.

Findings inform theory on collaboration by investigating both SRL and SSRL strategies for adapting in response to collaborative challenges. They also offer potential guidance in scaffolding and supporting collaboration in interdisciplinary tasks.

ROUND TABLE

Constraints of institutional and social trust among students

Hermann J. Abs, University of Giessen, Germany; Bryony Hoskins, University of London, United Kingdom; Germ Janmaat, University of London, United Kingdom

Background: Current social research shows the importance of trust for the functionality of societies (Bryk et al. 2002; Putnam 2000). Moreover research hints to the transient character of trust, which is likely to decrease during adolescence and constrained by many social factors (e.g. Rahn et al. 1998; Welch et al. 2005; Flanagan et al. 2010). In this paper we distinguish between institutional and social trust. The social dimension relates to fellow human beings while the institutional dimension relates to subsystems of the society. **Purpose:** The research question for the study is in how far the social constellation within the class, individual group memberships and students' interpretations of equality within school and society constrain attitudes towards trust. **Sample:** Data has been collected in schools in Denmark, England, France and Germany during the first half of 2010. More than 2000 students of the age of 14 (grade 8), 17 (grade 11) constitute the sample used. Sampling acknowledged the fact of diverse school systems within countries, so that comparison between different academic profiles is possible. **Design and Method:** The analysis proceeds as comparative analysis for the four countries using descriptive statistics and structural equation modelling with an adjustment for the nestedness of the data. **Results:** Research will compare between country and within country (school or school type related) differences with respect to levels of trust. Starting from this, different models for the prediction of trust are tested. Hypotheses on the predictive value of the proportion of students with a unfold and a multifold sense of belonging to various groups within class are analysed in different school systems and socioeconomic school contexts.

Background:

Current social research shows the importance of trust for the functionality of societies (Bryk et al. 2002; Putnam 2000). Trust is seen as one component of social cohesion (Green et al. 2009). Moreover research hints to the transient character of trust, which is likely to decrease during adolescence and constrained by many social factors (e.g. Rahn et al. 1998; Welch et al. 2005; Flanagan et al. 2007 & 2010). In this paper we distinguish between institutional and social trust. The social dimension relates to fellow human beings of the same or other groups while the institutional dimension relates to subsystems of the society like parliament, police, banks and schools.

Purpose:

The research question for the study is in how far the social constellation within school systems and the classes, (multiple) individual group-memberships and the interpretation of inequality within school and society constrain attitudes towards trust. A special interest consists in the analysis of conditions which allow for the development of belief in a just world as a coping mechanism for perceived inequalities (Furnham 2003), so that people can develop trust even under conditions of unequal distributions of goods and even unequal acknowledgement for performance.

Sample:

Data has been collected in schools in Denmark, England, France and Germany during the first half of 2010. More than 2000 students of the age of 14 (grade 8), 17 (grade 11) constitute the sample used. Sampling acknowledged the fact of diverse school systems within countries, so that comparison between different academic profiles is possible.

Design and Method:

The analysis proceeds as comparative analysis for the four countries using a range of methods from descriptive statistics up to structural equation modelling with an adjustment for the nestedness of the data. **Results:** Research will compare between country and within country (school or school type related) differences with respect to levels of trust. Starting from this, different models for the prediction of trust are tested. Hypotheses on the predictive value of the proportion of students with a unfold and a multifold sense of belonging to various groups within class are analysed in different school systems and socioeconomic school contexts. Moreover students' perception of inequalities in school (assignment of grades) and society (distribution of goods) and the interpretation of these perceptions in terms of being fair or unfair are taken into account. The study is going to test the whole path from Perceptions (equal-unequal) over interpretations (just-unjust) towards attitudes (trust-no trust) and wants to show in how far belief in a just world can be looked on as a coping resource that allows people to develop trust even in contexts of high inequality.

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References:

- Bryk, A. S.; Schneider, B. (2002). *Trust in schools: A core resource for improvement*. New York: Sage.
- Flanagan, C. A., Stout, M. (2010). Developmental Patterns of Social Trust between Early and Late Adolescence: Age and School Climate Effects In: *Journal of Research on adolescence*.
- Flanagan, C., Cumsille, P., Gill, S., Gallay, L. (2007). School and community climates and civic commitments: Processes for ethnic minority and majority students. *Journal of Educational Psychology*, 99(2), 421-431.
- Furnham, A. (2003). Belief in a just world: research progress over the past decade. In: *Personality and individual differences* 34. 795-817.
- Green, A., Janmaat, G., Han, C. (2009). *Regimes of social cohesion*. London (LLAKES).
- Putnam, R.D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster.
- Rahn, W.M., Transue, J.E. (1998). Social trust and value change: The decline of social capital in American youth, 1976-1995. *Political Psychology*, 19, 545-565.
- Welch, M. R., Rivera, R. E. N., Conway, B. P., Yonkoski, J., Lupton, P. M., Giancola, R. (2005). Determinants and consequences of social trust. *Sociological Inquiry*, 75(4), 453-473.

Psychological Correlates of Individuals' Perception of Society and Right-Wing Authoritarianism

Lori Olafson, University of Nevada Las Vegas, United States; Gregory Schraw, University of Nevada, United States; Catherine Ortner, Thompson Rivers University, Canada; Raelynn Lee, University of Nevada, Las Vegas, United States; Jennifer Palma, Thompson Rivers University, Canada

In order to explore the psychological correlates of perceptions of society and right-wing authoritarianism, we conducted a mixed methods study involving 104 undergraduates (50 Canadian undergraduates and 54 American undergraduates). Quantitative data sources included the Belief in a Dangerous World scale, the Right-Wing Authoritarianism scale, the Epistemic Beliefs Inventory, the Mindful Attention Awareness Scale, and the Need for Cognition scale. Additionally, participants read a news article about Iran's nuclear capability and responded to an essay prompt. The purpose of the essay was to determine if undergraduates' beliefs and attitudes as measured by the quantitative instruments were also reflected in their writing about a real-world issue. Our preliminary findings are in accordance with the proposition that individuals' authoritarian views are related to their beliefs in a dangerous world and cognitive styles. Individuals high in right-wing authoritarianism tended to show a perception of the world as threatening and were more fearful than those low in right-wing authoritarianism. These beliefs were reflected in the essays. Undergraduates who endorsed more extreme right-wing views were apt to view Iran as a threat to national security. In addition, American students scored higher than Canadian students on Beliefs in a Dangerous World and Right-Wing Authoritarianism; however these results were not statistically significant owing to the small sample size. From this preliminary analysis, it appears that a conservative ideology is a function of both personal beliefs and nationality. In our round table session we will explore the educational implications of these findings.

Purpose

Today's world has been described as a "current global crisis of terrorist violence," (Pyszczynski, Rothschild, & Abdollahi, 2008, p. 318) where media reports of negative world events contribute to increasing fears of world danger, death, and the appeal of extreme political conservatism (Jost et al., 2003). In addition, our information age—characterized by the abundance in publication, consumption, and manipulation of information, provides plenty of opportunities for the constant bombardment of negative reports. Such information is a critical determinant for effortful cognitive elaboration and processing in the political world (Rudolph & Popp, 2007) because it has the ability to motivate, rationalize and legitimize people's construction and preservation of ideological belief systems (Jost et al., 2003). Within this context, van Leeuwen and Park (2009) proposed that people adopt a conservative ideology "to fulfill psychological needs related to managing uncertainty and threat" (p. 170). The purpose of the current study was to explore the relationship between people's perception of how dangerous society is and authoritarianism, while examining if the amount of attention/awareness to the present time and their preference for complex cognition plays a role in these relationships. We examined the relationship among beliefs, especially negative beliefs about danger versus positive beliefs about cognition and agency. We also examined the relationship between country of residence and beliefs. The study was guided by the following research questions: 1) To what extent do participants express an extreme conservative ideology? 2) Do more sophisticated epistemological beliefs and need for cognition mediate beliefs about social dangers and support of extreme authoritarian ideologies? 3) How is political ideology invoked when participants are asked to consider a real-life dilemma?

Methodology

Participants Sample 1. The first sample of Canadian undergraduates (9 males, 41 females; average age 20.76 years) was gathered in October 2009 at a small university in the southwest region of Canada. Sample 2. The second sample of American undergraduates (9 males, 45 females; average age 24.05 years) was collected in February 2010 at a large university in the southwestern United States.

Measures In addition to collecting basic demographic information, data was collected from the following sources: Belief in a Dangerous World Scale (BDW; Altemeyer, 1988) - a 12 item scale that assesses individual differences in perceptions of a dangerous world. Right-Wing Authoritarianism Scale (RWA; Altemeyer, 2006) - a 20 item scale that measures attitudes about authoritarian submission, authoritarian aggression, and conventionalism. Epistemic Beliefs Inventory (EBI) - a 28 item scale that examines adults' beliefs about the nature and acquisition of knowledge (Schraw, Bendixen, & Dunkle, 2002). Mindful Attention Awareness Scale (MAAS) - a 15 item scale that measures the presence or absence of attention to and awareness of what is occurring in the present (Brown & Ryan, 2003). Need for Cognition Scale (Cacioppo, Petty, Feinstein, & Jarvis, 1996) - an 18 item scale measuring a person's preference for complex cognition. Structured Essay Task developed for this study. Participants read a newspaper article about Iran's nuclear capability, and then responded to an essay prompt. Participants in both samples received identical research packets and completed the measures in small groups with one of the researchers present.

Results

Quantitative Analysis As predicted, Beliefs in a Dangerous World and Right-Wing Authoritarianism were highly correlated ($r = .49$) and Need for Cognition and Right-Wing Authoritarianism were negatively correlated ($r = -.40$). American students scored higher than Canadian students on the BDW and RWA; however these results were not statistically significant owing to the small sample size. From this preliminary analysis, it appears that a conservative ideology is more a function of personal beliefs than nationality. In the next phase of analysis, we will divide our sample into three groups based on RWA scores (low RWA, medium RWA, and high RWA) and conduct additional analyses to determine how these groups differ on other measures. From this, we hope to gain an understanding of the kinds of thinking and beliefs that drive extreme views.

Qualitative Analysis The essays were entered into a program for qualitative analysis (ATLAS.ti) and will be scored in two phases. In phase 1, we coded the essays based on responses to two questions that were asked. When asked "Is Iran developing their nuclear program for peaceful purposes or nuclear weapons?" 55.6% of the American sample and 47.1 % of the Canadian sample indicated that they believed the nuclear program was for weapons capability. Participants also responded to the question "How should the United Nations respond?" For both groups, continued monitoring was the most frequent response (42.6% for the American sample; 39.2% for the Canadian sample). However, more American respondents (35.2%) than Canadian respondents (19.6%) indicated that increased sanctions or closing the plant should be considered by the UN. These qualitative results provide support for the view that American students are more apt to endorse the belief that the world is inherently dangerous and that perceived threats must be dealt with in a punitive way. In phase 2 of the essay analysis, we will engage in a more inductive form of analysis, following procedures for grounded theory analysis (open coding, axial coding, selective coding).

Theoretical Issues to be Discussed at the Round Table

During our round table discussion, we will revisit the research questions and provide results of the fully completed quantitative and qualitative analyses. Topics for discussion will include the following: 1) What are the psychological correlates of conservatism as a belief system (i.e. what are the cognitive and motivational needs that are met with conservatism)? 2) Why might individuals in different countries respond to world threats differently? 3) Given that resistance to change and endorsing inequality are two key aspects of conservative thought (Jost, Glaser, Kruglanski, & Sulloway, 2003), what are the classroom implications for undergraduates with extreme views? For example, RWA is positively correlated with endorsement of military aggression and suspension of civil liberties (Crowson, 2009) – how can these issues be addressed in a democratic classroom?

Students' knowledge of the national past: a shared frame of reference?

Marc Kropman, University of Amsterdam, Netherlands; Carla Van Boxtel, University of Amsterdam, Netherlands; Jannet van Drie, University of Amsterdam, Netherlands

There is an ongoing discussion in the field of history education on the topic of teaching the national past. In the Netherlands there are complaints about the presumed lack of knowledge on Dutch history, which is considered important in the context of citizenship education and social cohesion. Yet there is no clear understanding of what students do know about Dutch history, nor about the narrative structures they use, or the connections they draw to their own lives or the community they live in. Studies from other countries indicated that students of different ethnic background give a different appraisal of the significance of facts, events, developments, and persons in their respective national histories. The main question of this study is: What knowledge of the national past do students acquire during secondary education and to what extent is this knowledge shared? We have collected data from

interviews with students age 15 -16 in intermediate general secondary education. Furthermore, we have collected 177 essays from freshmen in history teacher training. Analysis focuses on events, persons, and developments that students mention, the narrative structure used, and sources of knowledge. Although we have identified what students considered important in Dutch history, we will discuss in this contribution the problematic aspects of relating these to the background of the students.

There is an ongoing discussion in the field of history education on the topic of teaching the national past. In the Netherlands there are complaints about the presumed lack of knowledge on Dutch history, which is considered important in the context of citizenship education and social cohesion. Yet there is no clear understanding of what students do know about Dutch history, nor about the narrative structures they use, or the connections they draw to their own lives or the community they live in. Studies from other countries indicated that students of different ethnic background give a different appraisal of the significance of facts, events, developments, and persons in their respective national histories (e.g., Barton & McCully, 2005; Epstein & Shiller, 2005; Levstik, 2008; Peck, 2010). In addition, Barton & Levstik (2004) showed that students from the US use the same narrative structure – a 'story of progress and emancipation'- to describe their national history. Cercadillo (2001) classifies significance into five types: contemporary, causal, pattern, symbolic and present/future. Peck (2010), building on findings of Cercadillo (2001), argues that ethnic identity structures historical significance addressed to event, persons, and developments, which leads to specific narrative templates. The main question of this study is: What knowledge of the national past do students acquire during secondary education and to what extent is this knowledge shared? Data collection included task-based interviews with 12 students age 14-15 (intermediate general secondary education) following the interview format developed by Levstik (2008). The interviews were conducted in groups of three students, and one group of six students. The students were asked to make a selection of 5 out of 25 pictures on Dutch history (1500 – 2000). Furthermore, we have collected 177 essays of freshmen in history teacher training at the University of Applied Sciences, who were asked to describe what they thought were the main themes in Dutch history since 1500 and give arguments for their choices. Analysis focuses on events, persons, and developments that students mention and how they relate these to their personal life stories, the narrative structure used, and sources of knowledge. From the analyses of the essays two main themes in Dutch history emerged: the Dutch Revolt (1566 - 1648) and the Occupation (1940-1945). Also from the task-based interview it becomes clear what persons and events are considered important, such as the murder of William of Orange, the voyages of the East Indian Company, and the deportation of the Dutch Jewish community during WO II. In analysing the essays and interviews we'll use the types of significance developed by Cercadillo (2001) and Peck (2010). A preliminary look at the interviews show that in the process of choosing pictures the students refer to their ethnic background. However, in the essays no such references are explicitly made. It is well possible that the task based interview elicit more explicit referring to their respective ethnic background than the writing task. Complementary interviews seem to be necessary to clarify the absence of explicit references to ethnic background. Although we have identified what students considered important in Dutch history, we are still in search of adequate methods that shed light on the underlying narrative structures underlying these main lines. In this contribution, we will discuss the problematic aspects of relating these findings to the background of the students.

References

- Barton, K., & McCully, A. (2005). History, identity, and the school curriculum in Northern Ireland: an empirical study of secondary students' ideas and perspectives. *Journal of Curriculum Studies*, 37(1), 85 - 116.
- Barton, K. C., & Levstik, L. (2004). *Teaching History for the Common Good*. Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Cercadillo, L. (2001). Significance in History: Students' Ideas in England and Spain. In: Lee, P. & A. Dickinson (Ed.), *International Review of History Education* (Vol. 3, pp. 116 - 145): Woburn.
- Epstein, T., & Shiller, J. (2005). Perspective Matters: Social Identity and the Teaching and Learning of National History. *Social Education*, 69(4), 201-204.
- Levstik, L. L. (2008). Crossing empty spaces. Perspective taking in New Zealand adolescents' understanding of national history. In: Levstik, L. & K. Barton (Ed.), *Researching history education. Theory, method and context* (pp. 366 - 389). New York; London: Routledge.
- Peck, C. L. (2010). Storying the Nation: How students' ethnic identities influence their understanding of historical significance in Canadian history. Paper presented at the Annual Meeting of the American Educational Research Association.

Hong Kong tertiary students' conceptions of assessment: Reading their drawings

Zhenlin Wang, Hong Kong Institute of Education, Hong Kong; Gavin Brown, Hong Kong Institute of Education, Hong Kong

Assessment in Hong Kong is a meritocratic basis for upward social mobility and for selecting talent and has very high-stakes. Chinese learners attribute success to effort and quality teaching. However, Chinese society also attributes individual merit, worth, and value through academic performance. In a highly competitive environment in which individual worth depends on performance, it is likely that students are aware of both positive and negative aspects of the educational assessment system. Since the uses of assessment in Hong Kong are similar to western contexts and since there are aspects which differ, we expect that current models of how students conceive of assessment may be inadequate in Chinese contexts. The study aims to identify patterns in Hong Kong students' beliefs about assessment from six focus groups drawn from multiple faculties and departments in seven Hong Kong higher education institutions. Students drew a picture of assessment and discussed their drawings. Content analysis showed that students are aware of assessment's potential to improve their learning and performance, through feedback. Additionally, the student drawings showed much greater awareness of the evaluative, controlling role that assessment plays or has played in their lives. Consistent with the evaluative role, the dominant emotional response was negative. The paper will discuss aspects of students' beliefs that are unique to the Hong Kong context and culture and those that have also been reported in western contexts. This will contribute to a greater understanding of the unique and universal aspects of assessment's role on student learning and life.

Background

Students appear to be aware that assessment serves multiple purposes. For instance, they might recognize that assessment can lead to improvement, or that it might be irrelevant; they might be aware as well of some of its social and emotional effects, and see that assessment is a function of external factors. In previous studies, often students appeared to endorse most of those purposes that lead to greater academic performance. For example, they showed endorsement of the improvement purpose predicted increased student performance among New Zealand secondary students and, among university students, increased effort (Wise & Cotten, 2009) and learning strategy selection (Hirschfeld & van Brachel, 2008). These results are consistent with the notion that the "improvement purpose" of assessment involves students' regulating their response to assessment and teachers using assessment to improve teaching. Furthermore, students showed both positive (e.g., enjoyment, pride, and hope) and negative (i.e., boredom, anger, anxiety, helplessness, and shame) emotional responses to achievement experiences (Pekrun, Elliot, & Maier, 2006). Hence, we can expect that students will have multiple conceptions of assessment as a consequence of its multiple purposes and effects.

Assessment in Hong Kong plays a powerful selective role (e.g., there are spaces in tertiary education in Hong Kong for only 20% of students). At the same time, high academic performance on high-stakes examinations is seen as a meritocratic basis for upward social mobility and for selecting talent, regardless of social background (Cheung, 2008). Furthermore, Chinese learners are known to attribute success to effort and quality teaching, consistent with self-regulation theory (Li, 2002). However, Chinese society has historically attributed individual merit, worth, and value through academic performance (China Civilisation Centre, 2007), and this habit persists in Hong Kong (Pong & Chow, 2002). In a highly competitive environment in which individual worth depends on performance, it is likely that students are aware of both positive and negative aspects of the educational assessment system. Since the uses of assessment in Hong Kong are similar to western contexts and since there are aspects which differ, we expect that current models of how students conceive of assessment may be inadequate for use with students from Chinese contexts.

Aim of the study

The study aims to identify patterns in Hong Kong students' beliefs about assessment from samples of students who have successfully overcome the selective processes used to admit students into higher education.

Method

Six focus groups drawn from multiple faculties and departments in seven Hong Kong higher education institutions were asked to draw individual pictures of assessment and discuss their drawings within the group. Previous picture drawing studies have revealed student understanding of both the improvement and evaluative roles of assessment, as well as students' emotional responses to assessment.

Analysis and results

Content analysis of the discussions, drawings, and captions focused on students' understanding of the purposes and structures of assessment and their personal and emotional responses to assessment.

Preliminary results indicated that students are aware of assessment's potential to improve their learning and performance, through feedback. Although, this awareness appeared to be more prevalent among students from the

more prestigious institutions, suggesting the ability to perceive assessment as more than evaluative may be conditional upon awareness of relative status. However, the student drawings showed much more awareness of the evaluative, controlling role that assessment plays or has played in their lives. Such pictures include images of athletic contests (e.g., races and even a bull-fight), surveillance by assessors, and entrapment or oppression by the high-stakes consequences of the system. Consistent with the evaluative role, the dominant emotional response was negative.

Foreseen discussion

The pattern of results appears to be ecologically rational (Rieskamp & Reimer, 2007); that is, students perceived assessment as predominantly highly selective and highly controlling, which is classically how the public examination system for entry to university is implemented in Hong Kong. Furthermore, evidence was seen for the evaluation of an individual's worth as a consequence of assessment, a characteristic associated with even contemporary Chinese societies. With further detailed categorical analysis, the paper will be able to identify aspects of students' beliefs that are unique to the Hong Kong context and culture and those that have also been reported in western contexts. This will contribute to a greater understanding of the unique and universal aspects of assessment's role on student learning and life.

References

- Cheung, T. K.-Y. (2008). An assessment blueprint in curriculum reform. *Journal of Quality School Education*, 5, 23-37.
- China Civilisation Centre. (2007). *China: Five thousand years of history and civilization*. Hong Kong: City University of Hong Kong Press.
- Hirschfeld, G. H. F., & von Brachel, R. (2008, July). Students' conceptions of assessment predict learning strategy-use in higher education. Paper presented at the Biannual Conference of the International Test Commission (ITC), Liverpool, UK.
- Li, J. (2002). A cultural model of learning: Chinese "heart and mind for wanting to learn." *Journal of Cross-Cultural Psychology*, 33(3), 248-269.
- Pekrun, R., Elliot, A. J., & Maier, M. A. (2006). Achievement goals and discrete achievement emotions: A theoretical model and prospective test. *Journal of Educational Psychology*, 98(3), 583-597.
- Pong, W. Y., & Chow, J. C. S. (2002). On the pedagogy of examinations in Hong Kong. *Teaching & Teacher Education*, 18(2), 139-149.
- Rieskamp, J., & Reimer, T. (2007). Ecological rationality. In R. F. Baumeister & K. D. Vohs (Eds.), *Encyclopedia of Social Psychology* (pp. 273-275). Thousand Oaks, CA: Sage.
- Wise, S. L., & Cotten, M. R. (2009). Test-taking effort and score validity: The influence of student conceptions of assessment. In D. M. McNerney, G. T. L. Brown & G. A. D. Liem (Eds.), *Student perspectives on assessment: What students can tell us about assessment for learning* (pp. 187-205). Charlotte, NC: Information Age Publishing

Perceptions of Wildlife Conservation among Zoo Visitors in Multicultural Societies

Chagit Tishler, Ben Gurion University of the Negev, Israel; Michael Fried, Ben Gurion University of the Negev, Israel; Orit Ben Zvi -Assaraf, Ben Gurion University of the Negev, Israel, Israel

The nature of education in zoos is that of a free choice learning environment. The present paper looks exclusively at experiences and prior knowledge and at the cultural and socio-cultural aspects of visitor learning in the specific setting of the Tisch Family Zoological Gardens in Jerusalem (TFZ). Among its main goals TFZ aims to: promote the values of nature conservation and wildlife protection among its visitors; enhance public awareness of environmental issues and encourage the love of animals. The questions of the study address the breadth and level of understanding of wildlife conservation issues and concepts, and the aspects of the zoo, as a free-choice learning environment, that most influence the different visitor populations in this regard. The TFZ provides an excellent opportunity to study possible cultural influences on how zoo's conservation messages are perceived, by Jewish, religious and nonreligious visitors and Muslim, and Christian Arab visitors. Preliminary findings show that Arab and Jewish visitors: perceive nature conservation differently; have differences in preference to animals; Different degrees of religiosity also seem to affect the ways in which the zoo messages are perceived. These results raise questions as to the factors that influence the impression an animal makes on the zoo visitor, how these are affected by the background of the visitors and what are the possible implications of these on the means to convey environmental messages in the zoo.

There are about 10,000 zoos worldwide visited by an estimated 600-700 million visitors annually. About 1000 of these zoos are federated into national, regional, or international zoo federations. They are formally obligated to promote conservation of endangered wildlife and aim to assist in inculcating positive attitudes towards wildlife, highlight the importance of maintaining biodiversity, and foster sustainable development. Because of this commitment, federated zoos are of obvious interest in examining zoos' potential for educating the public vis-à-vis conservation and

environmental issues. From the educational point of view, zoos are for the most part free-choice learning environments. To gain insight into how learning occurs in such environments, and in zoos specifically, it is necessary to take into account visitors' prior knowledge and experiences, the physical aspects of the zoo as well as cultural and socio-cultural influences. The connection between their knowledge and experience, and the ways both relate to the zoos' own educational intentions are essential for understanding ultimately whether and how zoos fulfill the educational potential described above. In the present paper, we shall present findings on visitors' experiences and prior knowledge manifest at one particular zoo, the TFZ. The research to be reported, however, is part of a broader investigation taking into account other aspects of zoo visits. Our research questions were designed to probe the state of visitors' prior knowledge, the connection between that knowledge and their zoo experience, and the ways both relate to the zoos' educational objectives. A special focus is given to the different visitor populations, as will be outlined below. With that in mind, the questions are: What conservation themes are prevalent among different populations of zoo visitors? What are the principal features of these themes?2. What messages do visitors think the zoo is trying to convey to them? How do these relate to the actual mission statements of the zoo?The study takes place at the Tisch Family Zoological Gardens in Jerusalem (TFZ), which is a member in EAZA (European Association of zoos and Aquaria). Among the explicit goals of the TFZ are the following: to develop and conduct educational activities and outreach programs for promoting values of nature conservation and wildlife protection in the general public. The zoo also encourages community participation, and conducts educational and cultural activities geared towards Jerusalem's unique and diverse population. To this end, one of its main challenges is to respond to heterogeneous visitor populations, including ultra-orthodox, orthodox and secular Jews, Christians, and Muslim Arabs. The significance of the research derives first of all from its focus on zoos as an educational conduit for conservation messages. The examination of this particular zoo, the TFZ, provides an excellent opportunity to study possible cultural influences on how a zoo's conservation messages are perceived because of its diverse visitor population (Jewish, religious and nonreligious and Arab Muslims, and Arab Christians). To the extent that the zoo is a free-choice learning environment, the study should provide, moreover, insights into the character, difficulties and potentialities of such environments. This paper is the summation only of the first stage of that more general investigation, the stage addressing the two research questions given above. For this stage, an open questionnaire was developed, "Zoo Messages Open Questionnaire." Respondents were first asked to choose three kinds of species they saw in the zoo. Afterwards, they were asked to elaborate on the message they believed the zoo wanted them to remember about the animals of their choice. Finally, they were asked to define 'nature conservation'. The results were analyzed with respect to the general population and according to the following cultural groups: Religious, semi-religious, and nonreligious Jews; Arab Muslims; and Arab Christians

Preliminary finding show:a) Zoo visitors used various expressions showing some exposure to environmental issues. They had no special preference to species conservation but were familiar with the term. The different cultural groups seem to have had the same general knowledge about nature conservation. We assumed that in light of their zoo experience these visitors would connect their general knowledge to what they found in the zoo. Our results, however, did not support this assumption ($\chi^2(1, N=276)=13.077, p<0.01$).b) How visitors received messages conveyed by the zoo seems to be dependent on the degree of their religiousness. Specifically, different degrees of religiosity in the Jewish population seem to affect how visitors receive messages conveyed by the zoo. A significant difference was observed between the messages of conservation associated from the animals exhibited in the zoo noted by the religious/semi-religious visitors and those of the secular visitors. Secular visitors included animal conservation in their messages 17% more often than did the religious/semi-religious visitors ($\chi^2(2, N=359)=11.737, p<0.01$). c) An observation was made relating the degree to which that the animals were chosen as a representative of the zoo, and whether or not the visitors associated the animal with conservation. Findings suggest differences in which exhibits and animals were most popular among the Arab and Jewish populations. For example, large predators, monkeys and elephants, which were the three most popular groups of animals among the Jewish visitors while the Arab visitors chose the large predators and did not tend to chose monkeys. Although these animals were the most popular they did not associate them with a conservation message. For example, only 5.4% of the visitors who chose monkeys associated them with conservation. Questions arising from the results are: Is the conservation message reproduced differently by Jewish and Arab visitors? What role does religious faith have in the ways of perceiving conservation concepts and ideas in zoos? Is the difference due only to a different set of formulations of the same concepts and ideas? A more general question arises as to the factors influencing the impression an animal makes on the zoo visitor and how these are affected by the background of the visitors. The kind of differences according to cultural and religiosity that we have described calls to mind the claim that zoos must speak to the community or communities in the 'language of their values'. Our study strengthens these claims and reinforces the need to investigate further the different aspects of the zoo that were intended to mediate these messages. Ultimately, our results may add to zoos' ability to develop improved means for conveying general environmental and more specific conservation messages.

Identifying and overcoming methodological challenges associated with interviewing in academia

Tine Wirenfeldt Jensen, Aarhus University, Denmark

I would like to discuss some of the challenges specific to interviewing in academia and to propose an adapted version of the concept of the elite interview (Leech, 2002, and Aberback & Rockman, 2002) as one way of articulating the challenges the interview poses for the "novice researcher" (Gunasekara, 2007) in the field. I suggest the vignette technique (Barter & Renold, 1999) as one especially useful strategy for overcoming some of these challenges in semi-structured interviews with focus on the themes provocation, power and establishing alternative frameworks for discourse. I draw on experiences with interviewing 20 Master's thesis supervisors at a Danish university about their conceptualization of the Master's thesis as a form of assessment and its meaning and role in HE.

On the basis of the interviews performed for my PhD project and prior academic interview experiences (Andersen & Jensen, 2007), I draw on the concepts of the elite interview (Leech, 2002, and Aberback & Rockman, 2002) and the active interview (Holstein & Gubrium, 1995) as well as others' experiences (Gunasekara, 2007) in order to identify some of the specific factors that should be taken into consideration when interviewing teachers and supervisors in HE. An elite interview is an interview with "people in decision-making or leadership roles" (Leech, 2002), which has implications for interviewing, as "a good many well-informed or influential people are unwilling to accept the assumptions with which the investigator starts: they insist on explaining to him how they see the situation, what the real problems are as they view the matter" (Dexter, 1969, in Leech, 2002). In this sense, Master's thesis supervisors certainly qualify as elite interview candidates. However, the academic interview situation is complicated by the position of the interviewer within the very hierarchy to which the supervisors belong.

As Gunasekara's (2007) work reveals, hierarchy and accompanying power structures are a central part of academic life: "Hierarchical structures in academia are often linked to seniority and perceived experience, at least in terms of certain norms that subsist in academe." This means that the PhD student or young researcher interviewing a supervisor assumes the position of the "novice researcher" (Gunasekara, 2007). In this context, the roles of subject/interviewer have many similarities to the supervisor/student relationship, and as a consequence, the roles of 'supervisor/student' might interfere with the roles of 'supervisors as subject'/'PhD student as interviewer'. For the novice researcher, the academic interview is therefore an elite interview in more than one respect, and the consequences of the potential overlap between the roles of participants should be considered when planning and carrying out interviews in this setting. Possible subject reactions which should be anticipated include unwillingness to be "put in the straightjacket of closed-ended questions" (Aberback & Rockman, 2002), wanting to know everything about the research project and the research questions 'behind' the interview questions, wanting to know about the hypothesis shaping the research, what the final dissertation or report will conclude (see also Gunasekara, 2007) and questions about who the supervisor of the project is.

Because interviews with supervisors are elite interviews in this double sense, the interviews need to be framed as active interviews (Holstein & Gubrium, 1995) and the active, contributing and meaning-making role of the subject needs to be emphasized. This means that semi-structured interviews shaped in a conversational manner can be a good strategy, as they give the subject a sense of freedom from "the straightjacket of closed-ended questions" referred to above.

The use of vignette technique in semi-structured interviews: provocation, power and alternative frameworks for discourse. Interviewing as a method in HE research must be conducted with an awareness of the aspect of hierarchy in academic culture. But on a very basic level, it is also important to be aware of the fact that when interviewing in HE we are by definition doing research in our own cultural backyard; more likely than not, the interviewer shares a lot of tacit knowledge with the subject. We therefore need strategies and methods to help us avoid interviews dominated by vague references and implicit understanding.

To avoid this trap, I have explored several strategies. Employing the vignette technique (Barter & Renold, 1999) in semi-structured interviews with supervisors about the Master's thesis as a form of assessment has proved most successful.

During the interviews, I offered the supervisors six alternatives to the current Master's thesis form (for example a shorter Master's thesis, acceptance of website/films/performances with no requirement to submit other written work or discontinuation of the Master's thesis altogether). Some of these were deliberately designed to provoke the supervisor and as a result to provoke critique. The norms, criteria and values revealed by such critique are of interest, as they reveal how the subject understands the Master's thesis as a form of assessment. Instead of a conventional approach to the interview based on accounts of the role and justification of the existing Master's thesis, I offered the

subjects an alternative framework which allowed them to articulate their understandings in terms of negation and critical reflection rather than simple affirmation or declaration.

The vignette technique placed the supervisors in a position of power and invited them accept and reject the alternatives I proposed and to offer their reasons for doing so. I chose this approach for several reasons: it highlights the supervisors' active role in the interview, it accommodates the elite subjects' understanding of themselves as decision-makers, it offers an alternative framework for discussing the topic that makes simple reproduction of the dominant discourse on the topic impossible, and as a result it forces the supervisors to actively reflect on and articulate the values and criteria they base their decisions on.

I would like to discuss the challenges specific to interviewing in academia and the relevance of my adaptation of the concept of elite interviews to an academic setting for preparing and conducting interviews in HE. I would also like to discuss the potential pitfalls of using this version of the vignette technique with regard to the quality of the interviews and the process of analyzing them.

Andersen & Jensen, 2007. *Specialevejledning – rammer og roller* (Master's Thesis Supervision: Framework and Roles). Samfundslitteratur, Denmark.

Barter, C & E. Renold. 1999. "The Use of Vignettes in Qualitative Research", *Social Research Update*, vol. 25. Department of Sociology, University of Surrey, England.

Gunasekara, C., 2007. Pivoting the Centre: Reflections on Undertaking Qualitative Interviewing in Academia. *Qualitative Research* 7(4):pp. 459-473.

Holstein & Gubrium, 1995, *The active Interview*, Qualitative Research Method Series 37, Sage.

Leech, B., 2002. "Asking Questions: Techniques for Semistructured Interviews" in Leech B. et al. "Symposium: Interview Methods" in *Political Science and Politics*, Vol 35, no. 4, Cambridge University Press, Cambridge Journals.

Aberback J. & Rockman B, 2002. "Conducting and Coding Elite Interviews" in Leech B. et al. "Symposium: Interview Methods" in *Political Science and Politics*, Vol 35, no. 4, Cambridge University Press, Cambridge Journals.

Research as a Patchwork Quilt: International Collaborative Research.

Jacqueline van Swet, Fontys, Netherlands

The scope of policies within universities is becoming increasingly global and more and more networks of professionals and researchers are starting to work collaboratively. They often experience problems caused by cultural differences, power issues, differences in contexts, differences in perspectives towards research. In this round table I will tell about an international masters programme where we have tried to prepare students for such collaborative (research) projects. I will present data about alumni's experiences, based on reflective logs, informal meetings, a survey asking the alumni (105; with a response rate > 50%) and on an ongoing collaborative research project. We have found that collaborative research is a process, which takes time. It requires careful and precise communication in order that participants can create their own, new shared culture with rules that are acceptable to all. The metaphor of research as a patchwork quilt is used as a model for collaborative research and examples of that strategy will be given. In such a model it is possible to work towards both bonding, tying people with people who are more like them within in their cultural context, and bridging, tying people who are unlike them and are from another cultural context (Putnam, 2007).

In this round table I would like to explore the issue of conducting collaborative research on an international perspective, the problems that may be encountered and I will present a model for collaborative research that might be a helpful strategy. I will draw from my experiences in the Erasmus Mundus programme of which I have been a programme convener for five years (2005-2010) and the research we have done in this context. One of the aims of this programme is to build a global network of professionals working in the field of SEN and inclusive practice. Such a network has the potential to become a very powerful network where teachers, researchers and educators can collaborate and exchange their ideas (Diniz-Pereira, 2002). The expectation is that after the programme former students and staff will keep in touch and will be engaged in collaborative research and projects. However, many authors have written about the complexity and often problematic outcomes of such collaboration. Many factors are playing a role such as cultural differences, power differences between participants and parties involved, the influence of the context, intercultural and communicative competences of participants, group dynamics and the establishment of trust between partners and parties involved. Awareness and openness of those factors without any judgment is often described as helpful (Hoffman 2002). Hoffmans's theory of intercultural communication assumes that communication and behaviour cannot be explained by someone's cultural background only, but by many other factors as well, such as social class, religion, age and gender. Hoffman's so called TOPOI-model offers a reflective tool to

discuss and analyse the communication between participants systematically. Establishment of trust between participants is generally seen as conditional (Gannon, 2004). This issue of trust has been extensively discussed in literature on 'social capital', for example by Robert Putnam (2007) who is developing his theory about social networks, ethnic diversity and social trust. These theories use concepts like 'bonding' and 'bridging', which might be important concepts in the area of international collaborative research. In bonding there are ties between people who are like each other in some important way and in bridging there are ties between people who are unlike each other. Research has found that people find it easier to trust one another and to cooperate when there is less social distance between them (Putnam, 2007). Many authors stress the possible impact of cultural differences and of often implicit behaviour and values on collaboration (see f.e. Hall & Hall, 1990; Hofstede & Hofstede, 2005; Matsumoto, 2000) and it thus seems important in international collaborative research to be aware of this phenomenon. One of the often emphasized factors influencing international collaboration is the issue of power and especially the problematic effects of the inequality and dependency relationship between countries from the North and from the South (Armstrong, Armstrong, and Spandagou 2010). Stephens (2007) for example warns for the often made mistake of what he calls 'Glocalisation', which means that global solutions are being applied too easily to local problems. People involved in collaborative projects will differ in many aspects, and thus also in their intercultural competences. For example Bennett (1993) has described a developmental model of intercultural sensitivity and describes six stages where individuals move and go through different stages. Group dynamics will play a role and have to be dealt with (Judith Torney-Purta, 2006, Kant and Sprenger, 2004). It is a challenge to achieve equal roles (Avgitidou, 2009) and clarity about the level of participation of all stakeholders (Arnstein, 1969) and this takes time and demands a systematic procedure. Participants need time to get to know each other, to discuss their expectations towards the collaboration, to engage gradually in the project and feel more and more confident. During and after the Erasmus Mundus programme the staff has conducted several studies on the collaboration between students and students and staff (Van Swet e.a. 2009a, Van Swet e.a. 2009b). Reflection reports have been analysed qualitatively, action research on critical friendship has been done and a questionnaire has been sent to 105 EM alumni (response rate > 50%) in order to find out more about the opinions on and experiences with research after their study MA/Mgr SEN. The concept of trust was prominent in the reflections of the alumni, in the research on critical friends and in the questionnaire. Overall the research has indicated that communication about the differences in contexts is important and at the same time problematic, especially in the first phases of the collaboration. Tools like the TOPOI-model, where for example the T stands for Tongue (=Language) can be helpful in analyzing the important elements, such as the practical issue of differences in accents or in competence in speaking English and the English terms used in the projects. Another item that was mentioned frequently in relation to collaboration was the power issue. In this round table I would like to discuss the metaphor of international collaborative research as a patchwork quilt and how we prepared our students for this collaborative research. Like patchwork quilting collaborative research demands good preparation, taking enough time and no rushing. Both work best if one adapts to the characteristics of the rags available and allows oneself get inspired by these rags, their shapes and colours. It is important to invest in the relationships, to make the expectations of all participants explicitly and to take the time for the last phases of finishing and sharing the results. This patchwork quilt model combines bonding and bridging (Putnam, 2007) and recognizes the existence of both.

Global teaching and learning for sustainable development

Birgitta Norden, Malmö University, Sweden; Elsie Anderberg, Jönköping University, Sweden

Though, repeatedly since 1972 (Agenda 21, chapter 36) proclaims for initiating the process of global teaching and learning about sustainability issues in global-local settings, reviews of literature show a dominance of rhetoric (Anderberg, Norden & Hansson, 2009). Few implementation attempts have led to continuity in the didactic steps to developing global teaching. By capturing some of the experiences of the many stakeholders in a recent research project on the process of initiating implementation teaching and learning in global settings, Lund Calling (Norden & Anderberg, 2010), a framework for the further development of the implementation processes was recognised. To be of practical use, the process of developing global teaching for sustainable development has to be understood more carefully. This paper describes an empirical follow-up research of the implementation process, concerning how 13 teachers at an upper secondary school develop their common planning and conduct teaching for sustainable development with a global focus transdisciplinarily, during the years 2010–2011. A phenomenographic approach and semi-structured interview questions are used for analysing and describing the teacher thinking in relation to the process. The result of the participating teachers' concrete practice will be presented. The findings show among other things the importance of awareness raising dialogues among teachers, who from their various subject matter expertises were heading for a common development of education in teaching of sustainable development with a global focus. This research clearly points to a link between transdisciplinary and global teaching within the field of global learning for sustainable development (GLSD).

Towards sustainability the implementation of Global Learning for Sustainable Development (GLSD) is crucial in education (Scheunpflug and Asbrant, 2006). A better understanding of how to – from a global didactic angle – establish globally genuine dialogues (Biesta, 1994; Roth, 2006) forming nuanced conceptions of sustainable development (SD) is necessary (Scott and Gough, 2004; Tatoo, 2007; Jickling and Wals, 2008). Global teaching as well as global learning has to identify the challenges in various contexts for transdisciplinary knowledge formation (Wals, 2010). Aiming to reach established and new target groups; higher education and secondary school as well as informal learning situations demands a holistic understanding (Pierce, 1934; Bateson, 1972; Hansson, 2000). The challenges take their main point of departure in the particular global perspective (Anderberg, Norden & Hansson, 2009), and concerns ways to see the whole and the parts, on the one hand, while on the other learning how to relate the parts to one another, and to the whole (Svensson, 1986), respectively. Students in a globalized setting could also achieve intercultural qualities of learning outcomes, in terms of competencies and capabilities (Bowden, 2004; Anderberg, Haggstrom & Nordquist, 2007) needed for constructive intercultural encounters and interaction. According to Svensson and Wihlborg (2010), intercultural learning could lead to a development of 'global consciousness' and support global citizenship, capabilities and competencies. On a global level, an 'emergent holistic consciousness', through the connection of cultures to a complex collective whole, would form a collective consciousness. Because of the complex demands underlying the discourse of GLSD and related topics, a curriculum dimension is also needed, for learning and teaching SD in a globalized context. Emphasizing that 'globalization and the need for curricula change will become the great challenge in higher education world-wide in the decades to come', Svensson and Wihlborg (2010, p. 15) recommend this. Though, the global perspective (Svensson & Wihlborg, 2010) has to be integrated in curriculum to achieve a competence-driven global curriculum. Thereby, capabilities through constructive interaction for various qualities of global learning and knowledge formation for sustainable development will be a central part of the outcome. According to Rickinson (2001), until recently, most studies have devoted less attention to learning processes and the students' learning experiences and preferences, than to learning outcomes and 'factual' knowledge about sustainability. This has serious implications, since: "Quintessentially, global learning is not about conveying factual knowledge, but is a critical approach to concerns, interests and experiences. Global learning per se cannot serve to create a better world, but encourages self-determination in a global context" (Rauch and Steiner, 2006, p. 121) More specifically, global learning presupposes competencies, which individuals need to acquire if they want to actively shape the development of world society. The aim of the study is not to research social policy, and how or what tends to promote and reinforce a more global perspective in education (Stevenson, 2007). Nor is focus placed on globalization in terms of changes, at economic, technological, political, and cultural levels of society. The purpose is instead to highlight some crucial elements of the global dimension in teaching and learning towards sustainability in the context of professional teacher development and i.e. their development of teaching management strategies (Reid, 2009; Cole, 2006). Within this framework, global learning for sustainable development (GLSD) has been recognized as a productive concept (Anderberg, Norden & Hansson, 2009). Our approach addresses the challenge of teaching about the complex field of sustainable development (SD) in a number of contexts, including higher education (HE), secondary school education, informal or life-long learning situations, as well as in outreach from university or enterprises, aiming to reach new target groups. The understanding of learning, which underpins most of our research studies of the context for learning, is that which has emerged from phenomenographic studies, now known as variation theory (Marton and Booth, 1997). Learning is characterised above all as coming to see things in qualitatively new ways. This involves the learner (i.e. the "learning" teacher) becoming able to discern new qualities in some focal phenomenon or aspects of that phenomenon, which demands opening dimensions of variation in awareness, becoming able to see that that which has been taken for granted could be otherwise (Åkerlind, 2007; Runesson, 2006). With a phenomenographic approach, semi-structured interview questions are used for analysing and describing the process of teacher experiencing, teacher thinking and teacher reflection concerning global teaching and learning of SD. Upper secondary school teachers (n=13), who have competence in different subject matters and are working together in teams educating SD transdisciplinarily in a global context, are interviewed three times (before, in the middle of, and after a specific course moment of SD with a global focus) in a longitudinal study during 2010-2011. According to the theoretical foundation of the research questions, we will through the phenomenographic approach (Marton & Booth, 1997) focus on (1) the content that is the transdisciplinary subject matter of SD within a global focus; (2) the individual learning within awareness raising dialogues with a global focus, and (3) the knowledge formation and the development of capability, competence and skills (Booth & Anderberg, 2005; Bowden, 2004). The result, presented at the EARLI 2011 conference, will be related to teacher thinking. The findings show that in any educational context – and in this teaching practice, particularly, how – the concept of GLSD continuously needs to be renegotiated by participating teachers in every concrete learning situation (Dahlin, 1999). While Rauch and Steiner (2006) see SD mainly as a narrowing idea, providing a heuristic format for reflection, the complexities of SD also provide a bearing for processes of global research and learning. Due to the complexity of SD issues, it is necessary to bring in an open-minded elucidation of the globalization factors actually present, already in the foundation of the SD concept. The findings clearly point to a link between transdisciplinary and global teaching within the field of global

learning for sustainable development (Nordéén and Anderberg, 2010). With this study, we wish to shed light on the concept of SD from a global didactic angle.

Understanding Teachers' Personal Epistemologies

Gregory Schraw, University of Nevada, United States; Jo Brownlee, QUT, Australia; Donna Berthelsen, Queensland University of Technology, Australia

This roundtable summarizes the rationale, results, and educational implications of a recently completed volume on teachers' personal epistemologies by Brownlee, Schraw and Berthelsen (2011). Each of the three editors will participate. Personal epistemology involves an individual's cognition about knowing and knowledge. This research field has explored the nature of teachers' personal epistemologies and how these cognitions inform teachers' practices in classrooms to promote effective learning and teaching in a range of education contexts. The rationale for the volume was to focus on the current status of research knowledge in this field that aimed to improve teachers' personal epistemologies as a catalyst for better educational practices in classrooms. This volume augments other recent volumes that have addressed students' personal epistemology and measurement issues. Joanne Brownlee will discuss the theoretical rationale for the importance of addressing personal epistemologies in teacher education and professional development programs. We summarize five main themes of the research from the edited volume (Gregory Schraw) and discuss implications for educational practice and future research (Donna Berthelsen). The roundtable will inform a critical discussion about the current and future directions for research in development and change in the personal epistemologies of teachers.

The goal of the round table interactive discussion is to summarize the rationale, contents, main themes, and educational implications of an edited volume on teachers' personal epistemologies (Brownlee, Schraw & Berthelsen, 2011). The three co-editors will each participate. The editors will bring their personal experiences with the test's chapters to the roundtable, including their interpretations of each chapter and the overall contribution of the edited volume. This roundtable will enable participants' interests in epistemology to be updated on cutting edge research by 16 authors representing eight different countries. A personal epistemology involves an individual's cognition about knowing and knowledge, but especially the origins and development of knowledge. This research field has explored the nature of teachers' personal epistemologies and how these cognitions inform teachers' practices in classrooms to promote effective learning and teaching in a range of education contexts. The rationale for the volume was to focus on the current status of research knowledge in this field that aimed to improve teachers' personal epistemologies as a catalyst for better educational practices in classrooms. This volume augments other recent volumes that have addressed students' personal epistemology and measurement issues through its focus on teachers' personal epistemologies and learning; teachers' personal epistemologies and teaching; and changing personal epistemologies in teacher education programs. Joanne Brownlee will describe the rationale for the edited volume and situate its unique contributions within the context of recent research and edited volumes that focused on students' personal epistemologies and theoretical/measurement issues related to personal epistemologies. Brownlee will provide definitions of teachers' personal epistemologies and discuss the intended contribution of the volume. Personal epistemologies will be linked to previous work by Perry (197), Kuhn (1991), King and Kitchener (1994), Schommer-Aikins (2004) and Hofer (2004). Gregory Schraw will provide a summary of 16 chapters, focusing on five overarching research questions which include: How do we conceptualize teachers' personal epistemology? Are personal epistemologies domain-specific or domain general? How are teachers' personal epistemologies related to teaching? How are teachers' personal epistemologies related to student learning? How do personal epistemologies change? Schraw will discuss data and theoretical conjectures from each of the authors who addressed these questions, focusing on whether authors reached consensus and how to characterize their consensus. Donna Berthelsen will discuss the contributions of the volume compared to other recent volumes that addressed related topics and the implications for educational practice. This discussion will center on the propositions that active cognitive engagement with the subject matter promotes conceptual change; that awareness of typical preconceptions of teachers and teacher education students can provide the means to inform efforts for change; whether a focus on explicit, concrete principles and strategies promotes conceptual change more than does a focus on abstract generalizations; how information and events that create disequilibrium promote change; and the importance of frequent and critical self-reflection. The argument will be made that each of these factors promotes epistemological development in a manner that improves explicit awareness of one's personal epistemology, classroom teaching practices, and student development. The three authors will present a prioritized list of implications that focus on two key concerns. The first is to develop a better understanding of the intellectual mechanisms which mediate teachers' personal epistemologies, teacher's classroom practices, and student learning. The second is to develop strategies to promote change in personal epistemologies in order to improve teaching practices and student learning. Each author will be given 6 to 8 minutes to present a summary and orient participants to summary tables and visual displays prepared for the round

table. Participants will be encouraged to ask clarifying questions. The remainder of the session will focus on interactive discussion of points raised by the editors, but personal epistemologies improving teacher practice in the classroom, changing personal epistemologies, and identifying questions for future research.

Two different classroom activities with the same interaction classroom context

Javier Rosales Pardo, Universidad de Salamanca, Spain; Irene Alvarez, University of Salamanca, Spain; David Munez, University of Salamanca, Spain; Santiago Vicente, University of Salamanca, Spain; Jose Chamoso, Facultad de Educacion, Spain

Classroom context can facilitate or frustrate the supporting autonomy process. Normally, teaching patterns are based on teachers' individual routines and knowledge structures which can vary over the course of different lessons (Seidel & Prenzel, 2006). In this study, we are interested in how the task (word problem solving or text comprehension), might determine the interaction classroom context. The participants were 2 Primary Education teachers with more than 10 years' experience. All of the participants were audio-taped in their ordinary classrooms and during the time normally devoted to text comprehension and word problem solving. An analysis of the interaction was required at different levels: 1) The interaction was broken down into episodes; 2) The episodes were broken down into interaction cycles and 3) The interaction cycles was categorized as: Monologue, IRE, IRF or Symmetric. No significant differences were found when comparing the participation structures between two different classroom activities (word problem solving and text comprehension). Furthermore, in both classroom activities the percentage of cycles categorized as IRE was significantly superior to the percentage of cycles categorized as IRF and Monologue.

Introduction

One of the main goals for educators is to create and foster classrooms that support students in becoming truly autonomous or self-determined as learners. Scaffolding involves students as co-participants in teaching and learning by constantly balancing challenge and skill. In scaffolding, the teacher provides guidance for accomplishing the learning goal only as necessary and to move from a position of shared responsibility to one in which the student takes control of learning goals and processes (Turner, Meyer, Cox, Logan, DiCintio & Thomas, 1998). Obviously, classroom context can facilitate or frustrate this scaffolding process. In this sense, Stefanou, Perencevich, DiCintio & Turner (2004) propose that autonomy support can be manifested in the classroom in at least 3 distinct ways: organizational autonomy support (e.g., allowing students some decision-making role in terms of classroom management issues), procedural autonomy support (e.g., offering students choices about the use of different media to present ideas), and cognitive autonomy support (e.g., affording opportunities for students to evaluate work from a self-referent standard). In the present study, we are interested in studying cognitive autonomy support and, specifically, we want to analyse how the task (word problem solving and text comprehension) might determine the interaction classroom context. Normally, teaching patterns are based on teachers' individual routines and knowledge structures which vary over the course of different lessons. For example, Seidel & Prenzel (2006) suggest that teaching patterns vary due to the domain of instruction, the topic taught in class, as well as the individual instructional practices of the teachers. However, as stated by the same authors, in order to change and stimulate teacher improvement, further research is required with respect to the variances that are caused by domain specificity, topic specificity and individual teacher routines.

Method

The participants were 2 primary education teachers with more than 10 years' experience. Each teacher was audio-taped when teaching two fourth-grade lessons (Science and Mathematics), which were composed by different sessions. Two typical classroom activities, word problem solving and text comprehension, were isolated from each session. In sum, our aimed involved two different classroom activities that were carried out by the same teacher. All of the participants were audio-taped in their ordinary classrooms and during the time normally devoted to this type of work. Analysis of the interaction required 3 different levels: 1) the interaction was broken down into episodes. An episode was defined as a set of activities that presents: a) a recognizable objective or goal, b) a regular structure of participation, and c) a recognizable sequence of routines. In the present work we distinguish four types of episodes; 2) the episodes were broken down into interaction cycles. Basically, an interaction cycle starts with an initial question/order and it finishes when that question/order is completed; 3) the interaction cycles were categorized as participation structures: Monologue (students do not participate); IRE (the cycle involves a closed question and a simple feedback); IRF (the cycle involves an open question and a complex feedback which allows the students 'participation'); Symmetric (students begin the interaction cycle). Measures In the present study the percentages of participation structures during word problem solving and text comprehension were considered.

Results

Overall, no significant differences were found when comparing the interaction classroom context between problem solving and text comprehension $\chi^2(3, N= 200) = 2.77, p > .42$. However, in both classroom activities, significant differences were found between the percentages of the different participation structures: Science, $\chi^2(4, N= 100) = 165.60, p$

Discussion

The absence of significant differences between the participation structures points out that the task does not influence on how the interaction classroom context is organized when solving word problems and comprehending texts. Similarly, in both groups significant differences were found between IREs and the rest of participation structures which indicates that the teachers take control of the learning process. Despite the results found by Seidel & Prenzel (2006), which suggests that teaching patterns can vary due to the domain of instruction and the topic taught in class, our results show that if we take into account the interaction patterns then the instructional classroom context does not vary. Educational implications Knowing what teachers usually do in their classrooms is important because it will allow us to propose changes that are not very remote from what is already being done. In this sense, the present study reinforces the idea that teaching patterns remains the same under different tasks. Hence, this fact should be taken into account in order to improve teaching practices.

An Examination of the Assessment Accuracy of Teacher Tutors and Student Tutors

Stephanie Herppich, Georg-August-University Goettingen, Germany; Joerg Wittwer, University of Goettingen, Germany; Matthias Nuckles, University of Freiburg, Germany; Alexander Renkl, University of Freiburg, Germany

Tutors often have difficulty with accurately assessing a tutee's understanding. However, little is known about how the professional expertise of tutors influences their assessment accuracy. Therefore, we conducted a study with $N = 46$ tutor-tutee dyads and compared the accuracy with which teacher tutors and student tutors assessed a tutee's understanding of the human circulatory system. The results showed that whether teacher tutors were more accurate in assessing than student tutors depended on the type of a tutee's understanding being assessed. When assessing a tutee's understanding at the level of concepts, teacher tutors outperformed student tutors. However, this was only true for the assessment of a tutee's correct understanding of concepts. When assessing a tutee's understanding at the level of mental models, teacher tutors and student tutors faced similar difficulties. However, in contrast to student tutors, teacher tutors were more aware of their ability to accurately assess a tutee's understanding. Overall, the results suggest that teacher tutors assess a tutee's understanding at the level of concepts more systematically than student tutors. In contrast, when assessing a tutee's understanding at the level of mental models, teacher tutors like student tutors tend to be overwhelmed by processing all information that make up a tutee's mental model. Hence, regardless of their professional expertise, tutors need to be supported in assessing a tutee's understanding.

Aim

To be effective, instruction should be adapted to the individual learner. Human one-to-one tutoring is a method that offers many opportunities to adapt instruction to a tutee's understanding. However, an important prerequisite of adaptive instruction is the accurate assessment of the tutee's understanding. Research has shown that tutors have difficulty with accurately assessing a tutee's understanding. Nevertheless, no previous study has directly compared the extent to which tutors with different levels of professional expertise can accurately assess a tutee's understanding. It can be assumed that – due to their professional expertise – teachers who serve as a tutor process information about a tutee more systematically than students who serve as a tutor. As a result, teacher tutors are more likely to assess a tutee's understanding accurately than student tutors.

Methodology

In this study, we investigated how the professional expertise of tutors influenced the accuracy with which they assess a tutee's understanding. We examined the accuracy with which 21 teacher tutors and 25 university student tutors assessed a tutee's understanding. In the tutoring session, the dyads of tutors and tutees discussed a text passage about the human circulatory system. After tutoring, the tutees completed a concepts test measuring their correct and incorrect understanding of concepts related to the human circulatory system. The tutors were asked to indicate how the tutee would answer each of the items in the concept test (= level of concepts). Moreover, the tutees were asked to draw and explain the blood path of the human circulatory system. The tutors were asked to draw and explain the blood path as they assumed their tutee to draw and explain it (= level of mental models).

To analyze the tutors' assessment accuracy, we compared the tutees' actual performance with the tutors' estimates of the tutees' performance. We measured the assessment accuracy for the concepts test by comparing the tutors' estimates of how many items the tutees would answer correctly or incorrectly against the number of items that were

actually answered correctly or incorrectly by the tutees. To measure assessment accuracy for the drawing task, we compared the number of tutors that assumed their tutee to have a correct or incorrect mental model against the number of tutees that actually had a correct or incorrect mental model. The correctness of a mental model was coded by assigning a tutee's mental model to one of twelve categories with higher categories indicating a more complete understanding. In addition, we asked the tutors to self-assess their assessment accuracy in the drawing task on a 4-point rating scale.

Results

Results showed that tutors overestimated the tutees' correct understanding and even more strongly underestimated the tutees' incorrect understanding. This was true for the level of concepts (correct: MTutor = 14.59, SDTutor = 3.21, MTutee = 13.35, SDTutee = 3.18; $t(45) = -2.05$, $p = .05$, $\eta^2 = .09$; incorrect: MTutor = 6.83, SDTutor = 1.91, MTutee = 9.70, SDTutee = 3.23; $t(45) = 5.98$, $p = .01$, $\eta^2 = .44$) and for the level of mental models (correct: nTutor = 36, nTutee = 19; incorrect: nTutor = 10, nTutee = 27; goodness of fit test: $\chi^2(1, N = 46) = 14.70$, p

The comparison between the teacher tutors and the student tutors revealed that the teacher tutors (MTutor = 14.19, SDTutor = 3.04; MTutee = 14.10, SDTutee = 3.13) assessed a tutee's correct understanding at the level of concepts significantly more accurately than the student tutors (MTutor = 14.92, SDTutor = 3.37; MTutee = 12.72, SDTutee = 3.16): $t(44) = 1.77$, $p = .04$ (one-tailed), $\eta^2 = .07$. However, there was no significant difference between the teacher tutors (MTutor = 7.29, SDTutor = 2.22; MTutee = 9.57, SDTutee = 2.96) and the student tutors (MTutor = 6.44, SDTutor = 1.56; MTutee = 9.80, SDTutee = 3.50) with regard to the assessment of a tutee's incorrect understanding: $t(44) = -1.12$, $p = .27$ (one-tailed), $\eta^2 = .03$. At the level of mental models, the assessment accuracy of the teacher tutors (correct: nTutor = 16, nTutee = 9; incorrect: nTutor = 5, nTutee = 12) was also not significantly different from the assessment accuracy of the student tutors (correct: nTutor = 20, nTutee = 10; incorrect: nTutor = 5, nTutee = 15): $\chi^2(1) = 0.00$, $p = .49$ (one-tailed; log-linear analysis). However, the correlation between the teacher tutors' self-assessments ($M = 2.85$, $SD = 0.49$) and their assessment accuracy, reflected by the difference between the category number assigned to the tutor's assumed mental model and the category number assigned to the tutee's actual mental model (MTutor = 10.00, SDTutor = 0.84; MTutee = 8.05, SDTutee = 2.67), indicated that the teacher tutors were fairly accurate in self-assessing their assessment accuracy ($r = -.56$, $p = .01$). The student tutors' self-assessments ($M = 3.00$, $SD = 0.58$), however, did not reflect their true assessment performance (category number: MTutor = 10.12, SDTutor = 0.93; MTutee = 7.84, SDTutee = 2.75; $r = .00$, $p = .99$). Thus, in contrast to the student tutors, the teacher tutors were quite aware of whether or not they were able to accurately assess a tutee's mental model of the human circulatory system.

Theoretical and educational implications The results replicate previous findings and suggest that the tutors' assessment accuracy is influenced by a bias that leads them to impute their own understanding to the tutee. Consequently, tutors overestimate a tutee's correct understanding and underestimate a tutee's incorrect understanding. Teacher tutors, however, seem to be less influenced by such a bias because they assess a tutee's correct understanding at the level of concepts more accurately than student tutors. Nonetheless, teacher tutors and student tutors face similar difficulties in assessing a tutee's understanding at the level of mental models. Despite these similarities, teacher tutors seem to be more aware of the difficulties with assessing a tutee's mental model than student tutors. Overall, the results suggest that tutors need support in assessing a tutee's understanding to help them providing adaptive instruction in tutoring.

Is there an integration process of pictures and words in working memory?

Jana Arndt, Knowledge Media Research Center, Germany; Anne Schueler, Knowledge Media Research Center, Germany; Katharina Scheiter, Knowledge Media Research Center, Germany

According to the Cognitive Theory of Multimedia Learning (Mayer, 2009) one crucial step for learning with words and pictures is the integration of the verbal and pictorial representations with each other. However, so far, there have been no studies explicitly investigating this assumed integration process. Thus, the first aim of the current study is to investigate the integration of words and pictures by using a paradigm introduced by Gentner and Loftus (1979): Learners are instructed to memorize 40 pairs of pictures and sentences that result from cross-varying type of picture (specific vs. general) with type of sentence (specific vs. general). Integration is assumed to occur whenever the two sources of information differ in their specificity (i.e., when a general sentence is paired with a specific picture and vice versa). As a consequence, learners should be less able to trace back the learned information to a specific representation. Hence, they should have higher false alarms when for instance being asked to verify whether they have seen a specific picture when this specific information had actually been given in a sentence paired with a general picture compare to a situation where both representations have the same level of specificity. The second aim of the

present study is to investigate whether the assumed integration process takes place in the episodic buffer of working memory (Baddeley, 2000). The results of the study as well as the appropriateness of the used methods will be discussed at the conference.

ROUND TABLE

A typology of informal learning in the workplace

Anoush Margaryan, Glasgow Caledonian University, United Kingdom; Colin Milligan, Glasgow Caledonian University, United Kingdom; Allison Littlejohn, Glasgow Caledonian University, United Kingdom

The aim of this study is to contribute to understanding of the ways in which professionals learn and develop their expertise in the context of work. A key research question is: What is learned in the workplace? To address this question, the study was designed to elicit categories of knowledge, skills and dispositions that professionals acquired through engagement in work. The study was conducted in a multinational company in the energy sector. Data was collected using semi-structured interviews. Participants were 29 professionals (engineers, scientists, learning specialists and others) working in 12 different countries. Respondents were asked to think about their most significant learning experience in the past year - the project or task from which they had learned the most. Through a series of semi-structured questions they were prompted to articulate what they learned. Synthesis of the responses generated a typology of knowledge and skills acquired through work. These were grouped under 5 categories: understanding and awareness; know-how; locative knowledge; personal development and enculturation. The findings contribute empirical evidence on the breadth and variety of types of knowledge and skills that can be acquired through work, helping refine our understanding of the learning potential of the workplace. The findings could contribute to practice by enabling organisations to provide more effective learning opportunities for their employees and ensuring recognition of knowledge and skills that employees acquire through every day.

The workplace is often viewed as site of experience and performance rather than learning. This is partly explained by organisational imperatives, whereby learning is considered a by-product of work rather than a goal in itself, and partly by the complex politics of naming oneself as learner in the workplace (Boud et al, 2003). However, this separation between learning and work also reflects a certain bias that traditionally existed towards informal workplace learning as being devoid of structure, situationally non-transferrable, lacking certifiability and a sound basis in codified knowledge (Billett, 2001). The workplace thus tended to be viewed as a place of application, extension and augmentation of learning, while learning itself has been viewed to occur mainly through participation in formal education and training (Colley et al, 2002). In reality the workplace is an environment where powerful, deep and effective learning takes place (Eraut et al, 2000). The aim of this study is to develop an understanding of the ways in which professionals learn in the context of their work. Of special interest is the question of how professionals interact with the collective knowledge (knowledge residing in people, epistemic practices, resources and machines) in the process of their learning. The study was conducted in a multinational company in the energy sector. The study was guided by three research questions:

- 1) What is learned in the workplace?
- 2) How is it learned?
- 3) Who is it learned with?

In this session, we report initial findings related to the first research question only, presenting a typology of what is learned in the workplace.

Methodology:

The data was collected through semi-structured interviews with 29 professionals (engineers, scientists, learning specialists, among others). Participants were distributed in 12 countries and the interviews (lasting on average 1 hour) were conducted by telephone. At the start of the interview, the respondents were asked to think about their most significant learning experience in the past year - the project or task from which they had learned the most. The interview questions were designed to elicit data about the ways in which professionals set and attain their learning and development goals to complete the project/tasks. The interview script is available at: <http://www.scribd.com/doc/15426750/Interview-Script> Data was coded using both pre-defined codes related to the key research questions, as well as codes emerging from the data. Coding for a sample of data was cross-checked by two researchers to ensure inter-rater reliability and consistency.

Findings:

Synthesis of responses generated a set of 21 categories that cover a wide collection of types of knowledge and skills. These range from conceptual knowledge (know what) and procedural knowledge (know how) to locative knowledge (know where) and dispositional knowledge (personal values and behaviours). The typology is outlined in Table 1.

Conclusions, contributions and issues for discussion:

The traditional view is that the acquisition of certain types of knowledge (eg conceptual knowledge) can only occur in formal learning settings (such as a university programme or a training course in a corporate learning centre). However, as our findings show, this view is limited. This initial typology demonstrates the breadth and variety of knowledge and skills that individuals acquire through work. These findings contribute empirical evidence on the variety of types of expertise that can be acquired through work itself, helping refine our understanding of the learning potential of the workplace. Improved understanding of what can be learned through work can also contribute to practice, enabling organisations to provide more effective learning opportunities for their employees and ensuring that the knowledge and skills that employees acquire through every day work are recognised.

The study highlighted some theoretical, methodological and pragmatic issues. We propose to discuss the following three issues:

1. To what extent 'what is learned' can be linked to 'who with/from' and 'by what mechanism'? Do any patterns emerge? This could be an interesting area for further research.
2. What are the appropriate methodologies to help us study how people learn in the context of work? Given the informal and often tacit nature of workplace learning, much of it tends not to be recognised as learning, meaning that people often lack awareness of what they are learning in the context of work. Quantitative surveys are generally considered inappropriate for studying the sorts of research questions that we posed here. Interviews are the most common method, but are they may not allow a sufficiently in-depth exploration. Ethnographic studies (including observations) could give more in-depth insights, but they are costly and it is difficult to get organisational commitment or funding for these.
3. How can this typology be used in research and practice? How could organisations/individuals apply it to improve learning?

References:

- Billett, S. (2001). Learning in the workplace: Strategies for effective practice. Crows Nest: Allen & Unwin.
- Boud, D., & Solomon, N. (2003). "I don't think I am a learner": Acts of naming learners at work. *Journal of Workplace Learning*, 15(7/8), 326-331.
- Colley, H., Hodkinson, P., & Malcolm, J. (2002). Non-formal learning: Mapping the conceptual terrain. A consultation report. Leeds: University of Leeds. http://www.infed.org/archives/e-texts/colley_informal_learning.htm
- Eraut, M., Alderton, J., Cole, G., Senker, P. (2000).. Development of knowledge and skills at work. In Coffield, F. (Ed.), *Differing visions of a learning society*, Vol.1 (pp. 231-262). Bristol: The Policy Press.

How to cultivate experts to their new tasks?

Tuire Palonen, University of Turku, Finland; Erno Lehtinen, University of Turku, Finland

The changes taking place in the societies and their technological systems, and future's demands in general, create pressures for the experts' work in different types of organizations (Tynjälä & Heikkinen 2010; Hakkarainen et al. 2004). There is evidence that experience alone does not cultivate workers so that they could learn without being aware of it (Boshuizen, 2004). Not either the traditional professional programs organized by the centers of extensional studies have fulfilled the expectations related to the future's competences. Therefore, new type of education model for academic experts was implemented in Finland. The aim was to integrate higher education and workplace learning. The purpose of the study was to investigate how the new type of education can train experts to their future tasks. The reply to the online questionnaire was sent back by 108 respondents, studying altogether in 6 expert programs.

The opinions toward the new educational model were varying. The prior knowledge of the participants were not always taken into consideration, expectations toward the programs were high and not always met. Obviously, there is a need to re-think how to create new educational models that combine the strengths of the university training and workplace learning. The comments toward the apprenticeship type features of the model were critical, especially given by the respondents coming from rather tiny organizations or working at the field in which they did not have any close colleague that would have shared their tasks.

Introduction

The changes taking place in the societies and their technological systems, threats brought along globalization, limits of the environmental capacity and future's demands in general, create pressures for the experts' work in different types of organizations (Tynjälä & Heikkinen 2010; Hakkarainen, Palonen, Paavola & Lehtinen, 2004). There is evidence that experience alone does not cultivate workers so that they would easily learn without being aware of it and even if the environment is changing and new knowledge would be at hand (Eraut, 2007; Boshuizen, 2004). Not either the traditional professional programs organized by the centers of extensional studies of the universities have fulfilled the expectations focused on future's competencies. Obviously, there is a need to re-think how to create new educational models that combine the strengths of the university training and workplace learning. Therefore, new type of education model for academic experts was implemented in Finland. The aim was to integrate higher education and workplace expert knowledge together by supervising, learning by doing and getting newest pieces of knowledge to students along various channels provided by universities. The ten first programs called as "apprenticeship type education" started at 2009, following by 35 next programs at 2010. These first 45 pilot programs are focusing on very different domains such as environmental and technological expert tasks, work on the field of social and health care and business administration. They were tailored to train experts to tasks such as game addiction therapy, energy counseling, multicultural counseling and leaders for rapidly growing industry and so on. The first pilot courses are soon finishing their first year and the evaluation round was conducted in order to study the first impressions of the new model.

Research problems

The aim was to investigate 1) how the new type of education that is tightly tied to workplace learning can train experts for their future tasks. 2) How mentoring, apprenticeship type workplace counseling and face-to-face sessions at university can be integrated together? 3) Is prior learning taken into consideration by supervisors and planners of the courses?

Participants

Altogether 108 experts responded to the online questionnaire from 6 different pilot programs. Their experiences and evaluation about the new model were asked in the formula. Instruments An online questionnaire was created in order to evaluate the prior knowledge base and overall evaluation of the supervising practices and the ways how the learning was sequenced during the studying period. In addition, in three open-ended questions they were asked about the profits and obstacles of the new education model in general. The data gathered by questionnaires will later be complemented by interviews.

Results

The opinions toward the new educational model were varying. The prior knowledge of the participants did not always fit to their work tasks or learning episodes. The expectations toward the programs were high and not always met. There were many obstacles in organizing the supervision, mentoring or guidance at workplaces. The face to face sessions were not always integrated to the problems found at workplaces. Especially, the time was too short for learning tasks and there were too much of them. The most positive comments were given for work-circulating practices and training the students toward the new skills somewhere else than in one's own workplace. Further, expert lectures organized by universities, were often experienced to be fruitful. In sum, the comments toward the apprenticeship type features of the model were critical, especially given by the experts coming from rather tiny organizations or working at the field in which they did not have any colleagues that would have shared their field.

Discussion

Even if positive comments about the new model were given, it seems obvious that the first pilot programs have not been able to renew the earlier practices very much. More innovative tools, methods and styles are needed to get real change that is needed to educate the future experts.

References:

- Eraut, M. (2000). Non-formal learning and tacit knowledge in professional Work. *British Journal of Educational Psychology*, 70, 113-136.
- Gartmeier, M., Bauer, J., Gruber, H., & Heid, H. (2008). Negative knowledge: Understanding professional learning and expertise. *Vocations and Learning*, 1, 87-103.
- Gott, S. P., & Lesgold, A. M. (2000). Competence in the workplace: How cognitive performance models and situated instruction can accelerate skill acquisition. In R. Glaser (Ed.), *Advances in instructional psychology*. Volume 5: Educational design and cognitive science (pp. 239-327). Mahwah: Erlbaum.
- Hakkarainen, K., Palonen, T., Paavola, S., & Lehtinen, E. (2004). *Communities of networked expertise: Educational and professional perspectives*. Amsterdam: Elsevier.

Tynjälä, P. & Heikkinen, H. 2010. Peer Group Mentoring for Teachers' Well-Being and Professional Development. A keynote presentation in the international conference Promoting Learning and Well-Being of Students and Teachers, Jyväskylä, Finland, June 7th 2010.

Reorganization of collaboration and learning in organizational change in emergency unit

Kaija Collin, University of Jyväskylä, Finland; Sanna Herranen, University of Jyväskylä, Finland; Ulla Maija Valleala, University of Jyväskylä, Finland

In this paper we aim to describe various organizational changes caused by increasing volume of patient care in regional emergency polyclinic at the Central Finland Central Hospital. In particular, we focus on how changes unfold in division of labor and recomposing the nursing teams and how the change challenges personnel's learning. The paper is part of a larger research and developmental project which aims to uncover the different teamwork processes and inter-professional collaboration and learning that take place in medical emergency work. Despite the voluminous amount of research in the area of organization and management studies and nursing there has been little focus on inter-professional collaboration in organizational change situation.

Ethnography was applied as a methodological approach in conducting the research. With this approach we aim to describe and understand the organizational culture, everyday work practice and inter-professional collaboration in the clinical context of emergency work. Empirical data will be collected with the help of observations and interviews. Suitable qualitative methods will be utilized in the data analysis. As preliminary findings we describe the process of how head and charge nurses as well as charge physicians are prepared to changes, that is, to increased volume of patients from the beginning of 2011.

The findings will be utilized in building a model of inter-professional shared expertise which will be applied more broadly in hospital organizations, particular in promoting physicians' and nurses' inter-professional education and continuing education among health care professionals.

In this paper we aim to describe various organizational changes caused by increasing volume of patient care in regional emergency polyclinic at the Central Finland Central Hospital. In particular, we focus on how changes unfold in division of labor and recomposing the nursing teams and how the change challenges learning. The paper is part of a larger research and developmental project which aims to uncover the different teamwork processes and inter-professional collaboration and learning that take place in medical emergency work. The project is divided into three phases and the findings presented in the paper are based on the second phase in which inter-professional team work processes are developed. In the project we aim to identify what practices of inter-professional team work most effectively enhance employee wellbeing and patient safety. In addition, we aim to identify what inter-professional practices need to be further developed in the project.

Hospitals are environments in which inter-professional teamwork and collaboration are essential to ensure patient safety and effective practice (e.g. McCallin 2001; Nembhard & Edmondson 2006). However, it has been revealed in many studies that inter-professional collaborative work in hospital organizations faces many challenges and constraints (see Kvanström 2008; Lingard, Espin, Evans & Hawryluck 2004; Phelan, Barlow & Iversen 2006; Pisano, Bohmer & Edmondson 2001). In order to enhance the effectiveness of patient-centered practices, such as ensuring patient safety, the Central Finland Hospital has started a regional, the first of its kind in Finland, emergency polyclinic. Since a massive structural and functional change of this kind has not been properly investigated and assessed before, research which could assist in the further development of collaborative innovations is needed. From the beginning of 2011 an additional increase of volume of patients in regional emergency polyclinic will occur. Due to this change reorganization of collaboration is needed. Besides the reorganization also other conditions can be taken care of. These are, for instance, ensuring patient safety, ensuring wide expertise of nursing personnel in emergency unit (including expertise of primary health care and special health care) and competence development, wellbeing and orientation of new personnel.

Despite the voluminous amount of research in the area of organization and management studies (Nembhard & Edmondson 2006; Ramanujam & Rousseau 2006) and nursing (Baker, Day & Salas 2006; D'Amour, Ferrada-Videla, Rodriguez & Beaulieu 2005; Kvanström 2008) there has been little focus on inter-professional collaboration in organizational change situation. As a change situation in this paper we refer to increased volume of patients in regional emergency polyclinic. Since emergency work occurs in circumstances of continuous change in the composition of team members, especially nursing practices are challenged. Consequently, in this paper we ask how various planned organizational changes are manifested in reorganization of nursing and division of labor in emergency

work. In particular, we focus on changes that can be seen in the division and reorganization between different care groups and team composition.

Ethnography was applied as a methodological approach in conducting the research. With this approach we aim to describe and understand the organizational culture, everyday work practice and inter-professional collaboration in the clinical context of emergency work. Empirical data will be collected with the help of observations, audio taping and individual and focus group interviews. Suitable qualitative methods, such as ethnographic, discourse and thematic analysis, will be utilized in the data analysis.

As preliminary findings we describe the process of how head and charge nurses as well as charge physicians are prepared to changes, that is, to increased volume of patients from the beginning of 2011. We also describe how the planned changes actually will be shown after the date of which the changes come into effect. We also describe how the recomposition of care groups and inter-professional teamwork will succeed from the point of view of how the changes were explained and argued. In addition, what kinds of new challenges and possibilities for learning will emerge in the situation will be discussed. The findings will be utilized in building a model of inter-professional shared expertise which will be applied more broadly in hospital organizations, particular in promoting physicians' and nurses' inter-professional education and continuing education among health care professionals.

References

- Baker, D. P., Day, R. & Salas, E. 2006. Teamwork as an essential component of high-reliability organizations. *Health Services Research* 41 (4, Part II), 1577–1598.
- D'Amour, D., Ferrada-Videla, M., Rodriguez, L.S.M. & Beaulieu, M-D. 2005. The conceptual basis for interpersonal collaboration: Core concepts and theoretical frameworks. *Journal of Interprofessional Care*, (May 2005) Supplement 1, 116–131.
- Kvanström, S. 2008. Difficulties in collaboration: A critical incident study of interprofessional healthcare teamwork. *Journal of Interprofessional Care*, 22 (2), 191–203.
- Lingard, L., Espin, S., Evans, C. and Hawryluck, L. 2004. The rules of the game: Inter-professional collaboration on the intensive care unit team. *Critical Care* 8 (6), R403-R408.
- Mccallin, A. 2001. Interdisciplinary practice – a matter of teamwork: an integrated literature review. *Journal of Clinical Nursing* 10 (4), 419–428.
- Nembhard, I. M. and Edmondson A. C. 2006. Making it safe: The effects of leader inclusiveness and professional status on psychological safety and improvement efforts in health care teams, *Journal of Organizational Behaviour* 27, 941-966.
- Phelan, A.M., Barlow, C.A. & Iversen, S. 2006. Occasioning learning in the workplace: The case of inter-professional peer collaboration. *Journal of Inter-professional Care* 20 (4), 415–424.
- Pisano, G., Bohmer, R.M.J. and Edmondson, A. M. 2001. Organizational differences in rates of learning: Evidence from the adoption of minimally invasive cardiac surgery. *Management Science* 47 (6), 752-768.
- Ramanujam, R. & Rousseau, D. M. 2006. The challenges are organizational not just clinical. *Journal of Organizational Behavior* 27 (7), 811-827.

Can we improve student satisfaction by team learning in a first year undergraduate accounting course

Evelien Opdecam, Ghent University, Belgium; Patricia Everaert, Ghent University, Belgium

This paper discusses student satisfaction and experiences of a large cohort of first year undergraduate students. Team learning was implemented in a financial accounting course. The learning experiences and the satisfaction, as perceived by students in the team learning condition, were compared to those in a traditional lecture-based control condition. A post-experimental questionnaire, with open and closed-ended questions, was administered. Students reported higher levels of satisfaction in the team learning condition and a better learning experience compared to students in the lecture-based condition. The amount of pre-class preparation and in-class participation was higher for the team learning students in comparison to the lecture-based students. This paper elaborates on the elements in effective team learning design in accounting education and contributes by illustrating a basic model to implement team learning in a large undergraduate accounting course.

Introduction

Implementing team learning in the current circumstances in higher education is not easy. The pivotal change in higher education of the last decade has been the massification of student population (Tynjala, Valimaa, & Sarja, 2003). As a

result, many accounting courses are taught in large classes (Cunningham, 2008). The large size makes it challenging in terms of effort and resources for the university to offer small class tutorials or to check up on homework assignments. Students attend accounting class with about 500 students and attend the tutorials in classes of around 100 to 150. Many students would wait until the end of the semester to practise accounting topics and, as a result, fail the course. This sense of freedom is in sharp contrast to high school, where students are forced to study on a continuous basis. The reason to place more pressure on studying the material during the semester by increasing pre-class preparation for tutorials was one of the motivations for implementing team learning.

Previous research has investigated the effects of cooperative learning on student performance in accounting (Hite, 1996; Hwang, Lui, & Yew Jen Wu Tong, 2008; Ravenscroft, Buckless, McCombs, & Zucherman, 1997). To date, few research has focused on the influence on student satisfaction and learning experience in an accounting context. It may be interesting to consider information concerning student satisfaction and learning experiences, as educators construct the learning environment (Strand Norman, Rose, & Lehmann, 2004). Therefore, the first objective of this study was to investigate the influence of team learning on satisfaction and learning experiences. Furthermore, the second objective was to explore the advantages of team learning in an accounting setting.

Research Design

In this research setting, team learning was introduced to a first year undergraduate class in financial accounting. For the tutorials students were able to choose between lecture-based and team learning. Lecture-based was a traditional method of teaching using lectures to discuss the curriculum materials. There is almost no interaction between teacher and student; students mainly absorb the information. As such, there are few opportunities for students to ask questions, receive feedback on their pre-class preparation, or to find an answer on a problem they might have with the course content. Furthermore, in this lecture-based setting, students decide themselves whether they prepare the exercises beforehand or not. For the second learning path, team learning, students were required to be active learners. To make a proper implementation of team learning in an accounting setting, the five basic elements of cooperative learning (Johnson & Johnson, 1999) were taken into account. Students were divided into student-selected (Hilton & Phillips, 2010) groups of five. The teacher assigned these groups exercises to prepare (identical to those of the lecture-based path) and students were required to discuss their solutions with team members during the sessions. During these sessions, the instructor was available for questions. The core issue in team learning is that students do not learn solely from their own experiences, rather they learn from the experiences of the other team members as well. Because team members interact, they can possess and transfer information through feedback, explanation, or advice (Ellis et al., 2003). Furthermore, in the team learning condition, students were given the opportunity to accept responsibility for their own learning process (Michaelsen & Black, 1994). As a result, students in the team learning condition were expected to attend classes fully prepared.

Measurement Instrument

In order to evaluate the success of team learning, a post-experimental questionnaire was developed. Data were collected during the Spring 2010 semester. Satisfaction was measured via six items adapted from Janvrin (2008). In these items students were asked to report whether they liked the learning experience and whether the chosen path fulfilled their expectations. To measure learning experiences, the latest version of the 'Course Experience Questionnaire' (CEQ) was used. The CEQ has been successfully deployed in an accounting context in the past (Byrne & Flood, 2003). Specifically, Byrne and Flood highlighted the potential of the CEQ to offer reliable and useful feedback on teaching effectiveness. A 19-item CEQ with a 5-point Likert scale, consisted of four scales: Good Teaching; Clear Goals; Appropriate Workload; and Generic Skills. The specific items in each scale, factor loadings, and Cronbach's alpha are detailed in Table 1. Almost all items loaded as expected and the alpha values were satisfactory and demonstrate moderate to high levels of internal consistency.

Although the analyses of this quasi-experiment are still in progress, it is possible to report some preliminary results. Students who opted for team learning reported a significantly higher satisfaction than did students who opted for lecture-based learning ($F = 53.81$; $p = .000$). More team-learning students, in comparison to lecture-based students, declared that they made the right choice concerning the learning paths. Second, students in the team learning path reported a significantly higher mean score for good teaching ($F = 55.72$, $p = .000$) and generic skills ($F = 40.19$, $p = .000$), while there was no significant difference in the mean score for clear goals ($F = .00$, $p = .955$) and workload ($F = 1.72$, $p = .191$). Third, the time spent studying and preparing for the class during the semester was significantly higher for the team-learning students compared to the lecture-based students ($F = 59.82$; $p = .000$). The radar diagram illustrates these differences (see Figure 1). Fourth, the qualitative analyses of the open-ended questions provided further insight into the reasons for higher satisfaction and better learning experience. Important advantages of the team learning path were a factor in forcing students to study the theories and prepare the exercises prior to the class. Furthermore, the discussions on the material within the team were helpful for understanding the difficult topics within the course.

The aversion of accounting, for some students, changed into a slight appreciation of accounting. Finally, the team learning path was considered fun. The ability to provide a stimulating learning atmosphere is the main reason why we have implemented this innovative approach.

Inclusion in Secondary School: a training for teachers

Bortolotti Elena, Università di Trieste, Italy; Emanuela Cren, PhD at the Università degli Studi di Trieste, Italy., Italy;
Francesca Zanon, Faculty of Formation at the Università degli Studi di Trieste, Dipartimento della Formazione e dei Processi culturali, Italy, Italy

The Convention on the Rights of Persons with Disabilities (2006) is a recent international human rights instrument of the United Nations, that intend to protect the rights and dignity of persons with disabilities. In the field of Education, the Convention states that persons with disabilities should be guaranteed the right to inclusive education at all levels. The inclusion in a regular classroom is a important step for people with disabilities, but it requires a new perspective of teachers training.

This research investigates the ways in which the learning in blended modality is functional to the specialized knowledge development and how it promotes the effective practices sharing, on the theme of inclusion. The sample is given by a class of 54 teachers and one e-tutor attending a postgraduate course. This training iter requires that probationer teachers discuss about practices and question them inside the fields of disability and teaching students with special needs. Students are required to reflect on issues debated online. The strengths are the online collaborative discussion, presentations among participants and the interactions between online participants and tutor.

The role of educational research is to develop models that can explain how educational processes take place, evaluate their effectiveness and efficiency, propose and analyze intervention strategies (Klieme et al., 2008). An important topic that today involves the world of education, concerns the issues of inclusion of people with disabilities. The inclusion in a regular classroom is an important step for people with disabilities, it provides age-appropriate role-models and interactions with peers. Naturally, additional support services might be needed to ensure that all students' needs are met (Ashman, 2005). Despite the trend towards more inclusive practice, research has indicated that regular classroom teachers are not convinced of the effectiveness of this approach (Cook, 2001). One explanation for this attitude can be found in the absence of strategies for inclusion. At school it's very important planning support actions: teachers are required to modify the curriculum to include the needs of students, to develop positive attitudes to disability, to examine the role of school integration policies and to assume major responsibility for educating children with special needs (Elkins, 2005). In this way the teachers education becomes very strategic to guarantee the right of inclusions for students.

The Convention on the Rights of Persons with Disabilities (2006) is a recent international human rights instrument of the United Nations, that intend to protect the rights and dignity of persons with disabilities. Particullary, in the field of Education, the Convention states that persons with disabilities should be guaranteed the right to inclusive education at all levels, regardless of age, without discrimination and on the basis of equal opportunity.

The Convention notes that disability is an evolving concept and results from the interaction between a person's impairment and obstacles such as physical barriers and prevailing attitudes that prevent their participation in society. This concept is present in another important document, the International Classification of Functioning, Disability and Health, known more commonly as ICF, a classification of health and health-related domains.

In the future, all countries that have signed the Convention, should organize inclusive practices, and the school is an important starting point. For this reason, there is the need to establish models of learning to frame the inclusive experience. It should be considered, for example, the importance of models already coded, the opportunities for reflection, proposals, etc.

The aim of this work is to examine the effectiveness of online learning in courses of high professional training, for teachers who are specializing in supportive teaching (in Italy people with disabilities are used to attend common schools, and they have a support by a specialized teacher).

This training iter requires that probationer teachers discuss about inclusive practices at school. Questions involving the fields of disability and teaching students with special needs. Students-teachers are required to reflect on issues debated online.

Methods

Subjects

The 54 teachers involved in the research are specializing in working with students with special needs. They work in secondary school in regular classes yet. The specializing course they have been attending aims at preparing them to be special education teachers, what implies working for the inclusion of students with special needs in a regular class.

Instruments

The instruments given to the course participants included the use of LMS (Learning Management System) and Virtual classroom. These set up the structure through which the group can naturally switch from a guided learning configuration to a Practice and Learning Community. The online discussion is an interesting topic to develop. It lends itself to a constructive and cooperative approach, thanks to the access to online discussion forums and to the web contacts with the e-tutor educator and with other students.

In order to facilitate the passage from Virtual Classroom to Practice Community, an e-tutor has faced the themes connected to the know how (f.i. "Special education teacher", "Didactic strategies"). Debates and experience narration were the interaction modalities present in the forum.

Results

The paper will present some data obtained from surveys.

The development in the themes confirms the usefulness of a learning activity mediated by the share of knowledge and practices. They regard for instance: the number of themes developed (f.i. disabilities and school facilities; complicated relations ...), the practice exchange (f.i. for instance, how to control outbursts; physical restraint ...), material exchange (f.i. detection grids, didactic materials ...), listening and informal counselling activities targeted on the unique need (emphatic sustainment, listening and comparison to get the teacher to define a possible action to take when needed ...).

References

- Klieme E., Hartig J., Rauch D. (2008) The Concept of Competence in Educational Contexts. In Hartig J., Klieme E., Leutner D. (Editors) –Assessment of Competencies in Educational Contexts», Hogrefe, Göttingen, Germany, pp.3-22.
- Ashman A. (2005) Opportunities, rights and the individual.. In A.F. Ashman & J. Elkins (Eds.) "Educating children with diverse abilities", pp. 64-95, Sydney, NSW, Australia, Prentice-Hall.
- Cook B.G. (2001) A comparison of teachers' attitudes toward their included students with mild and severe abilities, "The Journal of Special Education", 34, 203-214
- Elkins J. (2005) The school context. In A.F. Ashman & J. Elkins (Eds.) "Educating children with diverse abilities", pp. 37-64, Sydney, NSW, Australia, Prentice-Hall.
- Convention on the Rights of Persons with Disabilities (2006) of the United Nations International Classification of Functioning, Disability and Health (ICF) (1999) WHO

Honors education in the Netherlands

Nelleke de Jong, Utrecht University, Netherlands; Marca V.C. Wolfensberger, Hanzehogeschool Groningen, Netherlands

The topic of this paper is the development of honors education in the Netherlands. In the last 15 years the number of honors programs on offer in higher education institutions is increased. We have made a list of excellence programs offered in higher education institutions in 2010. Educational institutions are more and more interested in attracting highly motivated and talented students. The various honors programs currently on offer are indicative of this phenomenon. In this paper the differences in content as well as in objectives of programs will be discussed. The development of honors programs in higher education will be explained on different levels. The longitudinal character of this study illustrates the impact of interventions coordinated by the government. The study further opens up possibilities for developing various plans for new excellence programs in higher education in the Netherlands. Insight in the relationship between societal developments and the development of excellence education, as well as knowledge of the various ways in which excellence education can be shaped, can provide directions for further development of excellence education in higher education institutions across Europe.

Introduction

The topic of this paper is the development of honors education in the Netherlands. In the past 15 years the number of honors programs on offer in higher education has increased. Honors programs are specially designed programs for talented and motivated students, also called excellence education. More and more energy seems to go into providing academic challenges for talented students. Excellence education, although initially only provided by a small number of research universities, is increasingly offered by other higher education institutions such as universities of applied

sciences. This increase in the number of excellence programs in higher education is among other things caused by a greater interest in the promotion of excellence in Dutch society. The Dutch government for example, has developed and funded two initiatives in order to promote excellence in higher education. In this paper, the relationship between developments in society concerning excellence and the development of excellence programs in higher education will be explored.

The bachelor/master system was implemented in the EU in order to, among other things, make the European higher education more transparent. It also makes it easier for students to study abroad. As a consequence students have more choice in selecting programs in the Netherlands and abroad. This has resulted in greater competition between different educational institutions. Institutions can attract highly motivated and talented students by offering excellence programs and this is one of the reasons why institutions are offering honors programs. There are also other ambitions, such as the promotion of an innovative knowledge economy that are related to the growth of the number of honors programs. For students it can be an advantage having successfully completed an honors program when applying to competitive master programs. Excellence education in this way contributes to the internationalization of student communities. This paper offers an overview of the Dutch situation by analyzing the objectives and content of excellence programs during a period of 10 years.

Methods

We have compiled a list of the characteristic features of all excellence programs offered by Dutch higher education institutions in 2010. All higher education institutions, both research universities and universities of applied sciences were included (N=55). A combination of sources was used to create this empirical data set, in a similar way as Long (2002) did. Institutional reports were analyzed and digital information was combined with conducted interviews and some in-depth interviews. This review builds upon previous studies (Eijl et al., 2003; Eijl et al., 2005; Groothengel & Van Eijl, 2008), thereby allowing for a longitudinal analysis of the development of honors education in the Netherlands. For the case study of Utrecht University we analyzed assessments, student material and conducted several interviews.

Included in the list of characteristics were organizational features, content-related features and characteristics of students. Content-related features include the objective of the program, its content and the employed methods of teaching. Organizational features include the scale and duration of the program and the way in which the program is organized within the institution as a whole. Furthermore information about the criteria for selecting prospective students was requested.

Results

Nearly all research universities are currently offering one or more honors program(s) at the undergraduate level and an increasing number of the universities of applied sciences are developing honors programs. The increasing number of programs on offer as well as the efforts used in developing new programs are indicative of a greater interest in the promotion of excellence. Educational institutions are more and more interested in highly talented and motivated students which can be seen from the abundance of programs currently on offer. Whilst in some programs an emphasis is placed on research and academic qualities, others stress the importance of personal development, the promotion of excellence or interdisciplinarity. In this paper the development of honors programs in higher education will be explained on different levels. The effects of initiatives by the national government to promote excellence in higher education will be discussed. Differences between programs of different institutions concerning content as well as objectives will be discussed. Utrecht University designed the first honors programs and the first residential honors college. The development of excellence education at Utrecht University will be used as an example of the laboratory impact of initiatives on higher levels.

Significance of the research

Honors education is emerging as an innovative, challenging academic agenda in Europe and especially in the Netherlands. In this research the development of excellence programs in the Netherlands has been outlined. The longitudinal character of this study illustrates the impact of interventions coordinated by the government. Also the relations between societal developments and the changes within higher education are outlined. The study opens up possibilities for developing various plans for new excellence programs in higher education and it shows different ways within education to evoke excellence. Insight in the relationship between societal developments and the development of excellence education, as well as knowledge of the various ways in which excellence education can be shaped, can provide directions for further development of excellence education in higher education institutions across Europe.

References

Eijl, P.J. van, M.V.C. Wolfensberger, M. Cadée, S. Siesling, E.J. Schreve-Brinkman, W.M. Beer, G. Faber & A. Pilot (2003). Plusprogramma's als proeftuin, met als bijlage een inventarisatie van plusprogramma's in Nederland. Utrecht: Universiteit Utrecht (IVLOS-mededeling 69)

Eijl, P.J. van, M.V.C. Wolfensberger, P.J. van Tilborgh & A. Pilot (2005). Honoursprogramma's in Nederland. Resultaten van een landelijke inventarisatie in 2004. Utrecht: Universiteit Utrecht (IVLOS-mededeling 77)

Groothengel, C. & P. van Eijl (2008). Honoursprogramma's in het HBO. Inventarisatie 2007 (deel I) met een nadere verkenning (deel II). Deelproject in het kader van het project 'Talentontwikkeling in Honoursprogramma's en de meerwaarde die dat oplevert'. Utrecht: Universiteit Utrecht (IVLOS-mededeling 85)

Long, B.T. (2002) Attracting the Best: The Use of Honors Programs to Compete for Students. Harvard Graduate School of Education: Working Paper

Re-Conceptualising the Core Competences for Adult Learners in the Knowledge-Based Society

Rosario Sergio Maniscalco, University of Turku, Finland

This paper investigates the intertwinement between the scientific terminology used in the academic research on adult skills in the fields of education and cognitive neuroscience, and the use of concepts such as 'soft skills' and 'key competences' in the organizational and educational policy debate. The prevailing definitions of skills and competences, in fact, do not seem to be adequate to feed the educational policy statements, which seem to give emphasis mainly to the basic skills for adult learners, and a remarkable mismatch with the theoretical frameworks developed in the fields of the education and cognitive science, business and organizational studies has appeared rather evident. The methodology used in this paper is the interpretative concept analysis, which combines the features of knowledge, skills and competences together with recurrent expressions such as 'hard' and 'soft skills', 'key competences' and other labels nowadays widely used in the human resources and political debate. The concept definition is significant, in this scenario, not only for theoretical use, but is intended to be a useful tool for scholars and practitioners. For this purpose, a theoretical proposal seeks to strike a functional balance of the concepts first conceptualized.

Introduction

This article investigates the intertwinement between the scientific terminology used in the academic research on adult skills in the fields of education and cognitive neuroscience, and the use of concepts such as 'soft skills' and 'key competences' in the organizational and educational policy debate. The prevailing definitions of skills and competences, in fact, do not seem to be adequate to feed the educational policy statements, which seem to give emphasis mainly to the basic skills for adult learners, and a remarkable mismatch with the theoretical frameworks developed in the fields of the education and cognitive science, business and organizational studies has appeared rather evident.

BackgroundThe terminological disambiguation is not straightforward. Interesting conceptual research has been carried out by CEDEFOP (an agency of the European Union): Descy & Tessaring (2000), for example, is indeed a first meaningful attempt to conceptualize buzz-word 'soft skills' in the framework of the recent policy statements on skills, but still containing ambiguities and cross-definitions (skills defined as knowledge or experience, competence as capacity to use "know-how, skills, qualifications or knowledge" etc.) and again borrowing a big deal from the business and HR sector. A deeper link with the cognitive science developments on skills, competences and knowledge has been established in a tender also by CEDEFOP to the Groupe ESC Toulouse of the Centre for European Research on Employment and Human Resources (Winterton et al., 2005) containing a very comprehensive scientific review on the issue, where also a new theoretical 'prototype' is introduced in order to solve the incoherence and fragmentation of the former literature reviewed, called "Unified typology of Knowledge, Skills and Competence". Indeed keeping an eye on the mandate of bridging the academic research and the HR literature with the last EU policy documents on competence, skills, qualifications and recognition/validation of previous learning, it reflects well the main trends in the scientific studies on KSA which are more and more often using holistic approaches to the definition of competence (Gonczi, 1994; Tovey, 1993; Engle et al, 2001; Hager, 1994), aiming at "combining knowledge, skills and attitudes" (Winterton et al, 2005: 40).

MethodologyThe methodology used in the paper is the interpretative concept analysis, which combines the features of knowledge, skills and competences together with recurrent expressions such as 'hard' and 'soft skills', 'key competences' and other labels nowadays widely used in the human resources and political debate. The concept definition is significant, in this scenario, not only for theoretical use, but is intended to be a useful tool for scholars and practitioners. For this purpose, a theoretical proposal seeks to strike a functional balance of the concepts first conceptualized.

Theoretical proposal

In the light of the literature review presented in the paper, the only explicit classification of the soft skills is 'by contrast' with the hard skills in terms of wider range of measurability and broader applicability. The measurement of

the outcomes of the skills deployed in a certain situation is strictly correlated to the possibility to analytically approach them for the assessment. According to the most recent research on the functioning of the human brain, and in particular the theory of the brain functions lateralization (Tucker, Shearer & Murray, 1977; Tucker, 1981) and in particular the right-hemisphere hypothesis (Borod, Koff & Caron, 1983; Heilman & Bowers, 1990; Ross, 1985), knowledge can be defined as a conceptual base ('propositional knowledge'), while skill holds the place of the procedural access to the knowledge base and its analytical domain-related use ('hard skills'), while the competence is the operational access to the knowledge base and its global non-domain-related use ('soft competence'). Discussion Especially in view of the mismatch existing nowadays between the learning curricula and the qualifications obtained and the core competences required by the knowledge societies. And as the world has new rules, democracies involve their people in other ways than a few decades ago, and the media have become an incredibly powerful tool to spread knowledge but also a dangerous instrument of mass persuasion. Knowledge is nowadays broadly accessible but, considering the quantity of data available, without scanning and synthesizing skills and without critical thinking it has become almost impossible to organize these data into a coherent and usable framework. In other words, learning how to google does not involve being able to deal with the impressive amount of information this tool can provide, and the political approach of the basic skills-centered curricula for adult learners will soon reveal its limits in the perspective of proactive citizenship in a global and integrated- knowledge and competence-based society.

Searching for a reliable method to listen to the voice of the young child in school.

Anja Tertoolen, Interactum, Netherlands; Bert van Oers, VU University of Amsterdam, Netherlands; Jeannette Geldens, Kempelresearchcentre Helmond, Netherlands; Herman Popeijus, Kempelresearchcentre Helmond, Netherlands

In educational settings teachers always have to deal with children, who have their own images and judgments about the purposes of school, about what is going on there, what you have to or can do, and what is or isn't allowed. Children have the right to be listened to. What do they experience in school? What is the meaning of school? What is their motivation? And if we could answer the formulated questions, what might be the impact of those answers on education for instance? Opinions children have about all kinds of objects are partly determined by social, cultural, historical and biographical influences, as well as elements of context-related interactions (e.g. Bourdieu). The question is then which settings under which circumstances are appropriate to listen to young children taking in account also the notion that the perspective of young children and the way in which they express their views is multiple and changeable. To what extent are the ideas of young children their own? We started our own research project by testing settings, collecting data and building a coding system, using the grounded theory approach. Until now we have carried out a pilot study and two case studies. We'll present and discuss the outcomes of our data analysis, and the measures we took to increase the reliability and construct validity of our research method.

Research aims

In the 'Convention on the Rights of the Child' (1989) it is stated that every child, who is capable of forming his own views, has the right to express his opinions freely in all matters affecting the child (article 12 and 13). In recent years it is assumed that young children have a voice of their own. In the light of this context we raise the question: Is it possible to identify the young child's own voice? From the perspective of educational contexts emphasizing authenticity and autonomy of the child this is a crucial question. This paper reports about a project that aims at the construction of a valid and reliable method for identifying the young child's own voice.

Theoretical and conceptual framework

The theoretical framework of the project is based on the cultural-historical activity theory. From this point of view we start out from the assumption that children should not only be seen as persons who 'become', but especially as persons who 'are' with their ideas, notions, choices and relations (Clark, 2007; Prout, 2003). Children's notions originate from a specific situation, in a specific context in which, besides children, others are involved. In interpreting the children's expressions that specific context needs to be taken in account (Pramling Samuelsson, 2003). Not only the context and the own life history are crucial for the individual's actions, but also the culture in which the individual participates and meets other people. In that sense acting is a form of cultural acting in cooperation with others (e.g. Bourdieu, 1991). Individuals act with the aid of others, who contribute to the activity by being a model, by intervening and/or supporting the agent. In such a context the individual then can connect his actions with emotions, affects and his own motives. In this way the individual can accomplish cultural actions with the help of others and at the same time attach personal sense to his actions. We see here that the autonomy for social participation is developed in cooperation with others (van Oers, 2009). Autonomy can thus be seen as a polyphonic concept, built on different voices, more or less supported by others. A kind of autonomy which is also very diverse, (i.e. different per situation and per person), depending on the life history and culture of the individual, dictated by several others met

by the individual. The voices of those others are not only different; they may also be contradictory (van Oers, 2009). In our research project we focus on voice (expression) and attribution of meaning by young children in situations and events at school, as can be seen and heard in the speaking and acting of these children in interactions with other children and adults. We define attribution of meaning in this research project as the way in which the young child expresses his notions, verbally and non-verbally, on three aspects he encounters in the context of the daily practice of his educational setting: the activities, the organization in the school context and the roles of his teacher or teachers.

Methodology

As yet very little is known about how children's voices should be listened to and reliably interpreted. Due to this situation, it is almost impossible to design experimental research projects for scrutinizing the functional details of children's voices. As we want to study phenomena in real life situations in general, and to answer questions about how we can search for the child's voice more specifically, the most appropriate way in our research project (Yin, 2009) is to use the design of the multiple case study. It enables us to look into meaningful characteristics of young children's school lives by direct observations of young children in the school context and to get a more profound insight in the social process of young children's behavior in context and in the way they experience this context (Wester & Peters, 2004; Yin, 2009). In short, we designed a so called multiple case study (Yin, 2009) with a qualitative-interpretative approach in a flexible design (Robson, 2002). Until now we have carried out a pilot study and two case studies. In each case study a boy and a girl, aged 5 – 6, are involved in interaction with their teacher(s) and peers, while participating and being observed in several activities in school during a week: Observations during daily school activities, playing school in the play area, taking photos and talking about them, answering questions and taking part in an interview. An interview with their teacher(s) and their parents is part of the research design as well. Following the grounded theory approach (Glaser & Strauss, 1967) we analyzed the data first by observing the child in his or her social reality of school life with a researcher participating in the observed educational setting. We have described the way in which we aim to build a method for researching attribution of meaning by children aged 5 to 6 in school, and we have set the first steps in developing a coding system for analyzing elements of the voice of the young child (Tertoolen, van Oers, Geldens & Popeijus, 2010).

Main findings and discussion

One of our main concerns in this research project is the question if it is possible to develop a reliable method to listen to the young child. We follow for instance Yin (2009) in his three principles of collecting evidence in case study research: using multiple sources of evidence, creating a case study database and maintaining a chain of evidence. To increase the reliability of the information we found in our case studies, we have also invited external observers screening the data. They use independently the same coding framework as the internal observer did before. This process is still going on. At the conference we'll present and discuss the outcomes of these processes of triangulation, related to the issues of reliability and construct validity.

Feedback clickers in plenary lectures

Rune Krumsvik, University of Bergen, Norway

This paper focuses on if, and eventually how, feedback clickers (TurningPoint™) can be used to overcome some of the challenges lecturers have in large plenary lectures. The Bologna-process, new standards for national curricula, increasing diversity among university students, the Network society and the digital revolution have changed some of the underlying premises for teaching and learning in today's universities. New policy documents, research and experiences from the university field suggest that there is a potential to develop plenary lectures in light of new technology and more updated teaching methods. A new concept, digital didactics, is underpinning this time of upheaval and this case study focus on how psychology students in large plenary lectures experience the use of feedback clickers from their points of view. This case study consist of surveys, 'live surveys', observations and document studies and shows that the students feel quite positively towards several of the areas focused on in the study. In particular, the feedback clickers have the potential to enhance interactivity, attention and reflection, as well providing feedback, which seem to be of great value for the students in the study. One of the implications of this article is that good planning, the use of feedback clickers and multimodality in plenary lectures seem to overcome some of the well-known challenges in plenary lectures and strengthen the possibility for formative assessment.

This paper focuses on if, and eventually how, feedback clickers (TurningPoint™) can be used to overcome some of the challenges lecturers have in large plenary lectures (100-500 students) at universities. This has become more pressing as a result of the Bologna process (1998, 2005, 2007) with the new degree system (Bachelor/Master's degrees and Diploma Supplement), the European Credit Transfer System (ECTS, Bologna process 2007), The Quality Reform (Ministry of Knowledge, (MOK), 2001), the establishment of the Norwegian Agency for Quality Assurance in Education

(NOKUT 2005), The White Paper 16 (MOD 2006) focusing on lifelong learning, Tuning Educational Structures in Europe (Tuning, 2009) and the new Frame Work for Qualifications (MOK, 2010). All of these demand that student curricula in Norway must be more specifically formulated around learning outcomes as well as the use of (Information and Communication Technology (ICT) as a tool in teaching and student learning processes. This also implies a higher awareness towards the increasing diversity among university students which needs innovative ways of engaging students who might have previously experienced educational alienation. Every university lecturer has experienced the same problem: how to reach the students in plenary lectures when there are several hundred students. Lecturers have tried different remedies throughout history, such as prompting questions and raising hands, for example, but in large classes, like plenary lectures, there are several disadvantages with these kinds of traditional strategies: Many students feel uncomfortable raising their hands in large plenary lectures because they are afraid of giving wrong answers (Caldwell 2007). Another aspect of the same issue is that the students "will vote with the majority" and not give their honest votes or answers in plenary lectures (Caldwell 2007). The minority of students who want to speak up can very often be associated as representatives for the majority of students (Caldwell, 2007). Increased diversity among university student makes it necessary to engage students in more creative ways in large plenary lectures. The average human attention span is no longer than 20 minutes (Burns 1985) and there is a mismatch between this fact and traditional "chalk and talk" lectures in universities. Several of these frame factors have always been there as hindrance to interactions in plenary lectures and it is large challenge for lecturers to give meaningful lectures. Even if we still have many of the same problems and challenges with plenary lectures today, the digital revolution and the Network society (Castells 2001) over the last ten years has altered some of the underlying conditions for teaching and learning. Lifelong learning and an increasing diversity among university students has given both new challenges and possibilities for university teachers which have pedagogical implications. These new educational streams and policy regulations create a situation which calls for a revitalisation of pedagogy in general and the more specific term didactic[1](Hopmann, S. & Riquarts, K. (2000), where one has to elaborate how new concepts, digital didactics (Krumsvik and Almås, 2009) and ICT (more specifically feedback clickers), can function (or not) as remedies to fulfil some of these new policies and also how well they can overcome some of the well-known pitfalls in plenary lectures. The aim of this case study (Yin 2009) was to examine the perceptions of psychology students on the use of feedback clickers in plenary lectures in relation to their own learning processes. The question considered by this article was: What perceptions do psychology students have of feedback clickers in plenary lectures in relation to their own learning aims and learning outcomes? The sample consists of 200 psychology students and was based on purposeful selection (Maxwell 2005). The methods used in the study was semi-structured interview (Kvale & Brinkmann 2008), quasi statistics (Maxwell 2005), observations (Merriam 2009), document analysis (Merriam 2009). Triangulation and respondent validation were used to enhance the validity in the study. Data analysis was carried out by content analysis (Kvale & Brinkmann 2008) and NVivo (Qualitative Analysis Software). Preliminary results show that the feedback clickers have the potential to enhance interactivity, attention and reflection, as well providing feedback (Hattie & Timperley (2007) for the students.

Processes Mediating Expertise in a Visual Task: Eye Movements, Verbal Reports, and Spatial Abilities

Halszka Maria Jarodzka, Open University of the Netherlands, Netherlands; Ludo van Meeuwen, Open Universiteit Nederland, Netherlands; Saskia Brand-Gruwel, Open University, Netherlands; Jeroen Van Merriënboer, Maastricht University, Netherlands; Jeano de Bock, Air Traffic Control The Netherlands, Schiphol-Oost, Netherlands; Paul A. Kirschner, Open Universiteit, Netherlands

Operators of air traffic control (ATC) stations deal with complex visualizations involving many airplanes that must be navigated towards one airport. Making decisions based on those visualizations requires not only domain knowledge but also perceptual skills, like efficient visual search of critical airplane compositions, their quick and correct interpretations, and the appropriate decisions. This study compared 21 participants of three different expertise levels in interpreting ATC stimuli to investigate the role of perceptual skills in this task. ATC performance, eye movements, verbal reports, and spatial abilities were recorded for three task difficulties. Results show that novices performed this task slower than intermediates ($p=.01$) and experts ($pp=.06$) and experts ($p=.05$). Eye tracking data revealed that participants did not differ in total viewing time on the airplanes, but in total viewing time at the airport position. In that, novices looked significantly longer at this area than intermediates (pp

To understand expertise, it is important to investigate its mediating processes and individual characteristics (Ericsson & Lehman, 1996). This has already been done in detail for cognitive processes (e.g., Boshuizen & Schmidt, 1992). For tasks that involve interpreting visualizations, however, not only the cognitive, but in particular the perceptual processes play a crucial role. In these cases expert performance comprises perceptual skills, i.e., the ability to perceive relevant information in complex visualizations and to draw inferences based upon the perceived information. However, not much is known in this topic, yet (for an exception see Jarodzka, Scheiter, Gerjets, & Van Gog, 2010).

Furthermore, literature about the relation of spatial abilities to expert performance is contradictory (e.g., in chess: Frydman & Lynn, 1992; in ATC: Kirchberger, Heintz, & Laaser, 2010).

In sum, in domains that involve complex visual stimuli not much is known about how experts allocate their attention during task performance, how this differs from novices and intermediates, and how this is related to individual characteristics, like spatial abilities. Hence, the present study examined the interplay between perceptual processes (measured by means of eye tracking) and cognitive processes (measured by means of verbal reports) as a function of expertise and its relation to spatial abilities in the domain of ATC.

Method

Participants in the study were 21 individuals with three different levels of expertise (mean age 28.33 years; 5 females). In that, ten participants were experts (full licensed air traffic controllers with at least two years of work experience), five intermediates (final phase of the ATC training), and six novices (initial phase of the ATC training). The experiment was run in individual sessions of approximately 60 minutes. Participants received nine static visualizations of an ATC radar situation composed of a number of inbound airplanes towards an airport and were asked to determine the optimal order of arrival for all planes. The nine trials were composed of three different difficulty levels and were presented in a counter balanced manner. During task performance, eye-movements of participants were recorded with a Tobii 1750 eye tracker (50 Hz). After each trial, participants reviewed the recordings of their own eye movements superimposed on the stimulus and verbalized the thoughts they had while performing the task (cued retrospective reporting; Van Gog, Paas, Van Merriënboer, & Witte, 2005). Finally, participants filled in the mental rotation test (Vandenberg & Kuse, 1978).

Results

Time on task differed for all nine radar screens significantly between conditions ($p=.01$) and than experts ($p=.12$). Similar results were found for the three task difficulty levels. No differences were found for overall mental effort ratings ($p=.18$). Univariate analyses of the three task difficulty levels separately showed that experts experienced significantly less mental effort than novices ($p=.05$) and marginally less than intermediates ($p=.06$). There was no difference between groups for medium ($p=.29$) and for difficult tasks ($Fp=.67$), neither for easy ($p=.09$), medium ($FFpppF$)

Discussion

These results indicate that a higher expertise in the domain of ATC is not related to higher spatial abilities. This, however, does not mean that spatial abilities are not important for ATC. As novices in this study were already preselected to be trained as air traffic controllers, it is possible that they already have high spatial abilities in comparison to non-ATC people. Moreover, experts were faster in performing the easy ATC tasks while investing less mental effort compared to novices and intermediates. This indicates the superiority of experts in this task. Further analyses of the performance data will indicate, whether they are also more efficient. Interestingly, participants did not differ in terms of looking time at the to-be-navigated airplanes. Instead, experts looked less at the airport region. These results indicate that experts have a well established mental model of the airport surroundings such that they do not need to look at the airport to navigate the airplanes towards it. The findings of this study will inform professional education not only in ATC, but also in other domains comprising comparable complex visualizations (e.g., medical specialists, pilots, train traffic controllers).

References

- Boshuizen, H.P.A., & Schmidt, H.G. (1992). On the role of biomedical knowledge in clinical reasoning by experts, intermediates, and novices. *Cognitive Science*, 16, 153-184.
- Ericsson, K.A., & Lehmann, A.C. (1996). Expert and exceptional performance: Evidence of maximal adaptation to task constraints. *Annual Reviews in Psychology*, 47, 273-305.
- Frydman, M. & Lynn, R. (1992). The general intelligence and spatial abilities of gifted young Belgian chess players. *British Journal of Psychology*, 83, 233-235.
- Jarodzka, H., Scheiter, K., Gerjets, P., & Van Gog, T. (2010). In the eyes of the beholder: How experts and novices interpret dynamic stimuli. *Learning and Instruction*, 20, 146–154.
- Kirchberger, F., Heintz, A., & Laaser, I. (2010). Is being good at rotating cubes required to become an air traffic controller? An explorative study on spatial abilities in the context of ATC selection. Paper presented at the 29th Conference of the European Association for Aviation Psychology.
- Van Gog, T., Paas, F., Van Merriënboer, J. J.G., & Witte, P. (2005). Uncovering the Problem-Solving Process: Cued Retrospective Reporting Versus Concurrent and Retrospective Reporting. *Journal of Experimental Psychology: Applied*, 11, 237-244.

Vandenberg, S.G. & Kuse, A.R. (1978). Mental rotations, a group test of three dimensional spatial visualization. *Perceptual Motor Skills*, 47, 599-604.

Personal epistemological and metacognitive awareness (PEMA) in first year university students.

Erika Spray, University of Newcastle, Australia; Jill Scevak, University of Newcastle, Australia; Robert Cantwell, University of Newcastle, Australia

This paper reports a study of preservice teacher education students' developing personal epistemological and metacognitive awareness (PEMA). The study has significance in two areas: in developing the theoretical relationship between personal epistemology and metacognition, and their relationship to self-regulation in learning; and in the practical implications of this for developing the capacity of first year university students to manage the intellectual demands of university study. Text analysis of students' reflective journals produced as part of a first year degree course was undertaken for evidence of PEMA and self-regulation of learning and their relationship to academic success. Relationships were found between PEMA, self-regulatory behaviours and academic performance. The results have implications for first year pedagogical practice to better equip students for successful tertiary study through encouraging higher awareness.

Study of knowledge, or epistemology, has long challenged philosophers; Plato, Socrates and Descartes grappled with the ambiguity of human sense and sensibility. To this day, such issues remain unresolved, yet we depend on knowledge to inform decision-making at every level. The framework within which individuals interpret, accept or reject information is termed personal epistemology (PE) (Hofer & Pintrich, 1997). PE provides an oft subliminal matrix to frame the metacognition by which we interpret our environment, generating meaning and understanding. This process underpins self-regulation, including self-regulation of learning (SRL): the activation and maintenance of cognitions and behaviours oriented toward attainment of learning goals (Zimmerman, 1986).

Clear definitions are often lacking in educational research (Schunk, 2008) and the obvious conceptual overlap which occurs between constructs can easily lead to confusion or misinterpretation of findings, as well as contributing to weaknesses of discriminant validity (Mussel, 2010). Increased effort is required to achieve conceptual clarity of constructs in order to facilitate effective collaboration and to 'focus the conceptual lens' (Dinsmore et al., 2008). This research focused on personal epistemological and metacognitive awareness (PEMA): individuals' conscious recognition and consideration of their own epistemology and metacognition. Such conscious deliberation necessarily forms part of wider metacognition, or 'thinking about thinking', hence a degree of conceptual overlap exists despite the two terms being in no way interchangeable. Similarly, while metacognition is intimately connected to self-regulation by monitoring and controlling cognition, self-regulation and SRL span both cognitive and behavioural domains. (see Dinsmore et al., 2008). Despite its significance for metacognition and thus learning, personal epistemology often operates implicitly: 'assumed' rather than consciously constructed convictions.

The aim of this study was to analyse first year university students' reflective learning journals for evidence of explicit personal epistemological and metacognitive awareness (PEMA) and self-regulated learning to explore the relationship between these constructs and academic performance.

The reflective learning journals of 18 pre-service teacher education students were analysed using content analysis. Students were required to keep a reflective learning journal that was not directly assessed but which would inform an essay that was part of their assessment. The journal and the essay was part of their undergraduate Educational Psychology course conducted in Semester 1 in their first year of university. The journals were selected for analysis on the basis on participants' academic performance in the course, with 1/3 representing the highest achievers, 1/3 the lowest and 1/3 who achieved medial results. The first six weeks of journal entries were analysed, which represented most students' first tertiary experience, so it was anticipated that this challenge may have stimulated PEMA. The journals were produced quite freely, without probing from interviewers or direction from questionnaire items that might impose a framework upon subsequent results. It was therefore expected that only students' explicitly held beliefs were represented, providing direct insight into PEMA and enabling candidness and depth of reflection not always achieved through interviews or questionnaires (Hoover, 1994). This methodology was therefore appropriate and valid for investigating PEMA.

At the end of Semester 1 and after students' final grades were awarded, first year students were invited to participate in the study by giving consent for their journals to be used in the study and consent for their grades in the course to be accessed. Therefore students were not aware of the focus of this research before producing their journals, and this

latency of purpose reinforced the intention that only consciously explicit PEMA was reported, without distraction or bias from external encouragement. As all evidence was self-generated, it was the participants themselves who identified what they considered sufficiently significant to record. This resulted in far greater authenticity than might otherwise have been achieved.

The results of the analysis showed a relationship between PEMA, self-regulated learning and academic performance. Students with higher academic grades produced clearer evidence of PEMA and self-regulatory behaviours. There was a positive relationship between students who reported PEMA, self regulated learning and academic performance. Conversely, students who produced less evidence of PEMA and self-regulated learning were not as successful in their academic performance.

This study contributes to the literature by using text analysis to focus on epistemological awareness as opposed to beliefs or assumptions. It is very difficult to access individuals' actual personal epistemology without risking distortion of data through 'led' methodology such as questionnaires, or influencing responses through the pressure of an interview situation. Awareness, on the other hand, can be observed without such imposition of a research framework. The insights provided by this study are thus drawn from authentic data interpreted through strong theoretical foundations, thereby directly informing pedagogical design to aid students' development of adaptive beliefs to facilitate wider achievement.

Many students enter university showing great naivety (Brownlee et al, 2009), and various techniques have been proposed to support first year students practically and to illustrate academic conventions such as referencing. However, given the results from this study, it may also be helpful to illuminate the process of learning itself, showing students how to develop themselves as effective learners. These findings support previous claims that students' personal epistemology can be influenced by their educational experiences (e.g. Lehrer, Schauble & Lucas, 2008), and indicate that developing stronger PEMA supports achievement of successful academic outcomes. This adds weight to the argument that epistemological considerations should form part of any effective pedagogy. Better understanding of PEMA will enable tertiary educators to provide more effective teaching and learning, particularly for the inclusion of students who may otherwise struggle to successfully engage with tertiary education.

ROUND TABLE

Teaching self-evaluation: a research with Padova University teachers

Raffaella Semeraro, University of Padova, Italy; Debora Aquario, University of Padova, Italy

The University of Padova (Italy) has launched an initiative to promote self-evaluation of teaching by teachers on the basis of the current guidelines of the literature concerning self-evaluation based on self-reflection about the teaching practices (Clegg, 2000; Kane et al., 2004; Kinsella, 2007; McAlpine et al., 2004; Seldin, 1999). In this perspective, the Governing Council of the University promoted a project about teaching self-evaluation and a working group (Commission) including representatives from each of the thirteen Faculties of the University was instituted.

In a first step, the Commission has considered several models and instruments of teaching self-evaluation adopted internationally (the model developed by Seldin, 1999 and some instruments of self-evaluation used by teachers in different universities -Flinders University of Adelaide, Harvard, Berkeley-) in order to develop an initial version of a questionnaire composed by 55 items divided into four sections: 1) organisation of the course; 2) classroom practice; 3) assessment criteria of students' learning; 4) students' outcomes (5-points Likert scale). The questionnaire was emailed to 2000 teachers of Padova University and 1158 of them answered.

After an initial descriptive analysis of the answers, factor analysis has allowed the emergence of four factors (high levels of Cronbach's Alpha). Anova test has revealed significant differences based on the different Faculties.

The findings will be used in order to promote the implementation of self-evaluation procedures in the University and to foster self-reflection in a context of change and improvement of instructional practice.

The University of Padova (Italy) has launched an initiative to promote self-evaluation of teaching by teachers on the basis of the current guidelines of the scientific literature concerning not only the external evaluation of the performance of teachers, but also the self-evaluation based on self-reflection about the teaching practices (Clegg, 2000; Kane et al., 2004; Kinsella, 2007; McAlpine et al., 2004; Moon, 1999; Seldin, 1999). The initiative is part of a three-year plan of development of evaluation models and tools aimed to the improvement of the educational offer of the University. It is the first initiative focused on self-evaluation in this University, where teachers have always been assessed only by students.

In this perspective, the Governing Council of the University promoted a project about teaching self-evaluation aimed at focusing teachers' attention on the importance of self-reflection about their own teaching practice. Under the direction of R. Semeraro, a working group (Commission) including representatives from each of the thirteen Faculties of the University of Padova was instituted in order to conduct a research with the aim of developing teaching self-evaluation procedures.

The recent literature suggests different models for teaching evaluation, all of them sharing the same principle, that is the active involvement of teachers in the evaluation process. Among the most relevant of these models: the participatory evaluation (Cousins, 2003; Scriven, 2003), the empowerment evaluation (Fetterman, 2003), the deliberative democratic evaluation (House and Howe, 2003), the collaborative evaluation (Lincoln, 2003). All these models are based on the assumption of the importance of bottom-up processes, where evaluation is to be considered as a complex process not only directed to the collection of quantitative data, but strongly linked to the assumption of responsibility by all actors involved (Semeraro, 2006). It seems fundamental to adopt a model of participatory, collaborative and democratic evaluation, where teachers are not only assessed from someone else, but become active players in this process.

Basing on these premises, the specific objectives of the research here presented are the following: a) to explore a wide range of models and instruments of teaching self-evaluation; b) to develop a map of aspects of the teaching practice considered important for self-evaluation; c) to develop a teaching self-evaluation instrument to be used by teachers with the aim of reflecting on and evaluating their own teaching practice.

In a first step, the Commission has considered several models and instruments of teaching self-evaluation adopted internationally. Among others, the model developed by Seldin (1999) and some instruments of self-evaluation used by teachers in different universities (Self-Evaluation Inventory of Flinders University - Adelaide, Harvard and Berkeley University) were taken into account. In a second phase, the discussion within the Commission about these models and instruments led to the identification of a set of aspects regarding the instructional practice and to the development of an initial version of a questionnaire. After multiple revisions of the items (through the administration to groups of teachers), the questionnaire results to be composed by 55 items divided into four sections: 1) organisation of the course; 2) classroom practice; 3) assessment criteria of students' learning; 4) students' outcomes (Dublin Descriptors). In addition, there was an empty space in which respondents could indicate other aspects not considered in the questionnaire. Respondents have expressed their points of view about the relevance of the aspects considered in the instrument through a 5-points Likert scale (from "really important" to "not important") plus "not applicable". Respondents were asked to indicate the degree of relevance of each aspect for self-evaluation. The questionnaire was emailed to 2000 teachers of Padova University and 1158 of them answered.

After an initial descriptive analysis of the answers (frequencies, means and percentages), factor analysis has allowed the emergence of four factors (high levels of Cronbach's Alpha): Design and planning of the course, Revision of teaching practice on the basis of students' reactions; Promotion of critical thinking and skills; Use of multiple teaching methodologies. Anova test has revealed significant differences based on the different Faculties.

The findings, that will be presented and discussed in detail, will promote the use of self-evaluation procedures in the University in a context of change and improvement of instructional practice. The next step is constituted by the involvement of each Faculty Dean in the discussion of the results with teachers and in the utilisation of the questionnaire as a proposal for reflection and a guide for the elaboration of a teaching self-evaluation instrument.

Implications for future research and practice concerning undertaking a process within the University to support teachers in the implementation of self-evaluation procedures will be presented and discussed.

- Clegg S. (2000), Knowing through reflective practice in higher education, *Educational Action Research*, 8, 451-469.
- Cousins J. (2003), Utilization effects of participatory evaluation, in T. Kellaghan, D.L. Stufflebeam (Eds.), *International Handbook of Educational Evaluation*, Kluwer Academic Publishers, Dordrecht, pp. 245-265.
- Fetterman D. (2003), Empowerment evaluation strikes a responsive chord, in S.L. Donaldson, M. Scriven (Eds.), *Evaluating social programs and problems*, Lawrence Erlbaum Ass. Publishers, Mahwah, NJ, pp. 63-76.
- House E., Howe K. (2003), Deliberative democratic evaluation, in T. Kellaghan, D.L. Stufflebeam (Eds.), pp. 79-100.
- Kane R., Sandretto S. & Heath C. (2004), An investigation into excellent tertiary teaching: Emphasising reflective practice, *Higher Education*, 47, 283-310.
- Kinsella E. (2007), Embodied Reflection and the Epistemology of Reflective Practice, *Journal of Philosophy of Education*, 41, 395-409.
- Lincoln Y. (2003), Fourth generation evaluation in the new millennium, in S. L. Donaldson, M. Scriven (Eds.), pp. 77-90.

McAlpine L., Weston C., Berthiaume D., Fairbank-Roch G. and Owen M. (2004), Reflection on Teaching: Types and Goals of Reflection, *Educational Research and Evaluation*, 10, 337-363.

Moon J. (1999), Reflection in learning and professional development, London, Kogan Page.

Seldin P. and Ass. (1999), Changing practices in evaluating teaching, Anker Publishing Company, Bolton, MA.

Semeraro R. (2006), La valutazione della didattica universitaria, Franco Angeli, Milano.

Scriven M. (2003), Evaluation theory and metathory, in T. Kellaghan, D.L. Stufflebeam (Eds.), pp. 15-30.

Model Competence in Biology Education – Evaluation of a Theoretical Structure using Hands-On Tasks

Juliane Haensch, Humboldt-Universität zu Berlin, Germany; Annette Upmeyer zu Belzen, Humboldt-Universität, Germany

Working with models is an effective way for students to attain basic aims of Science Education (Hodson, 1993; Henze et al., 2007). In this way, not only declarative subject matter knowledge, but also procedural knowledge and manual skills are obtained. The latter are difficult to measure with paper-pencil tests whereas hands-on tasks are an adequate method for such purposes (Hamilton et al., 1997). Modelling skills and applied individual concepts about models are each described in two dimensions of the theoretical structure of model competence (Upmeyer zu Belzen & Krueger, 2010). In this study, problem-oriented hands-on tasks were developed based on this structure. The tasks aim for measuring students' model competence to empirically evaluate the theoretical structure. The tested students (grade 7 to grade 10, Gymnasium) are videotaped. Knowledge about models is covered by two instruments: thinking aloud protocols and a semi-structured interview. The data are analyzed using qualitative content analysis (Mayring, 2003). Students' activities and students' answers are assigned to the theoretical structure using coding manuals. The results of the pilot study indicate that the theoretical model fits to empirical data. Results of the main study in spring 2011 will provide a broader data basis for these findings that will be presented at the Earli 2011.

Relevance

Science can neither be taught nor learned without models (Harrison & Treagust, 2000). Models are not only seen as means to teach scientific knowledge, but also defined as scientific thinking and working tools to generate new knowledge (Stachowiak, 1973; Mahr, 2009; Upmeyer zu Belzen & Krueger, 2010). That is why model competence is also considered as a "door opener" to an elaborated understanding of the nature of science (Leisner, 2005) and as a part of Scientific Literacy (Gilbert & Boulter, 2000).

However, many studies have shown that both students (Meisert, 2008; Trier & Upmeyer zu Belzen, 2009) as well teachers (Justi & Gilbert, 2002; Crawford & Cullin, 2005) have a limited view on the role of models as a scientific inquiry tool. In school everyday life, models are mainly used for visualization and hardly considered as research tools (Treagust et al., 2002).

Theoretical Background

Model competence includes skills to gain useful findings with models and the willingness to apply these skills to solve problems (Upmeyer zu Belzen & Krueger, 2010). In the theoretical structure of model competence, skills needed in scientific inquiry with models are described in the dimension 'modelling' with the aspects 'purpose of models', 'testing models' and 'changing models' (Upmeyer zu Belzen & Krueger, 2010). The dimension 'knowledge about models' with the aspects 'nature of models' and 'multiple models' describes individual concepts that are applied when dealing with models (Upmeyer zu Belzen & Krueger, 2010). Each aspect of model competence is differentiated in three levels of reflection about models (Upmeyer zu Belzen & Krueger, 2010).

Handling models leads to practical skills on the one hand and an understanding of epistemological beliefs on the other (Mayer, 2007). If students experience themselves in problem-solving by using models, they comprehend models as scientific inquiry tools more easily (Grosslight et al., 1991). This project provides two approaches of fostering model competence: The evaluated hands-on tasks can be used as teaching modules for scientific inquiry with models. The coding manual can help teachers to evaluate their students' model competence.

Aims

Until now, cooperating projects (Grýnkorn & Krueger, 2010; Terzer & Upmeyer zu Belzen, 2010; Krell & Krueger, in press) developed open-ended, multiple-choice and forced-choice tasks with the objective of empirical evaluation of the theoretical structure of model competence. The use of different instruments allows the investigation of various facets of model competence (White & Gunstone, 1999). However, this should not be limited to paper-pencil tests, because they hardly measure procedural knowledge and manual skills (Hamilton et al., 1997). That is why this study aims for the empirical evaluation of the theoretical structure (Upmeyer zu Belzen & Krueger, 2010) using problem-oriented hands-on tasks. With this objective, this study will respond to the following questions:

. To what extent is model competence empirically observed applying hands-on tasks?

Hypothesis 1: The students' activities as their statements can be assigned to the theoretical structure.

. In which way are the results of the paper-pencil tests of model competence related to those of the hands-on tasks?

Hypothesis 2:

2 a) Hands-on tasks interrelate to open-ended, multiple-choice and forced-choice tasks, as the development of all task formats is based on the same theoretical structure.

2 b) Hands-on and open-ended tasks lead to similar results in the dimension 'knowledge about models' and the aspect 'purpose of models' since both go back to abstract student concepts about models. 2 c) The results of hands-on and multiple-choice tasks are more closely connected to the aspects 'testing models' and 'changing models' since both include concrete experimental conditions. 2 d) Compared to the open-ended and multiple-choice tasks, hands-on and forced-choice tasks are less closely related to each other, since forced-choice tasks measure model competence in the most abstract way. In contrast, hands-on tasks deal with application-based knowledge and actions of students. Hypothesis 3: Dealing with hands-on tasks, students achieve higher levels than dealing with paper-pencil formats, as students activate more concepts when solving a concrete problem actionally.

. Which aspects of model competence do the activities of students reveal which are poorly covered by paper-pencil items?

H4: In addition to cognitive aspects, hands-on tasks also include procedural aspects of model competence (Ruiz-Primo & Shavelson, 1996).

Methodology

Hands-on tasks are a form of performance assessment and measure especially manual skills and domain-specific knowledge (Baxter & Shavelson, 1994). To cover also the practical facet of model competence (Schecker & Parchmann, 2006), six problem-oriented hands-on tasks were developed on the basis of the theoretical structure. They are characterized by posing a problem and offering students (grade 7 to grade 10, Gymnasium) concrete material for problem-solving in biology (Hamilton & Nussbaum, 1997). In this process, a hypothetical, deductive procedure is required to register students' scientific comprehension via models (Shavelson & Ruiz-Primo, 1999). The tasks were designed using contexts familiar to students in order to support an ambitious problem-solving (Brown, Collins & Duguid, 1989).

The optimal method to cover the behavior and actions at hands-on tasks is the observation (Ruiz-Primo & Shavelson, 1996). To detect students cognitive processes, the students are requested to think aloud when building their own models (Glaser et al., 1992). At the same time, a semi-structured interview points out the knowledge about models (Grosslight et al., 1991). The processing of the hands-on tasks is audio- and videotaped. The audiodata are analyzed by qualitative content analysis (Mayring, 2003). Students' activities and students' answers are assigned to the theoretical structure using coding manuals.

Findings

A first pilot study with 3 students shows that the hands-on tasks can be solved by the students and that the results are compatible to the theoretical structure. As part of ongoing preliminary investigation, 3 students per grade (7-10) solve each 3 hands-on tasks (N=12 students). Coding manuals for the video and the audio data are created on this database. Both are used in the main study with a larger sample (N = 24) for an empirical evaluation of the theoretical structure using hands-on tasks. These results will be available in spring 2011 and will be presented at the Earli 2011th.

Design of a University-Level Instrument for Direct Writing Assessment (DWA)

Jorge Manzi, Pontificia Universidad Catolica de Chile, Chile; David Preiss, Pontificia Universidad Catolica de Chile, Chile; Paulina Flotts, Pontificia Universidad Catolica de Chile, Chile

We present an initiative of direct writing assessment (DWA) implemented in Chile. DWA involves relevant assessment challenges, which include those related to the generation of writing prompts and the rating process. We describe the 2008 round of application of the assessment and how we addressed these challenges. 3612 students took the test in 2008. The assessment used involved 50-minute argumentative tasks. The examinees obtained better scores in content related aspects of the writing (such as structure, text cohesion and thesis), while the worst scores corresponded to two dimensions related to the formal aspects of discourse (orthography and vocabulary). Counter-arguing also showed a low average. If we compare these results across time, we can notice that there has been a steady increase of the scores in all of them excepting orthography. The 76.8 percent of the assessed students obtained scores equal or over to the grade established to pass the exam (3 points). Average differences among academic programs are relevant: the difference between the program with best and worst average represented one and a half standard deviations. The results show that DWA is a good predictor of academic achievement and suggest that the ability to

produce a text and the verbal skills required in multiple choice tests are differentiated. Of particular relevance for Chile, DWA has a minor correlation with socioeconomic measures than other university entry conventional tests.

Aims

The purpose of this paper is to present an initiative of writing assessment implemented in Chile. Large-scale writing assessment has a broad appeal because it has some attributes that make it distinguishable from other assessment tools (Powers, Fowles, & Willard, 1994). Writing tests are commonly labeled as direct writing assessment (hereafter, DWA) since the skills that are the target of measurement are assessed directly. In contrast to multiple-choice tests, which measure latent constructs, writing tests do not measure a latent ability. Provided that measurement standards are established precisely, writing abilities can be assessed in a straightforward way.

Renewed interest for writing in higher education have been instigated by the evidence suggesting that, after twelve years of schooling, only a small group of students are able to produce high quality text (Johnstone, Ashbaugh, & Warfield, 2002; The National Commission on Writing in America's schools and colleges, 2003). Notwithstanding the relevance of written communication skills (hereafter, WCS), it was only recently that educational institutions started to seriously taking systematic assessment of these skills into account (Hamp-Lyons, 2005; Jeffery, 2009; Norris, Oppler, Kuang, Day, & Adams, 2004). In Chile, awareness of the students' deficits in WCS has prompted many institutions to implement writing assessment initiatives either as a graduation requirement or for diagnostic purposes. Specifically, at the Pontificia Universidad Catolica de Chile, since 2003 we have been working in developing a test whose approval is required for graduation.

Writing Assessment involves relevant assessment challenges present across the whole testing process. These challenges include those related to the generation of writing prompts, the definition of the construct and the rating process. Next, we proceed to describe the 2008 round of application of the test and how we address these challenges. Although the results of this round were very similar to previous ones, we present the average profile of students in the dimensions assessed for 2004, 2006 and 2008.

Methodology

Participants. 3612 students took the test in 2008.

Procedure. The assessment used involved 50-minute argumentative tasks. The students were presented with three topics and asked to produce a 2-page essay on a theme of their preference, among three possible alternatives. We excluded themes that were related to specific disciplines to avoid possible biases.

An analytic rubric was used for grading. The rubric distinguishes five performance levels in the different dimensions that are object of assessment: orthography, vocabulary, global structure, textual cohesion, use of sentences, argument quality, thesis, consideration of counter arguments, global assessment.

All the essays were assessed using two raters. 95 percent of discrepancies were less than 1 point, which was established as the critical point. In the few cases where discrepancies between raters exceeded 1 point, a third rater (a supervisor of the assessment process) assigned the final score. In all other cases, the final score was the mean of the two scores produced by the raters.

Final score. The final score for each essay was computed as the mean for each one of the nine dimensions assessed in the rubric. This value was reported with one decimal. The final score shows an adequate level of consistence (Cronbach's $\alpha=0,72$), which supports the use of this global score as a synthesis of the different assessed aspects.

Findings

The students did not perform in a similar way across the different dimensions of the rubric. The examinees obtained better scores in content related aspects of the writing (such as structure, text cohesion and thesis), while the worst scores corresponded to two dimensions related to the formal aspects of discourse (orthography and vocabulary). Counter-arguing also showed a low average. As shown in Figure 1, If we compare these results across time, we can notice that there has been a steady increase of the scores in all of them excepting orthography. On the other hand, in the 2008 assessment we noticed an increase in text cohesion whereas the global assessment has a similar average across the years, excepting 2006.

The 76.8 percent of the assessed students obtained scores equal or over to the grade established to pass the exam (3 points). Average differences among academic programs are relevant: the difference between the program with best and worst average represented one and a half standard deviations.

The scores in the essay were correlated with the scores of students in the national admissions tests (PSU) and high-school grades. Correlations are higher with the verbal ability test ($r=.25$) than with the mathematics ability test ($r=.09$), confirming that the essay is more related to the verbal domain. Correlations with average high school grades fell in between ($r=.17$). We calculated –separately for each academic program- the correlation between the essay score and the students GPA. As shown in Table 1, results indicate that WCT performance is positively correlated to academic achievement in most undergraduate programs, with an average correlation of .12.

We assessed how much the scores in the essay were correlated with socioeconomic antecedents, as measured by parent's education. The results, shown in Table 2, indicate that the essay score is less correlated with socioeconomic background than the tests used in university admissions.

Theoretical and educational significance of the research

The results show that DWA is a good predictor of academic achievement. Consequently, DWA may be used either as an entrance test or as a graduation requirement. Since correlations with the verbal tests are only moderate, these results indicate that the ability to produce a text and the verbal skills required in multiple choice tests are clearly differentiated. Of particular relevance for Chile, DWA has a minor correlation with socioeconomic measures than other university entry conventional tests. This finding must be interpreted cautiously, since it may be a consequence of the lack of attention given to writing in the school system.

Although this test measures a generic argumentative genre, its results are predictive of academic performance in a wide range of academic disciplines. The question remains whether this test will predict good quality writing across a different number of professional genres once their specific writing styles settle in.

Using artifacts in videotaped interviews about the earth with four to six years old children

Asa Larsson, department of education, Sweden; Ola Hallden, Stockholm University, Sweden

Preschool children were interviewed once a year during three years from the year they were four with the aim to describe their developing conceptions of the earth. We describe their development of models and how these were scaffolded by different conceptions introduced during the course of development. The interviews were videotaped by a stationary camera and then transcribed including gestures and bodily movements. During the interviews the children were presented different artifacts. The artefacts used in the interviews—for example, the terrestrial globe and the drawings—together with the interlocutors constituted a relationship that made negotiations of meaning possible. The results show that the children described models similar to earlier findings with regard to older children. For the children the incentive for changing ideas about the earth was their problem solving activities. Conceptual change involves a simultaneous processing of information and complex conceptions, on the one hand, and revisions and changes at a model level on the other. This directs the focus of conceptual change from specific conceptions to structural changes.

Using artifacts in videotaped interviews about the earth with four to six years old children Aim Preschool children were interviewed once a year during three years from the year they were four with the aim to describe their developing conceptions of the earth. We describe their development of models and how these were scaffolded by different conceptions introduced during the course of development.

Methodology

During a three year period 29 preschool children were interviewed about their conceptions of the earth. In the first interview they were about four years old and in the last about six years old. The interviews were videotaped by a stationary camera and then transcribed including gestures and bodily movements. During the interviews the children were presented different artifacts. Data analysis In the analysis the problems the children encountered were identified and how they solved these problems was described (Halldén, 1988). In short, this means reading through the transcriptions of the interviews several times as well as looking at the videotapes for bodily movements and gestures important for the interpretation. Trying to find out what the children talked about also means deciding upon which topic their utterances are relevant to. This also included deciding on the contexts for their explanations. In interviews we cannot take for granted that interviewees use words and expressions like we do as interviewers or in the way they are used in specific speech genres like for example in physics (Halldén, Haglund, & Strömdahl, 2007). In particular, this is pronounced when interviewing very young children, sometimes turning into a situation quite similar to radical interpretation (Davidson, 2001). For example, children use prepositions in quite unpredictable ways. Proposing that people live in the earth does not unequivocally mean that they live inside the earth. The children participating in this study often used gestures and bodily movements in their communication. For example, they pointed upwards to

explain the location of the earth, and they pointed out things on their drawings when explaining them, and showed different things on the representations of the earth. In deciding on the interpretation of meaning of words these instances often were of decisive importance. The process of interpretation already began during the interviews. The interviewer tried to understand the child by ascribing coherence to the child, and it is out of this understanding that the interviews proceeded. This can be regarded as a negotiating process (Fontana & Frey, 2005). At times, this took the explicit form of a triangulation process (Davidson, 2001). A prerequisite for understanding in a dialogue, according to Davidson (2001), is the possibility of referring to a common outside world. By pointing at something in a shared world, we can ask the speaker to assent to or disagree with the specific use of words. The artefacts used in the interviews—for example, the terrestrial globe and the drawings—together with the interlocutors constituted a relationship that made triangulation possible. In the subsequent analysis of the transcriptions and videotapes, these negotiations were often of decisive importance for deciding what problem the child was struggling with (cf. Ehrléên, 2008; 2009; Lindar, Almqvist, & Östman, 2010). The interpretation was done in a holistic fashion by looking for coherence in three respects; first, within the individual interview, second, related to other children, and third, according to development at an individual as well as group level.

Results

The children described models similar to earlier findings with regard to older children (Nussbaum, 1979; Vosniadou & Brewer, 1992). Contrary to Hannust and Kikas (2010) it was here possible to identify models of the earth already when the children were four years old. For the children the incentive for changing ideas about the earth was their problem solving activities. This process was affected by incoherencies revealed in a relation between at least three entities, that is, two or more different facts or conceptions that conflict and this when related to one specific context. Conceptual change involves a simultaneous processing of information and complex conceptions, on the one hand, and revisions and changes at a model level on the other. This directs the focus of conceptual change from specific conceptions to structural changes.

Discussion

Conceptual change is often described as a causal process in which changes in an embraced system of beliefs result in a new system of beliefs. Here, it is argued that conceptual change is better understood as an intentional activity with regard to the learner, that is, what the learner is doing when trying to understand something.

References

- Davidson, D. (2001). *Inquiries into truth and interpretation* (2nd ed.). Oxford: Oxford Clarendon Press.
- Ehrléên, K. (2008). Children's understanding of globes as a model of the earth: A problem of contextualizing. *International Journal of Science Education*, 30, 223-240.
- Ehrléên, K. (2009). Drawings as representations of children's conceptions. *International Journal of Science Education*, 31, 41-57.
- Fontana, A., & Frey, J. (2005). The interview: From neutral stance to political involvement. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (pp. 695-727). London: Sage.
- Halldéên, O. (1988). Alternative frameworks and the concept of task: Cognitive constraints in pupils' interpretation of teachers' assignments. *Scandinavian Journal of Educational Research*, 32, 123-140.
- Halldéên, O., Haglund, L., & Strömdahl, H. (2007). Conceptions and contexts: On the interpretation of interviews and observational data. *Educational Psychologist*, 42, 25-40.
- Hannust, T., & Kikas, E. (2010). Young children's acquisition of knowledge about the earth: a longitudinal study. *Journal of Experimental Child Psychology*, 107, 164-180.
- Lindar, M., Almqvist, J., & Östman, L. (2010). A pragmatist approach to meaning making in children's discussions about gravity and the shape of the earth. *Science Education*, 4, 689-709.
- Nussbaum, J. (1979). Children's conceptions of the Earth as a cosmic body: A cross age study. *Science Education*, 63, 83-93.
- Vosniadou, S., & Brewer, W. F. (1992). Mental models of the earth; A study of conceptual change in childhood. *Cognitive Psychology*, 24, 535-585.

Global Education for Social Justice

Charalambos Vrasidas, CARDET - University of Nicosia, Cyprus; Katerina Theodoridou, Centre for the Advancement of Research & Development in Educational Technology, Cyprus; Michalinos Zembylas, CARDET - Open CY, Cyprus; Christiana Aravi, CARDET, Cyprus; Sotiris Themistokleous, CARDET, Cyprus; Odysseas Christou, CARDET - UNIC, Cyprus

The purpose of this paper is to discuss a European project that focuses on developing curricula for universities to raise awareness on development education (global education). Partners from 4 EU countries collaborated to develop modules that can be used to raise awareness about the Millennium Development Goals (MDGs) and poverty

eradication. Concrete activities will be presented which can be integrated in various education context to raise awareness on poverty eradication and social justice education.

The purpose of this paper is to discuss a European project that focuses on developing curricula for universities to raise awareness on development education (global education). Partners from 4 EU countries collaborated to develop modules that can be used to raise awareness about the Millennium Development Goals (MDGs) and poverty eradication. There is still an ongoing debate on the most appropriate terminology concerning 'development education'. Alternative terms are 'global education', 'global/cosmopolitan citizenship', 'global learning' or even 'MDGs education'. These terms are by no means value-neutral but carry particular cultural and political assumptions. To delineate those assumptions one has to begin from the use of the term 'development' itself—which is clearly not unproblematic.

There are two dominant 'development paradigms' linked to our work. According to the first paradigm, the modernization development paradigm, 'development' means closing the economic gap among nations; at its core is a Western concept of 'modernization' that perceives some means (e.g. technology, industrialization) as important in spreading development from the West to the rest of the world. These means are viewed as crucial in the development agenda because it is argued that they can be used to assist in poverty reduction and the expansion of opportunities for economic development. In this view, 'development' becomes a part of economic discourse while other renditions of its meaning—for instance, cultural development, personal development, spiritual development—are too easily drowned out or marginalized (Selby, 2006). Development is primarily linked, then, to economic output, so the argument is that the 'means' will result in economic growth.

On the other hand, the second paradigm, the social justice development paradigm, questions the meaning and type of 'development' governments or agencies aspire to. In this view, 'development' aims at problematising the capitalist model of expansion that harms people and the environment. By 'development', writes Rigby, "we mean simply moving forward in time, rather than that the majority world has to convert to the western obsessions with competition and increasing materialism" (cited in Selby, 2006, p. 356). The 'means' of development—that have center stage in the first paradigm—may in fact increase existing inequalities. Development can no longer be understood merely in economic terms but has to say something about how unequal social structures and power relations are questioned. Consequently, the question "Who really benefits from this?" has to be constantly addressed in discourses and practices that deal with development issues. Our project, then, places notions of social justice and equity at its core and engages in curriculum development that provides opportunities to raise this and other important questions.

Recognizing the current popularity of indicators, given that they measure, simplify and communicate important information, any references with our project curricula will avoid purely economic indicators that reflect the modernization paradigm, such as "standard of living" and privilege indicators that challenge the economic model such as "quality of life". The term 'social justice' is hotly contested throughout the field of education (North, 2006), but in our theoretical framework we define socially just education as the efforts to develop curricula, policies and pedagogies that improve the learning and life opportunities of typically underserved students (Cochran-Smith, 2004; Ladson-Billings, 1994).

For the purposes of this project, curricula are developed to provide opportunities to students in their mastery of content in order to acquire the equitable level of education each citizen needs to function as a successful member of society. Curricula with this focus lead students to problem-pose the ordinary, taken-for-granted events of life that are, in fact, hegemonic expressions of oppression (Freire, 1970; Giroux, 1988; Kincheloe, 2005; McLaren, 2003). Students need to be exposed to particulars of societal injustice that can pierce apathy and provoke the empathy and outrage needed to prompt them to act for the betterment of society. In the development of our modules we should make sure that there are openings for students and teachers to delve into the particulars of societal injustice.

Each module within our project will aim to broaden the understanding of the learner (i.e. those targeted by our modules) of the various kinds of power and our sense of possibilities for social justice. For each module we will be looking into developing the (political) skills to act on the power relations. Furthermore, the modules currently being developed place notions of gender equality at their core and consider gender equality to be a prerequisite to human development. Concrete activities will be presented which can be integrated in various education context to raise awareness on poverty eradication and social justice education.

References

Beijing Declaration and Platform for Action, Fourth World Conference on Women, 15 September 1995, A/CONF.177/20 (1995) and A/CONF.177/20/Add.1 (1995).

- Cochran-Smith, M. (2004). *Walking the road: Race, diversity, and social justice in teacher education*. New York City: Teachers College Press.
- Freire, P. (1970). *Pedagogy of the oppressed*. (M.B. Ramos, Trans.). New York: Continuum. (Original work published in 1955).
- Giroux, H. A. (1988). *Teachers as intellectuals: Toward a critical pedagogy of learning*. Westport, CO: Bergin and Garvey.
- Greene, M. (1998). Introduction: Teaching for social justice. In W. Ayers, J.A. Hunt, & T. Quinn (Eds.) *Teaching for social justice* (pp. xxvii-xlvi). New York: New Press.
- Kincheloe, J. L. (2005). *Critical pedagogy*. New York: Peter Lang.
- Ladson-Billings, G. (1994). *Dreamkeepers: Successful teachers of African American children*. San Francisco: Jossey-Bass.
- McLaren, P. (2003). *Life in schools: An introduction to critical pedagogy in the foundations of education*, 4th Edition. Boston: Allyn and Bacon.
- North, C. (2006). More than words? Delving into the substantive meaning(s) of "social justice" in education. *Review of Educational Research*, 76(4), 507-535.
- Selby, D. (2006). The first and shaky ground of education for sustainable development. *Journal of Geography in Higher Education*, 30(2), 351-365.
- Vrasidas, C., Zembylas, M. & Glass, G. (Eds.). (2009). *ICT for education, development, and social justice*. Greenwich, CT: Information Age Publishing.

Complex systems and learning about racism: A 21st century pedagogy for 'color-blind' racism?

Thomas Philip, UCLA, United States

Through a synthesis of Omi and Winant's (1994) seminal work on racial formation and scholarship in the learning sciences on students' understandings of complex systems, I analyzed in-depth interviews with teachers to argue that reasoning about race and racism requires complex systems reasoning. I further argue that part of the difficulty teachers face in reasoning about these issues is their reliance on mechanistic reasoning. This study contributes to the literature on teacher preparation and development and also contributes more generally to how students reason about complex systems and processes that pertain to issues of equity and justice.

Aims

Through a synthesis of Omi and Winant's (1994) seminal work on racial formation and scholarship in the learning sciences on students' understandings of complex systems (Chi, 2005; Jacobson, 2001; Jacobson & Wilensky, 2006; Rappoport & Ashkenazi, 2008; Wilensky & Resnick, 1999), I analyzed in-depth interviews with teachers to argue that reasoning about race and racism requires complex systems reasoning. I further argue that part of the difficulty teachers face in reasoning about these issues is their reliance on mechanistic reasoning.

Educational Significance

The equity implications for how teachers understand the nature and purpose of their work, particularly when there are stark differences between teachers' and students' racial, ethnic, class and immigration backgrounds has been well documented (Hollins & Guzman, 2005; Sleeter 2008). This study contributes to the literature on teacher preparation and development, particularly for teachers from dominant backgrounds who teach historically marginalized students. It also contributes more generally to how students reason about complex systems and processes that pertain to issues of equity and justice.

Theoretical Framework and Significance

Omi and Winant's (1994) theory of racial formation is perhaps one of the single most influential contemporary theories of race. I argue that due to the different disciplinary traditions in which theories of race and complex systems have developed, prominent theories of race conceptualize society and racial processes as a complex system, albeit without the explicit language of emergent properties. While complex systems are implicitly central to these theories of race, the pedagogical approaches used to teach these theories are still largely mechanistic, creating a highly problematic disjuncture between theory and pedagogical practice.

Omi and Winant disrupt the idea of race as an essence or an illusion, arguing that "race is a concept which signifies and symbolizes social conflicts and interests by referring to different types of human bodies" (p. 55). A defining characteristic of Omi and Winant's concept of race is that they approach it as "an unstable and 'decentered' complex of social meanings constantly being transformed by political struggle" (p. 55). Strikingly parallel to the language and central tenets of complex systems, Omi and Winant argue that is useful to think of racial order in Western

democracies as an "unstable equilibrium," stressing that such order is in the "continuous process of formation" (p. 85). The racial order is equilibrated by the state as it is encoded in law, organized through policy-making, and enforced by a repressive apparatus. The apparent "order" is dynamic and the equilibrium is constantly in flux.

Findings from scholarship on complex systems reasoning closely parallels many of the difficulties that are observed when teachers reason mechanistically about racialized inequity, which is characterized by thinking about the parts of a system in isolation without considering their interdependent relationships (Chi, 2005; Jacobson, 2001; Rappoport & Ashkenazi, 2008; Wilensky & Resnick, 1999). For instance, Chi (2005) proposes that difficulties arise in conceptualizing emergent properties because agents have a non-direct effect on the observed pattern, some of the actions of agents might not correspond to the observed pattern, and agents do not interact with the purpose of producing a global goal. People often make sense of complex dynamics by "expecting the components to act as small copies of the observable system, or to intentionally move in the direction that fulfils the goal of the system" (Rappoport & Ashkenazi, 2008, p. 1589). Similarly, teachers often assume that people's intentions must correspond to systemic patterns, which makes it difficult for them to reason through the nuances of contemporary forms of "color-blind" racism, where racialized outcomes can emerge from seemingly unracialized actions (Bonilla-Silva, 2003). (Additional parallels that offer insights into teachers' racialized reasoning will be explored more extensively in the presentation.)

Methods and Data Sources

The data sources consisted of fourteen in-depth, open-ended interviews with pre-service teachers in which they were asked to explain the reasons of differential achievement among racialized groups of students. The interviews were coded for evidence of mechanistic and complex systems reasoning based on characteristics proposed by Jacobson (2001).

Results

While the participants reasoned across a spectrum of mechanistic and complex systems reasoning when explaining differential achievement among racialized groups of students, of the 14 participants, 12 mostly relied on mechanistic reasoning and 2 mostly relied on complex systems reasoning. The patterns and nuances of shifts between mechanistic and complex systems reasoning in the data will be discussed through the interpretative lens of the theoretical framework described above.

References

- Bonilla-Silva, E. (2003). *Racism without racists: Color-blind racism and the persistence of racial inequality in the United States*. New York: Rowman and Littlefield Publishers.
- Chi, M.T. H. (2005). Commonsense conceptions of emergent processes: Why some misconceptions are robust. *Journal of the Learning Sciences*, 14(2), 161-199.
- Hollins, E. R., & Guzman, M. T. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the aera panel on research and teacher education* (pp. 477-548). Mahway, New Jersey: Lawrence Erlbaum Associates, Inc.
- Jacobson, M. (2001). Problem solving, cognition, and complex systems: Differences between experts and novices. *Complexity*, 6(3), 41-49.
- Omi, M. & Winant, H. (1994). *Racial formation in the United States: From the 1960's to the 1990's*. New York: Routledge.
- Rappoport, L.T. & Ashkenazi, G. (2008). Connecting levels of representation: Emergent versus submergent perspective. *International Journal of Science Education*, 30(12), 1585-1603.
- Sleeter, C. E. (2008). Preparing white teachers for diverse students. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre & K. E. Demers (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (pp. 559-582). New York: Routledge.
- Wilensky, U. & Resnick, M. (1999). Thinking in levels: A dynamic systems approach to making sense of the world. *Journal of Science Education and Technology*, 8(1), 3-20.

Carbon cycle narratives in diagram form: their variety and some content and design issues

Simon Gates, University of Exeter, United Kingdom

The visual literacy of narratives for the carbon cycle topic in secondary school science in England, as displayed in diagrams, was investigated in an interpretive study. A selection of diagrams was used by informants at interview. Educators' published output was also evaluated. In all, the creations of over 200 educators were inspected. The study showed that rectangular and circular shapes are common. Many diagrams have visual literacy faults as well as content

errors. Little has been reported in the literature about the visual literacy, narrative version, diagram form, or accuracy of these diagrams. It seems to be assumed, wrongly, that published diagrams will have accurate content and be visually literate; that teachers and pupils will use them without difficulty. Although they can be made so they translate precisely into speech and written English, informants did not find their narratives easy to access. This poster presentation provides a reference diagram for the visual narrative; illustrates shapes, and forms; presents visual literacy faults and content errors; displays the range of different narrative versions found in publications for school science; examines the problems informants reported in teaching the part microbes play in the cycle.

The aim of this qualitative research has been to explore, with educators, issues of visual literacy, design, content and use of diagrams available to teach the carbon cycle topic to secondary science pupils aged 14-16 in England, as part of our National Curriculum. Research questions were general: How do educators see and use carbon cycle diagrams? What do they notice, like and dislike about them? The methodology for this empirical, interpretive-constructivist study, (Schwandt, 1994), was modelled on a naturalistic approach, and contained elements of multiple case studies (Bassey, 1999). Two instruments were used. First, semi-structured interviews with an opportunistic selection of educators, focused on tasks set with carbon cycle diagrams selected from textbooks and exam papers. This was followed by an archival survey of the content, structure, and accuracy of published carbon cycle diagrams. Its focus was informed by the first instrument. The informants, and the outputs of other diagram makers, together provided evidence about carbon cycle narratives produced by over 200 education professionals, most in the UK; others in Europe and the USA. Informants were asked to evaluate carbon cycle diagrams, carry out tasks with them and say how they might use them in their own teaching. Informants talking at interview; the transcripts; diagrams they made, were coded for categories, and then transformed to present the findings. A number of criteria were used to provide reliability, and generalizability (Taylor and Wallace, 2007). Importantly, each of the two instruments did provide evidence which reinforced and complimented the findings of the other.

Findings.

Informants preferred diagrams which contained naturalistic depictions. They commented on surface features, not those to do with narrative version, accuracy of content, the visual conventions used, or form and its implications for using these visual narratives with pupils. Most flaws in design or content went unremarked. When presented with unfamiliar diagrams they found their narratives difficult to access and evaluate. The first poster shows how a text version of the carbon cycle narrative is translated into a reference diagram. The places in the narrative where faults occurred are marked. Informants agreed a preferred version of the diagram. This diagram is presented and their reasoning is summarised. The second poster illustrates content faults, which include the following: Entity confused with process; Process confused with entity; Wrong process linking two entities; Placing a process the wrong side of an entity; Another entity substituted for microbes; Confused use of process and entity symbols. It is the processes that usually prove difficult to use accurately. The third poster introduces the shapes and forms found in textbooks and exam papers. Informants preferred circular shapes, but rectangular ones are common in exam papers. Forms are created when the maker puts the entities in place on the page. They have a strong influence on the usefulness of a carbon cycle diagram. Some forms are easier to 'read' than others, as shown by adding reading pathways. The fourth poster presents different versions of the narrative found in textbooks and exam papers. Informants disliked contracted versions, finding it difficult to access their narratives or to accept their designs. The fifth poster examines a common problem for informants: telling the narrative accurately with respect to the microbes. Surprisingly, omitting the microbes is common in textbook versions. In the late 90s, they were omitted from exam board syllabus versions of this topic. They have since been restored. Reasons why the cycle cannot be taught effectively without them are demonstrated visually. Informants reported that their pupils found this sector of the narrative difficult. However, reports of research on the topic carried out elsewhere do not confirm this. Possible causes and proposed solutions are presented.

Educational significance.

No direct reference is made to these diagram features in the literature, except that the features presented here are to be found in them. Teaching the topic is discussed by Winterbottom, 1990. Exposing the problems informs a useful training specification that would provide for accuracy and fluency in the visual literacy required for more effective instruction with carbon cycle diagrams, a topic which should be of interest to all of us now that we are confronted with the change in atmospheric carbon dioxide and its consequences (Fýssel, 2009). More generally, Avgerinou gives a current perspective on the universal importance of visual literacy. Pauwels, too, describes what we need for practical, everyday, 21st century 'visuality'. Without it, we cannot teach, learn, or function adequately in or out of school, in our contemporary, global, visual culture. Visual literacy is a fundamental requirement for unambiguous communication using any and every medium.

References

- Avgerinou, M. D. (2009). Re-viewing visual literacy in the "bain d'image" era. *TechTrends*. 53, 2, 28-34.
- Bassey, M. (1999). Case study research in educational settings. Maidenhead, England: Open University Press.
- Fussel, H.-M. (2009). An updated assessment of the risks from climate change based on research published since the IPCC Fourth Assessment Report. *Climatic Change*, 97, 469-482.
- National Curriculum. (1999). London: Department for Education and Employment.
- Pauwels, L. (2009). Visual literacy, visual culture and visual scholarship: Adjusting a distorted picture. In *Engaging creativity & critical thinking: Selected readings of the International Visual Literacy Association* (pp. 19-24). Loretto, PA: Saint Francis University.
- Schwandt, T. A. (1994). Constructivist, interpretivist approaches to human inquiry. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd edn.). (pp. 118-137) Thousand Oaks, CA: Sage.
- Taylor, P. C., and Wallace, J. (2007). Contemporary qualitative research: Exemplars for science and mathematics educators. (pp. 45-57). Dordrecht, The Netherlands: Springer.
- Winterbottom, M. (1999). *The non-specialist handbook: Teaching biology to Key Stage 4*. London: Hodder & Stoughton.

Pedagogical Reasoning in Special Education in Authentic Contexts

Julien Mercier, University of Quebec in Montreal, Canada; Line Laplante, University of Quebec in Montreal, Canada; Marie-France Cote, University of Quebec in Montreal, Canada; Andree-Anne Cyr, University of Quebec in Montreal, Canada

The processes by which theoretical knowledge gets integrated into teaching practice are relatively under-researched from a cognitive perspective. Current cognitive theories led to the construction of a model of pedagogical reasoning, as a prototype of situations of theory-practice articulation. The aim of this study is to test such a model in authentic teaching contexts and to examine novice-expert differences using a sample of special education student teachers and teachers. Eighteen participants planned remedial reading instruction in the context of their regular teaching during three weeks. Through think-aloud protocols, pedagogical-reasoning processes were identified. Results show the prevalence of the processes and their typical chronology. Novice-expert comparisons reveal essentially no difference in prevalence but differences in the sequencing of the processes. This model suggests the configuration of learning activities in teachers' preservice training.

Aims The stance adopted in this study is that the translation of theory into practice in the context of preservice teacher education is a pedagogical problem that can be solved by the design of appropriate instructional tasks on the basis of the study of teacher cognition (see Cochran-Smith & Fries, 2006). The aim of this study is to test a model of the cognitive processes involved in pedagogical reasoning in the context of authentic teacher planning and to examine how these cognitive processes get enacted across different expertise levels.

Theoretical framework

Cognitive research suggests a pedagogical-reasoning model constituted of three modules: (1) the comprehension of the case, (2) the diagnostic of student's difficulties, and (3) the elaboration of pedagogical interventions (Mercier, Girard, Laplante & Brodeur, 2010). These modules are associated with theories of discourse comprehension and production, reasoning, and problem solving, respectively. The first module, comprehension of the case, is based on the activation of one or more schemas on the basis of information provided and on teacher's prior knowledge. Second, the diagnostic implies the elaboration of one or more hypotheses and their testing, including their hierarchical organization when more than one hypothesis is formulated. Finally, the module handling the elaboration of pedagogical interventions comprises the identification of goals, their hierarchy, followed by the identification of actions, accompanied by pertinent justifications such as the diagnostic, expected effects, application constraints and available means. These three modules are articulated by a problem-solving process that controls the performance of the global task. The results presented are limited to the control process and component actions due to space constraints.

Methodology

The sample was constituted of 12 student teachers (six in second, six in fourth year) and 6 teachers in special education (2 had between 5 and 10 years of experience and 4 were remedial education teachers who had graduate training in reading instruction). Participants were asked to plan lessons for remedial reading instruction as they would do normally during practicum or everyday teaching during a period of three weeks. They were instructed to think-aloud and to use a portable computer especially configured to record automatically the computer screen, ambient sound, and any documents. To ensure completeness of the protocols, the computer was configured to display a reminder to talk out loud whenever no voice was recorded for five seconds. The protocols were coded; frequencies and conditional probabilities are used to aggregate sample data as related to levels of expertise.

Results and Conclusions

Tables 1 and 2 present time-budget information regarding how often participants engaged in particular pedagogical-reasoning activities. Globally, participants spent the bulk of their time (around two thirds) performing pedagogical-reasoning actions. There is no difference in the prevalence of categories attributable to expertise. At the level of actions, there is a strong tendency to put more time on diagnosis and less time on the elaboration of the intervention as the level of expertise increases, with experts spending twice as much time as beginners on diagnosis.

The following section presents general results regarding the modulations in the sequential structure of pedagogical reasoning that are attributable to expertise levels. Conditional probabilities in the following four figures represent the probability of a particular process of being followed by another given process. Probabilities below 0.15 were not included for clarity. Please see the attached figures. Globally, differences attributable to expertise lie in the sequence of pedagogical reasoning processes, and not in their prevalence (with the exception of making a diagnostic). By showing differences in pedagogical reasoning related to the level of expertise, the results suggest that more emphasis should be put on the diagnostic of student's difficulties in initial training, especially if this diagnostic is seen as a foundation for differentiated instruction. Domain knowledge seems to have an impact on how pedagogical reasoning unfolds. More analyses considering the modeling of the domain knowledge evoked during pedagogical reasoning and associated to each process are needed to explain these differences.

Theoretical and educational significance

This study is part of a series of studies investigating the relations between teacher knowledge and teacher decision-making and extends our prior results from laboratory data. The proposed cognitive model, as a way to characterize proactive decision-making, complements models of interactive decision-making (Peterson and Clark, 1978) ; Shavelson and Stern, 1981). This complementarity represents potential for future studies examining discrepancies between teacher planning and classroom processes in terms of how they arise and how they are resolved. This discrepancy is linked to important findings of earlier studies (Morine-Dersheimer, 1978-79) and has implications for the transfer of theory into practice since teachers' interactive decision-making and information-processing is highly influenced by it (Morine-Dersheimer, 1979). Initial investigations are leading to descriptive models of teachers' pedagogical reasoning. These models may develop into more prescriptive models that could orient teacher education programs. Empirically validated models of pedagogical-reasoning skills determine, on the one hand, the nature of teacher pedagogical reasoning skills that should be taught. On the other hand, they serve as a basis for studies investigating the design of methods for teaching and assessing these skills.

The Noble Image of Bildung

Herner Saeverot, University of Bergen, Norway; Glenn-Egil Torgersen, Norwegian Defence University College , Norway

This paper will show selected results from the ongoing research project "The Noble Image of Bildung." The paper will raise several questions that in their own way centre on pedagogic challenges, but the main question is: Do art students remember images better than others? The study will reveal if the art students (n=100) have a greater capacity to remember pictorial information than others with different backgrounds (eg. officers (n=94) and teachers (n=194)), but not in a stigmatising way. Twenty assertions relating to an image was used to measure the respondent's memory of this particular image. A digital-based short-term memory test measured the general capacity/memory span, and a non-verbal intelligence test (Raven) was used to identify the form combinatorial ability. These cognitive processes can affect iconophobic development, and may also be an underlying cause of art skills. The empirical data are discussed in light of cognitive theory and classical theory of Bildung. Art educational, and general pedagogic implications, are discussed on the basis of the empirical outcomes and the theoretical approach.

This paper will show selected results from the ongoing research project "The Noble Image of Bildung," with the overall problem: Do art students remember images better than others? The purpose is to examine how well art students (n=100) remember from a particular image, compared with other groups (including teachers (n=194) and officers (n=94)). The study will reveal if the art students have a greater capacity to remember pictorial information than others with different backgrounds, but not in a stigmatising way. A non-verbal intelligence test (Raven) is also used to identify the form combinatorial ability. These cognitive processes can affect iconophobic development, and may also be an underlying cause of art skills.

The study relates to the German word Bildung, which activates a broad association register. Firstly, the word relates to the formation or transformation of something. Second, Bildung is strongly associated with the image, so that the word is given a pictorial and figurative sense. The notion of Bildung is fairly unique in the sense that it combines the idea of

creation and transformation with the use of evocative images. Bildung is in many ways to transform oneself as a human being in the light of a by-frame or an ideal. The study's concern is that the individual creates or draws itself by way of images, which also means that one obtains insight.

In Norway and other Nordic countries, none has investigated these issues with both empirical and theoretical approach. This research is therefore important with regard to art educational challenges. These include facilitation of teaching with images, image analysis, image mediation of knowledge, development of artistic skills in visual arts, educational use of ICT, as well as basic educational-psychological understanding of image reception and learning, etc. The empirical data will be discussed in light of cognitive theory and classical theory of Bildung. The discussion will be directed towards iconophobic features and other aspects of perception of images that can affect the use of images with regard to learning. Art educational and general pedagogic implications will be discussed on the basis of the empirical outcomes and the theoretical approach.

The respondents are art students, all categories. The survey is carried out in the sense that all respondents are gathered in a plenary/ classroom. There will be displayed a PowerPoint series of pictures and Raven matrices. Questions and time for answering are integrated in the presentation. The collection lasts for 20 minutes. Surveys are then collected. Data is transmitted in Statistical Package for the Social Sciences (SPSS). The material will be statistically processed (ANOVA/MANOVA-analysis). The project is registered in the Norwegian Social Science Data Services (NSD).

The project The Noble Image of Bildung (NIB) is using a developed digital-based short-term memory test measuring capacity and capability functions (Raven). This test was developed at the Norwegian Defence University College for use in the military. The test can be carried out for large groups in natural learning environments. NIB has already spent 120 hours to prepare and facilitate empirical implementation at a national academy of the arts in Norway. There will be a need to collect 100 respondents. The test should be carried out during the fall 2010 and spring 2011. A psychologist specialist with lots of experience in psychometric analysis from the military will be connected to the project.

References

- Bagui, S. 1998. Reasons for Increasing Learning Using Multimedia. *Journal of Educational Multimedia and Hypermedia*, 7 (1), 3-18.
- Baddely, A.D. 1986. *Working Memory*. Oxford: Oxford University Press.
- Biesta, G. 2002. How General Can Bildung Be? Reflections on the Future of a Modern Educational Idea. *Journal of Philosophy of Education*, 36 (3), 377-391.
- Clark, R. C. & Mayer, R. 2003. *e-Learning and the Science of Instruction*. San Francisco: Pfeiffer Giere, R. (eds). 1992. *Cognitive models of science*. University of Minnesota Press.
- Miller, G. 1956. The magical number seven, plus minus two. Some limits on our capacity for processing information. *Psychological Review*, 63, 81-96.

Frequency and intensity ratings of school-related participation experiences.

Gregor Maxwell, Hogskolan for larande och kommunikation, Sweden; Lilly Augustine, Statens folkhalsainstitut , Sweden

This to compares the self-reported experience of pupils with an additional support need (including children with disabilities) of being involved with what they were thinking or doing. Data about what children were thinking or doing during an activity were gathered from self-reporting questionnaires from 22 children with and 22 without additional needs. This will be analysed for relation between thinking and doing and also interpretation of focus with a view to getting an accurate measure of the intensity of the participation in the activity. All items have been coded with ICF-CY values using the Cieza et al. (2005) coding rules and will be analysed using factor analysis and multi-variant methods to identify if a measure of the intensity of participation can be made.

Theoretical background

With children the nature of child functioning and environmental settings of life situations vary greatly in comparison with adults (WHO, 2007) and for this reason the Child and Youth version of the International Classification of Functioning, Disability and Health (ICF-CY) has been produced in 2007 (WHO, 2007). Building on the existing and previous research results within the Children Health Intervention Learning and Development research group (CHILD,

see <http://www.hlk.hj.se/doc/5531>) this paper investigates participation from an involvement perspective of children in need of additional support (including children with disabilities) at school.

Participation can be regarded as a multi-dimensional phenomenon and can be defined as “involvement in a life situation” (Bjorck-Akesson, Granlund, & Simeonsson, 2005; WHO, 2007). However, the need to provide clarity on the participation construct is currently well debated in the literature with a number of studies discussing how to measure participation (Badley, 2008; Coster & Khetani, 2008; McConachie, Colver, Forsyth, Jarvis, & Parkinson, 2006). While definitions of participation may vary, higher degrees of participation will lead to increased independence, academic achievement and social inclusion for students with disabilities. Participation can be conceived as a complex and multi-dimensional phenomenon (Simeonsson, Carlson, Huntington, McMillen, & Brent, 2001). From previous studies it has been shown that differences in participation are context-specific (Eriksson, Welander, & Granlund, 2007) for both children with and children without disabilities. Participation patterns and students’ concepts of participation are not strongly dependent on type or degree of disability (Almqvist & Granlund, 2005; Eriksson & Granlund, 2004a, 2004b; Granlund, Eriksson, & Ylven, 2004) with students’ conceptions of participation being more age-dependent (Eriksson & Granlund, 2004a). Similarly, environmental factors are also seen as influential in these studies.

Aims

To compare the self-reported experience of pupils with an additional support need (including children with disabilities) of being involved with what they were thinking or doing with a view to creating a measure of intensity by using these research questions:

When thinking and doing descriptions are positively correlated is a child involved in an activity? Does this correlate with whether the child thinks he or she was focused on the activity?

How does the frequency and intensity of participation of school-aged children with additional needs in an educational setting manifest itself within the ICF-CY framework?

Methods

Data were gathered from an existing study of participation in school environments of students with disabilities in Sweden carried out by the second author. The data-set consists of data collected from schools which contain both frequency and intensity data. The frequency data are in the form of questionnaires and the intensity data came from self-reports. The data come from self-reporting questionnaires gathered at random points during the course of a normal school week by prompting 22 children with additional needs and 22 controls with questionnaires. Data about what each child was thinking about and doing will be analysed along with data on the child’s rating of being focused. Additional data which could also be analysed was gathered relating to the child’s mood, their interpretation of the importance and complexity of the situation, and with whom they were doing the activity. All items have been coded with ICF-CY values using the Cieza et al. (2005) coding rules and will be analysed using factor analysis and multi-variant methods to identify if a measure of the intensity of participation can be made. Both non-parametric and parametric multi-variant analysis will be used to report on the findings.

References

- Almqvist, L., & Granlund, M. (2005). Participation in school environment of children and youth with disabilities: A person-oriented approach. *Scandinavian Journal of Psychology*, 46, 305-314.
- Badley, E. M. (2008). Enhancing the conceptual clarity of the activity and participation components of the International Classification of Functioning, Disability, and Health. *Social Science & Medicine*, 66(11), 2335-2345.
- Bjorck-Akesson, E., Granlund, M., & Simeonsson, R. J. (2005). A systems theory perspective. In E. Heimdahl Mattson, A.-L. Lange, L. Roll-Pettersson & M. Westling Allodi (Eds.), *Mangsidigt samspel: en vanbok till siva fischbein*. Stockholm: HLS Fotlag.
- Cieza, A., Geyh, S., Chatterji, S., Kostanjsek, N., Ustun, B., & Stucki, G. (2005). ICF linking rules: an update based on lessons learned. *Journal of Rehabilitation Medicine*, 37, 212-218.
- Coster, W., & Khetani, M. A. (2008). Measuring participation of children with disabilities: Issues and challenges. *Disability & Rehabilitation*, 30(8), 639 - 648.
- Eriksson, L., & Granlund, M. (2004a). Conceptions of participation in students with disabilities and persons in their close environment. *Journal of Developmental and Physical Disabilities*, 16(3), 229-245.
- Eriksson, L., & Granlund, M. (2004b). Perceived participation. A comparison of students with disabilities and students without disabilities. *Scandinavian Journal of Disability Research*, 6(3), 206-224.
- Eriksson, L., Welander, J., & Granlund, M. (2007). Participation in Everyday School Activities For Children With and Without Disabilities. *Journal of Developmental Physical Disability*, 19, 485-502.
- Granlund, M., Eriksson, L., & Ylven, R. (2004). Utility of international classification of functioning, disability and health's participation dimension in assigning ICF codes to items from extant rating instruments. *Journal of Rehabilitation Medicine*, 36, 130-137.

McConachie, H., Colver, A. F., Forsyth, R. J., Jarvis, S. N., & Parkinson, K. N. (2006). Participation of disabled children: how should it be characterised and measured? *Disability and Rehabilitation*, 28(18), 1157-1164.

Simeonsson, R. J., Carlson, D., Huntington, G. S., McMillen, J. S., & Brent, J. L. (2001). Students with disabilities: a national survey of participation in school activities. *Disability and Rehabilitation*, 23(2), 49-63.

Wachs, T. D. (2000). Necessary but not sufficient: the respective roles of single and multiple influences on individual development. Washington DC: American Psychological Association.

WHO. (2007). International Classification of Functioning, Disability and Health – Version for Children & Youth (ICF-CY). Geneva: World Health Organization.

ROUND TABLE

Developing The Skills of Critical Thinking by Probability Teaching

Einav Aizikovitsh-Udi, Harvard, Israel

The purpose of this initial study was to explore whether teaching our specially designed learning unit would enhance the students' critical thinking skills. The unit "Probability in Daily Life" was taught to a group of tenth-grade students, with the purpose of encouraging critical thinking dispositions and abilities such as open-mindedness, truth-seeking, self-confidence and maturity. The teacher encouraged class discussion and planned investigative lessons. The students completed a pre and post CCTDI and Cornell test. The presentation will argue that it need not take significant extra teacher time or effort to prepare the unit and that no special training is needed to accomplish the goal of developing students' CT skills. What is essential is the teacher's understanding of CT skills and the importance of developing critical thinking abilities in their students.

In a challenging world that changes continuously, students need to develop their advanced thinking skills, such as critical thinking (Ennis, 1987; Facione, 1994), decision-making and problem solving and to be able to translate these skills and knowledge into responsible action in society (Ben-Haim & Zoller, 2000).

The goal of the new mathematics curriculum in Israel is a conceptual understanding of mathematics through investigation, problem solving, high-order skills and mathematical discourse. The students are supposed to actively construct their knowledge and understanding, while the teachers function as 'mediators' by asking questions, posing challenges and assigning investigation tasks, and helping the students to think in deeper ways about various concepts, ideas and mathematical contexts. To study and teach mathematics in such a way is a very difficult task, because the ways of teaching and learning are very demanding, requiring deep knowledge and understanding of mathematics on the teacher's part, coping with the unknown on the student's part, and much intellectual effort by both. Earlier research findings point to the importance of learning experiences that develop critical thinking by means of various specially designed curricula. The purpose of this initial study was to explore whether teaching our specially designed learning unit would enhance the students' critical thinking skills. The research reported in this presentation is likely to contribute to the development of new study programs and methods based on the connections between critical thinking and the study of mathematics, which this study has revealed. This research offers new possibilities for the integration of critical thinking development programs into the formal high-school mathematics curriculum.

Methods

To investigate whether teaching conducted with the purpose of promoting higher-order thinking skills through probability instruction would improve the students' critical thinking abilities, forty-three children between the ages of fifteen and sixteen participated in an extra curricular program aimed at enhancing thinking skills of students from different cultural backgrounds and socio-economic levels. The study was conducted over one academic year (eight months) and involved fifteen lessons, each lasting ninety minutes. The teacher was one of the researchers. A teaching experiment was conducted in which probability lessons were combined with CT skill development.

Results

This study shows that through the instruction of the probability learning unit students developed three types of CT skills: variable isolation, attention to references and reliability. Results will be reported to show that most (there are three iteration) of the students were able to retain these skills and use them in later mathematical topics. Most importantly, this study has shown that it is possible to incorporate particular CT skill activities into the regular activities of the mathematics classroom in a way that will develop the students' critical thinking abilities. The subject matter was part of the existing high-school curriculum, and the teaching experiment has, therefore, demonstrated that the teaching of CT skills need not take time away from the class syllabus. The presentation will argue that it need not take significant extra teacher time or effort to prepare the unit and that no special training is needed to

accomplish the goal of developing students' CT skills. What is essential is the teacher's understanding of CT skills and the importance of developing critical thinking abilities in their students.

References

- Ben-Chaim, D., Ron, S., & Zoller, U. (2000). The Disposition of Eleventh-Grade Science Students toward Critical Thinking. *Journal of Science Education and Technology*, 9(2), 149-159.
- Ennis, R. H. (1987). A taxonomy of critical thinking dispositions and abilities. In J. B. Baron & R. J. Sternberg (Eds.), *Teaching thinking skills: Theory and practice* (pp. 9-26). New York: Freeman.
- Facione, P. A., & Facione N. C. (1994). *The California Critical Thinking Skills Test: Manual*. Millbrae, CA: California Academic Press.

Claims of games: a decade of research on motivational and learning effects reviewed

Jantina Huizenga, Universiteit van Amsterdam, Netherlands; Wilfried Admiraal, University of Amsterdam, Netherlands; Geert Ten Dam, University of Amsterdam, Netherlands

The widespread interest in digital game-based learning can be explained by the popularity of games together with ongoing research on the power of digital game-based learning (DGBL), on the one hand, and increased disengagement of the so-called net generation or digital natives from traditional instruction, on the other hand (Van Eck, 2006). This holds for not only students and researchers, but also teachers and parents (Kirriemuir & McFarlane, 2004). Many claims have been made about DGBL in terms of learning and engagement, including, for example, a claim that it motivates the learners because it's fun (Prensky, 2007, p. 3). With this review we want to answer the following questions: Are the claims on the motivational and learning effects of DGBL substantiated? What are the motivational effects of DGBL? What are the learning effects of DGBL? Are there different effects for different subgroups? We have performed a systematic review to provide answers to these questions. Of the hundreds of articles we started with, only 46 articles have been included in the final selection that has been used for our conclusions. The general outcome of this review is that game-based learning seems to work for both motivation and learning, though not always better than other educational methods. Finally, information that is still lacking includes which game elements might be important to trigger effects on motivation and learning, and how student background moderates the effects.

Introduction

The widespread interest in digital game-based learning can be explained by the popularity of games together with ongoing research on the power of digital game-based learning (DGBL), on the one hand, and increased disengagement of the so-called net generation or digital natives from traditional instruction, on the other hand (Van Eck, 2006). This holds for not only students and researchers, but also teachers and parents (Kirriemuir & McFarlane, 2004). Many claims have been made about DGBL in terms of learning and engagement, including, for example, a claim that it motivates the learners because it's fun (Prensky, 2007, p. 3). Mishra and Foster (2007) found over 250 claims relating to psychological or physiological effects. They commented, however, "most of these claims have not been validated empirically" (Mishra & Foster, 2007, p.3). As we want to use game-based learning in education, a stronger empirical basis for the effectiveness of games for learning and engagement is required. Our research questions in this review are: Are the claims on the motivational and learning effects of DGBL substantiated? What are the motivational effects of DGBL? What are the learning effects of DGBL? Are there different effects for different subgroups?

In addition, we include information on the interventions and what authors consider to be important in future research. We will review the literature of the last decade with respect to claims that games trigger learning, motivation for the content and engagement in playing. We want to provide a review avoiding some of the limitations of previous reviews. In contrast to these reviews, we will: Exclude articles that are not based on empirical research; Exclude articles with a low quality in research methods; Include articles based on qualitative, quantitative or mix-method research, and Be explicit about the research methods used in our review.

Method

This paper provides the results of a review study on digital game-based learning of 4-18 years old children in a formal educational (in- or out-school) context. Only studies of digital games are included, no simulations or card- or board games. We define games as a set of activities involving one or more players with goals, constraints, payoffs and consequences and rule-oriented and artificial in some respects. Finally a game involves some aspects of competition, even if that is competition with oneself (based on Dempsey et al. 1996, p. 2). We also add Prensky's (2007) notions of

game as organised play that gives enjoyment and pleasure, feedback, challenge and representation (meaning that there are some narrative, story or fantasy elements in the game).

To select relevant articles the most-used databases (e.g., ERIC and Digiplay), four journals on technology and education, and proceedings of three conferences are searched for relevant articles and papers published between 1999 en 2009. Generally, we search with the terms Gam*, in combination with Learn* or Educ* with * used as a joker. Analysis of the abstracts of more than 600 articles, resulted in 92 relevant articles.

The analyses of these articles are performed in six steps. In the first step, the quality of the research methods of the articles is measured resulting in 75 articles that meet our basic criteria. In the second step, possible claims are examined on the basis of research questions resulting in 57 articles that meet our criteria. In the third step, relevant conclusions have been examined resulting in 46 articles that meet our criteria. In the fourth step, the 46 articles were analysed on effects on motivation and learning. Motivation is a multifaceted term and we distinguish between engagement in the game and motivation for the content. For learning, we are interested in cognitive learning, not learning of sensory or motor skills. Therefore, we distinguish between factual knowledge, cognitive skills and meta-cognitive skills. In the fifth step, we check whether the conclusions with respect to these five terms are grounded or not. In the final, sixth step, the results of the 46 articles are summarized with respect of the claims that are made, the intervention (both games and teaching) and moderating effects for student background. In addition, we summarize the authors' suggestions – if any- for future research in game-based learning.

Results and conclusions

The conclusions on engagement and motivation are mostly positive and grounded, but conclusions based on comparison with other ways of teaching are not always significant. With respect to learning, all (positive) conclusions on factual knowledge are grounded, with 78% for cognitive skills. Only two effects on meta-cognitive skills are found. The games used in the interventions are mostly educational games. So, the general outcome of this review is that game-based learning seems to work for both motivation and learning, though not always better than other educational methods. Finally, information that is still lacking includes which game elements might be important to trigger effects on motivation and learning, and how student background moderates the effects.

Literature

Eck, R. van. (2006). It's not just the digital natives who are restless. Retrieved 08/08/2008 from <http://net.educause.edu/ir/library/pdf/erm0620.pdf>

Kirriemuir, J., & McFarlane, A. (2004). Report 8: Literature review in games and learning. NESTA Future lab series. [Online] Available from http://www.futurelab.org.uk/download/pdfs/research/lit_reviews/Games_Review1.pdf

Mishra, P., & Foster, A. N. (2007). The claims of games: A comprehensive review and directions for future research. In R. Carlsen, K. McFerrin, J. Price, R. Weber & D.A. Willis (Eds.) Society for Information Technology & Teacher Education, 18th International Conference. San Antonio, TX: Association for the Advancement of Computing in Education (AACE).

Prensky, M. (2007). Digital game-based learning. New York: McGraw-Hill.

Mathematics teachers' acceptance of computer supported-open learning environments

Enrica Borromeo, Faculty of Psychology and Educational Sciences, Italy; Jan Elen, Katholieke Universiteit Leuven, Belgium; Lieven Verschaffel, Katholieke Universiteit Leuven, Belgium

The efficiency of instructional methods is not universal but depends on the desired outcomes and the instructional conditions. It is claimed that open learning environments can be an appropriate instructional approach for some goals and challenges in (mathematics) education. This survey study examines mathematics teachers' acceptance of the notion of computer supported-open learning environment (CS-OLE) in relation to teachers' beliefs on the nature of mathematics, mathematics teaching, and technology as a mathematics teaching tool. Data about teachers' beliefs and their acceptance of CS-OLE were collected through a beliefs-questionnaire which reached about 250 Italian mathematics teachers in 36 first degree secondary schools. Four fifth of the answering teachers accept CS-OLEs as a method for teaching/learning problem solving, but half of them do not use them due to lack of technology in schools or lack of competence. As expected, teachers accepting CS-OLEs are significantly more at ease with technology as a mathematics teaching tool and have a stronger problem-solving view than the teachers who do not accept CS-OLEs. Furthermore, they have a different view to some of the four subthemes of mathematics teaching. An unexpected result is that teachers who accept CS-OLEs more strongly hold both instrumentalist and Platonist views of the nature of mathematics.

A deep reflection on the analysis of the data can further increase our understanding of teachers' views on mathematics and on innovative concepts in mathematics education such as CS-OLEs, and may contribute to solve some actual difficulties with respect to mathematics education in Italian schools.

The efficiency of instructional methods is not universal but depends on the desired outcomes and the instructional conditions (Reigeluth, 1999). Teachers may use therefore functionally different teaching strategies (Beane & Brodhagen, 2001). Furthermore, the methods to support student learning used by instructors have great impact on how much students learn (NCTM, 1998). Hannafin's statement that "instruction is neither the only, nor in many cases the best, method to support learning" (1996, revelation 5) opens the door for alternative teaching/learning methods. Open learning environments (OLEs) can contribute to meet the goals and challenges of (mathematics) education. This is one of the reasons to survey how mathematics teachers tackle some specific instructional choices, such as the use of OLEs to support problem solving processes in mathematics. The present survey study examines mathematics teachers' acceptance (in the sense of approving its utility in teaching/learning mathematics and teachers' willingness to implement it) of the notion of computer supported-OLE (CS-OLE) and its relationships with teachers' beliefs on the nature of mathematics (NM), mathematics teaching (MT), and technology as a mathematics teaching tool (TMTT). In this research, we adopt the framework on teachers' beliefs proposed by Philipp (2007) and Thompson (1992). The critical role of teachers' beliefs about education on mathematics classroom practices was demonstrated in several studies (Cross, 2009; Da Ponte, 2009; Fennema & Franke, 1992; Handal, 2003; Hermans, Tondeur, van Braak, & Valcke, 2008; Niederhauser & Stoddart, 2001; Pajares, 1992; Thompson, 1984, 1992; Woolley, Benjamin, & Woolley, 2004). The present study focuses on teachers' beliefs about NM and MT, because they have been argued to specifically affect teachers' approaches to mathematics teaching (Cross, 2009; Ernest 1988, 1989, 2004; Thompson, 1992). Furthermore, since computers have a significant function in CS-OLEs, we also focus on teachers' beliefs about TMTT. This research is based on: -Ernest's theory of the three views of NM (1989, 1991): instrumentalist, Platonist, and problem solving; -the study of Kaiser (Kaiser, 2002; Kaiser, Hino, & Knipping, 2006) on central orientations of teaching in mathematics education, classifying beliefs about MT into two categories with contrasting peculiarities: scientific versus pragmatic understanding of mathematics theory; -the technology acceptance model (Davis, 1989), also applied in educational studies about other curricular domains (Stols, 2007; Teo, 2009). -the model of OLE developed by Clarebout (2005), which integrates the main features of the OLEs given by influential researchers (Hannafin, Hall, Land, & Hill, 1994; Jonassen, 1999).

Aim of the study

This study surveys the answer to the following question: Do teachers' beliefs about nature of mathematics, mathematics teaching and technology as a mathematics teaching tool affect their acceptance of the concept of CS-OLE as an appropriate method for helping students to learn mathematical problem solving? It is part of a wider research project aimed to gain a better understanding of mathematics teachers' views and actual use of innovative concepts in mathematics education, specifically CS-OLEs.

Methodology

The data about the teachers' beliefs and acceptance of CS-OLEs were collected through a beliefs-questionnaire. The survey reached about 250 mathematics teachers in 36 first degree secondary schools in central Italy. In Italy, the situation of mathematical education (particularly concerning students' handling of mathematical problem solving) is in peril (see the results of the last PISA and TIMSS surveys), in spite of the guidelines given by the European Union. The questionnaire is divided into three parts. The first part asks for some basic background information about each respondent. Part two is made up of 31 items. Each item is a statement to be commented through means of a Likert-type scale (Andrews & Hatch, 1999; Philipp, 2007). The following items were included: -two sets respectively of 6 and 13 items to survey NM and MT (measured on 5 points Likert-type scale) proposed by Yu (2008a, 2008b, 2009). His study refers to Ernest's classification of NM and to beliefs on MT based on the conception of mathematics education by Kaiser et al., (2006). The items that survey MT are divided in four sub-themes of MT: introduction of new concepts and methods, position and function of proofs, role of precise language, role of real-world examples; -a set of 12 items to survey TMTT (measured on a 7 points Likert-type scale) proposed by Davis (1989). It is divided in two variables, perceived usefulness (PUT) and perceived ease of use of (a specific) technology (PEUT). The third part of the questionnaire surveys teachers' acceptance of the notion of CS-OLE.

Results

The main results were: Four fifth of the answering teachers accept CS-OLEs as method for teaching/learning mathematical problem solving, but half of them stated that they do not use CS-OLEs for lack of competence or technology in schools. According to the Italian Guidelines for the curriculum (MIUR, 2007), most of the Italian teachers have a strong problem-solving view of mathematics and, on the contrary, a weak instrumentalist or Platonist one. Unexpectedly, these two views of the NM are hold significantly stronger by teachers who accept CS-OLEs than by

those who don't. Furthermore, these two variables came out to be highly correlated. As expected, teachers accepting CS-OLEs have a different approach to the subthemes of mathematics teaching. In particular, the beliefs on position and function of proofs tend to be stronger in teachers accepting CS-OLEs. As expected, beliefs on PUT and PEUT are held significantly stronger by teachers who accept CS-OLEs than by those who don't. With a view to better understand some of the above findings, we are now doing a deeper analysis focusing on the individual characteristics of the sample of respondents and on the psychometric features of the different survey instruments (reliability, factor structure...). An interesting discussion on the emerging data could improve our theoretical understanding of teachers' views on mathematics and on how to teach it effectively by making use of innovative concepts such as CS-OLEs. It may contribute to solve some serious actual difficulties with respect to mathematics education in Italy, mainly concerning students' handling of mathematical problem solving (e.g. through improving pre-service and in-service teacher education).

Methodological issues about time in e-learning research

Elena Barbera, UOC, Spain; Marc Clara, University of Barcelona, Spain; Armando Cortes, University of Barcelona, Spain

Consideration of time is crucial for understanding educational phenomena. In this connection, several conceptualizations have been drawn during the 20th century about this relation: e.g., the work related to the Carroll's model, the operant conditioning approach, and the genetic approach. In the last decades there has been a rising of digital technologies as mediators in educational processes, which have transformed the traditional limits of time regarding these processes. This fact demands to better understand, by means of course of empirical research, how the relationship between time and educational processes is transformed by digital technologies. Addressing this problem from empirical research on on-line learning presents several methodological challenges. The purpose of this paper is to review how empirical literature on on-line learning addresses these methodological challenges. For doing so we qualitatively review 24 systematically selected empirical papers on on-line learning. We examine the following five issues: the conception of time, its inclusion in an explicative model, its inclusion in the research process, the analytical units and the data used in the study of time. According to our analysis, we propose three issues for the further development of e-learning research: the need for a broader consideration of time, the need for a consistent theoretical consideration of time, and the need for theoretical elaboration of the conceptualisation of learning in relation with time.

Introduction

Several influent approaches to learning have consistently argued that educational phenomena can not be properly understood unless time is seriously considered as part of the phenomena. Some of these approaches are for example the Carroll's (1963, 1984) school learning model and the developments based on it (e.g., Bennett, 1978; Bloom, 1976; Burt, 2006; Cooley & Leinhardt, 1975), the Skinner's (1968) operant conditioning and the broad number of approaches influenced by it (see Leiser, 1996; Rodrigo, 1996; Shulman, 1986), or the genetic approach mainly represented by the proposals of Vygotsky (1978, 1997) and Piaget (1980), and the more recent developments based on them (e.g., Coll, Onrubia and Mauri, 2008; Engeström, 2001; Karmilov-Smith, 1994; Mercer, 2008; Pozo, 2001). During the last decades there has been an important increase of the use of digital technologies as mediators of educational processes. This, because of the nature of these technologies, implies the transformation of the time conditions and limits that traditionally had been associated to educational processes. On-line learning research, therefore, faces the challenge of understanding how the digital technologies modify the relation between time and educational processes. Obviously, this understanding can only be reached by grounding it on empirical research. However, empirical research on the relation between time and on-line learning presents several methodological challenges. In this paper we qualitatively review how the empirical literature on on-line learning addresses these challenges.

Method

By means of explicit criteria, we iteratively selected empirical on-line learning papers which included time in analysis. We began from an ERIC selection of on-line papers published during 2006-2009, we get 8511 papers. From these we iteratively refined the search by introducing progressively more demanding time criteria, and in the end of the process we get 24 papers that considered time in the methodological scheme and in the analysis of results. These 24 papers were then qualitatively analysed, by means of a grounded theory procedure (Strauss, 1987). This analytic procedure consists of generating categories directly from data (not from a specific theoretical frame). We analyzed data departing from five generative questions: 1. How is time conceptualised in relation to teaching and learning phenomena? 2. How is time introduced in a theoretical explicative model about on-line teaching and learning? 3. How is time operationalised and introduced in a research process? 4. Which kinds of units are used for this operationalisation of time? 5. Which kinds of data are useful for studying time?

Results

ABLE 1[1] QuestionAnswers found in the review# of papers (n=24)% of papersConceptualisation of timeTime as the while during which a phenomenon is taking place1041.7%Time as the moment in which a phenomenon takes place312.5%Time as the temporal distance between two phenomena833.3%Time as the evolution of a phenomenon729.2%Introduction of time into an explicative modelVariable-based model2083.3%Model of a process416.7%Introduction of time into the research processIntroduction into the phase of defining dimensions and variables 2395.8%Introduction into the analytic phase312.5%Units used for analysing and measuring timeUnits based on formal time1562.5%Units based on internal components of the setting1041.7%Theoretical-based units312.5%Data used for studying timeElectronic log files1250%Questionnaires, surveys and interviews625%Learning process students' products14.2%Institutional documents14.2%Setting design1041.7%

Table 1. Answers found in the review for the five guiding questions. The results of the review are summarized in table 1. Regarding the first questions we found four conceptions of time. Papers which considers "time as the while during which a phenomenon is taking place" typically considers the amount of study time or the amount of time spent on training. Papers which considers "time as the moment in which a phenomenon takes place", are interested in the when an action is carried out. The third conception is "time as the temporal distance between two phenomena", which typically considers, for example, the time a tutor lasts before responding a question of a student. Regarding the second question, we identified two different kinds of explicative models: variable based models, and models of a process. In variable based models, time is considered an isolated variable in specific relation to other variables. Instead, in models of a process, time is not an isolated variable, but it is considered as interwoven with context, as something intrinsic and inseparable of the studied phenomena. Regarding the third question, in the reviewed papers time is incorporated in the research process in two moments. Time is sometimes incorporated in the phase of definition of dimensions or variables: one dimension is time, or time is part of another dimension. But time is also sometimes incorporated in the phase of analysis, by considering in different moments the values of a no time dimension. Regarding the fourth question, we identified three types of units of time: units based on standardized time –minutes, hours, days, etc- units based on intrinsic features of the setting –course, thematic modules, etc.- and theoretically defined units- theoretical phases of a process. Finally, regarding the fifth question, we identified five kinds of data used by the different papers: log files – electronic registration of the participants' activity- questionnaires, surveys and interviews, products of the learning process itself –e.g., a written reflection which is required in the course- institutional documents –e.g., the list of inscriptions of a course- and the setting design itself –which permits manipulate some time variables.

Implications for further research

From the results of the review, we can point out three lines for further development of the consideration of time in e-learning research. First, time should be more broadly included in e-learning research. Second, e-learning research should be based on any explicit and well articulated theoretical conceptualisation of learning in relation with time. Thirdly, e-learning research should take the opportunity and the possibilities of theoretically developing and re-conceptualising the understanding of the temporal nature of learning.[1] The categories in each Question are not exclusive (indeed they are only exclusive in the second question); i.e., one and the same approach can include, for example, two different ideas of time, can introduce time into both phases, can simultaneously use units of different nature, and can combine different kinds of data. For this reason, in each question, the frequencies of each of the categories do not total 24, and the percentages do not total 100.

Languaging in online higher educational environments. Unimodal multilingual behaviors?

Giulia Messina Dahlberg, Dalarna University, Sweden; Sangeeta Bagga-Gupta, University of Orebro, Sweden

This presentation focuses upon a pilot study which is trying to understand the nature of human communication and learning in online synchronous communities within higher education in Sweden. The preliminary findings from the pilot study draws upon empirical material that consist of 12 sessions of approximately 30 minutes each, that are part of an "Italian for beginners" language online course. These sessions take place once a week over a period of one semester. Our study focuses upon interaction in the virtual classroom as a community of practice where students participate without teacher intervention. Our interests here relate to accounting for what communicative strategies are employed by students who are dealing with a common task without teacher supervision, and how these activities are negotiated within the constraints and opportunities accorded in the multimodal multilingual virtual setting. Taking sociocultural theoretical points of departure, we are currently analyzing how students create meaning in language learning using tools that allow them to interact when they have access to multimodal resources. Preliminary findings suggest that the students interact in the online videoconferencing environment using communication strategies in a rather flexible manner. Examples of the use of different modes – i.e. instant messaging, whiteboard and audio – and different codes will be presented. These highlight the complexity of communication in online communities of practice. The fluidity of the written and oral communication in face-to-face interaction appears to be dis-preferred and instead

members in these settings tend to communicate unimodally. Our analysis offers ways to understand this multilingual, unimodal communicative behavior.

This presentation focuses upon a pilot study which is trying to understand the nature of human communication and learning in online synchronous communities within higher education in Sweden. The aim of the study is to investigate the communication strategies employed by participants in a virtual classroom, a setting where the visual access to bodies, gaze and gestures is mediated through the computer screen. The preliminary findings from the pilot study that are presented in this paper draw upon empirical material that consist of 12 recorded sessions of approximately 30 minutes each, that are part of an "Italian for beginners" language online course offered by a Swedish university. The empirical data makes available to us as analysts access to the entire sessions, including sound as well as everything that has occurred on screen during the online lessons. The online synchronous meetings occurred once a week, over a period of one semester, in the videoconferencing program Adobe Connect, an environment that permits oral communication, but that also allows the students to share each other's web cam images, an Instant Messages device and a shared whiteboard, all in one application and one window in the computer desk. In this type of context, different participants are expected to deal with a task and simultaneously adjust their activities according to the options that are offered by the environment where interaction is taking place. The multimodal connotation of this setting, but also the different languages that are available to the participants, are aspects that need to be taken into consideration when analyzing interactional meaning in online synchronous environments since oral communication in different codes is only one of the several modes that can be used in this community of practice. Our interests here relate to accounting for what communicative strategies are employed by students who are dealing with a common task without teacher supervision, and how these activities are negotiated within the constraints and opportunities accorded in the virtual setting. Tudini (2005) argues that in this kind of virtual space, where students are trying to communicate in a language in which they have limited experiences, it is possible to define the notion of collaborative negotiation which defines students' interaction and their activity of languaging in online synchronous environments. Taking sociocultural theoretical points of departure, we are currently analyzing how students create meaning in language learning using tools that allows them to interact using multimodal resources. Preliminary findings suggest that the students are able to interact in the online videoconferencing environment using communication strategies in a rather flexible manner. Examples of the use of different modes – i.e. instant messaging, whiteboard and audio – and different codes will be presented. These will highlight the complexity of communication in these communities of practice. The organization of the meetings without teacher supervision gives rise to an overall pattern where each session can be understood in terms of three phases: an introduction, the core phase and a concluding phase. Some of the characteristics of students' interaction have been mapped and these include utterances like request for confirmation and phatics that can be understood as the equivalents of a smile or a nod where neither mouth nor head is actually visible, thus playing a predominant role as far as the social presence in the virtual classroom is concerned. Moreover, participants in these practices express concern over whether they are doing things right. If a student has problems with the audio modality and he/she has to use the chat-window inside the Adobe Connect environment, the communication tends to get less dynamic. Such delay in eliciting a response implies that there may be uncertainty about which medium they anticipate will be used by participants. The fluidity of the written and oral communication in face-to-face interaction is dis-preferred and instead members in these settings tend to communicate unimodally. Our analysis offers ways to understand this multilingual, unimodal communicative behavior.

References

Tudini, V. 2005. Chatlines for beginners: Negotiating Conversation at a Distance in Holmberg, B. 2005. Distance Education and Language: Evolution and Change. Clevedon: Multilingual Matters Limited at <http://site.ebrary.com/lib/dalarna/Doc?id=10110155&ppg=230>

Interdisciplinary design research: developing educational technology

Emma Mercier, Durham University, United Kingdom; Steven Higgins, University of Durham, United Kingdom; Liz Burd, Durham University, United Kingdom

As educators facing a global networked society, we recognize the need to develop high quality learning tools, that take advantage of advances in technology and our understanding of how people learn. However, we also recognize the documented difficulties encountered by interdisciplinary research teams, and how this has the potential to harm the development of these new tools. In this paper, we present three themes that may emerged from our own work designing technology-integrated classrooms. These themes, collaboration not cooperation, design research methods and decision making based on multiple disciplines and collaborative design, have the potential to support the interdisciplinary collaborative design of learning technologies.

Aims

Designing, studying and creating educational technology is, by its very nature, an interdisciplinary task, best achieved through an iterative design-research agenda (Goldman, DiGiano & Chorost, 2009). However, studies of interdisciplinary teams tell us that, while publications that result from collaborations can have an usually high impact (Panzarasa & Opsahl, 2008), research that spans multiple disciplines is at risk for not having any publications at all (Cummings & Kiesler, 2007). In this paper, we outline the research approach taken by the SynergyNet team, a research group focused on understanding and developing multi-touch technology for classrooms. This group spans computer science, education and psychology, reflecting the core disciplines necessary to develop and evaluate educational technology. In line with the conference theme, we will explore how the design research approach can be used to foster development of technology to support education for a global networked society.

Methodology

In this paper, we reflect on three themes which emerge through our research process, highlighting how each of these influences design decision, research directions and findings. Drawing on research about the science of team science (e.g. Stokols, Misra, Moser, Hall, & Taylor, 2008), and the design of educational technology (e.g. DiGiano, Goldman & Chorost, 2009), and participant observation of our own process, we will provide examples for each of the themes, and highlight how they can be used to support successful collaborative design of educational technology.

Findings

Collaboration, not cooperation

While interdisciplinary research is on the rise (Whitfield, 2008), the tendency can be for interdisciplinary research groups to function as separate teams, interacting within a 'trading zone' of shared meaning (Galison, 1997), before returning to their separate home disciplines. While this form of interaction facilitates understanding within the sphere of the project, and is identified as providing a useful space for an interdisciplinary team to function, there is little evidence to suggest it promotes transdisciplinary science, the form of interdisciplinary research associated with finding answers to novel questions (Rosenfield, 1992). Research into how students learn to design educational technology suggests that when they identify themselves as part of a cohesive team, they learn more and produce better learning activities, (Mercier, Goldman, & Booker, 2009) indicating the value of true collaborative engagement in the process, rather than the type of cooperative behaviour represented by Galison (1997). We draw on Bratman, (1992) to identify three features of interdisciplinary research collaborations that are necessary for the emergence of transdisciplinary science; namely mutual responsiveness, commitment to a joint goal and commitment to mutual support. Operationalizing these features when conducting design research in the field of educational technology results in the need to develop an attitude of attentiveness to each member of the team's actions, and response to the needs of the different disciplines, the identification of a common goal, and commitment to providing support to each other so that the goal can be achieved.

Design research methods

Design research, identified as a key method to bridge the scientific and practical demands of educational research (e.g. Brown, 1992), provides a structure within which findings from ongoing design and testing of these designs can be fed back into the design and research process, resulting in an iterative form of research, suitable for development of learning technology for formal education use. However, we also recognize the value of integrating traditional research methods, and answering smaller research questions through the process. This results in a process that holds the large research design structure as the driving force behind phases of the study, but integration of smaller, interesting questions, that have relevance to either the interdisciplinary questions, or the single disciplines represented in the team.

Decision making based on multiple disciplines and collaborative design

Our work also points towards the importance of collaborative design (Goldman, Mercier, & Booker, 2009), bringing multiple views to the design process, throughout the process, to inform the work. This results in continued consultation with teachers, researchers, designers, and learners at numerous stages of the design process. In this way, tensions between needs of the learners and teachers, limitations of the technology and research constraints, can be raised and incorporated into the process. In addition to direct collaboration with the various designers, researchers and users of this technology, we also recognize the importance of integrating existing research from multiple disciplines into our development process. From an education standpoint, the field of human-computer interaction provides a vast amount of research on how people interact with technology, creating an unparalleled starting point for those of us adapting or developing new technologies. By drawing on this literature, paying attention to how the findings relate to educational situations, we strengthen the tools that are being created, providing better ways of interacting with the technology, and thus, better opportunities for learning to occur (See Burd et al, under review, for an example of this process).

Significance

Education in a global networked society will require a new approach to the use of technology to support learning, and a new understanding of how interdisciplinary collaboration should function to develop these tools. In this paper, we present three themes that emerge from our interdisciplinary endeavor to create a multi-touch technology integrated classroom. The first theme, collaboration not cooperation, promotes the type of collaboration that should lead to transdisciplinary research, thus leading to a better understanding of how new technologies can be used for learning. The use of design research methodology, while also attending to more discrete research questions, allows for teams to continue to add to particular research domains, while being engaged in a longer-term project. Additionally, this feature eliminates the concern for low levels of publication from inter-disciplinary projects, and early career researcher's documented fear of engaging in such work due to fears that it will harm them within their primary field (Rhoten & Parker, 2004). Finally, by drawing on multiple fields and consulting teachers, students and researchers from different disciplines, the technology that is created for the global networked society can reflect best practices within all spheres, resulting in tools that are more valuable.

Exploring the impact of watching videotaped lectures on student academic performance in exams

Wanda Costen, University of Tennessee-Knoxville, United States

College students have a high degree of comfort with technology, and expect technology to play a large part in their learning environment. Research suggests that incorporating asynchronous web-based learning with face-to-face instruction can enhance student learning. This study was designed to measure the impact of using videotaped lectures posted to the course Virtual Learning Environment (VLE) of a traditional lecture course on student preparation for an exam in a hospitality human resources management course.

Introduction

Today's college students have grown up in the digital age with cell phones, personal digital assistants (PDAs), and computers. This means that today's college students have a high degree of comfort with technology, and expect technology to play a large part in their learning environment (Lowry and Flohr, 2004). As a result of this shift in students' technological capabilities, expectations, and the growing need for employees with digital skills, colleges and universities are pushing the use of technology. Vaidhyathan (2008) cautions however, that only a handful of first year college students understand "how the Internet fundamentally differs from the other major media platforms" (p. B7). Just because today's college students are comfortable texting messages and using Instant Messenger, and spend some of their leisure time playing video games, does not mean that they are truly technologically savvy or even comprehend how to use the available technology to help them learn. One of the ways to begin to leverage the value of technology on college and university campuses is to incorporate asynchronous web-based learning with face-to-face instruction (Garrison and Kanuka, 2004). Some research suggests that this approach can enhance student learning. One study (Tuckman, 2002), found that using a hybrid instructional model (ADAPT), which combined web-based and classroom components, significantly enhanced undergraduate student academic performance.

This study explores to what degree students use videotaped mini-lectures posted to the course Virtual Learning Environment (VLE) of a traditional lecture course to prepare for an exam. Additionally, this study is designed to uncover how using streaming video might help faculty provide additional resources that can deepen student learning. Specifically, this study was designed to address the following research questions:

1. Will students use videotaped mini-lectures posted to a course VLE to help them prepare for an exam?
2. Do videotaped mini-lectures posted to a course VLE help students prepare for an in-class exam?
3. How do videotaped lectures posted to a course VLE help students prepare for an in-class exam?

Methodology

This study was conducted in a required undergraduate human resources management course at a land grant university in the southeastern U.S. This is a traditional lecture course, and the students were primarily second and third year undergraduate students in the Retail, Hospitality & Tourism Management department.

During winter break 2007, the researcher video-recorded thirteen mini-lectures. Ten of the videos were under 6 minutes, and the longest video was almost 14 minutes. Each of the videos was uploaded to the course VLE, which contained separate links to each of the lectures.

After the exam was administered, the researcher conducted face-to-face, semi-structured interviews with each of the students who watched the videos. The interviews, which lasted 10-15 minutes, were conducted in the researcher's

office. The interviews were tape recorded and transcribed by a professional transcriber. The interviews were then coded using QDA Miner qualitative data analysis software.

Findings

The first research question addressed whether or not students would be interested in viewing online videotaped lectures to help them prepare for an exam. Based on the student response, this answer appears to be no. Only 20 of the 65 students (30.7%) in the course actually accessed the videotaped mini-lectures. Twelve of the eighteen participants mentioned that they spent more time studying for the exam than they would have without the online review sessions. One participant commented, "...I would not have hardly read my notes as much as I rewatched those videos". Another participant even remarked that the videotaped lectures actually encouraged her to study more, "Sometimes it kinda made me want to study more since I wasn't like had to read the book, because you get burnt out on reading the book". Yet another added, "It sorta forced me to go ahead and [start preparing for the exam], and that was very helpful in a very stressful week".

One of the most interesting findings was that the participants developed multiple study methods as a result of having the videotaped lectures available to them. Many students created their own study guides or took notes during the online lectures: "...just to be able to listen, and type, and just make me a study guide by what you were saying". Another commented, "I could go to my book or go to my class notes", while yet another mentioned, "I would listen to what you had to say and look in the book and re-read that information".

Finally, providing the video lectures online seemed to prompt the students to take an active role in preparing for the exam. Student participants indicated that they liked having control over which topics they were covering, and when they could study the online material. The findings also suggest that the student participants were engaged in meaningful learning. They were able to take the explanations and examples presented in the videotaped lectures and combine them with the knowledge they had already gained from in-class lectures and reading their text book, to prepare themselves to apply this knowledge to the situations presented on the exam.

Conclusion

The results of this study indicate that using videotaped lectures posted to a VLE website allowed student participants to take control over their learning process, and determine which resources were most valuable to them in preparing for an exam. The videotaped lectures also seemed to encourage these participants begin the exam preparation process earlier than they might have. Finally, the videotaped lectures seemed to help the student deepen their knowledge of the concepts. It is therefore in the faculty's best interest to discover ways of incorporating technology into their teaching methods.

How Do Online Distance Learners Work During Collaborative Writing Tasks?

Virginie Demeure, Universitat Autònoma de Barcelona, France; Margarida Romero, Esade, Spain; Niki Lambropoulos, LSBU, United Kingdom

Online distance learners are in majority adults with work and family constraints. They generally choose to engage in a virtual campus for the time flexibility that is offered through them but are often confronted with collaborative learning activities which, by increasing organizational efforts, reduce their individual time flexibility in proportion. Given this information, this paper argues that time is a major variable in Computer Supported Collaborative Learning (hereinafter CSCL) activities and proposes an assessment of students time use in these situations. The aim being to help instructional designers to propose an adequate temporal scripting to plan these kinds of more and more strewed educational activities. The case study presents an exploratory analysis of temporal patterns of 15 groups of students (n=66) involved in a collaborative writing task. Results reveal that (i) e-learners' time-on-task increased from the beginning of the activity, (ii) they work more during week days than during the weekend, and (iii) they tend to work during "conventional" hours of the day instead of working during early or late hours. The identification of these patterns is the first step toward the development of new methodologies and computer-supported tools able to enhance the temporal organisation and social aspects of CSCL.

Despite the large interest for Computer Supported Collaborative Learning (CSCL), in literature (Dillenbourg, Järvelä & Fisher, 2009; Stahl, Koschmann & Suthers, 2006), very few studies have examined the efforts required in regards to coordination when considering time as a focus variable (Gros, Barbera & Kirshner). This paper supports the idea that time is a major variable in CSCL activities, and that understanding the time factor in e-learning is important to help students succeed.

Indeed, several studies have shown the importance of time flexibility in a student's decision to enrol in an online course, but this individual flexibility is no longer a guarantee in collaborative learning contexts because of the increase in organizational effort. At the collective level, the realization of a task requires not only academic work from students but also organizational efforts to be able to coordinate their work on the task. Students must also find a shared time to discuss their work and decide who will do each part of the task. The more time students spend on coordination, the less remains for the learning task itself. Students' time use is thus valuable data for people trying to support collaborative e-learning activities. However, few studies focus on the time factor assessment in this kind of activities. We think that assessment of temporal patterns of e-learners' activities can provide us with essential information about how and when giving supports in CSCL and e-learning in general.

Temporal patterns have been largely used in working groups to describe their dynamics, but very few studies focused on the learning context in general and the CSCL contexts in particular. We argue that knowing how e-learners manage their time can enable researchers to better understand the learning process in CSCL, while enabling instructional designers and teachers to better adapt the temporal characteristics of learning activities (duration, milestones, synchronicity, etc.). The literature about temporal patterns is highly heterogeneous regarding the duration of the investigated patterns (from some seconds to decades). In our context, we choose to follow the recommendation of Cress (2008), and to study students' temporal patterns according to a multilevel model including task level, weekly level, and daily level. The task level includes the total duration of the academic task and is the least studied in literature. The second level explores the way students organize their time schedule for the week, with a particular interest in the differences between week days and weekends. Finally, the third level compares students' time-on-task during the daytime hours.

Data have been recollected during an authentic CSCL task conducted in an international context. During the collaborative tasks, groups of five students ($n=15$) were asked to write an article on the theme of CSCL on a Knol (wiki technology). Recollected Knols logs describe the type of contribution made by each group member, with its date and hour of publication. For our exploratory analysis, we considered the date of the contribution in relation to the beginning of the task, (day after the start of the activity), the day of the week when the contribution was made, and at what hour.

Results were analysed using within subject ANOVA, including groups of students as a between subject factor. As no group effects have been found in each of the three levels of analysis, the following results include all the students.

Firstly, at the task level, results reveal a main effect of longitudinal activity, [$F(2,46) = 13.09$, $p = .001$], and post-hoc test shows that students' time-on-task increased constantly until the deadline. The mean of participation on the Knol goes from 4.43 ($SD = .80$), at the beginning of the task, (days 0 to 10), to 10.93 ($SD = 1.65$), at the mid-point of the task, (days 11 to 21), $p = .001$, at the end of the activity, (days 22 to 32), $p = .004$.

Secondly, at the weekly level, results conducted on the basis of the participation mean of each participant during week days, (Monday to Friday), as well as weekend days, revealed one main effect on the days of the week, [$F(6,42) = 2.44$, $p = .04$, $\eta^2 = .005$]. Post-hoc tests show that e-learners tend to work more during week days, (mean = 5.36, $SD = 6.57$), than during weekend days, (mean = 3.07, $SD = 4.72$) [$F(1,47) = 7.15$, $p = .01$, $\eta^2 = .04$].

Finally, at the daily level, results reveal a main effect on the time period, [$F(5,43) = 7.61$, $p = .001$], and a post-hoc test showed that students tend to work more in the late morning, (10 a.m. to 1 p.m.), mean = 8.65, $SD = 1.52$, afternoon, (2 p.m. to 5 p.m.), mean = 9.41, $SD = 1.65$, and early evening, (6 p.m. to 9 p.m.), mean = 8.18, $SD = 1.48$, than in the early morning, (6 a.m. to 9 a.m.), mean = 4.15, $SD = 0.89$, (respectively $p = .001$, $p = .002$ and $p = .011$), the late evening (10 p.m. to 1 a.m.), mean = 1.31, $SD = 0.52$ (all $p < .05$ a.m.), mean = 0.27, $SD = 0.24$ (all $p < .05$).

These results tend to substantiate the fact that students spend the first part of the task on organizational concerns and start progressively to work on the academic task itself. They also show that e-learners, maybe due to their work and family constraints, avoid to work during weekends and non-conventional hours of work (i.e. early morning, night and late evening).

On this basis, we can recommend the use of tools facilitating the organizational phase in order to free up time for the academic task earlier in the fixed time of the activity. This measure could help students to succeed by increasing their time-on-task. Moreover, considering that e-learners used residual time for their academic tasks, better knowledge of their temporal patterns can also be useful to help them to free up time of better quality.

Learning and digital technologies: A reframing of the relationship

Judy M. Parr, University of Auckland, Faculty of Education, New Zealand; Lorrae Ward, CYPERUS, New Zealand

Integration of technology into education as a catalyst for change seemingly remains problematic. Computers have been largely a solution looking for a problem. In this paper we illustrate how technology can be a means by which schools can instantiate their educational philosophy and achieve particular goals or meet specific needs for student learning. We examine how the integration of technology into classrooms was given impetus by the provision of personal laptops for teachers. As part of a longitudinal evaluative study of the impact of teacher laptops, we identified from our larger sample, three case study schools, where technology had been embedded into practice. In each, we observed teaching and learning in a sample of classrooms, interviewing both students and teachers. The identified learning goals and needs were different in each school. However, digital technologies were an integral part of the solution in each: to enact invitational learning, the overarching philosophy in the first school; to enrich the learning experiences of students, the foremost aim in the second school and to promote language development, the goal of the third school. Across the schools, the teacher laptops had become a hub for technology-supported learning; a fundamental tool of the trade in classroom practice.

Aims

This paper is drawn from a longitudinal evaluative research project investigating the impact of the provision of portable computers to teachers in primary schools (5 - 13 year old students). Here we specifically consider pedagogical practice in three case-study schools; situating the role of digital technologies within the daily activities of classrooms.

Methods

The study employed a case study design; the bounded phenomenon was that of the teacher laptop in teaching and learning, particularly in the classroom. As a conceptual framework for viewing the thematic data gathered we utilised a simplified version of problem-based methodology (Robinson, 1993). Within this methodology, practice is viewed as a solution to a problem (goal or purpose) within a given context and set of constraints.

Participants

Three schools were selected from our wider sample of participant schools as we had discerned from earlier evaluation activities (surveys, visits, interviews) that the laptops and other technology were likely to be embedded in the school. Three classrooms within each school were purposively selected to represent the age range of children in the primary sector. These had been recommended by senior leaders as classrooms where technology was consistently used by teachers and students to support learning.

Data collection and analysis

Each case study school was visited for two or three days. In a sample of classrooms (n=9), we observed lessons and talked with students about the use of digital technologies. Where possible we asked students to show us samples of their work and tell us about the process of creation. We interviewed teachers about the classroom events we had observed and also about their learning and experiences with respect to technology. We obtained samples of student work, details of blog sites, of assignments and took copies of page dumps from the laptops to examine how teachers utilised their laptops and as an indicator of the range and extent of use. We held a semi-structured interview to discuss technology in the school and the teacher laptop program with both the technology leader and the principal. We also compiled an inventory of available technology and obtained copies of any policies pertaining to technology use.

A constant comparative analysis process (Glaser, 1965) was used to determine the central ideas and themes arising from the data. As an initial step, at the end of each day of observation, we reviewed our field notes, discussed emergent themes and ideas and cross-checked our inferences. A systematic, summative analysis of the data was then undertaken, looking for similarities and differences.

Findings

There were some strong commonalities across all three schools despite the contextual differences such as school demographics and infrastructure. First, each of the schools had a clearly articulated vision for learning. In one of the schools there was a focus on invitational learning; in another on promoting diverse and authentic learning opportunities and, in the third, specific emphasis on supporting and enriching the development of oral and written language in the third.

Second, in each school, the place and purpose of digital technologies was natural and unforced. They were part of a wide range of pedagogies and associated media employed, where appropriate, to meet student needs and to enrich their learning experiences. They were also ubiquitous in terms of planning and professional work.

Third, the teacher laptops were the hub for digital technologies; a central and indispensable tool for teaching and learning. They provided access to resources; links to the outside world and connection to a broad range of other tools and infrastructure. They were resource and student work repositories, communication tools and devices for teacher planning and preparation.

The findings from this study showed that when digital technologies are seen as part of the pedagogical solution to achieving a desired learning outcome they are readily embedded into practice. The use of digital technologies was not an end in and of itself in these schools; it was a means to a clearly articulated and shared vision for learning.

Educational significance

The vision of digital technologies as embedded classroom tools has long remained elusive. Despite, increased access to technology for students there appears to have been little change to the teaching and learning practices in many classrooms (Cox et al 2003; Hayes, 2007). Integration, the vision where technology is a seamless part of the educational environment, providing support for the type of learning experiences that engage students; experiences that are meaningful, relevant and intellectually stimulating (Bransford, Brown, & Cocking, 2003), has reportedly not happened except in isolated instances.

The significance of this study lies in its illustration of the importance of considering the use of digital technologies through a learning lens; both in terms of teacher practice and the study of that practice. The methodology employed specifically focused on classroom practice and on student learning rather than the use of technology. Likewise the teachers studied focused on student learning and pedagogy; the integration of technology flowed from this central concern. Critically, we uncovered more diverse types of use than had been anticipated from the data from the wider evaluation pertaining to these schools. The questions that should be asked both by researchers and practitioners are: what are the desired outcomes for students and what pedagogical tools, knowledge and resources will best achieve these outcomes? Digital technologies are likely to feature in both the answers and the solutions.

References

- Bransford, J.D., Brown, A.L., & Cocking, R.R. (2003). How people learning: brain, mind, experience and school. Washington, DC: National Academy Press
- Cox, K., Abbot, C., Webb, M., Blakely, B., Beauchamp, T., & Rhodes, V. (2003). ICT and pedagogy: A review of the research literature (A report to the DfES No 18). British Educational Communication and Technology Agency.
- Glaser, B. (1965). The constant comparative method of qualitative analysis in Social Problems Vol 12, Issue 4. California: University of California Press
- Hayes, D. (2007). ICT and learning: Lessons from Australian Classrooms. Computers and Education, 49, 385-395.
- Robinson, V.M.J. (1993). Problem-based methodology: Research for the improvement of practice. Oxford: Pergamon Press

Creating Personal Learning Environments with Open Educational Resources

Stefanie Panke, Ulm University, Germany; Tina Seufert, Ulm University, Germany

In the past ten years, the idea of educational material, freely and openly accessible on the Web, has attracted growing attention. Current research on Open Educational Resources (OER) usually focuses on benefits on the institutional and organizational level as well as models for the sustainable production and provision. To fully understand the concept's role in informal as well as institutional learning, we need to shift our attention towards the learners' use of OER. Information is everywhere; but how do learners actively make sense of their everyday information ecology? To adequately inform instructional design practice, we need empirical studies, training programs and theoretical frameworks that address effective self-organized learning strategies for open environments. The goal of the proposed round table is to discuss a research agenda that focuses on the individual learner in a tripartite, exploratory strategy: 1. What is the current level of OER-usage among formal and informal learners? 2. How do informal and formal learners create resp. enrich their personal learning environments with open educational resources? 3. What competencies students need to interact with open educational resources? With regards to methodology, the research design follows a mixed methods approach based on content analysis, qualitative interviews, observations and questionnaires. Initial data will be presented and discussed at the roundtable session.

Introduction

The term OER was coined in 2002 on a forum held by the UNESCO as „the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes". Since then, the concept has gained an undeniable momentum. In 2010, the Horizon report, which identifies emerging technologies likely to have a large impact on teaching and learning, described "Open Content" as a key trend, expected to reach mainstream within the next twelve months. In the fall 2010, the UNESCO initiated an international online discussion on OER-related topics. The "European Consultative group on Open Educational Practices" currently develops a roadmap towards quality management in OER.

Despite the substantial attention, a general consensus on the scope and classification of the term OER is yet to be found. Goertz and Johanning (2007) conclude from the analysis of selected OER-portals that their design is extremely heterogeneous. Also, numerous projects are in accordance with the goals of the OER movement, without explicitly referring to the label.

Aims

The aim of this research is to understand the use of open educational resources from the individual learner's point of view, adding a new perspective to the institutional or group focus of recent surveys (e.g. OPAL, 2010). What theoretical considerations account for the assumption that learners profit from OER in the first place? The theoretical framework can build on concepts such as learner autonomy (Bouchard, 2009), self-efficacy (Bandura, 1997), open-ended learning environments (Land & Hannafin, 1996) and cognitive flexibility theory (Spiro et al., 1992). OER provide the building-blocks to construct personal learning environments - and pose challenges to self-organized learners: Given that "the level of adoption of OERs into common teaching practices remains quite low" (De Liddo, 2010), many university students are unaware of open learning opportunities or struggle to negotiate and integrate open educational resources with the formal, institutionalized parts of their education. Informal learners, on the other hand, express difficulties with the lack of formal recognition and assessment components (Godwin and McAndrew, 2008). For both groups, the quantity of OER poses problems in itself - filtering what is useful and applies to the individual learner's needs can be a large task (Richards et al., 2010). Making effective use of OER in instructional contexts requires strategies to support coherence formation to integrate multiple representations from multiple sources (Seufert, 2003).

The research aims at (1) depicting the state of the art of OER usage in formal and informal learning, (2) categorizing learning strategies, (3) identifying the competencies necessary for effective use of OER.

Methods

The research design is exploratory and seeks to gather preliminary information to illuminate the phenomenon. For the roundtable, initial data from the following sources will be presented: User Models & User data of OER suppliers: The secondary analysis of qualitative data (OPAL, 2010; Helsdingen, Janssen & Schuwer, in press) as well as the systematic review of research literature, grey literature, and mailing lists, depicts current OER user models and user data. Learning Strategies of Informal Learners: The participatory observation of open educational practices serves to identify interview partners for gathering primary data on informal learning strategies. Learning Strategies of Formal Learners: Individual students' learning diaries (before and after receiving OER-trainings) serve as a starting point to systematize open educational practices within higher education settings. Competencies for Filtering and Coherence Formation: Thinking aloud protocols, screen recordings and questionnaires are used to observe the interaction of students with selected OER portals.

Outlook

Despite the considerable momentum of the OER movement, its impact is still limited. The mere availability of learning material does not mean that learning occurs. Shifting the focus from the resources to the learners' practices can help to stimulate and support students' integration of open educational resources into their learning environment.

References

- Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: Worth Publishers.
- Bouchard, Paul (2009). Some Factors to Consider When Designing Semi-Autonomous Learning Environments. *European Journal of E-Learning* 7, (2).pp. 93-100
- De Liddo, A. (2010). From Open Content to Open Thinking. In *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2010* (pp. 3178-3183). Chesapeake, VA: AACE.
- Godwin, S. & McAndrew, P. (2008). Exploring User Types and What Users Seek in an Open Content Based Educational Resource. In *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications* (pp. 3711-3718). Chesapeake, VA: AACE.

Goertz, L. & Johanning, A. (2007). OER – Deutschlands Hochschulen im internationalen Vergleich weit abgeschlagen? M. Merkt, K. Mayrberger, R. Schulmeister, A. Sommer & I. van den Berk (eds.). *Studieren neu erfinden – Hochschule neu denken* (pp. 253-263). Mynster: Waxmann.

Helsdingen, A.S., Janssen, B. Schuwer, R. (in press). *Business Models in OER, a Contingency Approach*. OpenEd Conference 2010, Barcelona.

Land, S.M., & Hannafin, M.J. (1996). A conceptual framework for the development of theories-in-action with open-ended learning environments. *Educational Technology Research & Development*, 44 (3), 37-53.

OPAL (2010). OER Case studies. <http://cloudworks.ac.uk/cloudscape/view/2085>

Richards, G., Marshall, S., Elias, T., Quirk, D., Ives, C. & Siemens, G. (2010). *Developing University Courses with OERs*. In *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2010* (pp. 1069-1073). Chesapeake, VA: AACE.

Seufert, T. (2003). Supporting coherence formation in learning from multiple representations. *Learning and Instruction*, 13, 227-237.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1992). Cognitive flexibility, constructivism and hypertext. In T. Duffy & D. Jonassen (Eds.), *Constructivism and the Technology of Instruction*. Hillsdale, NJ: Erlbaum.

Mobile Phones and Learning: Disruptive or Constructive?

Jocelyn Wishart, University of Bristol, United Kingdom

Whilst research shows mobile phones offer opportunities to support constructive learning in and across a range of context including classrooms, schools are more likely to ban them as potentially disruptive devices. As phones such as the Samsung Beam with inbuilt pico-projectors enabling them to project images on nearby walls or screens become more widely available we have ever more challenging learning opportunities to look forward to. Yet we are in danger of losing such opportunities through collective fear of cyberbullying and irresponsible use by pupils of a technology whose potential their teachers haven't been given time to fully explore. The proposed round table will bring researchers together to debate and share evidence to assess whether this is a sad reflection on the state of current education systems in the 'knowledge age' or a challenge that can be easily addressed through education for 'knowledge age' skills and to consider how this can be achieved. The discussion will address previous and current research into learning and instructional technology that can underpin the proposed focus on supporting young people to develop ethical and responsible practices for the use of personal, mobile devices including phones so that they can be deployed to their full potential in educational situations.

In a number of countries, especially those where information and communications technology (ICT) provision in schools is inconsistent or poor, teachers are turning to the use of mobile devices such as the students' mobile (cell) phones to support teaching and learning. For example, Vanska (2010) describes a project supported by Nokia where over 4,000 South African secondary school students are engaged in learning maths via tutorials and practice sessions that run on their mobile phones. The students' learning and engagement are supported via a Moodle mobile interface and a social networking via Mxlt, a very cheap 'chat' tool. Ekanayake & Wishart (2010) describe a much smaller project where teachers in four secondary schools in Sri Lanka designed science lessons centred on the pupils' use of mobile phones to support their learning. In particular mobile phones appear to offer students the ability to construct their learning by building on information captured (and often shared) across a range of contexts (Wishart, 2007). Whilst the above two projects differ massively in scale, they share a common finding in that the teachers are delighted with their students' response to the initiative. Yet, in secondary schools in the UK, use of mobile phones by students is more likely to be banned than celebrated. In December 2007 England's Children's Minister, Kevin Brennan, backed by the general secretary of a teaching union, urged parents not to allow their children to take their Christmas toys, such as mobile phones, to school (BBC News, 2007). Whilst there are some 'pockets of potential' particularly associated with science teaching such as the Personal Inquiry (PI) project being run by the Open and Nottingham Universities (Anastopoulou et al, 2009) and the Participate project at the University of Bath (Woodgate et al, 2007), these involve handheld data capture tools and netbooks rather than ordinary phones. Even the successful, district wide Learning2Go project run in 18 Wolverhampton schools relies on personal digital assistants (PDAs) customised for teaching and learning. The assumption, prevalent in UK schools, that mobile phones are disruptive devices led teacher trainees to feel reluctant to explore the potential of handheld PDAs loaned to them by their University to support their teaching and learning (Wishart et al, 2007). Their pupils were assuming the PDAs were phones. Similar issues occurred in the ALPS project with nurse trainees who were reprimanded by clinical staff, including their assessors, whilst legitimately using mobile devices for data entry in clinical settings. Patients too, apparently reported their nurses for 'texting' whilst on duty (Sandars and Dearnley, 2009). However, Hartnell Young and Heym (2008) found three secondary schools in England prepared to explore how mobile phones could help learning despite having policies banning their use in class. This led to the identification of 15 key activities where mobile phones could be used

successful to support learning. The use of the phone's camera was particularly helpful to capture one off events and experiments for later revision and review. Hartnell Young and Heym (2008) conclude that schools need to revisit their policies and consider shifting the focus of policy away from the devices themselves to consider the frequently-reported reasons for which mobile phones are banned: fear of distraction in class, cheating, inappropriate recording of students and teachers and publication on sites like YouTube.

As phones such as the Samsung Beam with inbuilt pico-projectors enabling them to project images on nearby walls or screens become more widely available, as does reliable and affordable connectivity, we have ever more exciting and engaging learning opportunities to look forward to. Yet we are in danger of losing such opportunities through collective fear of cyberbullying and irresponsible use by pupils of a technology whose potential their teachers haven't been given time to fully explore. Already state boards like those in New York and Toronto and even countries such as India, Brunei and Sri Lanka are banning mobile phones outright in schools, blaming irresponsible use by students. The proposed round table will bring researchers together to debate and share evidence to assess whether this is a sad reflection on the state of current education systems in the 'knowledge age' or a challenge that can be easily addressed through education for 'knowledge age' skills and consider how this can be achieved. The discussion will address previous and current research into learning and instructional technology that can underpin the proposed focus on supporting young people to develop ethical and responsible practices for the use of personal, mobile devices including phones so that they can be deployed to their full potential in educational situations.

References

- Anastopoulou, S., Sharples, M., Ainsworth, S., Crook, C. (2009). Personal Inquiry: linking the cultures of home and school with technology mediated science inquiry. In Pachler, N., Seipold, J. (Eds.) 'Mobile learning cultures across education, work and leisure.' Proceedings of the 3rd WLE Mobile Learning Symposium, London, 27th March 2009. Published by the WLE Centre, March 2009. ISSN 1753-3385
- BBC News, (2007) Keep Christmas gadgets 'at home'. Available from <http://news.bbc.co.uk/1/hi/education/7156326.stm> [Accessed 29/10/10]
- Ekanayake, S. and Wishart, J. (2010) Using mobile phones in implementing science lessons: teachers' pedagogical practices. Proceedings of MLearn 2010, Valletta, Malta, 32-39.
- Hartnell-Young, E. and Heym, N. (2008) How mobile phones help learning in secondary schools. Coventry: Becta
- Sanders, J. and Dearnley, C. (2009). Twelve tips for the use of mobile technologies for work based assessment, *Medical Teacher*, 31, pp. 18–21.
- Vanska, R. (2010) Sustainable, Scalable and Affordable Mobile Learning. Paper presented at MLearn 2010, Valletta, Malta.
- Wishart, J. (2007) The Seven Cs – No Eight, Nine Cs of M-Learning. Paper presented at Kaleidoscope Alpine Rendez-Vous, Villars, Switzerland. January 2007.
- Wishart, J., Ramsden, A. and McFarlane, A. (2007) PDAs and Handhelds: ICT at your side and not in your face *Technology, Pedagogy and Education* 16(1), 95-110.
- Woodgate, D., Stanton Fraser, D. and Crellin, D. (2007) "Providing an 'Authentic' Scientific Experience: Technology, Motivation and Learning". Proc. Workshop on 'Emerging Technologies for Inquiry-Based Learning in Science'. 13th International Conference on Artificial Intelligence in Education, 'Shaping the Future of Learning Through Intelligent Technologies', Marina Del Rey, CA.

ROUND TABLES

Merging and Crossing Knowledge Domains in Collaborative Design for Networked Learning

Yael Kali, University of Haifa, Israel; Lina Markauskaite, University of Sydney, Australia; Peter Goodyear, University of Sydney, Australia; Mary-Helen Ward, University of Sydney, Australia

Designing networked learning materials requires merging of technological, pedagogical, and content knowledge domains. Multiple-expertise collaborations are often regarded as a solution, however, such collaborations may involve challenges resulting from different ways of thinking between technology and pedagogy experts. The current research examined the collaborative design process of three teams who were part of an initiative to develop high-level networked learning materials within a university setting. Using an ethnographic case-study approach, we found that in all three teams: (1) participants suggested design solutions only after extensive group exploration of the pedagogical-content aspects of the problem, and the technological considerations it entails, (2) design decisions were made in a balanced process in which both academic team members and eLearning designers were equally involved, (3) participants appreciated each other's expertise and used the team-meetings to learn from their colleagues about

aspects of the design challenge they were not aware of, and (4) participants crossed their domain of expertise, and carefully provided ideas that were not in their own domain. The success of the three teams in designing solutions that were based on their shared knowledge is explained in light of the process of the university initiative.

Introduction

Designing networked learning materials requires merging of knowledge from several different domains. Mishra and Koehler (2006), who studied how teachers cope with this challenge, claim that three major knowledge domains are involved: technology, pedagogy content. They describe a unique type of knowledge merging the three, which they name Technological Pedagogical Content Knowledge (or TPCK).

Naturally, when major design endeavours are at hand, and when the knowledge domains involved require high-level expertise, people prefer to work in collaborative teams. There are many advantages in such collaborative design efforts, however, some major challenges have been documented. diSessa, Azevedo, & Parnafes (2004), for instance, note that in teams of educators and technologists, there might be cultural gaps that hinder the collaboration, and that educators tend to have a smaller contribution to the collaborative design effort.

The current research examined the collaborative design work of three teams who were part of an initiative to develop high-level networked learning materials within a university setting (Ward, Atkinson, & Peat, 2010). Each team came from a different knowledge domain (Nursing, Social-work and Health-science), and consisted of a few academic staff-members (domain experts) and one or two non-academic staff-members (eLearning design experts). The goal of the research was to decipher what makes a collaborative design process a productive one.

Method

We observed about 90% of the teams' meetings over a course of four months, in which a major part of the design work was conducted. Our data includes audio-taped team-meetings, observation-notes, team e-mails, and some interviews.

We followed an ethnographic case-study approach to: (a)choose the episodes to analyze, (b)develop and refine a coding scheme, (c)code the data and (d)develop our claims. Our coding scheme combined two frameworks. The first is Mishra & Koehler's TPCK, which enabled us to characterize participants' contributions in terms of the type of knowledge they brought to the collaboration. The second framework – shared epistemic agency - enabled us to distinguish between different types of collaborative knowledge-building activities in the group such as seeking information, sharing ideas, structuring ideas and producing ideas (Damsa et al., 2010).

Findings

Our analysis revealed four unique characteristics of the collaborative design process in each of the three teams:

1.Participants did not attempt to provide solutions before they had a good understanding of the pedagogical-content and technological challenge they were faced with, as is exemplified in Figure-1. (The figure represents the collaborative design process that took place in one of the team meetings. The horizontal axis shows a timeline of about one hour, each tick showing one saying of a team-member. The vertical axis represents accumulation of T, PC and TPC knowledge within the team. Each contribution of a piece of knowledge is counted as one arbitrary unit, and knowledge is viewed as accumulating within the team). The gradual rise of the three lines in Figure-1 indicates that the progression of design ideas was associated with extensive T and PC knowledge sharing.

2.Design decisions were made in a balanced process in which both academic team members and eLearning designers were equally involved. This is exemplified in Figure-2 by the interchange of red and blue light-bulb icons, representing design ideas suggested by academics and eLearning designers.

3.Participants appreciated each other's expertise and used the team-meetings to learn from their colleagues about aspects of the design challenge they were not aware of. This was evident in many instances in which participants seek knowledge either in their own domain of expertise or in the others' domain. See for example the question-marks in figure-2 representing seeking of knowledge by both academics and eLearning designers.

4.In some instances, participants crossed their domain of expertise, and carefully provided ideas that were not in their own domain. This was usually followed by feedback from a domain expert, and was a productive way to move the discussion forward. See for example the red exclamation mark (representing an academic team-member sharing knowledge) on the blue line (representing technology knowledge), and blue exclamation mark on the red line.

Discussion

Despite the challenges described in the literature regarding collaborative design, the three teams that we observed were highly successful in designing solutions that were based on a growing body of knowledge within the team, which was pretty equally contributed by the academics and the eLearning designers. The question is why? What was there in the specific settings of these three teams that enabled them to succeed so well where others have failed? We believe that the answer is in the thought-out process of the university initiative which these teams were part of (Ward et al., 2010).

We see at least two aspects of this process, which might have contributed to the mutual appreciation that academics and eLearning designers had to each other's expertise. First, the eLearning designers are carefully chosen with a significant pedagogical background. Second, the projects are chosen via an extended application and planning period, in which expert committees help to articulate and prioritise projects. We think that in this way only academic teams that have a good sense of what they can expect from the technology are chosen. These two aspects of the process probably helped minimize 'cultural gaps' and enabled the mutual respect that we found in our analysis.

Concluding remarks

Combining the TPCK and the shared epistemic agency frameworks help to shed light on the complex process of collaborative design for networked learning. The full paper will elaborate on our findings and practical implications, discuss the limitations of this study and directions for future research.

References

- diSessa, A.A., Azevedo, F.S. & Parnafes, O. (2004). Issues in component computing: A synthetic review. *Interactive Learning Environments*, 12, 109-159.
- Damsa, C.I., Kirschner, P.A., Andriessen, J.E.B., Erkens, G. & Sins, P.H.M. (2010). Shared epistemic agency: An empirical study of an emergent construct. *Journal of the Learning Sciences*, 19(2), 143-186.
- Mishra, P. & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.
- Ward, M.H., West, S., Atkinson, S. & Peat, M. (2010). Making it real: Project managing strategic e-learning development processes in a large, campus-based university. *Journal of Distance Education*, 24(1) 21-42.

Introducing planning in socio-constructionist activities in Environmental Education, Maths, Physics

Nikoleta Yiannoutsou, Educational Technology Lab, University of Athens, Greece; Maria Daskolia, University of Athens, Environmental Education Lab, Greece; Foteini Moustaki, University of Athens, Educational Technology Lab, Greece; Chronis Kynigos, University of Athens, Educational Technology Lab, Greece; Zacharoula Smyrniou, National Kapodistrian University of Athens, Greece

We describe here a research that focuses on the study of planning in constructionist learning environments that involve concepts related to environmental education, mathematics, and physics. We focus on constructionist activities because we consider them a different case for planning from those presented in the literature. Constructionist activities integrate self regulation and what we call emergent planning. We conducted a study with eleven secondary teachers to observe them as learners that plan their constructions and discuss the role of planning with them as reflective practitioners. Our findings show that planning took place during the enactment of the activity and not before and had a mainly reflective and not an "organizing" role for the task.

Planning has been addressed as an element, among others, of self-regulated learning (SRL) or as one of the three phases of cognitive regulation (along with monitoring and evaluation) and it has been described as a general domain metacognitive skill (Schraw 2007). In many studies planning is part of a broader research on self regulated learning and no special emphasis has been placed on it. We identify five main trends in research in self regulated learning a) on factors that influence self regulated learning such as personal epistemologies, motivation, characteristics of the task, discipline (VanderStoep 1996), b) on research and evaluation of self regulated learning and c) on tools that can support self regulated learning with special emphasis on technology based support (for a review see Schraw *ibid*) and d) on the role of self regulated learning in domain specific learning such as maths, (Labuhn et al 2010) reading comprehension etc, and in computer based learning which is the focus of our study also. The emphasis in computer based learning is documented upon the argument that the personal learning styles and the independence in learning require more than ever self-regulatory skills (see for example Strömsö & Bråten 2009 with emphasis on internet based learning) Most of the studies that focus in SRL in computer based environments involve cscl environments, internet based learning, hypertext or hypermedia environments but we found no reference to constructionist environments (i.e. microworlds). Constructionism, which could be considered as a branch of constructivism (Ackermann 2001) as it shares the view of building knowledge structures through progressive internalization of action adds that learning can take place more felicitously if learners are engaged in constructing a public entity (be it a computer model or a sand castle) with

personal meaning (Papert 1991). What makes constructionist activities an important aspect of study is the role of planning during this construction. As Papert claims (1993) learning in computer based constructionist environments (microworld) does not require a detailed planning but the learners can start with a vague idea of what they are going to do. In this case planning is an emergent process which evolves along with the construction informed by the task related feedback offered from the microworld. This seems to be a quite different learning situation from those described with the tools mentioned before. Taking into account that planning in this case is emergent and sometimes it is difficult to be made beforehand because the process of construction is dynamic, it is changing and evolves through the interaction with the microworld we formulated a Research Question that focused on how planning could be used in constructionist activities and apart from the emergent step by step plans that seem to formulate during construction is there place for a more general plan that includes them all?.

Method and research process

To make planning a specific task for the participants of our study we introduced a planning vocabulary consisting of twenty two concepts such as hypothesis forming and testing, discussion, observation, experimentation etc and by 2 types of concept relationships: dependent relationships, alternate relationships. The participants were informed that they could create their own concepts or relationships if those available were not sufficient for their planning. We report here on a study with 11 secondary teachers specialized in mathematics (4), physics (2) and environmental education (5). We used teachers in this phase of our study because we wanted not only to observe learners during the planning process but also to record their point of view about planning as experts. Participants formed 4 groups of two and one group of 3. Two groups worked with a microworld in 3d mathematics, one group worked with a microworld in 3d physics and two groups worked with a microworld in environmental education (focusing on issues of sustainability). All participants were familiar with constructionist environments and constructionist learning. In each group there was at least one person who was familiar with the task at hand and had the role to explain it to the other member(s) of the group. The data collected include: observational notes of group discussions and assembly discussions, the concept maps of the planning process created by the participants and the responses to the questionnaires distributed.

Findings- Final Remarks:

All plans contained task free information. Two out of the six plans were linear, the rest contained alternatives and loop relationships. The most concepts that were more frequently used were "discussion" "experimentation" "observation" and "Reflection". Planning took place during the enactment of the activity and not before. The planning vocabulary was used as a reflection tool and not as a driving force on how to organize the work on the task. Teachers in one group said that the planning vocabulary helped them to think more deeply on the teaching process because it allowed them to focus on the details of the task and on the functionalities of the microworld. These findings suggest that the role of planning in the self regulation process of learning can take a different form according to the characteristics of the learning environment.

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References

- Ackermann, E. (2001). "Piaget's Constructivism, Papert's Constructionism: What's the difference?", In *Constructivism: uses and perspectives in education*. (Volumes 1 & 2). Conference Proceedings, Geneva: Research Center in Education, pp 85-94.
- Labuhn, A. S., Zimmerman, B. J., Hasselhorn, M., (2010). Enhancing students' self-regulation and mathematics performance: the influence of feedback and self-evaluative standards. In *Metacognition and Learning* 5 (2), 173-194
- Papert, S. (1991). *Situating Constructionism*. In I. Harel & S. Papert (eds) *Constructionism*. (pp 1-12). New Jersey: Ablex Publishing Corporation.
- Papert, S. (1993) *The children's machine. Rethinking School in the Age of the Computer*. BasicBooks, A Division of HarperCollins Publishers, Inc. New York
- Schraw G., (2007). The use of computer-based environments for understanding and improving self-regulation. In *Metacognition and Learning*, 2 (2-3), 169 – 176
- Strömsö H.I., Bråten I., (2010) The role of personal epistemology in the self-regulation of internet-based learning. In *Metacognition and Learning*, 5: 91 -11
- VanderStoep, S., Pintrich, P. R., and Fagerlin, A. (1996). Disciplinary differences in selfregulated learning in college students. In *Contemporary Educational Psychology*. 21: 345–362.

A study of the relationship between meta-cognitive knowledge on essay writing and essay score

Aims of this research is to examine

1)the structure of meta-cognitive knowledge on Japanese college students' essay writing based on questionnaire survey

2)the relationship between the importance of each dimension on meta-cognitive knowledge and essay score.

Participant was 119 undergraduate students(98 freshmen, 5 sophomore, 10 junior, 6 senior; mean age=19.4) and they conducted the following two tasks; writing assignment about their participation in part-time job outside universities(in about 600 characters in Japanese) and questionnaire about the meta-cognitive knowledge on essay writing. Results showed that three factors emerged on meta-cognitive knowledge and that the dimension about readability of one's text produced was significantly correlated with "organization" of the text.

Introduction

Essay writing is one of the very complex and tough task even for college students in Japan. Promoting their essay writing skill is one of the most important things. In considering this, differences between expert(good) and novice(basic,or poor) writers on their writing activities is the central issue. Several studies have examined this theme. Bereiter and Scardamalia(1987), for example, found that experts could transform ideas from long term memory into what they wanted to say correctly and fluently("knowledge transforming"), while novice could not. Another study also showed the difference between them. Flower, Schriver, Carey, Haas, and Hayes(1993) pointed out that experts could select ideas and expressions considering readers and contexts in which the text was read. Considering the result of their findings, it would be assumed that writers have some kinds of meta-cognitive activities based on their meta-cognitive knowledge about essay writing, as Flower & Hayes(1980) pointed out.

However, little is known about how the content and structure of meta-cognitive knowledge they have is like, how it relates with essay scoring. In this study the followings were examined.

Aims

Aims of this research is to examine

1)the structure of meta-cognitive knowledge on Japanese college students' essay writing based on questionnaire survey

2)the relationship between the importance of each dimension on meta-cognitive knowledge and essay score

Method

Participant was 119 undergraduate students(98 freshmen, 5 sophomore, 10 junior, 6 senior;mean age=19.4). First, writing assignment was conducted. They were asked to write an essay about their participation in part-time job outside universities in about 600 characters in Japanese (about 250 words in English). Then, one week after the writing assignment, questionnaire about the meta-cognitive knowledge on essay writing was administered, which is consisted of 46 items related to what one does on during essay writing (e.g."I will pay attention to the context of my text produced"). Items were collected from several high-school "kokugo" (Japanese) textbooks (Kiri-hara-shoten,2007;Meijishoin,2007; Sanseido,2007;Sukenshuppan,2007a,2007b;Taishukan,2007a,2007b and Tokyo-shoseki, 2007). They were asked to mark the circle in each item about how they think it is important in writing activities in 7 point scale(1=strongly disagree, 7=strongly agree).

Results

The following data analyses were administered; factor analysis, essay scoring, and the relationship between scores of the importance on meta-cognitive knowledge in each factorial dimension and essay score.

1)Factor analysis

Exploratory factor analysis on meta-cognitive knowledge was examined and three factorial dimensions emerged; "Clarity of one's own ideas"(a=0.92),"Readability of the text produced "(a=0.92), and "Rules of the text production"(a=0.78).

2)Essay scoring

Their Essay produced was scored by JESS(Automated Japanese Essay Scoring System, like e-rater in the U.S.) from three dimensions;"rhetoric","organi-zation",and "content" in 6 point scale(from 0 to 5;0 is the lowest and 5 is the highest).

3)Correlation between factorial score and essay score

Scores of the importance on meta-cognitive knowledge in each factorial dimension was calculated by adding up all of the score participant marked. Then, correlation coefficient between score on the importance of meta-cognitive knowledge and essay score, which resulted in the significant correlation between "Readability of the text produced to other readers" and "organization" ($r=.29$)

Conclusion

In this study, significant correlation between "Readability of the text produced to other readers" and "organization" emerged, which implies some relationship between them. In "Readability of the text produced to other readers" dimension, items related to the better organization of the text (e.g. "I will pay attention to the context of my text produced") were included, which was assumed to lead such results. Considering this, it would be possible to predict "organization" skill from the questionnaire score. However, no significance emerged between other two dimensions on meta-cognitive knowledge and the rest of essay score ("content" and "rhetorical"), so item collection related to content and rhetorical dimensions and elaboration of the factorial dimension related to essay scoring would be required in my future research.

Writing in Bidialectal Settings and the Challenges Posed to Immigrant Pupils

Filio Constantinou, University of Cambridge, United Kingdom

The language of schooling poses a challenge to children, especially second language learners and non-standard speakers (Gibbons, 2006; Schleppegrell, 2004). This challenge becomes even more daunting for immigrant bidialectal pupils (i.e. second language learners concurrently exposed to a non-standard variety), who have to familiarise themselves with the conventions of the school register while developing competence in the second dialect of a second language. This study (work in progress) will explore, in particular, the writing challenges which these pupils are confronted with and is expected to provide policy-makers and practitioners with important guidelines with respect to the language education of a growing but still under-researched group of non-mainstream pupils. The project will adopt a mixed-methods approach to the investigation of pupils' written performance and will be conducted in Cyprus which, due to its bidialectal and increasingly multilingual character, constitutes an ideal setting for this research. The round-table discussion will focus on issues pertaining to the analysis and interpretation of the data.

The language of schooling, that is, the register which pupils are expected to employ when completing school-based tasks, differs from the conversational language typically used for social purposes outside the classroom (Gibbons, 2006; Schleppegrell, 2004). Consequently, its mastery poses a challenge for children who are normally not accustomed to constructing meaning using the linguistic structures favoured by the school register. This challenge becomes more daunting for non-mainstream pupils, such as second language learners and non-standard speakers, who have to familiarise themselves with the conventions of the new register while developing competence in a second language and a second dialect respectively.

The students, however, likely to face greater difficulties operating in the language of schooling, are the second language learners concurrently exposed to a non-standard variety. These pupils, namely immigrants attending schools in bidialectal communities (i.e. communities the members of which communicate through the means of two genetically related but functionally compartmentalised linguistic varieties, a standard and a non-standard one, see Ferguson, 1959/2003), need to develop competence not only in the school register but also in the educational variety, a variety which in reality is the second dialect of their second language. Despite their unique linguistic circumstances, these pupils – henceforth 'immigrant bidialectals' – are nevertheless still been considered under the general heading of 'immigrants' or 'second language learners' which inevitably results in their distinctive school-based linguistic needs remaining unacknowledged and thus unaddressed. In light of this, the current study will attempt to explore and expose the linguistic challenges which these pupils are confronted with at school. It will focus in particular on their written performance, as writing is itself a demanding skill – it is formally learnt rather than naturally acquired – and a domain exclusively occupied by the standard variety, pupils' second dialect. What legitimises and necessitates this inquiry into immigrant bidialectals' school-based written production is the fact that the ability to manipulate the language of schooling is a component of 'academic language proficiency', the inadequate development of which has been associated with the school underachievement which immigrant children often exhibit (Cummins, 2000).

The study will be conducted in Cyprus and will sample twelve-year-old pupils who are in their final year of primary schooling. Cyprus has been chosen as the context of the research for two main reasons. Firstly, its increasingly diverse linguistic landscape is in line with the sampling requirements of the project. In particular, it is bidialectal as Cypriots use two domain-specific genetically related varieties to communicate, Standard Modern Greek (i.e. the educational and written variety) and the Greek Cypriot Dialect (i.e. Cypriots' mother tongue) (Karyolemou & Pavlou, 2001; Pavlou & Papapavlou, 2004; Sciriha, 1996), while at the same time it hosts large numbers of immigrants who do not have

Greek as their first language (Hadjioannou, 2006; Panayiotopoulos & Nicolaidou, 2007; Papapavlou, 2003). Secondly, it provides a very interesting setting for studies focusing on the education of nonstandard-speaking populations, as its educational system tends to treat Cypriots – and consequently the immigrant pupils who attend Cypriot schools – as being monodialectal (Yiakoumetti, 2006). This linguistic and educational status quo necessitates the conduct of the current study, the findings of which are expected to have important implications for educational policy and practice. The issues under investigation will be examined by means of a two-phase mixed-methods design, the implementation of which is scheduled to commence in November 2010. The qualitative phase is expected to facilitate the in-depth exploration of immigrant bidialectals' school-based written language, while the quantitative phase will enable the emergence of its salient characteristics. The design involves mainly writing tasks which will cast light on pupils' actual written production as well as editing tasks aimed at yielding an insight into the participants thinking processes and perceptions about the workings of the school-based written language.

The round-table discussion will focus on the analysis and interpretation of the data. The potential sources of non-standard occurrences, the degree to which dialect interference can be held responsible for such non-standard instances and selecting the most appropriate methods of measuring aspects of pupils' written language, are some of the issues which will be brought forward for discussion.

List of References

- Cummins, J. (2000). *Language, Power and Pedagogy*. Clevedon: Multilingual Matters.
- Ferguson, C. (1959/2003). Diglossia. In C. B. Paulston, & G. R. Tucker (Eds), *Sociolinguistics: The Essential Readings* (pp. 345-357). Oxford: Blackwell.
- Gibbons, P. (2006). *Bridging Discourses in the ESL Classroom: Students, Teachers and Researchers*. London: Continuum.
- Hadjioannou, X. (2006). Linguistic Variation in Greek Cypriot Elementary Education. In W. Wiater, & G. Videsott (Eds), *School Systems in Multilingual Regions of Europe* (pp. 395-413). Frankfurt am Main: Peter Lang.
- Karyolemou, M., & Pavlou, P. (2001). Language attitudes and assessment of salient variables in a bi-dialectal speech community. In J. Fontana, L. McNally, T. Turell & E. Valldurí (Eds.), *Proceedings of the first international conference on language variation in Europe* (pp. 110–120). Barcelona: Universitat Pompeu Fabra.
- Panayiotopoulos, C., & Nicolaidou, M. (2007). At a crossroads of civilizations: multicultural educational provision in Cyprus through the lens of a case study. *Intercultural Education*, 18 (1), 65-79.
- Papapavlou, A. (2003). Linguistic, educational and social aspects of bilingual children in primary schools in Cyprus. *Studies in Greek Linguistics*, 23, 301–312 [Original in Greek].
- Pavlou, P., & Papapavlou, A. (2004). Issues of dialect use in education from the Greek Cypriot perspective. *International Journal of Applied Linguistics*, 14 (2), 243-258.
- Schleppegrell, M. J. (2004). *The Language of Schooling: A Functional Linguistics Perspective*. Mahwah, NJ: Lawrence Erlbaum.
- Scirha, L. (1996). *A question of identity: Language use in Cyprus*. Nicosia: Intercollege Press.
- Yiakoumetti, A. (2006). A Bidialectal Programme for the Learning of Standard Modern Greek in Cyprus. *Applied Linguistics*, 27 (2), 295-317.

Teachers' professional learning. Examining "communities of practice" as conceptual and methodologica

Leif Christian Lahn, University Of Oslo, Norway; Kirsti Klette, University Of Oslo, Norway

In recent years "community of practice" (CoP) and similar concepts has become increasingly popular when understanding professional learning among teachers or designing programs for personal development in schools. The purpose of the present paper is to question theoretical assumptions underlying this framework through a secondary analysis of a Norwegian study and a selective review of relevant literature. In our summary we conclude that teachers receive very little feedback on their classroom performance – either from colleagues or school leaders. Thus a community of mutual support reinforced norms of presentism and weakly developed routines for critical inquiries that could make a difference to class-room practices. Compared with our selected literature these findings have to be nuanced as the role of school management, recent educational policies of accountability, and the strength of subject affiliation between teachers at different school levels are intervening factors. In favouring interpretative schemes that highlight interactive patters that stabilize the social setting (the "community") CoP researchers tend to leave out external contingencies (institutions, knowledge domains, "global ideas") and internal contingencies (individual/collective agency, conversational routines etc.) that could be sustaining trajectories of participation. The paper argues in favour of a multi-level and longitudinal approach to studies of teachers' professional learning.

Objectives

In recent years "community of practice" (CoP) and similar concepts has become increasingly popular when understanding professional learning among teachers (Little,2002; Talbert&McLaughlin, 2002; Shulman & Sherin,2004, Orland-Barak,2006) or designing programs for personal development in schools (Borko, 2004; Kazemi& Franke,2004). The purpose of the present paper is to question theoretical assumptions underlying this framework – or a more loosely structured conceptual terrain that we refer to as CoP. We accept the legacy of a communitarian understanding of teaching, but through a secondary analysis of a Norwegian study and a selective review of relevant literature we have identified three elements that need to be addressed when studying teachers' professional learning in their work-place setting; the institutional context, teachers' content knowledge and mediating artefacts, and finally discursive practices within teaching communities. In this paper we argue that these tend to be absent in analyses inspired by CoP.

Theoretical framework

The concept of "community of practice" has served as a rallying point for a large variety of attacks on rationalistic approaches to human development. The prevalent cognitive perspective on expertise was replaced with a metaphor of legitimate participation in a practice and learning as changes of identities as novices moved along trajectories into full membership in their community (Lave,1988;Lave&Wenger, 1991). Very different professional systems and cultures were referred to as "community of practice". CoP has paved its way into the research on schools and teachers work (Little, 2002), taking it as more or less for granted that educational institutions innovate by facilitating the sharing of knowledge between teachers (Stoll & Louis, 2007). Thus creating a "professional learning community" that is seen as a remedial answer to the fragmented character of school as work places. However fine-grained studies of educational institutions challenge this description (Meyer & Rowan, 2006; Bryk et al., 2009). The situatedness of teachers' professional learning is further amplified in the CoP-literature as variants of conversation and interaction analysis become a favorite methodological tool, privileging mundane talk and general linguistic maneuvers for the stabilization of human communication (Emmanuelsson & Sahlström, 2008). Scholars in this tradition refrain from making conjectures about underlying mechanisms (of stabilization). However in understanding social and individual change, learning and destabilization of social orders, we need be concerned with causal chains – although in a non-deterministic version (Maxwell, 2004). To be short and somewhat programmatic, prevailing CoP-methodology does not sensitize the researchers towards external contingencies (institutions, knowledge domains, "global ideas") and internal contingencies (individual/collective agency, conversational routines etc.). It favors mechanisms that stabilize the social setting to those that transcend and change practices.

Methods

Above we have presented elements of a theoretical critique of the CoP literature that will be subjected to an exploratory validation based on two types of evidence. First a secondary analysis of a larger project on professional learning among Norwegian accountants, engineers, nurses and teachers (ProLearn). We will be using a subset of data that has a focus on novice teachers' collaborative learning and was collected in structured and focus group interviews, and "learning logs". Secondly a theoretical sampling of comparative studies serves to verify generalizations made from our secondary analysis, which is a rather common strategy of theory development within educational research (Eisenhart, 2009).

Results and conclusions

From our secondary analysis of the ProLearn-material we learn that Norwegian novice teachers in primary schools enter a culture with a great willingness to share knowledge - processes that take place on a day to day basis and that involve practical problem-solving like coordinating lesson plans. These exchanges are person-centered and to a lesser extent mediated through knowledge resources. Novice teachers felt an obligation to keep themselves updated, but found it hard to select the relevant knowledge to cope with class-room situations. They missed an infrastructure that would facilitate a translation from collective discourses to individual class-room practices. Our log-data confirmed these self-evaluations, and similar results have been reported in many other studies of Norwegian (Havnes, 2009; Haug, 2010;), Dutch (Orland-Barak & Tillema, 2006) and US-schools (Horn & Little, 2010). Novice teachers participated in different forms of professional communities that were organized within subsections of schools, whole schools or across school boundaries. They received very little feedback on their classroom performance – either from colleagues or school leaders. Thus a community of mutual support reinforced norms of presentism and weakly developed routines for critical inquiries that could make a difference to class-room practices. Compared with our selected literature these findings have to be nuanced as the role of school management, recent educational policies of accountability, and the strength of subject affiliation between teachers at different school levels are intervening factors. Our secondary analysis describes a teacher community in Norwegian schools that is not well understood if we apply a CoP-framework. Our study confirms several other studies about the importance of structural changes at school level in order to sustain teacher communities (Bryk et al. 2009; Talbert, 2010; Tillema & vanderWesthuizen, 2006). Destabilization of discursive patterns may be attributed to these contextual factors or more

global transformations of subject knowledge, teaching platforms – or just individuals as primary movers. In other words there is a need to go behind the metaphor of participation (Sfard,1998).Our study and the reviewed concur in stressing the need for a theoretical and methodological framework for research on teacher collaboration that is sensitive to the interrelations between discursive practices, community relationships, artefactual mediation, enactment of theoretical knowledge and institutional context – and individual creativity. Individual teachers may learn in groups by adopting global ideas that by-pass the community, and that are given legitimacy by being circulated in instructional artefacts. Several attempts have been made to transcend or expand the CoP-framework by grafting it to systemic approaches (Hargreaves et al.,2010 ; Sannino &Nocon, 2008) or restoring the position of the subject (Billett,2008). However in our review, researchers that follow these lines, tend to base their arguments on interactional analysis and a slightly modified version of CoP (Havnes, 2009; Ottesen,2007). They should critically examine the privileging of "micro-genetic studies" – and include multi-level analyses and longitudinal designs in their methodological tool-kit.

A theory for the classroom? - Effects of situated learning approaches on theory-based reasoning

Robin Stark, Dept of Education, University of the Saarland, Germany; Martin Klein, Saarland University Department of Education, Germany; Kai Wagner, Saarland University Department of Education, Germany

Abstract:

The main goal of our project "Theorizing in practice" is to teach competences for theory based reasoning in complex pedagogical situations in teacher training. A complex computer based learning environment will be developed aiming at fostering students' professional vision, i.e. their ability to notice and analyze complex pedagogical situations on the basis of scientific knowledge and reasoning. In this study we tested the effectiveness of three learning conditions (problem based learning, learning through identification of erroneous reasoning, learning by correcting erroneous reasoning). Effects on argumentation knowledge, quality of reasoning and cognitive load were assessed. Results showed that the three conditions are equally suitable and provide significant learning progress in near transfer, while far transfer could not be fostered. Cognitive load was unobtrusive in all conditions. Additional qualitative analysis will provide more insights into constraints and affordances of theory-based reasoning.

Extended summary:

Aims

Several studies in which teacher students were trained using classroom videos show that they have severe deficits regarding professional vision, i.e. the ability to notice and interpret significant features of classroom interactions (Sherin, 2007; Sherin & van Es, 2009). They frequently describe classrooms situations superficially and tend to over generalize situations (Berliner, 1988; Strickland & Star, 2008; van Es & Sherin, 2009). Many teacher candidates also have difficulties analyzing pedagogical situations on the basis of scientific knowledge and reasoning, rather mindlessly rely on subjective theories and harbor unfavorable attitudes toward scientific theories (Stark et al., 2010). This impedes teachers' theory-based perception which is a key factor of theory-based reasoning and action in the classroom (Neuweg, 2007).

These problems will be encountered in our project "Theorizing in practice" that follows the famous dictum of Kurt Lewin that nothing is more practical than a good theory. A complex computer based learning program will be developed aiming at fostering students' abilities to analyze pedagogical situations basing on of scientific knowledge and reasoning. From a didactic perspective this program will constitute an integrated learning environment combining elements of problem-based and example-based learning. Instructional errors will be implemented as a special variant of example-based learning. Typical errors associated with analysis and reasoning in pedagogic situations will be demonstrated and have to be identified and corrected. Positive cognitive and motivational effects were found using similar learning environments in other comparably complex domains (diagnosing in medicine). This study tested the effectiveness of three learning conditions.

Methodology

N = 43 teacher students in the fifth semester were randomly assigned to three different learning conditions. Subjects were given a short (about 400 words) description of two authentic, complex classroom scenarios. Group I (problem-based learning, n = 16) had to develop a situation analysis on their own. They were then given a selection of theories and had to correct and improve their analysis. As a feedback measure they were given an expert-analysis and asked for a written comparison. Group II (learning through correction of erroneous reasoning/analyses, n = 15) had to identify errors in an erroneous analysis on their own. They were then given an expert error-explanation and asked to compare it with their own results. The following steps were analogous to group I. Group III (learning through identification of erroneous reasoning, n = 12) only had to identify errors and compare to the expert error explanation analogous to group II. They were given the expert analysis, but only asked to reflect on it. Learning outcomes were

measured using three post-test scenarios with varying transfer distance (used to measure the quality of reasoning) and a test of scientific argumentation knowledge. Subjects additionally estimated their own training success and their acceptance of the training program. Cognitive load was assessed using a subjective rating scale.

The effectiveness of problem based learning will be compared with learning with instructional errors. Additionally, a comparison between groups II and III should yield new insights into learning with instructional errors. In order to secure internal validity, we controlled for prior argumentation and content knowledge and time-on-task.

Findings

Contrary to our hypotheses no differences in learning outcomes and time-on-task were found between the groups. Overall argumentation quality and argumentation knowledge were almost equal across all groups. However, for all groups, a significant learning progress was found for argumentation knowledge. A significant and practically relevant learning progress over all measuring times was found for two post-test scenarios with lower transfer distance. Far transfer could not be fostered. As a matter of fact, subjects on average scored higher in the second training scenario than in the third post-test scenario. Process data analysis showed no differences between groups over all measurements.

A significant difference in cognitive load was found between the two instructional error conditions. The "correction group" (i.e., group II) reported significantly higher cognitive load. However, there was no correlation between load and learning outcomes. Subjective training success and acceptance of the training program didn't yield any differences between groups, but were significantly correlated ($r = .31$, $p = .33$, p)

Theoretical and educational significance of the research

Our results show that the students improved their argumentation knowledge in all conditions. Contrary to our expectations based on cognitive load theory, the instructional error conditions as a form of example-based learning did not prove superior to problem-based learning. Working memory resources that should have been freed by the use of examples obviously were not utilized to improve learning, in spite of additional instructional support (feedback measure and written comparison). It is not astonishing that only identifying errors is less demanding than additionally correcting them.

Descriptive data show that the third post test scenario (far transfer) was the most difficult. In this scenario subjects were presented with new theories that they had to apply to a new situation. Since all scenarios are considered highly demanding, the results (more than 50 % on average) are regarded as a success from a pedagogical perspective. Since there were no differences between the groups over all measurements, all learning conditions seem to be equally suitable. Regarding theory-based reasoning our subjects showed significant improvements in their ability to give more sophisticated descriptions and analyses of complex classroom situations.

The absence of a significant correlation between subjective training success and quality of reasoning indicates that the students had difficulties estimating their learning progress. In spite of unobtrusive cognitive load scores in all conditions this result can be interpreted as consequence of cognitive overload.

Qualitative analyses will yield further insights into the effectiveness of our learning conditions in general and especially the students' problems with far transfer.

Furthermore, a control group will be assessed to complete the study design. In a follow-up study, an extended training phase is supposed to relieve the far transfer problem and improve overall learning outcomes.

Aspects of qualitative and quantitative measurement of teacher competency

Gabriele Kaiser, University of Hamburg, Germany; Sigrid Blomeke, Humboldt University of Berlin, Germany;
Erich Ramseier, PHBern – University of Teacher Education, Switzerland

The round table will discuss the problem of the measurement of the competencies of future teachers based on various studies on teacher's competency amongst others the international IEA study on teacher education TEDS-M-2008 (Teacher Education and Development Study in Mathematics – Learning to Teach Mathematics). Currently there exist several large-scale studies on the professional knowledge of (future) teachers, however the problem, how to integrate several facets of knowledge and how to integrate evaluations methods from different research paradigms are not sufficiently solved. The contributors to the round table will discuss these questions from various perspectives.

The first aspect the round table will tackle is the integration of quantitative and qualitative approaches. One possible answer lies in detailed item analysis of items for which special groups of students either show unexpected high or low achievements and which yield interesting achievement patterns lying beneath mean differences of various countries. The second problem, which is until now not sufficiently solved, is the integration of different facets of professional knowledge. It will be discussed how it might be possible to integrate pedagogical knowledge into the conceptualizations of teachers' professional knowledge and how to measure it using the data of the TEDS-M-study.

The round table will discuss the problem of the measurement of the competencies of future teachers based on various studies on teacher's competency such as the international IEA study on teacher education TEDS-M-2008 (Teacher Education and Development Study in Mathematics – Learning to Teach Mathematics). Until now the problems, how to integrate several facets of teachers' knowledge and how to integrate evaluations methods from different research paradigms are not sufficiently solved in the existing studies on teachers' professional knowledge. The contributors to the round table will shed light on these questions from various perspectives.

The first aspect the round table will discuss is the integration of quantitative and qualitative approaches.

The first discussant - Erich Ramseier - will use data from the international study on teacher education - TEDS-M – to compare the results from the mathematics content knowledge and the mathematics pedagogical content knowledge of future teachers discriminating the results for future primary and lower secondary school mathematics teachers. Departing from the observation that the study yields varying country results for the different cohorts, for example for pedagogical content knowledge future primary teachers in Norway and Switzerland achieve above the international mean and the German future teachers below the international mean, whereas the results are nearly reverse for future lower secondary teachers. This observation leads to the result that the four scales are very valuable to describe global differences between the knowledge levels of countries. However a separate scaling within Switzerland shows that the national item difficulties differ significantly from the international values. This contribution gives the opportunity to discuss what this tells about the specificity of content knowledge in Switzerland which is reflected in single tasks but not in the scale mean.

The second contribution by Gabriele Kaiser, Martina Doehrmann and Sigrid Bloemeke will use the results of TEDS-M-2008 as well, but propose a different approach to integrate quantitative and qualitative methods. The first quantitative analyses have shown great differences in the solution frequencies of the answers of the future teachers. These differences show the strengths and weaknesses of future teachers from different cultural backgrounds and also of the different routes of teacher education in Germany. Focussing on the German results, there are also items with a similar solution frequency of special groups of future teachers', which can sometimes be explained by referring to a common international core of the specific sub-domain, but which are sometimes quite unexpected. Therefore an interpretative analysis of the answers of the future teachers will be proposed, which may allow to illustrate the strengths and weaknesses of the future mathematics teachers by referring to culture dependent knowledge patterns, e.g. strengths of the groups of higher achieving future teachers in items using symbolic actions or remarkable difficulties of weaker future teachers in this respect.

The third contributor Matthias Baer will discuss the problem how to shed light on teaching competences and will propose a multi-perspective approach to student teachers', novice teachers', and experienced teachers' teaching competences. Since teaching quality is strongly related to students' learning outcomes, the professional quality of teachers plays a crucial role for the development of their students. However, still not much is known on an empirical basis about the effects of teacher education and of experiencing regularly teaching a class on prospective, novice and experienced teachers' competences.

In the round table it is planned to discuss how a light can be shed on emerging as well as already established teaching competences (a) by presenting the multi-method approach we applied in our research project on the acquisition of teaching competences and (b) by giving insights into results of this project. There will be a focus on three of totally eleven data collection instruments: (1) an online-questionnaire for self-estimating one's own teaching competencies, (2) vignettes to trace competences for planning and implementing a school lesson, and (3) videos of taught lessons to discover style and quality of teaching. Furthermore, the surprising fact that teaching competences improved throughout teacher education, but almost no further improvement could be found for the first two years in profession, shall be discussed.

Johannes Koenig and Sigrid Bloemeke will discuss the second problem of the round table, which is until now not sufficiently solved and strongly connected to the first aspect, namely, the integration of different facets of professional knowledge. It will be discussed how it might be possible to integrate pedagogical knowledge into the

conceptualizations of teachers' professional knowledge and how to measure it using experiences of the studies MT21 and TEDS-M. Both studies focused on content knowledge and pedagogical content knowledge in mathematics. According to Shulman and the current discussion on teacher knowledge, general pedagogical knowledge as a third cognitive domain of teacher knowledge has to be taken into account, too. As yet, there has been no attempt to model proficiency in pedagogy.

To close this research gap, TEDS-M data are used. The terminology and the cognitive complexity are used as indicators to describe the difficulty of the general pedagogy items. The distribution of the item parameter estimates allows to cut the scale into two proficiency levels. Frequency distributions of future teachers by teacher education programs point to the content validity of the model. This result will allow to develop further models for the integration of the three theoretically proposed facets of professional knowledge into an overall model.

A Cognitive Model of Concept Mapping as Knowledge Elicitation

Julien Mercier, University of Quebec in Montreal, Canada; Patrice Potvin, University of Quebec in Montreal, Canada; Martin Riopel, University of Quebec in Montreal, Canada; Caroline Girard, University of Quebec in Montreal, Canada

Concept maps are being widely used as assessment and learning tools. One pressing challenge is to elaborate concept-mapping tasks that elicit specific aspects of knowledge in semantically complex domains, depending on the learning or assessment objectives. The objective of this study is therefore to develop and test a cognitive model of concept mapping as knowledge elicitation within a problem-solving task that would inform the design of concept-mapping tasks. Eighteen teachers of varying level of expertise were asked to construct a map representing the knowledge they used in an instructional planning task. Annotated protocols are being coded according to the postulated model. Time-budget analyses will show how frequently and for how long each activity was conducted. Sequential and lag analyses will establish typical sequences of activities. Higher-order processes will be derived from these patterns. New insights about the cognitive task of concept mapping can foster the study of the potential of this process as a technique for knowledge elicitation and assessment for educational and research purposes. These results can also inform the support of the concept-mapping process.

Aims

Since the pioneering work of Novak and Gowin (1984), concept maps are being widely used as assessment and learning tools. Concept maps take the form of node-links assemblies of concepts and relations (Nesbit & Adesope, 2006). Procedures for optimizing the use of concept maps for learning and assessment purposes have been developed and refined in science over the last two decades. In semantically complex learning domains that are less formal than science, these procedures appear relatively underdeveloped. Given the critical impact that professionals in such domains (for example, medicine and education) have in society, helping novices in these fields learn and making sure they reach appropriate levels of expertise is essential. One pressing challenge is to elaborate concept-mapping tasks that elicit specific aspects of teacher knowledge, depending on the learning or assessment objectives. Those concept-mapping tasks must be conceptually and empirically tested in terms of the characteristics of teacher knowledge they elicit (Glaser & Baxter, 2002). By looking at the concept map, the nature of knowledge evoked can be established. To understand why particular features appear and do not appear in the map, the process of concept map construction needs to be examined (see Amadiou, van Gog, Paas, Tricot & Mariné, 2009). The objective of this study is therefore to develop and test a cognitive model of concept mapping by examining cognitive activities using a set of the most basic operations involved in constructing a map in order to (1) see how patterns of operations can describe higher-order concept-mapping strategies and (2) to study the relationship between the concept-mapping process and expertise in the domain. Theoretical framework Building a concept map involves the manipulation of knowledge structures by higher-order cognitive processes (Hilbert & Renkl, 2005). Higher-order cognitive processes have traditionally been conceived of as either discourse processes or problem solving (Hatano & Inahaki, 2000). These processes can be articulated in a complementary manner since discourse production is a coherence-seeking process whereas problem solving is a change-seeking process. In this regard, discourse production processes organize the structures in the map in a way that minimizes incoherence. Problem solving, on the other hand, serves as a control mechanism that manages the concept-mapping task in response to the directions imposed by the task. Discourse production proceeds from the specification of a conceptual representation to the generation of different types of semantic structures (Frederiksen, Bracewell, Breuleux & Renaud, 1990). Discourse production operates on three types of structures: conceptual networks, propositions, and natural language structures. Operations on conceptual networks involve the generation of a frame that is subsequently filled out with descriptive information. Information to be expressed is selected from the vast amount contained in a fully specified conceptual structure. The information to be expressed is then formulated as a set of sequenced propositions. Generic components of the model include the planning of goals and actions, the test of critical conditions for action, the execution of actions, the interpretation of problem states, the evaluation of the problem solution, and the correction of mistakes. The model is contextualised to

concept-mapping by the specification of the procedures planned, the actions carried out, and the elements subject to evaluation and corrections. The construction of a map is partitioned into several steps, such as listing concepts, building partial networks, or building and altering a single map. More specifically, these steps are constituted of a few basic operations: identification of a concept, positioning of the concept in the hierarchy, positioning the concept in a branch, establishment of a relation, and labelling of a relation. All these operations can be planned, evaluated, and corrected.

Research questions

1. What is the relative prevalence of postulated constituents of the concept-mapping process? 2. What is the typical sequence of postulated constituents of the concept-mapping process? 3. What are the higher-order processes that emerge from typical sequences of the postulated constituents of the concept-mapping process? 4. With respect to the first three questions, are there any differences associated with the level of expertise in the domain?

Methodology

Participants are 12 student teachers (6 beginning their baccalaureate, 6 in their final year), 2 teachers with five years of experience, and 4 teachers who have completed a graduate program in teaching. Participants were asked to construct a map representing the knowledge they used in an instructional planning task they realized just before the concept-mapping activity, as part of another study. Participants were instructed to think out loud. Think-aloud protocols were recorded on audiotape. A video camera recorded the concomitant drawing of the map. The protocols were transcribed for analysis, with annotations representing the graphic drawing of the map. Annotated protocols are being coded according to the postulated model. Time-budget analyses will show how frequently and for how long each activity was conducted. Sequential and lag analyses will establish typical sequences of activities. Higher-order processes will be derived from these patterns.

Findings

Preliminary results indicate that the categories derived from the model are adequate for coding the protocols. Complete results will be available in December 2010.

Theoretical and educational significance

New insights about the cognitive task of concept mapping can foster the study of the potential of this process as a technique for knowledge elicitation and assessment for educational and research purposes. Prospective outcomes of this endeavour abound in the field of teaching and teacher education: study of teacher knowledge as it is used in the numerous aspects of teaching practice, use of concept mapping as a knowledge management and communication device in the educational community, use of concept mapping as a learning and/or assessment tool in a variety of settings used in teacher education. These results can also inform the support of the concept-mapping process, both in the case of tutoring situations and in the context of computer tools for scaffolding concept mapping. Research is also needed to develop or refine scoring protocols based on inferences between characteristics of a concept map and the process underlying its elaboration.